The Unitary Quantum Theory and New Sources of Energy

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Preface to First American Edition in USA

Dear Reader:

The book you are holding is a thoroughly unconventional work wholly devoted to a new concept called 'Unitary Quantum Theory' (UQT).

According to this theory, all particles are not points. They are presented as wave packets or bunches of some united field moving in a nonlinear and dispersing "medium". All natural phenomena described in this work are reduced to interactions of such packets with each other and with external fields.

Following this approach, the motion equations for separate microparticles can be written in cases where the energies are small; there are no conservation laws for such a particle, and it should be possible to use this knowledge to develop a fundamentally new source of energy. This idea does not conflict with the conventional quantum theory, which also does not contain conservation laws and only predicts the probability of this or that event. Conservation laws appear within standard quantum theory only after averaging over an ensemble of particles. Contrary to the approach developed herein, the standard quantum theory is not able to suggest a way to create such a new energy source.

The following system of notation is used in this book: All equations and figures have triple numeration, divided by points. The first number indicates the chapter where the figure or equation appears for the first time. The second is the number of the section of that chapter, and the third is the number of the figure or equation within the section. For example, equation (2.1.16) means the sixteenth equation from the first section of Chapter 2.

Unitary Quantum Theory was written due to a combination of great dissatisfaction with certain aspects of quantum theory in its present form and nearly forty years of thought. Over so long a time, of course, we discussed thoughts and ideas with a great many people, both professional researchers and research managers who supported the investigations, and several citations and epigraphs from their work have been quoted in back translation. Some of them have left this world already, but nevertheless we would like to express our profound gratitude to them.

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- *in Germany:* Prof. Werner Heisenberg and Prof. Josef Gruber.

I would like to express my special gratitude to cosmonaut USSR and R. F. Air Force General Vladimir A. Dzhanibekov. Without his support and insistence, this book might have still been unwritten. Dzhanibekov is best known as a space explorer. He has participated five missions to two Soviet space stations between 1978 and 1985. Few may realize that he started his career as a physicist, but changed profession when he realized that physics alone would not open the door into space. Over the years, after all of our discussions about new quantum physics problems, Gen. Dzhanibekov not only insisted on the necessity of writing a book about the UQT but, in the long run, he also created conditions favourable for its existence.

I would like also to express sincere gratitude to Franz Mair, a wonderful man from Innsbruck, Austria, for our long talks about life, philosophy and physics in the Tyrolean Alp during the summer or 1992. Our conversations changed much in my perceptions of the world.

The authors also thank the creators of the perfect programs for mathematical symbol calculations, Maple and Mathematica. We foresee a great future for them.

We are Russian professors of physics and mathematics; this book is meant for physicists, mathematicians, and restless engineers, who often shock “official” science with their experiments and devices. Experience has shown that my excellent co-authors make fewer mistakes than I do, so any errors in this book are mine.

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Sept. 2000 – Dec. 2004

Editors' Foreword to the Russian Translation of the First American Edition

The book we would like to offer to our readers – "The Unitary quantum theory and the new energy sources" presents absolutely new physical theory created by professor Leo G. Sapogin. To give our readers the possibility to appreciate the significance of this theory we think we should retrospect moments of physics' history most important for today.

The bases of the current physics we call classical are Newton's mechanics laws, his definition of mass, force, his law of gravitation, as well as a line of other discoveries of XVII and XVIII centuries. The researches of mechanical processes in liquids and gases, nature of light, thermal, optical, magnetic and other phenomena, atom-molecular structure of substances were so successful that by the end of XIX physics looked like practically completed. A harmonious nearly completed picture of the world had been created, a picture where any substance (solid, liquid or gaseous) consisted of minute particles, atoms and molecules, and the space among them were filled by transparent elastic medium - ester, and it is ester who helps atoms and molecular interact with each other.

It seemed that each and any physical phenomenon could be explained by mechanical of atoms, molecular and ester. Any terrestrial phenomenon being explained by Classical physics looked quite understandable. Literature of physics history describes one story. In 1874 Max Plank (further famous physics and one of creators of the modern quantum theory) planning to devote his life to physics asked for advice the dean of physical department of the Munich University. And he was replied nearly like: "In physics nearly everything is already known. All important discoveries have been already done. I doubt there is a sense for you to enter Physical department".

But in short time the inquisitive scientists, theorists and experimentalists had arrived at discoveries that should be called more than important. These discoveries had resulted in revision of many ideas of classical physics and in appearance of principally new fundamental schools in Physics.

X-rays were discovered in 1895, radioactivity - in 1896, electron — a part of atom that was considered as a minute elementary particle before was opened in 1897 and so on. And all these phenomena were out of the classical physics framework. In 1904 in St. Louise (USA) at the International Congress of Art and Science Henri Poincare, noted physicist and mathematician made a report "The present and the future of mathematical physics". In this report A. Poincare made a fundamental analysis of the mail problems of classical physics and presented his own view of possible directions of its further development. He called critical the situation existed at the moment in Classical physics. His report became a signal to creation of new theory of physics; it was quantum theory (as usual it is called quantum mechanics).

The quantum mechanics was developed in general by 1926 thanks to the works of Erwin Schrodinger, Werner Heisenberg, Max Planck, Louie de Broglie, Wolfgang Pauli, Niels Bohr, Max Born and others. Nowadays it is considered the most detailed and comprehensive of physical science. It had been appeared that the laws of Classical physics and Classical mechanics were just particular cases of Quantum mechanics obtained in a result of data averaging of all particles participated in this or that process. The Quantum mechanics became very successful in XX century. For example, It could totally explain the structure of atoms being a complete system of protons, neutrons, electrons and other elementary particles, it could explain the blackbody thermal radiation spectrum, nuclear process of alpha disintegration and other phenomena of nuclear physics. It became the main operating tool for theorists and experimentalists in nuclear physics.

The key for Quantum mechanics is Schrodinger equation in wave function that displays the state of the micro-object under study. This function makes statistical sense, namely, the square of its module equals the density of the probability of the object occurrence in some state or area. The wave functions give the complete statistic characteristic of the object state and evolution. And if know it, we can calculate the probability of different physical characteristics of the particle or system of the particles in the process of their displacement in space and time and so on.

The Quantum Mechanics has been considered by the world scientific community as unshakeable cornerstone of physics that requires probably some additions and accurate definitions but not turnarounds.

But even the creators of Quantum Mechanics themselves (or at least half of them) felt some dissatisfaction with the statistical nature of their theory first of all, occasional formal usage of mathematical apparatus and some internal contradictions. Below we would like to use the words of Erwin Schrodinger: "The existing quantum picture of material reality is today feebler and more doubtful than it has ever been... The popular opinion among the scientists proceeds from the fact that the objective picture of reality is impossible in the primary sense (i.e. in terms of images and movements)... Only very big optimists, among whom I count myself, take it is as philosophic exaltation, as a desperate step in the face of a large crisis. A solution of this crisis will ultimately lead to something better than the existing disorderly set of formulas forming the subject of quantum physics... If we are going to keep the damned quantum jumps I regret that I have dealt with quantum theory at all..."

Professor Leo G. Sapogin is one of the scientists who is not satisfied with some ideas of Quantum mechanics, he has been developing his own theory within more than 40 years. In 1983 he printed in the magazine "Technology of youth" an article where he has shown that theoretical possibility of physical phenomenon later called "cold nuclear synthesis" followed from the new equations describing the micro-particles interactions and their proper computations. It was quite unexpected result, because in theory from the point of Quantum Mechanics view this phenomenon was absolutely impossible.

But in 1989 the prophetic words of famous American science fiction writer Sir Arthur Charles Clarke were confirmed: "Anything that is theoretically possible will be achieved in practice, no matter what the technical difficulties are, if it is desired greatly enough" ("Profiles of the Future", 1963).

On March 23, 1989 at the press-conference in the State Utah University 46 years old professor of chemistry Stanley Pons and his 62 years old British colleague Martin Fleischmann professor of electrochemistry announced about their experiments on electrolysis of heavy water at room temperature. They have detected the anomalous energy release, and at that the heat excess could not be explained from the point of chemistry. Thus all evidences of fusion reaction taking place at room temperature were on hand. It was a cold nuclear fusion (and these experiments were not accidental, the scientists were prepared it during 5 years and spent USD 100000.00 of own assets). According to quantum mechanics such reactions are possible only at extreme temperatures, about billion Kelvin degrees and enormous density of substance. These reactions, called thermonuclear or hot nuclear fusion, take place at H-bomb explosion and in hot nuclear plasma that can be created by "Tokamak" system, for example.

One can easily imagine the distrust and lack of understanding that met this announcement by scientists - adherents of quantum mechanics. The scientific community was stupefied and even outraged. The well-established and undisputed theory was given a dare.

But the main complexity of the situation was in fact that the results of Fleischmann and Pons experiments affected not only scientific problems but denoted new possibilities to produce thermal energy without normal energy sources, without huge fusion reactors, without atomic stations, and that affected USA officials.

For the better understanding of the situation that happened in USA we would like to cite abstracts from Memorandum submitted by American scientist Dr. Eugene

Mallove the strongest proponent of new physical theory and new energy to the President of USA. He considered that era of new energy had started exactly from the discovery of the cold nuclear fusion. His Memorandum is an outstanding document.

Staring from 1995 Eugene Mallove was a chief editor and publisher of Infinity Energy magazine published in USA twice a month. He authored a line of books for public at large, including very interesting fundamental book on cold fusion “Fire from Ice. Truth search” (1991) [89].

Abstracts from Eugene Mallove Memorandum (Cold Fusion Memo to the White House): “… After over a decade of work, hundreds of peer-reviewed scientific papers from laboratories around the world confirm the Pons-Fleischmann discovery. It was just the tip of an iceberg of a whole class of nuclear reactions… These are often called Low - Energy Nuclear Reactions…

When as an MIT (Massachusetts Institute of Technology) undergraduate I read George Gamow's book, Thirty Years that Shook Physics: The Story of Quantum Theory (1966) (George Gamow - American physics, cosmologist, developer of Big Bang theory - Russian expatriate - authors remarks) it was impossible to imagine that in less than 25 years another revolution, such as has been brought about by cold fusion, would shake physics in ways every bit as dramatic as what happened from 1900 to 1930… Gamow also wrote that next major physics revolution would be in understanding the very existence of elementary particles and it will involve concepts that will be as different from those of today as today's concepts are different from those of classical physics…”

Than Eugene Mallove wrote: “… Confirmation of the remarkable cold fusion claims of 1989 was not to come easily… When the exact radiation signatures and end-products of hot fusion reactions in a vacuum were not found in the Fleischmann-Pons results or in quickly-done tests at other laboratories, scientists at the MIT Plasma Fusion Center yelled “possible fraud”, “scam”, and “scientific schlock". On May 1, 1989, the story planted in the Boston Herald by the then MIT hot fusion director unleashed a torrent of anti-scientific bigotry. It did not occur to most scientists that a new class of nuclear reactions might have been discovered…

Most important to an understanding of the heated debate of the past decade: The Fleischmann-Pons announcement threatened an entrenched Federal research program. Over $15 billion had been invested by the U.S. government in its decades- long hot fusion program… Hot fusion had promised a distant era of safe, clean, infinite energy - variously estimated by funding seekers to begin by 2050 to 2100. These programs may have resulted in useful plasma physics research, but no net energy release in fusion energy beyond the magnitude of the electric power put in-ever. The magnetic hot fusion energy program should be terminated quickly to prevent any more waste of research funding.

The furor over cold fusion in the spring of 1989 prompted President of USA… to convene a group of cold fusion experts… Three major laboratories submitted negative reports. These were MIT, Caltech, and Harwell. The experts report was negative, and quickly so. A preliminary - came in July 1989 and the final - on November 1, 1989 with the following consequences:

U.S. government prohibited special funding by the for further research;

Flat denial by the U.S. Patent Office of any application mentioning cold fusion directly;

Suppression of research on the phenomenon in government laboratories;

Drs. Fleischmann and Pons would leave the United States to work on cold fusion in France for a subsidiary of the Toyota Corporation (IMRA Europe). Stanley Pons became a citizen of France, in legitimate disgust with his treatment in the United States… The reports of MIT, Caltech, and Harwell have each been analyzed by competent scientists… Each of the widely cited "null" experiments has been found to be deeply flawed… In the case of the MIT data, there is evidence of deliberate alteration of laboratory measurements by a lower-echelon worker to erase an indication of excess heat… A great irony: Each of these negative results were themselves the product of the kind of low quality work of which Fleischmann and Pons were accused. The difference was that the reports said what the hot fusion community wanted to hear… Fleischmann and Pons have been vindicated - if not by the media and by the establishment, certainly by mountains of high quality published results… others confirmed low-energy neutron radiation, as well as the production of tritium…The latter astonishing evidence has been irrefutably proved by the work of Dr. Thomas Clay tor at Los Alamos National Laboratory №1…

It's a contradictory situation. The creators of Quantum mechanics have sold these contradictions as follows: they have postulated that quantum mechanics does not consider and does not study individual processes (!?) and can only predict the probability of this or that result. Today it is asserted that quantum mechanics does not describe single processes, thus inside quantum mechanics, inside science, the problem has been solved. But it still exists in nature. The natural phenomena around us do not always or totally confirm the science laws created by people. At the end of XX century engineers were really attacking the great law of conservation of constructions… devices, equipment able to generate energy in excess of necessity for proper functioning, i.e. with coefficient of efficiency more than 1. Information about some facilities is given in the chapter 3 of this book.

The essential fact is that some of these facilities are successfully operated and bring profit. And at the same time no one author of such plant can give adequate theoretical explanation of the principles of operations, i.e. theoretical justification of these plants lack.

The result of abovementioned is evident: new theory of physics is required to explain the cold nuclear synthesis, nuclear transmutations and operation of amassing facilities. It is well-known from historical view that successful development of any industry is possible only if it is substantiated by strong scientific theoretical base. For example the achievements in aircraft construction, rocket engineering, and success in space development were achieved thanks to researches in corresponding areas in mathematics, mechanics, space dynamics and so on.

Meanwhile the problem of new alternative sources of energy transforms now from pure scientific (discussed in scientific lobby only) to great social problem of all humanity. The traditional sources of energy (oil, gas, coal, wood) at the Earth are limited. Easy computation show that at the current level of energy consumption and its further growth these resources will be exhausted in 50-70 (?!) years.

The hopes to replace traditional energy by nuclear are delusive in spite of assurance of its advocates. The exploitation of nuclear power plants remains unsafe for ecology and quite expensive taking into account all necessary costs including the cost of nuclear waste treatment. At the same time the problem of nuclear wastes treatment is not solved totally. The projects of nuclear production units using hot nuclear synthesis remain simply projects and require huge financial and human investments. So the problem of creation of the new energy sources and corresponding theoretical basis is now very urgent and we can only welcome the edition of this book translation.

Cosmonaut USSR, Academician RF V.A.Dzhanibekov

Academician RF N.S.Lidorenko

Professor Yu.I.Sazonov

Preface to Second American Edition

The first edition of our book was published about 10 years ago, and since then it became a bibliographical rarity. It's a quite long period and since then a lot of new results have been obtained. In particular, the mass spectrum of practically every elementary particle with the accuracy less than 1 % has been found. It appeared that the list of estimated masses contained even Higgs boson that was discovered 2-3 years after the publication of our article. By our calculations the Higgs boson mass equals 131.7 GeV while according to the consolidated data of the Large Hardron Collider and Tevatron with accuracy of 99% it lies in the rage of 125 – 140 GeV. Of course we have included these results in our book. The chapters 2.5, 2.6, 2.7, 2.8, 2.10, 2.11, 3.1, 3.3, 3.4 have been upgraded even the general design and style of the book remain unchanged. We have corrected the detected mistakes, but that does not mean that there are no mistakes ever more. A serious progress in energy took shape in recent three years. Thus Andrea Rossi managed to create new revolution sources of heat energy of Megawatt range that is impossible to falsify. However independent experts are inclined to believe that nature of such big volume of generated heat is absolutely unclear because neither enough products of nuclear reactions nor radiation have been detected. The Unitary Quantum Theory gives exhaustive explanation of these phenomena.

As the Unitary Quantum Theory describes considerably changed quantum picture of the world and it probably can be difficult for perception we have included into Conclusion nearly full text of the article "Modern Trend in Quantum Picture of the World" of Sapogin L. G., Dzhanibekov V. A., Ryabov Yu. A. published in magazine "SOP Transaction Theoretical Physics" vol., #3, September 2014, where practically the whole Unitary Quantum Theory is given in assessable and popular way. The authors are grateful to Cosmonaut of USSR General Air Force RF V. A. Dzhanibekov who enlivened the quantum pictures of the world by his image artistic thinking.

The readers can find every article of the authors dedicated to Unitary Quantum Theory (UQT) in the internet.

Introduction

The progress of Science goes on during every historical age, not only when men meditate on the whole, but when they concentrate their thoughts on such parts of the vast field of Science wherein developments are needed at the given time.

James Clerk Maxwell (1831-1879)

UQT is divided into four major chapters, and following is a brief review of the book by chapter.

Chapter 1

The first chapter describes the general theoretical basis of the Unitary Quantum Theory (UQT). In the standard quantum theory, a microparticle is described with the help of a wave function with a probabilistic interpretation. This does not follow from the strict mathematical formalism of the nonrelativistic quantum theory, but is simply postulated. A particle is represented as a point that is the source of a field, but cannot be reduced to the field itself and nothing can be said about its "structure" except with these vague words.

There is a school in physics, going back to William Clifford, A. Einstein, and Louis de Broglie, where a particle is represented as a cluster or packet of waves in a certain unified field. According to L. H. Germer's classification, this is a "unitary approach".

The essence of this paradigm can be most clearly expressed in Albert Einstein's own words:

"We could regard substance as those areas of space where a field is immense. From this point of view, a thrown stone is an area of immense field intensity moving at the stone's

> *speed. In such new physics there would be no place for substance and field, since field would be the only reality . . . and the laws of movement would automatically ensue from the laws of field.”*

The trouble with the many previous field unification attempts (L. de Broglie, Erwin Schrödinger, et al.) was in trying to construct a particle model from classical de Broglie waves, whose dispersion is such that the wave packet becomes blurred and spreads out over the whole of space. Moreover, the introduction of nonlinearity greatly complicates the task, and does not lead to a proper solution of the problem.

The UQT represents a particle as a bunched field (cluster) or a packet of partial waves with linear dispersion. Dispersion can be chosen in such a way that the wave packet would be periodically disappears and appears in movement, and the envelope of the process would coincide with the wave function. Based on this idea, a relativistic-invariant model of such a unitary quantum field theory was built.

In UQT, a particle is described with the help of a 32-component wave packet. The equation contains a 32x32 matrix dependent on 4-velocity. Limit transition of this equation leads strictly (!) to the relativistic Hamilton-Jacobi equation of classic mechanics, and in cases of especially low velocity (when all 4-velocity components are approaching zero), the UQT equation results in eight identical Dirac’s equations.

Further, the mass of the particle is naturally replaced in the equations by the integral of the bilinear field combination over its whole volume, producing a system of 32 nonlinear integral-differential equations, which in the scalar case allowed the authors to calculate to within 0.3% accuracy the non-dimensional electric charge and the fine structure constant. Quantification of the electric charge emerges as a balance between dispersion and nonlinearity, as became clear from the physics point of view. Usually dispersion and nonlinearity bring about destruction of the wave packet but, for certain types of wave packet forms and amplitudes, mutual compensation of these processes is possible and the packet periodically appears and disappears in movement at the de Broglie wavelength - yet its form is preserved.

A basic theory of microparticle-to-‘macrodevice’ interaction has been laid. The probability interpretation of the wave function is now not postulated, like it was earlier, but follows strictly from the mathematical formalism of the theory.

This approach makes the unitary quantum theory absolutely illuminating. For example, the tunnel effect completely loses its mysteriousness in the following way: when a particle approaches a potential barrier in such a phase that the amplitude of the wave packet is small, all the equations become linear, and the particle does not even “notice” the barrier. During another phase, when the packet amplitude is large, nonlinear interaction begins, and it can be reflected. The particle birth and disintegration mechanisms become entirely understandable as the splitting-up of the wave packets. This UQT approach regards all interactions and processes only as a result of mutual diffraction and interference of such wave packets between one another, due to nonlinearity.

Chapter 2

The second chapter concerns the approximate equation of an isolated particle with an oscillating charge. Initially, this equation was developed on the basis of UQT heuristic considerations, but later it was derived directly from the Schrödinger equation for very low energies.

The equation describes the behaviour of micro-particles in certain problems as classical particles whose charge oscillates and is dependent in a complicated way on time, speed, and coordinates. In such a paradigm, the tunnel effect also depends on the wave function phase, which was earlier a superfluous parameter in the standard quantum theory, since only the square of the wave function modulus had a physical sense and the phase did not affect it.

With the new paradigm, the situation is different. If a particle approaches a high potential barrier in a phase when its charge is very small, the repellent force is also small. It can overcome the barrier by climbing it, while in another phase it will rebound. Such an equation was applied to standard quantum-mechanical problems such as particle scattering, the tunnel effect, harmonious oscillators, and the J. Kepler problem for individual particles. Some analytical solution and modelling methods were also studied, since the equation with the oscillating charge had introduced a number of problems into the method of mathematical computation.

What was found most unexpected and intriguing is the absence of energy and impulse conservation laws for an isolated particle when its behaviour is described with the help of the oscillating charge equation, since it has no translation invariance. To be more precise, such invariance exists only when so called initial phase – a new controllable parameter introduced in UQT- takes the values divisible by π. This means that in some cases he conservation laws are valid but in general does not.

A look at the origin of fundamental conservation laws for self-contained mechanical systems shows that they follow from the Newtonian equations [references to thermodynamics have no relevance whatever, because they are postulated therefrom], but the latter themselves follow from quantum-mechanical equations, which are of an even more fundamental character.

The standard quantum theory for isolated processes can predict only the probability of this or that event, and so there are no conservation laws for isolated events. They appear only in cases of transition to classical mechanics, when very large numbers of particles are summed over. The conservation laws appear in the macrocosm in a similar way to that in UQT. But now the existence of controllable initial phase opens up a number of wonderful vistas in science and technology - especially in energy.

Chapter 3

Next, we will examine the application of the oscillating charge equation for interpreting rich experimental material, which doesn't fit into the framework of standard quantum-mechanical science. For instance, Unitary Quantum Theory made it possible to predict [9] in 1983 the phenomenon of cold nuclear fusion, discovered only later in 1989.

This is a totally unexpected opportunity for creating nuclear reactions requiring very small energy values. One obstacle to the most probable d-d reaction under the normal very low energy conditions is presented by a very high Coulomb barrier. In UQT, the deuteron (as calculations show) can overcome that barrier with a certain value of the initial phase.

Several phenomena, essentially implausible by current science, will be analyzed on the basis of solving the harmonic oscillator problem (as well as certain others):

- Anomalous heat production in cold nuclear fusion reactions (when nuclear reaction products are millions of times less numerous than is required to explain the thermal effects);
- cold nuclear transmutation;
- production of superfluous thermal energy in numerous cavity installations;
- sources of excess energy based on anomalous gas discharge;
- mysterious processes of electric current passage through quantum wires, and the possibility of creating new electronic devices utilizing a completely new electronic flow control principle based on the dependence of the tunnel effect upon the initial phase;
- a number of exotic energy sources, as well as experimental phenomena

absolutely unexplainable by current scientific methods.

Chapter 4

Chapter 4 is a brief review of a theory and general approach addressing the 'problem' of chemical catalysis. By and large, how to resolve somewhat difficult issues that exist in this field today remains absolutely unclear, as it is not understood at all where the additional energy for certain chemical reactions comes from.

Chemical reactions of polysaccharide decomposition (lysozyme) are known which disrupt connection with energies of up to 3 eV. For water decomposition, a three-times-weaker connection has to be broken. If such a water-decomposing catalyst is found (and the UQT can offer steps in the right direction), it could bring about a revolutionary change in energy for motor transportation. There are reports that such catalysts have already been found: an automobile operating on simple water without requiring any additional energy is being tested in Japan.

Many catalysis theories conceal energy shortage, and are unable to "make both ends meet", since practically all existing science is built on conservation laws which have heretofore been regarded as unshakeable. The constant progress of scientific knowledge leads, however, to limited applicability of these fundamental laws.

Nature already plays tricks with humanity's best physical laws: consider for now just the weak interactions 'issue', and the chaos it caused in physics. The existing Newtonian conservation laws are a few of the things that survived that chaos, and it is only natural that they resist the influence of subsequent scientific developments.

We would like to remind the reader that the standard quantum theory predicts only a probability for isolated events and that there are no conservation laws that apply to them. That is why to create an inexhaustible source of energy we merely have to collect events with the required result, such as for power generation, and then all the energy requirements of humanity could be solved by a method completely friendly to the environment. The broad-scale usage of such technologies in the future would eliminate the problem of environmental heat pollution. The UQT, unlike standard quantum theory, offers a way to accomplish the goal of clean, efficient, and virtually limitless energy for our future.

Contents

1

The Basis of Unitary Quantum Theory (UQT)

1.1 Some Difficulties in Standard Quantum Theory and Ideas for a New Approach

It is difficult, if not impossible; to avoid the conclusion that only mathematical description expresses all our knowledge about the various aspects of our reality.

- an opinion extracted from a Soviet newspaper

Over seventy-five years have passed since the field of quantum mechanics emerged. Each day, the experiments being done with huge particle accelerators reveal new details about the design of microcosmic structures, and supercomputers crunch vast quantities of resulting mathematical data. But till now we do not have any theoretical approach to the determination of the mass spectrum of elementary particles with number more than 750, more over we do not yet fully understand the strong interaction itself. The standard quantum theory avoids the physical descriptions of various phenomena in terms of images and movements. Many different approaches have been taken to develop a quantum field theory, but typically the divergences have created provoke abundant nightmares for theoretical physicists. Nevertheless, we'll try to classify and formalize these approaches somewhat below.

Let us begin with the common canonical point of view based on the properties of space-time, particles, and the vacuum, on particle interactions, and on mathematical modelling equations. Every postulate of canonical theory may be reduced to the following seven statements (not all of which are without issues):

1. Space-time is four-dimensional, continuous, homogeneous, and isotropic.

2. Particles and their interactions are local.

3. There is only one vacuum and it is non-degenerating.

4. It is a valid proposition in quantum theory that physical values correspond to Hermitian operators and that the physical state corresponds to vectors in Gilbert space with positively determined metrics.

5. The requirement of relativistic invariance is imposed (four-dimensional rotation with coordinate translation – Poincaré group).

6. The equations for non-interacting free particles are linear and do not contain derivatives higher than of the second order.

7. Particles' internal characteristics of symmetry are described with the SU2 and SU3 symmetry groups.

The previous statements provide the basis for the construction of the S-matrix, that describes the transformation of one asymptotic state into another and satisfies the conditions of causality and unity. Nevertheless, this approach, which seems mathematically excellent in outward appearance, still leads to divergences. Recent 'normalized' theories, derived to provide a means of avoiding infinities by one technique or another, sometimes end up seeming more like circus tricks.

We shall not criticize such normalized theories here; however, to quote P. A. M. Dirac*:

"...most physicists are completely satisfied with the existing situation. They consider relativistic quantum field theory and electrodynamics to be quite perfect theories and it is not necessary to be anxious about the situation. I should say that I do not like that at all, because according to such 'perfect' theory we have to neglect, without any reason, infinities that appear

*in the equations. It is just mathematical nonsense. Usually in mathematics the value can be rejected only in the case it were too small, but not because it is infinitely big and someone would like to get rid of it." * Direction in Physics, New York, 1978*

One can try to solve this problem by looking at it from the other side and forming a theory in such a way that it would not contain divergences at all. However, that way leads to the necessity to reject one or another thesis of the canonical point of view. In canonical theory, the appearance of divergences is caused by integrals connected with some of the particle parameters and considered in the whole of space, from zero to infinity, and for particles as points. The infinities appear by integration only in the region near zero, i.e., on an infinitesimal scale.

The elimination of divergences might be achieved within the purview of one or more of the following four different parameters or approaches in quantum theory:

1. the minimal elementary length is introduced and then the integration is carried out not from zero, and therefore all such integrals become finite;

2. it is considered that space-time is discontinuous, consisting entirely of separate points, whereby such a space-time model corresponds to a crystalline lattice. To get a discontinuous coordinate and time spectrum, time and coordinate operators are introduced (per quantized space-time theory);

3. non-linear equations containing derivatives of high order may be used instead of linear equations with derivatives of the first and second order only. Even more desperate measures are sometimes used: introduction of coordinate systems with indefinite metrics instead of coordinate systems with definite metrics;

4. it could be assumed that a particle is not a point, and hence a whole series of

non-local theories might be derived.

These four approaches have so far not yielded notable results, so another two techniques have been subsequently considered: enlargement of the Poincaré group, and generalization of internal symmetry groups.

Let us first discuss the problems connected with the enlargement of the Poincaré group, assuming in accordance with observations of natural phenomena that symmetries of sufficiently high level are realized. There are two such enlargement methods:

1. The Poincaré group is enlarged up to the conformal group, which includes scale and special conformal transformation in addition to the usual four-dimensional rotation (Lorentz group) and coordinate translations. However, if enlargement of the Poincaré group up to the conformal group is performed, then generators of the same tensor character should be added to the tensor generators of the Poincaré group's $M_{\mu\nu}$ (rotation) and P_{μ} (shifts). Unfortunately, after such enlargement the group multiplets contain either bosons or fermions only; in essence, these multiplets are not mixed. The worst situation is with the basic equation for particles. One can write such a conformal invariant equation only for particles with mass equal to zero. This situation may be improved with a new definition of mass (i.e., the so-called conformal mass is introduced), but thereafter its physical sense of particles becomes positively vague. To get out of a difficult situation in this case, attempts have been made to reject exact conformal invariance; then the mass appears as a result of conformal asymmetry violation. We have the same situation in the case of the SU3 symmetry group. This method was not successful.

2. Generators of the spinor type may be added to the enlarged Poincaré group. Such widening results in a new type of symmetry called 'super-symmetry'. For that purpose, so-called super-space is introduced: an eight-dimensional space where the points are denoted as the common coordinates $x_\mu(\mu = 0, 1, 2, 3)$ of space-time and also the anti-commutating spinor θ with four components. In this case, the super-symmetry group may be considered as a transformation group of the newly introduced super-space. The super-symmetry group then includes special super-transformation in addition to four-dimensional rotation and coordinate translations (Poincaré group). Representations (multiplets) Ψ of the super-symmetry group depend both on x_μ and $\theta : \Psi(\theta)$ operators. These functions are called super-fields and contain both boson and fermion fields. In other words, super-symmetries, bosons, and fermion fields are mixed. However, within such super-multiplets all particles have equal masses. In addition, this model is far from 'reality', as the physical meaning of super-symmetry is absolutely vague.

Let us now examine the so called second approach to eliminating divergences, connected with the generalization of the internal symmetry group. The simplest and most widely used groups of internal symmetry are SU2 and SU3. Two such generalizations have been actively investigated: the chiral group and a group of local calibrating transformations.

1. The chiral groups are direct products of SU2 and SU3, yielding SU2 x SU2 and SU3 x SU3 groups. For the construction of a chiral symmetric Lagrangian are used either chiral group multiplets in the form of polynomial functions of the field operators and their derivatives (i.e., linear realization of

chiral symmetry), or the Lagrangian is constructed with a small number of fields in the form of non-polynomial functions (for nonlinear realization of the chiral symmetry). In this case, some interesting results have been obtained, but the divergence problem seems to remains 'infinitely' far from solution.

2. With regards to local calibrating transformations, usually standard calibrating transformations do not depend on the coordinates of space-time; in other words, they are global. If we now assume that calibrating transformations are different in different points of the space-time coordinate system, then they may be combined into the local calibrating transformations group. If the Lagrangian is invariant in relation to global calibrating transformations, it is non-invariant in relation to the local calibrating group. Now it is necessary to somehow compensate incipient non-invariance of the global Lagrangian to derive the local invariant Lagrangian from the global invariant. This is done by the introduction of special Yang-Mills fields or compensating fields.

However, only particles with zero-mass vector like photons correspond to the Yang-Mills fields. Lack of mass results simply from the calibrating transformation. To obtain particles with non-zero mass, the special mechanism of spontaneous symmetry breaking has been proposed. This mechanism is such that, although the Lagrangian remains calibrating-invariant, the overall vacuum average of some fields that are part of the Lagrangian differs from zero, and the vacuum becomes degenerate. But it is impossible to create a substance field by means of Yang-Mills fields, and the former must be separately introduced.

There are several variations in theoretical development of this idea, the most successful being the Glashow-Weinberg-Salam model. According to this model, particles acquire finite mass if the terms responsible for spontaneous symmetry breakdown are added to the Lagrangian, usually by a certain combination of scalar fields (i.e., Higgs mechanism). Unfortunately, even that method has an essential defect, in that divergences still occur. A way was found to eliminate these divergences, but the neutral fields disappeared as well. Nevertheless, that method is considered as the one most propitious, and therefore the special mathematical apparatus based on equations of group renormalization is intensively developed.

Fifty years ago, J. Shwinger calculated the exact value of the anomalous magnetic moment of the electron. It was the remarkable result of modern quantum field theory magnificently confirmed by experimental data. However, in our opinion, his theory did not yield further essential physical correlations. While many mathematicians may deal primarily with quantum field theory, they seem to be still far from a deep physical understanding of the problem.

As a 'safe' example to illustrate this situation, we are going to examine the non-linear theory of A. Eddington, M. Born, and L. Infeld, which was favourably received and was incorporated into many quantum theory courses. Normally the authority of these scientists is presumed absolute; however…

The well-known Maxwell-Lorentz equations which describe the location and movement of an electron in a corresponding electro-magnetic field are as follows:

$$rot\,\mathbf{H} - \frac{1}{c}\frac{\partial \mathbf{E}}{\partial t} = 4\pi\rho\frac{\mathbf{v}}{c}, \text{ where } div\,\mathbf{E} = 4\pi\rho,$$

$$rot\,\mathbf{E} + \frac{1}{c}\frac{\partial \mathbf{H}}{\partial t} = 0, \text{ where } div\,\mathbf{H} = 0.$$

If we consider the electromagnetic field as a 'substance' but not the continuum of charged particles that make up different bodies, and use electrodynamics as a basis for mechanics, then charged particles should be regarded as nodal points of the electromagnetic field. Their location and movement should be governed by the laws of electromagnetic field variations in space and time. Then the only thing that prevents us to represent electrons as non-extended particles is the fact that the connected field created by electrons, according to the old concept (or creating them, in accordance with the new one), becomes infinite at their corresponding nodal points. Consequently, their mass estimated by their electromagnetic energy or momentum becomes infinite also. Thus, to combine the dynamic electromagnetic field theory (as a mechanical properties carrier) with the notion of the electron being non-extended, we should modify the above-mentioned Maxwell-Lorentz equation in such a way that, in spite of charge concentration at nodal points, the electromagnetic field would be finite at an arbitrarily small distance from those points. At median distances from the centre of the particle the field should appear 'normal', corresponding to the experimental data. Such a theoretical modification was made in 1922 by A. Eddington and in 1933 by M. Born and L. Infeld.

For this purpose, charge and current densities in the first two Maxwell-Lorentz equations were considered equal to zero over all of space except "special" points intended to be the electron locations. Furthermore, the vectors E and H in the same equations were correspondingly changed:

$$\mathbf{D} = \varepsilon \mathbf{E}; \ \mathbf{B} = \frac{1}{\mu}\mathbf{H}$$

where

$$\varepsilon = \frac{1}{\mu} = \frac{1}{\sqrt{1 - \frac{E^2 - H^2}{E_0^2}}}$$

Here, $E = \frac{e}{r_0^2}$ represents the maximum possible value of the electric field in the centre of the electron and parameter r0 is considered as the electron's effective radius. The solution of such equations gives the finite electron mass, calculated as total energy of the electric field created by the particle:

$$E = \frac{e}{\sqrt{r_0^4 + r^4}}$$

Actually, the electric field at $r >> r_0$ now behaves in a normal way. However, everything in such a theory, from beginning to end, is fundamentally wrong: In the spherically symmetric case (the only type of event under consideration), the electrostatic intensity ought to be zero in the center of the particle because E is a vector! One can find similar absurdities in numerous modern quantum field theory descriptions, but their authors are still with us.

As for us, we should learn from history, perhaps by considering two rather droll academic episodes connected with distinguished physicist Wolfgang Pauli (they are not generally mentioned in classic scientific literature). It is well known that Louis de Broglie heard crushing criticism from Pauli upon first report of his ideas –but he later received the Nobel Prize for them. (For some time after that incident, de Broglie didn't attend international conferences.) A bit later, Pauli rose in sharp opposition to the publication of the article by G. E. Uhlenbek and S. Goudsmit representing the basic concept of 'spin'. However, this did not prevent him from developing the same idea and obtaining similar fundamental results, for which he thereafter received the Nobel Prize!

In any case, the mathematical descriptions and exact predictions of numerous very different quantum effects were so impressive that physicists became proud of their quantum science to a point bordering on self-satisfaction and superciliousness. They stopped thinking about physical description of the underlying phenomena and concentrated on the mathematical descriptions only. However, many problems in quantum theory are still far from resolution.

The ideas developed in this book differ completely from the canonical approach and its previously described versions. Our own approach is non-local, wherein basic theses of standard quantum theory are modified accordingly, and until now no one seems to have investigated such a rearrangement of ideas.

To reiterate key basic premises of our Unitary Quantum Theory (from the Introduction):

According to standard quantum theory, any microparticle is described by a wave function with a probabilistic interpretation that cannot be obtained from the mathematical formalism of non-relativistic quantum theory but is postulated instead.

The particle is considered as a point, which is "the source of the field, bun cannot be reduced to the field". Nothing can really be said about that micro-particle's actual "structure".

According to UQT, such a particle is considered as a bunched field (cluster) or 32-component wave packet of partial waves with linear dispersion [1-9]. Dispersion can be chosen in such a way that the wave packet would be alternately disappear and reappear in movement. The envelopment of this process coincides with the quantum mechanical wave function. Such concept helps to construct the relativistic – invariant model of UQT. Due to that theory the particle/wave packet, regarded as a function of 4-velocity, is described by partial differential equation in matrix form with 32x32 matrix or by equivalent partial differential system of 32 order. The probabilistic approach to wave function is not postulated, like it was earlier, but strictly results from mathematical formalism of the theory.

Particle mass is replaced in the UQT equation system with the integral over the whole volume of the bilinear field combinations, yielding a system of 32 integral-differential equations. In the scalar case the authors were able to calculate with 0.3% accuracy the non-dimensional electric charge and the constant of thin structure (see 1.4).

Electric charge quantization emerges as the result of a balance between dispersion and nonlinearity. Since the influence of dispersion is opposite to that of nonlinearity, for certain wave packet types the mutual compensation of these processes is possible.

The moving wave packet periodically appears and disappears at the de Broglie wavelength, but retains its form. A similar phenomenon may correspond to the theoretical case of oscillating solutions, as yet non-investigated mathematically.

Micro-particle birth and disintegration mechanisms become readily understood as the reintegrating and splitting-up of partial wave packets. This approach regards all interactions and processes as being simply a result of the mutual diffraction and interference of such wave packets, due to nonlinearity.

The tunnelling effect completely loses within UQT its mysteriousness. When the particle approaches the potential barrier in such the phase where the amplitude of the wave packet is small, all the equations become linear and the particle does not even "notice" the barrier, and if the phase corresponds to large packet's amplitude, then nonlinear interaction begins and the particle can be reflected.

The most important result of our new Unitary Quantum Theory approach is the emergence of a general field basis for the whole of physical science, since the operational description of physical phenomena inherent in standard relativistic quantum theory is so wholly unsatisfying.

1.2 Further Inadequacies of Standard Quantum Mechanics and the Essence of a New Paradigm

Ernst Mach's outlook is well characterized by an episode from his life. Mach was studying ballistics and was often presented on the shooting grounds. Once he said to a colleague: "There is a question, which is constantly torturing me: Does the shell exist in the interval between the shooting and the hitting of the target? We do not see or feel it in any way."

"You are crazy," his colleague answered; "How can you doubt the existence of the shell? You yourself are calculating its trajectory, and your calculations agree with the experiment. Is this not proof of the shell's existence?"

"It does not prove anything," Mach objected. "The trajectory might only be a supplementary mathematical notion serving to predict further observations. The shell might not be moving along the trajectory at all. It might disappear at the moment of the shooting and reappear again at the moment it hits the target."

The colleague only shrugged his shoulders in surprise. But Mach did not stop there. In order to solve this problem he designed a special device for photographing the shell in flight. Mach was not only convinced that the shell existed in flight, but he also saw on the photos certain lines coming from the shell, which were called Mach lines.

It was due to his doubts about the existence of an unobserved flying shell that Mach created the supersonic gas dynamic theory. As a tribute to his achievements, the ratio of a flying *object's speed to the speed of sound is called the Mach number.*

H. Laitko and D. Hoffman,
Matters of Natural and Technical History, 1988 (4th), pp. 45-57.

Authors' note: The previous story happened long before quantum mechanics as well Newton comes to mind here with his theory of a 'quantum' ideology. It seems that new ideas often occur to the best researchers not in connection with any experimental data, and both stories would seem to confirm this well.

The most direct way of eliminating the existing theoretical difficulties in the relativistic interpretation of quantum-mechanical systems lies in the construction of a theory dealing only with a unified field, where the quantities and the values that characterize that field at different points in time and space are observed.

There is an impression that during the time since quantum theory was created, no substantial progress has been made in respect to our understanding of that theory. This impression is reinforced by the fact that neither field quantum theory nor the still imperfect theory of elementary particles made any serious strides in the posing or solution of the following traditional questions [1-3]:

- What are the reasons for the probabilistic interpretation of the wave function, and how can this interpretation be obtained from the mathematical formalism of the theory?
- What is really happening to a particle, when we "observe" it during interference experiments [for interference that cannot be explained without invoking the particle "splitting-up" concept]?
- What does this statement in standard quantum mechanics really mean?: *"a*

microparticle described by a point is the source of a field, but cannot be reduced to the field itself". Is it divisible or not? What does it really represent? Why everything in physics is based on two key notions: point-particle as the field source and the field itself? Can only one field aspect remains, and will physical entity be concidering as yet un-analyzable?

There are as yet no answers to these basic questions. "Exorcism" of the complementarity principle is irrelevant because that philosophy was invented ad hoc.

Many researchers think that the future of theoretical physics should be based upon a certain single field theory – a unitary approach. In such a theory, particles are represented in the form of field wave clusters or packets. Mass would be purely a field notion, but the movement equations and all 'physical' inter-actions should follow directly from the field equations.

This book deals in more detail than Refs. [1-9, 165, 166, 170, 200, 201] with a very simple and heretofore unstudied possibility of formulating the unitary quantum theory for a single particle. Here we will deal only with the very general properties inherent in all particles and not touch upon the problems connected with such properties as charge, spin, strangeness, and charm.

After appearance and development of quantum mechanics, a curious situation occurred: half of the founders of the theory clearly spoke out against it! Their few remarks are given below:

"The existing quantum picture of material reality is today feebler and more doubtful than it has ever been. We know many interesting details and learn new ones every day. But we are still unable to select from the basic ideas one that could be regarded as certain and used as the foundation for a

stable construction. The popular opinion among the scientists proceeds from the fact that the objective picture of reality is impossible in its primary sense [i.e. in terms of images and movements- remark of authors]. Only very big optimists, among whom I count myself, take it is as philosophic exaltation, as a desperate step in the face of a large crisis. A solution of this crisis will ultimately lead to something better than the existing disorderly set of formulas forming the subject of quantum physics…If we are going to keep the damned quantum jumps I regret that I have dealt with quantum theory at all…" – Erwin Schroedinger

"The relativistic quantum theory as the foundation of modern science is fit for nothing." – P. A. M. Dirac

"Quantum physics urgently needs new images and ideas, which can appear only in case of a thorough review of its underlying principles." – Louis de Broglie

Albert Einstein, also, had the following to say:

"Great initial success of the quantum theory could not make me believe in a dice game being the basis of it…I do not believe this principal conception being an appropriate foundation for physics as a whole… Physicists think me an old fool, but I am convinced that the future development of physics will go in another direction than heretofore…I reject the main idea of modern statistical quantum theory… I'm quite sure that the existing statistical character of modern quantum theory should be ascribed to the fact that that theory operates with incomplete descriptions of physical systems only…"– A. Einstein

Although today the quantum theory is believed to be essentially correct in describing the phenomena of the micro-world, there is nevertheless experimental evidence of cold nuclear fusion and mass nuclear transmutations, of anomalous energy sources and perhaps even perpetual mobile—which contradicts quantum theory.

The ‘official’ quantum science does not believe in cold nuclear fusion phenomenon and regards people working within this sphere almost as charlatans. A good illustration of this is an article that appeared in Scientific American describing the annual awarding of jester Nobel prizes for completely phony works that generated a lot of furore. The article stated that the first candidates for the next jester Nobel Prize should be M. Fleishman and S. Pons (the discoverers of the cold nuclear fusion phenomenon). More than ten years have passed since then, but that prize has yet to be awarded!

We think that such an attitude of official science in the world is extreme and hostile toward all things new. The history of science abounds in remarkable examples of blindness and short-sightedness on the part of the official scientific establishment.

Here are some examples: When D. E. Mendeleev presented his periodic table to the Presidium of the Russian Academy of Sciences, the Vice-President (evidently, Academician Parrot) asked him: *“Mr. Mendeleev, did you try placing the elements in alphabetical order?”* We know that Mendeleev never became an academician!

N. I. Lobachevsky was dismissed from the position of Rector of the Kazan University as a “madman” for the construction of non-Euclidian geometry, and it would be naive to think that such things happen only in Russia. Let’s not forget the fires and inquisitions that took place in the scientific community more than 150 years ago.

Ernest Rutherford, the father of nuclear physics, thought that nuclear fission would be an exotic phenomenon largely unknown to the public. Heinrich Hertz, discoverer of electromagnetic waves, criticized researchers all over the world who were trying to use his discoveries for transmitting information, because he thought it to have no prospects whatsoever.

Such examples of blindness among the scientific community and its best representatives could be continued, but the foregoing should suffice. The history of the science shows clearly the validity of the objective dialectic law of the New struggling against Old. Intolerance and rigidity in the science, which the epigraph to this chapter well illustrates, can hardly do any good.

E. Mach was not the first to contemplate motion intermittence. Epicurus in his letter to Herodotus [10] wrote: *"The opinion that time intervals perceived in mind only contain continuous motion is wrong."* Later that point of view was further developed and generalized by both Hindu and Arabic scholars. For example, according to Sautrantika teaching or doctrine [11] things appear from nothing, exist for a time, and then disappear again (!). In the same vein, Mutakallims asserted that everything in the world, all objects, properties, and even thought, change not continuously but in discrete steps: Things suddenly appear, exist within some time interval, and then similarly disappear to revive at another time and in another place – perhaps in a new form.

This principle, known in philosophy as that of 'renovation', was rediscovered by Leibnitz. In 1669, in a letter to his teacher and friend Thomasio, Leibnitz stated [12]: *"I have proven all that is moving is ceaselessly recreated, and that every body at any moment of motion is 'something'; and at any time between these moments of motion it is nothing – an object unknown but essential."*

The famous English mathematician W. Clifford also adhered to such a point of view. Philosopher Reichenbach wrote about similar phenomena [13] which should be described with adequate mathematical means, but it seems that no one has yet managed to accomplish it.

When the real phenomenon of corpuscular-wave dualism was discovered, the first idea that occurred to Schroedinger was to present the particle as a packet of de Broglie waves. Later, British mathematician C. G. Darwin [14] proved this idea to be wrong; as such wave packets would dissipate due to dispersion. Nevertheless, de Broglie studied the similar idea in a non-linear version, called the “double solution” (pilot wave) theory, until the end of his life.

The trouble with all previous attempts to present a particle as a field wave packet was that such a packet, according to proposed approaches, consisted of de Broglie waves. In our UQT approach, the packet consists of partial waves and de Broglie wave appears as a side product during the movement and evolution of that partial wave packet.

Since we intend to describe physical reality by a continuous field, neither the notion of particles as invariable material points nor the notion of movement can have a fundamental meaning. Only a limited zone of space wherein the quantum field strength or energy density is especially large can be considered as a particle.

In the standard quantum theory, a micro-particle is described with the help of a wave function with a probabilistic interpretation. This does not follow from the strict mathematical formalism of the non-relativistic quantum theory, but is simply postulated. A particle is represented as a point that is the source of a field, but cannot be reduced to the field itself and nothing can be said about its “structure” except with these vague words. Modern quantum field theory cannot even formulate the problem of mass spectrum searching.

This dualism is absolutely inadequate because both substances is introduced, i.e. the points and the fields. Presence of both points and fields at the same time is impossible from general philosophical positions – “razors of Ockama”. Besides that, the presence of the points leads to non-convergences, which are eliminated by various methods, including the introduction of a re-normalization group that is declined by many mathematicians and physicists, for example, P. A. M. Dirac.

The original idea of Schroedinger was to represent a particle as a wave packet of de Broglie waves. As he wrote in one of his letters, he “was happy for three months” before British mathematician Darwin showed that such packet quickly and steadily dissipates and disappears. So, it turned out that this beautiful and unique idea to represent a particle as a portion of a field was nonrealistic in the context of wave packets of de Broglie waves. Later, de Broglie tried to save this idea, he tried to prove nonlinearity till the end of his life, but he couldn’t obtain any significant result. V. E. Lyamov and L. G. Sapogin in 1968 proved [202] that every wave packet constructed from de Broglie waves with the spectrum $a(k)$ satisfying the condition of Viner-Pely (the condition for the existence of localized wave packets) became blurred in every case.

$$\int_{-\infty}^{\infty} \frac{\left| ln\left(a(k)\right)\right|}{1+k^{2}} \geq 0$$

Let us conduct the following thought experiment: at the origin of a fixed coordinate system located in an empty space free of other fields, there is a hypothetical immovable observer, past whom a particle moves along the x axis at a velocity of v<<c. Let us assume that the particle is represented by a wave packet creating a certain hitherto unknown field, and that the observer with the help of a hypothetical microprobe is measuring certain characteristics of the particle’s field at different moments in time. This measuring is done on the assumption that the size of the hypothetical energy measuring device is many times less than the size of

the particle and that it does not disrupt or influence the field created by this particle.

It is obvious that such an experiment is imaginary and cannot in principle be performed, but it doesn't prevent our imaginary device from being ideologically the simplest possible. In other words, we are interested in how the particle behaves and how it is structured when "no one is looking at it." Let the result of measurements at a certain point be function f(t), describing the structure of the wave packet, the size of which is very small and compared to the de Broglie wave. Knowing the particle's velocity v and the structural function f(t), the immovable observer can calculate the "apparent size" of the particle.

Let us assume that inside the corresponding wave packet the linearity of laws is not broken, and that the function f(t) satisfies the Dirichlet conditions and can be split into harmonic components which we will call 'partial waves'. In using the complex form of development, we can obtain:

$$f(t) = \sum_{s=-\infty}^{\infty} c_s exp(i\omega_s t), \qquad (1.2.1)$$

where coefficients c_s are the amplitudes of the partial harmonics (with the mean value of $c_0 = 0$), and ω_s are the corresponding frequencies. To find the dispersion equation for partial waves, let us use the Rayleigh ratio for the group velocity v of the wave packet:

$$v = v_p + k\frac{dv_p}{dk} \qquad (1.2.2)$$

Regarding the wave number k of the partial wave as a function of the phase velocity v_p, let us integrate (1.2.2) with v=const, since by the law of inertia the centre of the packet is moving at a constant speed. We will have:

$$k = \frac{C}{|v_p - v|}, \tag{1.2.3}$$

where C is the constant of integration. Integration is made on the assumption that velocity v is constant and does not depend on the frequency of the partial waves, which follows from the experimentally derived law of inertia. If we assume that the particle is a wave packet, then its group velocity will be equal to the classical velocity of the particle. Since the particle is moving at a constant speed (inertially) in the absence of external fields, the group velocity of the packet is a constant value independent of the phase velocities of the harmonic components.

The unsatisfying form of the dispersion equation (1.2.3) masks the linear dispersion law, which can be derived from (1.2.3) by substitution of $v_p = \frac{\omega_s}{k_s}$, whereby:

$$\omega_s = vk_s \pm C, \tag{1.2.4}$$

where plus sign corresponds to $v_p > v$ and minus sign corresponds to $v_p < v$.

We will now define the integration constant C as follows: since harmonic components $c_s exp(i\omega_s t)$ are propagated in the linear medium independently of each other, the behaviour of the wave packet can be presented as a superposition of the harmonic components:

$$c_s exp(i(\omega_s t - k_s x) + i\varphi) \tag{1.2.5}$$

Since the wave phase is now defined up to the additive constant, an additional constant ϕ for all partial waves is introduced. Essentially, this is possible by simple translation of the origin of the coordinates, so the value ϕ can actually be excluded from further consideration. Then, the moving wave packet can be represented as follows:

$$\Phi(x,t) = 2\Re e\sum_{1}^{\infty} c_s exp(i(\omega_s t - k_s x)) \qquad (1.2.6)$$

Considering the wave number as a frequency function $k(\omega)$ and substituting (1.2.4) into (1.2.6), we obtain:

$$\Phi(x,t) = 2\Re e(exp(-i(\frac{C}{v}x))\sum_{1}^{\infty} c_s exp(i\omega_s(t - \frac{x}{v})))$$

or

$$\Phi(x,t) = cos(\frac{C}{v}x)f(t - \frac{x}{v}) + sin(\frac{C}{v}x)f^*(t - \frac{x}{v}), \qquad (1.2.7)$$

where function $f^*(t - \frac{x}{v})$ describes some additional partial waves with the same frequencies ω_s.

Analyzing expression (1.2.7), we can see that the wave packet $\Phi(x,t)$ in its movement in a "medium" with linear dispersion described by equation (1.2.4) is disappearing and appearing again with period $\frac{2\pi v}{C}$ in x and can be considered as being inscribed in the flat envelope modulating with that period. [The state of the wave packet (and of its corresponding particle) in the range where it disappears or its amplitude becomes very small may be thought of as a "phantom state".]

Let us find integration constant C. For this, we require the wavelength of the monochromatic envelope to be equal to the de Broglie wavelength:

$$\lambda_B = \frac{2\pi}{k_B} = \frac{2\pi v}{C} \quad (1.2.8)$$

Then, $C = vk_B$, and expression (1.2.7) become as follows:

$$\Phi(x,t) = cos(k_B x) f(t - \frac{x}{v}) + sin(k_B x) f^*(t - \frac{x}{v}). \quad (1.2.9)$$

The disappearance and reappearance of the particle occurs periodically without change of its apparent dimensions (width and form). It is clear that the dimensions of each packet can be many times less than the de Broglie wavelength.

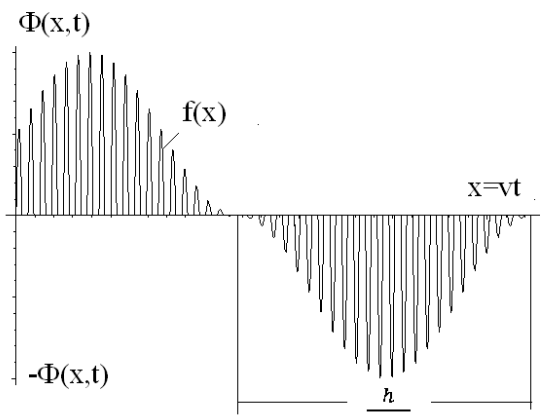

Fig. 1.2.1 *Behaviour of wave packet in linear dispersion medium (i.e., rather like a series of stroboscopic photographs).*

An approximate picture of the behaviour of such a packet in space and time [200, 201] is presented in Fig. 1.2.1 below, and the results of the mathematical modelling of the scalar Gauss wave packet behaviour in a medium with linear dispersion are presented in Fig. 1.2.2. The both figures show how such a packet disappears and reappears, changing it sign.

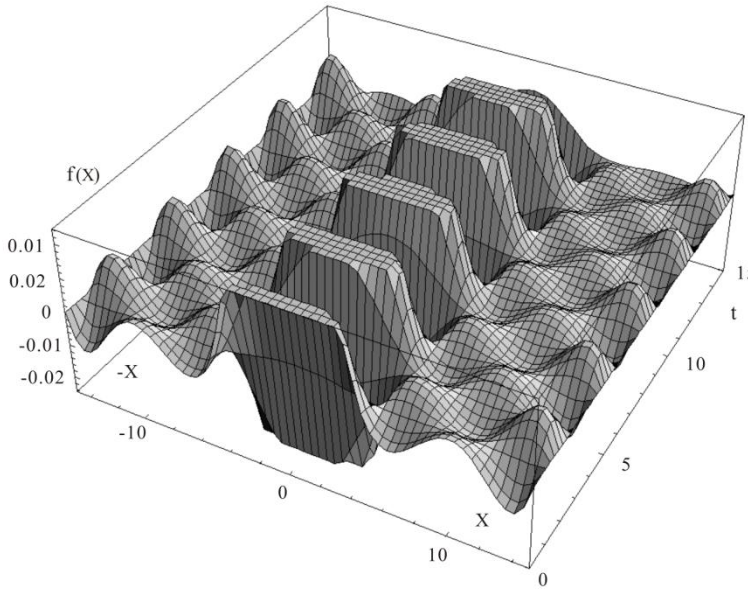

Fig. 1.2.2 *Mathematical modelling of Gauss packet behavior.*

Any dispersion without dissipation leaves the packet's energetic spectrum is unchanged. When the wave packet moves, only the phase relations between the harmonic components are changing, because the dissipation is absent. This concept is based on two postulates:

1. a particle represents a wave packet with linear field laws. The linear dispersion law follows from the law of inertia, and the particle is regarded as a moving wave packet inscribed in a flat envelope;
2. the envelope wavelength is equal to the de Broglie wavelength. Nevertheless, any packet of de Broglie waves that are localized enough is spread over the whole volume, as dispersion of the de Broglie wave $\omega_B = \dfrac{\hbar k_B^2}{2m}$ differs from linear dispersion. This does not contradict the suggested concept, as the envelope doesn't exist as a real wave and is not

included in the set of waves described by Eq. (1.2.5). More about this in section 2.13.

It is interesting to note that a dispersion space communication system has been developed, in which the transmitter emits a very long frequency-modulated impulse that cannot be detected even at a short distance, for the signal energy is widely distributed across the spectrum, yet in the transmitter area the signal turns into a short but very powerful impulse [15]. This can be achieved because the back part of the signal impulse spreads more quickly than the front, and is compressed into a very narrow impulse of the delta function type. Some species of bats use this effect in the ultrasonic range for echolocation [15]. With some imagination, it could be suggested that they learned this skill from quantum mechanics!

Please note that the process of periodicity in the appearance and disappearance of the wave-packet/particle is possible only for very small objects, and that the quantum teleportation of macro-objects being widely discussed today is hardly possible by the principles under discussion here.

However, the theoretical possibility of the wave packet spreading in the transverse direction due to diffraction is still a concern. It is in principle can be possible that the packet can disperse and not exist as a localized formation. To show that this won’t happen, let us put the equation of dispersion (1.2.3) into another form. Viz., according to P. Ehrenfest, the theoretical envelope velocity of the wave packet equals the classical particle velocity:

$$v = \frac{d\omega}{dk} = \frac{P}{m} \tag{1.2.10}$$

On the other hand,

$$\omega = \frac{E}{\hbar}, \text{ and } \frac{d\omega}{dk} = \frac{1}{\hbar}\frac{dE}{dk}.$$

According to classical mechanics, the energy of a free particle is:

$$E = \frac{P^2}{2m} \quad \text{or} \quad \frac{d\omega}{dk} = \frac{P}{\hbar m}\frac{dP}{dk}. \tag{1.2.11}$$

Comparing (1.2.10) and (1.2.11) we obtain:

$$\frac{P}{\hbar m}\frac{dP}{dk} = \frac{P}{m},$$

and by integrating that differential equation we get

$$P = \hbar k + C.$$

Now, the phase velocity of the waves,

$$v_p = \frac{\hbar\omega_s}{\hbar k_s + C},$$

does not remain a constant value but depends on constant of integration C.

By using another method to determine the velocity phase, the constant of integration may be added to the expression of energy (but this isn't a matter of principle). The choice of the constant of integration C does not influence the results to be obtained in terms of quantum mechanics, and so for simplicity we assume that C = 0.

The present conclusion represents a known fact that motion equation invariance regarding gradient calibrating transformation. The same relations for the phase velocity of quasi-particles also hold in solid-state physics, for quasi-particle momentum that can be written as a constant divisible by the reciprocal lattice constant.

Lets return to (1.2.3):

$$k = \frac{C}{|v_p - v|}.$$

The choice of constant C determines the type of dispersion. In the general case, that relation describes the wave set with different k and λ. As we could see previously (and as is true in all inertial coordinate systems), with a certain type of dispersion the envelope of the de Broglie wave is processed in a 'space-hold' conditions.

Putting vp = 0 in (1.2.3), we obtain

$$C = kv = \frac{mv^2}{\hbar}.$$

Substituting the value for C into the same expression (1.2.3) and taking into account that $k = \frac{\omega_s}{v_p}$, we will obtain the expression for subwave phase velocity:

$$v_p = \frac{\hbar\omega_s}{\pm mv + \frac{\hbar\omega_s}{v}}. \qquad (1.2.12)$$

We should note that according to some works in quantum field theory, divergences are in principle eliminated by choice of C.

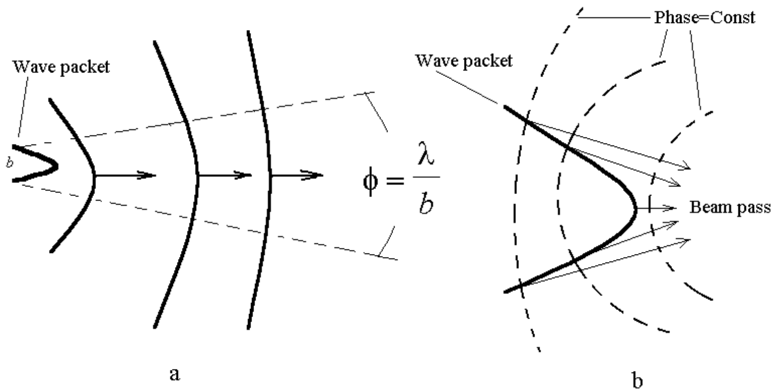

Fig. 1.2.3 *Wave packet dispersion and refocusing.*

If the theory of wave transmission is linear, the wave packet will diverge at the angle $\phi = \dfrac{\lambda}{b}$ (Fig. 1.2.3a).

Within the non-linear interpretation, one can see that self-focusing is able to compensate transverse diffraction (1.2.3b). For that to occur, the following relationship is necessary:

$$v_p = \frac{c}{n} = \frac{c}{n_0 + n_2 E^2},$$

where c is light velocity. Then, the peripheral phase fronts bend toward the packet's axis, thus compensating transverse diffraction [as in Fig. 1.2.3b above]. As the wave packet's mass is proportional to the square of its amplitude, relation (1.2.12) can be rewritten in the following form:

$$v_p = \frac{\hbar\omega_s}{\pm mv + \dfrac{\hbar\omega_s}{v}} = \frac{c}{\dfrac{c}{v} \pm \dfrac{mvc}{\hbar\omega_s}} = \frac{c}{n_0 + n_2 E^2}$$

providing $n_0 = \frac{c}{v}$, $n_2 = \pm \frac{vc}{\hbar \omega_S}$, and $m \approx E^2$ (to be discussed further).

As well we have said nothing about the nature of either the 'medium' or the waves propagating in it. In spite of various modern versions of quantum field theory, and the further development of UQT theory in the next chapters of the book, it is impossible to answer at present the very simple question "what is space-time?" Is it simply the "stage" where performers in the form of a multi-component field are continually appearing and disappearing? Or does the field represent dynamic distortions of the stage itself, so that it's impossible to separate the performers from that stage?

The authors can add little to W. Clifford's deep remarks in the epigraph of the next chapter. Here, we would like simply to remind the reader that in ordinary electrodynamics scalar and vector A conduct themselves in Lorentz transforms in the same way as time and three components of space. Moreover, while moving in space they are related to velocity v by a most natural relation:

$$\boldsymbol{A} = \boldsymbol{v}\varphi$$

The other question also appears: when the problem of corpuscular-wave dualism arose, then Schroedinger immediately arrived to idea that particle was a simple packet of de Broglie waves. Later because of packet spreading all over the space that idea was rejected although Louis de Broglie tried during all his life to make these processes non-linear and thus to save that perfect idea of the wave packet (double solutions theory and pilot wave). Why researchers have been taken no notice the extremely simple possibility of wave packet periodic disappearance and reappearance from the other wave theory discussed previously? We'll try to answer that 'philosophical' question below.

It is extremely difficult to imagine in the abstract things that never have been seen or heard before. In that light, the notion that our thoughts may merely be the reflections and transformations of something we have previously observed may be profoundly true. This may be illustrated in the following way: Relation (1.2.12) describes dispersion, including the phase velocity dependence of the wave on frequency. Then we may write the standard equation for the phase velocity

$$v_p = \frac{c}{n}$$

where c is the velocity of light and n is the index of refraction.

This coefficient, in accordance with modern theory and for any existing medium, is a complex analytical function and has both real and imaginary parts. Without any detailed assumptions about the medium, and using only the fact that any distortion will not propagate with a velocity higher than the velocity of light, Kramers and Kronig obtained the relation between real and imaginary parts of the index of refraction:

$$Re\left|n(\omega) - n(0)\right| = P\int_0^\infty \frac{2\omega^2 \, Im\, n(\omega')}{\pi\omega'(\omega'^2 - \omega^2)} d\omega'$$

Here, Re *n(ω)*is the real component of that index, If *n(ω)* is the imaginary part determining its dissipation, P indicates that the principal value of the integral is considered. From a mathematical viewpoint, this is simply a consequence of the well-known Hilbert transformation for an analytical function that does not contain poles and zeroes on the right half plane. The Cauchy integral of such function equals zero, and determines the relation between these two parts of the refraction index: that relation represents a mathematical expression of the causality principle that any medium existing in nature and consisting of atoms and molecules must satisfy.

However, in the case of the linear dispersion medium considered here, the index of refraction's imaginary part equals zero (assuming no dissipation) and so it real part is equal to zero also. The real part is then an exponential function having an imaginary index (corresponding to oscillation) and the Cauchy integral does not vanish. So, the Kramers-Kronig dispersion relations simply are not valid.

The process of periodic disappearance and reappearance of the wave packets in any real nonlinear medium consisting of particles thus cannot occur – so we could never detect it – thereby reinforcing the idea that space-time itself can hardly be considered discontinuous.

1.3 Unitary Quantum Theory

"I have no doubts about the following: small parts of space are similar in their nature to irregularities on a surface which, on the average, is flat. The quality of being curved and deformed continuously passes from one part of space to another like the phenomenon that we call the movement of matter, ethereal or corporeal. In the real physical world nothing happens except these variations, which is probably in compliance with the continuity law."

William Clifford, 1870

The wave function of a single particle (1.2.9) was derived on an assumption of non-relativistic velocities, i.e., for v<<c. To obtain its relativistic generalization it is first necessary to make the wave function relativistically phase invariant [1-3], i.e.,

$$\boldsymbol{\Phi} = exp[-i(Et - \mathbf{Px})]\mathbf{f}(\mathbf{x} - \mathbf{v}t), \tag{1.3.1}$$

where

$$\mathrm{E}=\frac{\mathrm{m}}{\gamma};\mathbf{P}=\frac{\mathrm{m}\mathbf{v}}{\gamma};\gamma=\sqrt{1-\mathbf{v}^2}$$

and $f(x-vt)$ is some structural function (in this paragraph, we use a unit system in which $c=\hbar=1$). It can be required that structural function $\mathrm{f}(x-v\mathrm{t})$ to be scalar and satisfy the Klein-Gordon equation. Then, we will get the following equation for f:

$$\left(\mathrm{v}_i\mathrm{v}_k-\delta_{ik}\right)\frac{\partial^2\mathbf{f}}{\partial\xi_i\partial\xi_k}=0$$

Here, $\xi_i=x_i-v_it$; i, k=1, 2, 3, and summarization is obtained by repeated indices as usual. A two-component solution of the Klein-Gordon equation will then appear as follows:

$$\Phi=exp\left(-i(Et-\mathbf{Px})\right)\begin{pmatrix}\frac{\gamma-1}{2\gamma}\mathbf{f}-\frac{i}{2m}\mathbf{v}\frac{\partial\mathbf{f}}{\partial\xi}\\ \frac{\gamma+1}{2\gamma}\mathbf{f}+\frac{i}{2m}\mathbf{v}\frac{\partial\mathbf{f}}{\partial\xi}\end{pmatrix} \qquad (1.3.2)$$

By substituting (1.3.1) into the Schrödinger equation we may obtain the Laplace equation for structural function:

$$\nabla_\xi^2 f=0,$$

and it solution enable us to regard the particle as a spherical wave packet “cut into parts” by spherical harmonics.

But such approach can only serve as a certain illustration, a first approximation based on the assumption of field law linearity. Function f described by the

Laplace equation will tend to infinity at zero, which is completely unsatisfactory from the physical point of view. Let us do otherwise, and consider just the simplest equations of first and second order, which are satisfied by a one-component relativistic wave function having an arbitrary structural function.

These equations have a clearly relativistic form:

$$(u_\mu \frac{\partial}{\partial x_\mu} + im)\boldsymbol{\Phi} = 0 \quad 1.3.3)$$

$$(u_\mu u_\nu \frac{\partial^2}{\partial x_\mu \partial x_\nu} + m^2)\boldsymbol{\Phi} = 0 \quad (1.3.4)$$

where: $x_\mu = (x, it)$; $u_\mu = (\frac{\mathbf{v}}{\gamma}, \frac{i}{\gamma})$ is the particle's four-velocity; and $\mu, \vartheta = 1, 2, 3, 4$. It is natural to consider that a particle with an arbitrary spin and mass m can be described by a relativistic equation

$$(\Lambda_\mu \frac{\partial}{\partial x_\mu} + m)\boldsymbol{\Phi} = 0 \quad (1.3.5)$$

where Φ is an n-component column and Λ_μ represents four (n x 4) – matrices (n rows, 4 column) describing the spin properties of the particle. These matrices are functions of the particle velocity and satisfy relations that are defined by the spin value.

Let us now express particle energy (mass) by means of a field. For Dirac-type equations, nether the character of charge with an integer spin nor charge energy with half-integer spin are defined. In relativistic electrodynamics, according to the Laue theorem, the tensor components of the energy-impulse of the electromagnetic field that is generated by the charge do not form four-vectors, so there is only one method of expressing the particle energy:

$$E = m = \int_V \boldsymbol{\Phi}^+ \boldsymbol{\Phi} d^3x \tag{1.3.6}$$

Usually in such cases it is required that the integral (1.3.6) contains the Green function (for example, see [19]). However, if we strictly follow the principles of the unitary theory, we should define the particle energy within non-relativistic limits as in expression (1.3.6).

Let us substitute the invariant relativistic expression $\langle \boldsymbol{\Phi} | \boldsymbol{\Phi} \rangle$ for $\int_V \boldsymbol{\Phi}^+ \boldsymbol{\Phi} d^3x$, which, for example, equals [16] for a spin field with a rest mass differing from zero (there are also formulas for the scalar and vector fields):

$$\langle \boldsymbol{\Phi} | \boldsymbol{\Phi} \rangle = \int \{ \boldsymbol{\Phi}^* i\gamma_4 \frac{\partial}{\partial t} \hat{\varepsilon} \boldsymbol{\Phi} - \frac{\partial}{\partial t} \boldsymbol{\Phi}^* i\gamma_4 \hat{\varepsilon} \boldsymbol{\Phi} \} dV \tag{1.3.7}$$

where γ_4 is a Dirac matrix, $\hat{\varepsilon} = +1$ for a particle, and $\hat{\varepsilon} = -1$ for an antiparticle. Then, Eq. (1.3.5) will look as follows:

$$\{ \boldsymbol{\Lambda}_\mu \frac{\partial}{\partial x_\mu} + \langle \boldsymbol{\Phi} | \boldsymbol{\Phi} \rangle \} \boldsymbol{\Phi} = 0 \tag{1.3.8}$$

This nonlinear integro-differential equations are, in our view, fundamental, and must describe all the properties and interactions of particles. The mass spectrum from such equations may be derived after solving stability problems of the Sturm-Liuville type, which will in turn give the particle lifetime. In the theory under consideration, the birth and decay of all particles, and all of their interactions and transformations, are consequences of wave packet splitting and mutual diffraction phenomena due to nonlinearity. The construction of solutions to that problem will plainly require some new mathematical methods.

Point-like particles may be required to simplify the solution of the preceding Eq. (1.3.8), whereby it is reduced to the main equation of nonlinear W. Heisenberg [17] theory written not in operator form but in c-numbers. To do this we should in Eq. (1.3.5) substitute $m = \Phi^{+}\Phi$. Then we obtain the following equation

$$(\Lambda_{\mu}\frac{\partial}{\partial x_{\mu}} + \Phi^{+}\Phi)\Phi = 0, \tag{1.3.9}$$

thus approximate particle mass spectrum has been derived [17] with help of this equation.

Let us pass from equation (1.3.5) to the equation of particle motion in an external electromagnetic field A_{μ}. We therefore makes a standard substitution $\frac{\partial}{\partial x_{\mu}} \rightarrow \frac{\partial}{\partial x_{\mu}} - ieA_{\mu}$, and Eq. (1.3.5) is transformed as follows:

$$(\frac{\partial}{\partial \mathrm{t}} + \mathbf{v}\frac{\partial}{\partial \mathbf{x}} - \mathrm{iL})\mathbf{\Phi} = 0 \tag{1.3.10}$$

where L is a relativistic Lagrangian, $L = m\gamma + e\gamma U_{\mu}A_{\mu}$.

If a particle is located in an external electromagnetic field, for example, with vector potential A and scalar potential φ, then the linear dispersion law is not changed. L and v will be certain functions of coordinates and the solution of Eq. (1.3.10) in a general form has the following form:

$$\Phi = exp(-i\int Ldt)\mathbf{f}\left(\mathbf{x} - \int \mathbf{v}dt\right) \tag{1.3.11}$$

It is easy to make a standard transition from the relativistic case to the non-relativistic case by using the well-known transformation $\Phi = \Phi e^{-imt}$.

Substitution of function (1.3.11) into the equation (1.3.10) shows that the equation is satisfied providing L as a non-relativistic Lagrangian.

Let us now look at the role of the wave function phase, which is the classic action S and will enable us to establish a connection between the proposed theory and classical mechanics. Actually, the wave function may be represented in the form below (following Hamilton’s principle in classic mechanics):

$$\mathbf{\Phi} = \exp(i\,S)\mathbf{f}(\mathbf{x} - \int \mathbf{v}dt)$$

If we substitute this expression into Eq. (1.3.10), we then obtain an equation for S:

$$\frac{\partial S}{dt} + \mathbf{v}\nabla S - L = 0 \qquad (1.3.12)$$

In keeping with the requirements of the Hamilton-Jacobi theory, it is necessary to assume that

$$\mathbf{P} = \nabla S;$$

then Eq. (1.3.12) will be transformed to the Hamilton-Jacobi equation:

$$\frac{\partial S}{\partial t} + H = 0,$$

where

$$H = \mathbf{P}\mathbf{v} - L$$

is the particle’s Hamiltonian.

The function S can thereby be found, dependent on the particle’s coordinates, the physical parameters of the Hamiltonian, and on q non-additive integration constants; and then perhaps the problems of motion and dynamics can be solved.

The imposed requirement $\mathbf{P} = \nabla S$ implies a transposition to classic mechanics using an optic analogy approximation, whereby the concept of particle trajectory as a beam can be introduced. Such a trajectory will be orthogonal to any given surface of a permanent operation or phase.

On the other hand, a quantum object becomes a classical construct after superposition of a large number of wave packets. The case where all wave packets composing an object spread and reintegrate simultaneously despite different velocities and phases is physically impossible. That is why such a combination when averaged out will appear, in general, like a stable and unchanging object moving under the laws of classical mechanics, whereas every elementary object obeys the quantum laws.

Note that a transfer from the unitary quantum theory to classical mechanics is mathematically strict. In the usual quantum theory, the transfer happens with an imposed condition $\hbar \to 0$. Mathematically, it is completely unsatisfactory, since $\hbar$ is some physical constant (equal to 1 if given a corresponding units system). We do not remember a single case in mathematics when a similar condition would be imposed in a proof, such as $\pi \to 0$.

Let us consider briefly the hydrogen atom problem. The solution of classical problem of particle movement in the central field allows to present the wave function (1.3.1) as follows:

$$\Phi = e^{-iEt} e^{i\int_{r_0}^{r} p_r dr} e^{i\int_{\varphi_0}^{\varphi} p_\varphi d\varphi} f(r - \int_0^t v_r dt; \varphi - \int_0^t \varphi dt)$$

Here, r_0 and ϕ_0 are particle coordinate values (radius and angle correspondingly) at time t=0. Stationary orbits appear when the envelope is a standing wave provided:

$$ET = 2\pi n_1 h; \oint p_r dr = 2\pi n_2 h; \oint p_\phi d\phi = 2\pi n_3 h\,,$$

where n_1, n_2, n_3 are integers. These requirements correspond to the terms of Bohr-Sommerfeld quantification.

An integral along trajectories can be constructed with the help of (1.3.11), and it is equivalent to a flow of monochromatic particles with equally distributed phases. After developing this integral in series (see Ref. [18]), we obtain the Schroedinger equation. On the other hand, the connection of the developed approach with the Schrödinger equation follows directly from (1.3.11). The process envelope can be identified with de Broglie wave and in essence the Schroedinger equation describes the envelope of the wave packet's maxima in motion.

In conclusion of this section, let us find matrices Λ_μ. Let us assume that matrices Λ_μ are linear relative to velocity:

$$\Lambda_\mu = \Lambda_{\mu 0} + \Lambda_{\mu\nu} u_\nu \tag{1.3.13}$$

where $\Lambda_{\mu 0}$ x $\Lambda_{\mu\nu}$ are numerical matrices. Let us apply equation (1.3.5) on the left with operator $\Lambda_\sigma \frac{\partial}{\partial x_\sigma} - m$, obtaining:

$$\{\frac{1}{2}(\Lambda_\mu \Lambda_\sigma + \Lambda_\sigma \Lambda_\mu)\frac{\partial^2}{\partial x_\mu \partial x_\sigma} - m^2\}\boldsymbol{\Phi} = 0 \tag{1.3.14}$$

If we require that each component of system (1.3.14) satisfies the second order equation (1.3.4), and then

$$\Lambda_\mu \Lambda_\sigma + \Lambda_\sigma \Lambda_\mu = -2u_\mu u_\sigma I \tag{1.3.15}$$

Relation (1.3.15) is satisfied identically if we take ten Hermitian matrices 32x32 as numerical matrices $\Lambda_{\mu\nu}$, satisfying the following commutation relations:

$$\Lambda_{\mu\nu}\Lambda_{\sigma\tau}+\Lambda_{\sigma\tau}\Lambda_{\mu\nu}=2(\delta_{\mu\sigma}\delta_{\nu\tau}-\delta_{\mu\tau}\delta_{\nu\sigma})I \qquad (1.3.16)$$

Here, indices μ, ν, σ, τ take values 0, 1, 2, 3, 4. It is interesting to note that if the particle's 4-velocity is assumed to be zero (u_μ=0), then system (1.3.5) will reduce to eight similar Dirac equations.

However, this requirement is absolutely unsatisfactory both from the physical and the mathematical points of view. Four-velocity has 4 components, three of them are usual components of the particle velocity along three axes, and they really can tend to zero. But the same impossible for the fourth component.

Hence, this approach is formally incorrect and requires explanation. In our view, although the Dirac equation describes the hydrogen atom spectrum absolutely correctly, it is not properly a fundamental equation. It has two weak points:

1) the correct magnitude of the velocity operator's proper value is absent. It is known that in any problem of this type the proper value of the velocity operator is always equal to the velocity of light! In fact, Russian physicist and mathematician V. A. Fok regarded this as an essential defect of the Dirac theory;

2) The Klein paradox [19] appears in the solution of the problem of barrier passage, when the number of the particles that pass is bigger than the number of incident particles.

The equations of the Unitary Quantum Theory we are proposing are more correct and fundamental. For this reason, a transition from correct fundamental equations to the incompletely accurate Dirac equation needs such a strange requirement as $u_\mu = 0$.

1.4 Relativistic Invariance, Commutation Relations and Deriving the Value of the Fine Structure Constant

Everything went very well, until the Austrian General Headquarters interfered: the shells were taken to the rear, and the wounded to the front.

Jaroslav Hasek, The Good Soldier Schweik

The previous investigations [2, 3, 200, 201] have suggested a model of the unitary field theory where a particle with mass m is described by the equation

$$i\lambda^\mu \frac{\partial \boldsymbol{\Phi}}{\partial x^\mu} - m\boldsymbol{\Phi} = 0 \tag{1.4.1}$$

and each component $\boldsymbol{\Phi}_s$ of the wave function satisfies the second order equation

$$u^\mu u^\nu \frac{\partial^2 \boldsymbol{\Phi}_s}{\partial x^\mu \partial x^\nu} + m^2 \boldsymbol{\Phi}_s = 0\,, \tag{1.4.2}$$

so that the commutation relations for matrices λ^μ have the form

$$\lambda^\mu \lambda^\nu + \lambda^\nu \lambda^\mu = 2g^{\mu\nu} I \tag{1.4.3}$$

where $\boldsymbol{x}^\mu = (t, \mathbf{x}); u^\mu = (\frac{1}{\gamma}, \frac{\mathbf{v}}{\gamma})$ is the particle velocity; $\mu, \boldsymbol{\nu} = 0,1,2,3$; a metrics with signature (+,-,-,-) is used; c and h equal 1, and repeated indices are assumed to be summed.

1. The commutation relation.

For equation (1.4.1) to be the starting point of the theory, the equation should first result in the correct energy-momentum relation for a free particle and then be the Lorentz covariant. Equation (1.4.2) meets the former condition in the form

$$\left(p^{\mu}u_{\mu}\right)^{2}=m^{2}$$

Matrices are functions of the particle velocity, and thus the commutation relations (1.4.3) alone are insufficient for proving invariance of Eq. (1.4.1) under the Lorentz transformations; therefore let us first specify the functional dependence of the matrices on the velocity. Since the trivial solution

$$\lambda^{\mu}=u^{\mu}I$$

is totally uninteresting, let us consider the case of linear dependence on the velocity

$$\lambda^{\mu}=\lambda^{\mu\sigma}u_{\sigma}+\lambda^{\mu4} \tag{1.4.4}$$

where $\lambda^{\mu\sigma}$ and $\lambda^{\mu4}$ are numerical matrices. The condition (3) holds identically if

$$\begin{aligned}
&\lambda^{\mu\sigma}\lambda^{\nu\tau}+\lambda^{\nu\tau}\lambda^{\mu\sigma}=2\left(g^{\mu\tau}g^{\nu\sigma}-g^{\mu\sigma}g^{\nu\tau}\right)I\\
&\lambda^{\mu4}\lambda^{\nu4}+\lambda^{\nu4}\lambda^{\mu4}=2g^{\mu\nu}I\\
&\lambda^{\mu4}\lambda^{\nu\tau}+\lambda^{\nu\tau}\lambda^{\mu4}=0
\end{aligned} \tag{1.4.5}$$

Because of the antisymmetry of $\lambda^{\mu\sigma}=-\lambda^{\sigma\mu}$, only ten out of the twenty matrices are independent quantities. These matrices mutually anticommute, the square of four of them is equal to unity and that of six, to minus unity. To put it differently, Eq. (1.4.5) is specified by ten generatrices of the alternion algebra

${}^4A_{11}$, which is isomorphous with the algebra of the sixteenth order quaternion matrices [23]. Since they are not convenient, let us replace the quaternion matrices with ten complex, irreducible, unitary 32nd order matrices

$$\left(\lambda^{\mu\nu}\right)^{+} = \left(\lambda^{\mu\nu}\right)^{-1}, \quad \left(\lambda^{\mu 4}\right)^{+} = \left(\lambda^{\mu 4}\right)^{-1} \qquad (1.4.6)$$

This situation arises in construction of Dirac matrices, which are usually chosen as complex fourth order matrices even though the equation

$$\gamma^{\mu}\gamma^{\nu} + \gamma^{\nu}\gamma^{\mu} = 2g^{\mu\nu}I$$

is satisfied by four second–order quaternion matrices.

From eqs. (1.4.5) and (1.4.6) it follows that four matrices are Hermitian and six are anti-Hermitian

$$\left(\lambda^{0a}\right)^{+} = \lambda^{0a}, \quad \left(\lambda^{ab}\right)^{+} = -\lambda^{ab}, \text{ a, b=1, 2, 3, 4} \qquad (1.4.7)$$

If a matrix Λ is introduced

$$\Lambda = \lambda^{12}\lambda^{13}\lambda^{14}\lambda^{23}\lambda^{24}\lambda^{34}, \quad \Lambda^{+} = \Lambda^{-1} = -\Lambda \qquad (1.4.8)$$

then the Hermitian conjugations conditions (7) can be rearranged into

$$\left(\lambda^{\alpha\beta}\right)^{+} = \Lambda\lambda^{\alpha\beta}\Lambda^{-1} \qquad (1.4.9)$$

Represented in the form (1.4.5) the commutation relations are unwieldy and inconvenient in proving the relativistic invariance; however, they can be represented in a simpler form. Let us define a symmetrical tensor $g_{\alpha\beta}$

$$g_{00} = -g_{11} = -g_{22} = -g_{33} = -g_{44} = 1 \quad g_{\alpha\beta} = 0 \text{ if } \alpha \neq \beta \qquad (1.4.10)$$

henceforth subscripts of initial letters of the Greek alphabet $\alpha, \beta, \gamma, \delta$ take on values from 0 to 4 while those of the middle of the alphabet from 0 to 3. The inverse tensor $g^{\alpha\beta}$ provides a compact restatement of commutation relation (1.4.5)

$$\lambda^{\alpha\beta}\lambda^{\gamma\delta}+\lambda^{\gamma\delta}\lambda^{\alpha\beta}=2\left(g^{\alpha\delta}g^{\beta\gamma}-g^{\alpha\gamma}g^{\beta\delta}\right)I \tag{1.4.11}$$

Eqs. (1.4.4), (1.4.10) and (1.4.11) make it possible to prove the relativistic invariance of Eq. (1.4.1) by using a five-dimensional group of transformations of coordinate O (4, 1). For this purpose extend Eq. (1.4.1) to the case of a five-dimensional pseudo-Euclidian space with a metric tensor (1.4.10)

$$i\lambda^{\alpha\beta}u_{\alpha}\frac{\partial\boldsymbol{\Phi}}{\partial x^{\beta}}-m\boldsymbol{\Phi}=0 \tag{1.4.12}$$

(where u^{α} is the 5-velocity, $u^{\alpha}u_{\alpha}=0$) and then prove invariance of this equation under the group of five-dimensional transformation O (4, 1), which contains the Lorentz group as a subgroup. Under reduction of O (4, 1) to the Lorentz group, we assume that $x^4=Const, u^4=1$ and $\frac{\partial}{\partial x^4}\equiv 1$ then we have Eq. (1); in other words, one can assume that Eq. (1.4.1) is invariant under five-dimensional transformations, but the physical solution does not depend on the fifth coordinate. Incidentally, Eq. (1.4.12) can be interpreted differently, but we will not discuss these possibilities, for using the five dimensions is merely a convenient tool, which enables us to make full use of simplicity of the commutation relations (1.4.11).

2. The invariance of the Equation.

To prove invariance of the equation, it is sufficient to show [23] that for any transformation of coordinates

$$\left(x^{\alpha}\right)' = a^{\alpha}_{\beta} x^{\beta}\,;\ \left(x^{\alpha}\right)' x'_{\alpha} = inv \tag{1.4.13}$$

there is a linear transformation S(a) of wave functions, the primed and unprimed reference frame

$$\boldsymbol{\Phi}'\left(x'\right) = S\left(a\right)\boldsymbol{\Phi}\left(x\right);\ \ \boldsymbol{\Phi}\left(x\right) = S^{-1}\left(a\right)\boldsymbol{\Phi}'\left(x'\right) \tag{1.4.14}$$

and $\boldsymbol{\Phi}'\left(x'\right)$ is a solution of the equation, which has the form of Eq. (1.4.12) in the primed reference frame

$$\left[i\lambda^{\gamma\delta}u'_{\gamma}\frac{\partial}{\partial\left(x^{\delta}\right)'} - m\right]\boldsymbol{\Phi}'\left(x'\right) = 0 \tag{1.4.15}$$

Substitute (1.4.14) into (1.4.12); multiply the left-hand side by S(a), and use the definition (1.4.13) to have

$$\left[iS\lambda^{\alpha\beta}S^{-1}a^{\gamma}_{\alpha}a^{\delta}_{\beta}u'_{\gamma}\frac{\partial}{\partial\left(x^{\delta}\right)'} - m\right]\boldsymbol{\Phi}'\left(x'\right) = 0$$

This equation coincides with (1.4.15), if the matrix has the property

$$a^{\gamma}_{\alpha}a^{\delta}_{\beta}S\lambda^{\alpha\beta}S^{-1} = \lambda^{\gamma\delta} \tag{1.4.16}$$

Construct S for the infinitesimal proper transformation of the group O (4, 1)

$$a^{\beta}_{\alpha} = \delta^{\beta}_{\alpha} + \varepsilon^{\beta}_{\alpha}\,;\, a_{\alpha\beta} = g_{\alpha\beta} + \varepsilon_{\alpha\beta} \tag{1.4.17}$$

with

$$\varepsilon_{\alpha\beta} = -\varepsilon_{\beta\alpha} \tag{1.4.18}$$

Expand S in power of ε and keep only linear terms

$$S = 1 - \frac{1}{4}\sigma^{\alpha\beta}\varepsilon_{\alpha\beta} \tag{1.4.19}$$

where $\sigma^{\alpha\beta} = -\sigma^{\beta\alpha}$ by Eq. (1.4.18). Substitute eqs. (1.4.17)-(1.4.19) into Eq. (1.4.16), keep first-order terms in ε, use the notation [B, C]=BC-CB for the commutation brackets and have

$$2\left[\sigma^{\alpha\beta}, \lambda^{\gamma\delta}\right] = g^{\alpha\delta}\lambda^{\beta\gamma} - g^{\alpha\gamma}\lambda^{\beta\delta} + g^{\beta\gamma}\lambda^{\alpha\delta} - g^{\beta\delta}\lambda^{\alpha\gamma}$$

The antisymmetric solution of this equation

$$\sigma^{\alpha\beta} = \frac{1}{2} g_{\gamma\delta}\left[\lambda^{\beta\gamma}, \lambda^{\alpha\delta}\right] \tag{1.4.20}$$

is, by virtue of diagonality of the metric tensor and antisymmetry of $\lambda^{\alpha\beta}$, a sum of mutually commutating terms; in particular, σ^{12} has the form

$$\sigma^{12} = \lambda^{20}\lambda^{10} - \lambda^{23}\lambda^{13} - \lambda^{24}\lambda^{14}$$

According to Eq. (1.4.19) S for an infinitesimal transformation is given by

$$S = 1 - \frac{1}{8} g_{\gamma\delta}\varepsilon_{\alpha\beta}\left[\lambda^{\beta\gamma}, \lambda^{\alpha\beta}\right]$$

Hence, for rotation through a finite angle ω about this axis in the direction labelled n is represented as

$$S = \exp\left\{-\frac{1}{4}\omega\sigma^{\alpha\beta}P^{n}_{\alpha\beta}\right\} \tag{1.4.21}$$

where $P^{n}_{\alpha\beta}$ is the generator of rotation about this axis. Generally speaking the matrix S is not unitary but formula (1.4.9) easily shows that

$$\Lambda^{-1}\sigma^{+}\Lambda = -\sigma,$$

consequently, for proper transformations

$$\Lambda^{-1}S^{+}\Lambda = S^{-1} \tag{1.4.22}$$

Let us consider improper transformations of space reflection and time reversal. For space reflection the matrix a is diagonal

$$a_0^0 = a_4^4 = -a_1^1 = -a_2^2 = -a_3^3 = 1,$$

then Eq. (1.4.16) for the space reflection operator P is satisfied by

$$P = \lambda^{01}\lambda^{02}\lambda^{03}\lambda^{14}\lambda^{24}\lambda^{34} = P^{+} = P^{-1} \tag{1.4.23}$$

which ensures invariance of both Eq. (1.4.1) and Eq. (1.4.12).

Construct a transformation of the time inversion; for this purpose introduce an interaction of a particle whose charge is e with an external electromagnetic field $A^{\mu} = \left(\phi, A^{k}\right)$ by means of the gauge invariant substitution

$$i\frac{\partial}{\partial x^{\mu}} \rightarrow i\frac{\partial}{\partial x^{\mu}} - eA_{\mu}$$

and rewrite Eq. (1.4.1) in the form [2, 3, 6]:

$$i\lambda^{0}\frac{\partial \boldsymbol{\Phi}}{\partial t} = \left[\lambda^{k}\left(-i\frac{\partial}{dx^{k}} + eA_{k}\right) + m + e\phi\lambda^{0}\right]\boldsymbol{\Phi} = H\boldsymbol{\Phi}$$

Determine transformation T as such that if $t^{'} = -t, \Phi_{T}^{'} = \Phi^{'}\left(t^{'}\right) = T\Phi\left(t\right)$; then the latter equation becomes

$$-\left(Ti\lambda^{0}T^{-1}\right)\frac{\partial \boldsymbol{\Phi}^{'}\left(t^{'}\right)}{\partial t^{'}} = \left(THT^{-1}\right)\boldsymbol{\Phi}^{'}\left(t^{'}\right)$$

When the sense of time is reserved

$$u_0^{'} = u_0; u_k^{'} = -u_k; \boldsymbol{\Phi}^{'} = \boldsymbol{\Phi}; A^{'k} = -A^k$$

and, before all, it is necessary to change the sign between two terms $i\frac{\partial}{\partial x^k}$ and eA_k; therefore the transformation is regarded as a complex conjugation operator multiplied by the matrix T:

$$\boldsymbol{\Phi}_T^{'} = T\boldsymbol{\Phi}(t) = T\boldsymbol{\Phi}^*(t) \qquad (1.4.24)$$

This gives

$$i\left(T\overset{*}{\lambda}{}^{0}T^{-1}\right)\frac{\partial\boldsymbol{\Phi}^{'}(t^{'})}{\partial t^{'}} = \left\{-(T\overset{*}{\lambda}{}^{k}T^{-1})\left[-i\frac{\partial}{\partial\left(x^k\right)^{'}} + eA_k^{'}\right] + m + e\phi\left(T\overset{*}{\lambda}{}^{0}T^{-1}\right)\right\}\boldsymbol{\Phi}^{'}(t^{'})$$

and for invariance of the equation it is necessary that

$$T\overset{*}{\lambda}{}^{0k}T^{-1} = -\lambda^{0k}; T\overset{*}{\lambda}{}^{k2}T^{-1} = \lambda^{k2}; T\overset{*}{\lambda}{}^{k4}T^{-1} = -\lambda^{k4}; T\overset{*}{\lambda}{}^{04}T^{-1} = \lambda^{04}. \qquad (1.4.25)$$

Thence it immediately follows that $T^* = T^{-1} = T$, though the explicit form of the matrix T depends on the particular representation of the matrix $\lambda^{\alpha\beta}$. Note that there is just one matrix

$$\lambda = \prod_{\alpha<\beta}^{4} \lambda^{\alpha\beta}$$

which commutes with both generators $\sigma^{\alpha\beta}$ for the representation of the group O (4, 1) and with the operators of discrete transformation P and T. Under reduction of O (4, 1) to the Lorentz group two more matrices

$$\Lambda_1 = \lambda^{04}\lambda^{14}\lambda^{24}\lambda^{34}; \Lambda_2 = \lambda\Lambda_1$$

are generated which commute with the generators $\sigma^{\mu\sigma}$ of the representation of the Lorentz group and anticommute with P and T. Consequently, formulae (1.4.21), (1.4.23)-(1.4.25) specify the reducible representation of the Lorentz group and this representation is double-valued. Indeed, consider a particular case, rotation through angle ω about the Z-axis. In this case $P_{12}^{Z} = -P_{21}^{Z} = 1$; using the explicit form of σ^{12} we have

$$S = exp\left(-\frac{\omega}{2}\sigma^{12}\right)$$
$$= cos^{3}\left(\frac{\omega}{2}\right) + \sigma^{12} cos^{2}\left(\frac{\omega}{2}\right) sin\left(\frac{\omega}{2}\right) + \frac{3+\left(\sigma^{12}\right)^{2}}{2} cos\left(\frac{\omega}{2}\right) sin^{2}\left(\frac{\omega}{2}\right)$$
$$+\lambda^{20}\lambda^{10}\lambda^{23}\lambda^{13}\lambda^{24}\lambda^{14} sin^{3}\left(\frac{\omega}{2}\right)$$

The half-angle is an expression of the double value of the wave function transformation. Therefore the observables in the theory should be bilinear in $\Phi(x)$. The matrix Λ makes it possible to determine the adjoint wave function $\bar{\Phi} = \Phi^{+}\Lambda$, which is a solution of the adjoint equation

$$i\frac{\partial\bar{\Phi}}{\partial x^{\mu}}\lambda^{\mu} + m\bar{\Phi} = 0$$

An adjoint wave function under an arbitrary transformation of the co-ordinates should be transformed by the equation $\bar{\Phi}' = \bar{\Phi}\Lambda^{-1}S^{+}\Lambda$ which for proper rotations (1.4.22) leads to $\bar{\Phi}' = \bar{\Phi}S^{-1}$, for space and time inversions $\bar{\Phi}'_{P} = -\bar{\Phi}P$ and $\bar{\Phi}' = -\bar{\Phi}^{*}T^{-1}$, respectively. The adjoint wave function and the matrices λ, Λ_{1} and Λ_{2} make it possible to construct four independent scalar functions $\bar{\boldsymbol{\Phi}}\boldsymbol{\Phi}; \bar{\boldsymbol{\Phi}}\lambda\boldsymbol{\Phi}; \bar{\boldsymbol{\Phi}}\Lambda_1\boldsymbol{\Phi};$ and $\bar{\boldsymbol{\Phi}}\Lambda_2\boldsymbol{\Phi}$, which under space and time inversions are transformed as

$$\bar{\boldsymbol{\Phi}}'_P\boldsymbol{\Phi}'_P = -\bar{\boldsymbol{\Phi}}\boldsymbol{\Phi}, \quad \bar{\boldsymbol{\Phi}}'_T\boldsymbol{\Phi}'_T = \bar{\boldsymbol{\Phi}}\boldsymbol{\Phi} \tag{1.4.26a}$$

$$\bar{\boldsymbol{\Phi}}'_P\lambda\boldsymbol{\Phi}'_P = -\bar{\boldsymbol{\Phi}}\lambda\boldsymbol{\Phi}, \quad \bar{\boldsymbol{\Phi}}'_T\lambda\boldsymbol{\Phi}'_T = -\bar{\boldsymbol{\Phi}}\lambda\boldsymbol{\Phi} \tag{1.4.26b}$$

$$\bar{\boldsymbol{\Phi}}'_P\Lambda_1\boldsymbol{\Phi}'_P = \bar{\boldsymbol{\Phi}}\Lambda_1\boldsymbol{\Phi} \quad \bar{\boldsymbol{\Phi}}'_T\Lambda_1\boldsymbol{\Phi}'_T = -\bar{\boldsymbol{\Phi}}\Lambda_1\boldsymbol{\Phi} \tag{1.4.26c}$$

$$\bar{\boldsymbol{\Phi}}'_P\Lambda_2\boldsymbol{\Phi}'_P = \bar{\boldsymbol{\Phi}}\Lambda_2\boldsymbol{\Phi}, \quad \bar{\boldsymbol{\Phi}}'_T\Lambda_2\boldsymbol{\Phi}'_T = \bar{\boldsymbol{\Phi}}\Lambda_2\boldsymbol{\Phi} \tag{1.4.26d}$$

Following the classification of [16, 23], the quantities (26a-d) are singular and simple pseudo-scalar and singular and simple scalar, respectively, each of these functions being a unique scalar function of the associated type, quadratic in $\boldsymbol{\Phi}(x)$. To obtain a numerical scalar let us use a representation of the function $\boldsymbol{\Phi}(x)$ as a four-dimensional Fourier integral. Since each component of $\boldsymbol{\Phi}(x)$ satisfies the second order equation (2), the general solution represented entirely in relativistic terms has the form

$$\boldsymbol{\Phi}(x) = \frac{2}{(2\pi)^{3/2}} \int d^4k\, e^{ik_\mu x^\mu} \delta\left\{\left(k_\mu u^\mu\right)^2 - m^2\right\} \boldsymbol{\Phi}(k) \tag{1.4.27}$$

where

$$\delta\left\{\left(k_\mu u^\mu\right)^2 - m^2\right\} = \frac{1}{2m}\left\{\delta\left(k_\mu u^\mu - m\right) + \delta\left(k_\mu u^\mu + m\right)\right\}$$

is the relativistic δ-function and the amplitude $\Phi(k) = \Phi\left(k^0, \mathrm{k}\right)$ satisfies the equation

$$\left(\lambda^{\mu}k_{\mu}+m\right)\Phi(k)=0 \quad \text{for} \quad (ku)^2=m^2$$

Because the integrand includes a δ-function, the integration is performed over just two Lorentz-invariant hyper surfaces $k_{\mu}u^{\mu}=\pm m$, rather than the entire four-dimensional k-space. This allows for decomposing the integral (27) into two summands

$$\boldsymbol{\Phi}(x)=\boldsymbol{\Phi}^{+}(x)+\boldsymbol{\Phi}^{-}(x);\boldsymbol{\Phi}^{\pm}(x)=\frac{1}{(2\pi)^{3/2}}\int d^{4}k\frac{\delta\left(k_{\mu}u^{\mu}\mp m\right)}{2m}\boldsymbol{\Phi}(k) \quad (1.4.28)$$

Using this representation and integrating over the three-dimensional volume, we have

$$\int\bar{\boldsymbol{\Phi}}^{\pm}u^{\mu}\frac{\partial\boldsymbol{\Phi}}{\partial x^{\mu}}\frac{dV}{\gamma}=-\int u^{\mu}\frac{\partial\bar{\boldsymbol{\Phi}}^{\pm}}{\partial x^{\mu}}\boldsymbol{\Phi}^{\pm}\frac{dV}{\gamma}=\pm\frac{i}{2m}\int d^{4}k\delta\left(k_{\mu}u^{\mu}\mp m\right)\bar{\boldsymbol{\Phi}}(k)\boldsymbol{\Phi}(k)$$

$$\int\bar{\boldsymbol{\Phi}}^{\pm}u^{\mu}\frac{\partial\boldsymbol{\Phi}^{\mp}}{\partial x^{\mu}}\frac{dV}{\gamma}=\int u^{\mu}\frac{\partial\bar{\boldsymbol{\Phi}}^{\pm}}{\partial x^{\mu}}\boldsymbol{\Phi}^{\mp}\frac{dV}{\gamma}=\mp\frac{i}{2m}\int dk\,exp\left(\mp\frac{2ix^{0}m}{u^{0}}\right)\bar{\boldsymbol{\Phi}}\left(\frac{\text{ku}\pm m}{u^{0}},\text{k}\right)\boldsymbol{\Phi}\left(\frac{\text{ku}\mp m}{u^{0}},\text{k}\right)$$

Combining these relations and using the equality

$$\delta\left(k_{\mu}u^{\mu}-m\right)-\delta\left(k_{\mu}u^{\mu}+m\right)=\theta\left(k_{\mu}u^{\mu}\right)\delta\left\{\left(k_{\mu}u^{\mu}\right)^{2}-m^{2}\right\}$$

we find that

$$\int\left(\bar{\boldsymbol{\Phi}}u^{\mu}\frac{\partial\boldsymbol{\Phi}}{\partial x^{\mu}}-u^{\mu}\frac{\partial\bar{\boldsymbol{\Phi}}}{\partial x^{\mu}}\boldsymbol{\Phi}\right)\frac{dV}{\gamma}=i\int d^{4}k\theta\left(k_{\mu}u^{\mu}\right)\delta\left\{\left(k_{\mu}u^{\mu}\right)^{2}-m^{2}\right\}\bar{\boldsymbol{\Phi}}(k)\boldsymbol{\Phi}(k) \quad (1.4.29)$$

where

$$\theta(ku) = \begin{cases} 1, \text{if } ku > 0 \\ \text{-1}, \text{if } ku < 0 \end{cases}$$

The right-hand side of Eq. (1.4.29) is explicitly represented in covariant form, which facilitates a study of properties, which can be traced to the space and time inversions. More specifically, Eq. (1.4.29) is a simple pseudo-scalar because $\int \cdots d^4 k$ and $\delta\left\{\left(k_\mu u^\mu\right)^2 - m^2\right\}$ are simple scalars, $\theta\left(k_\mu u^\mu\right)$ is a singular scalar, (θ is an odd function and k^μ and u^μ are simple and singular vectors, respectively), and $\bar{\boldsymbol{\Phi}}(k)\boldsymbol{\Phi}(k)$ is a singular pseudo-scalar, according to the definition (1.4.27) and Eq. (1.4.26a).

3. The mass Determination

It is easy to construct a simple scalar

$$\int\left(\bar{\boldsymbol{\Phi}}\Lambda_1 u^\mu \frac{\partial \boldsymbol{\Phi}}{\partial x^\mu} - u^\mu \frac{\partial \bar{\boldsymbol{\Phi}}}{\partial x^\mu}\Lambda_1 \boldsymbol{\Phi}\right)\frac{dV}{\gamma}$$

which can, following [2, 3, 6, 23], be interpreted as the particle mass while the nonlinear equation [6] is represented as follows:

$$i\lambda^\mu \frac{\partial \boldsymbol{\Phi}}{\partial x^\mu} - \boldsymbol{\Phi}\int\left(\bar{\boldsymbol{\Phi}}\Lambda_1 u^\mu \frac{\partial \boldsymbol{\Phi}}{\partial x^\mu} - u^\mu \frac{\partial \bar{\boldsymbol{\Phi}}}{\partial x^\mu}\Lambda_1 \boldsymbol{\Phi}\right)\frac{dV}{\gamma} = 0 \qquad (1.4.30)$$

Unfortunately, the authors can only look at this fundamental (in our view) equation. It appears that any further progress in finding a solution to such an equation will be achieved with the help of computers and future symbol mathematics programs (of the Maple-18, Mathematica-9 types, etc.). For this purpose equation (1.4.30) should have a form with a clear matrix appearance. It is well known that the solution will not depend on a concrete representation of matrices $\lambda_{\mu}, \Lambda_{2}$, it is only important that the commutations relations are satisfied. By the way, the latter can be checked by direct finding of commutators and anticommutators with apparent matrix representation. Let us note that the authors of [2-4] had received these results long before the epoch of personal computers and symbol math programs. When these things appeared, the first thing the authors did was to check the correctness of matrix correlations of the size 32x32!

In order to receive a concrete appearance of all the matrices, let us apply the bloc ideas. For this purpose, let us write down the basic matrices $\gamma 0, \gamma 1, \gamma 2, \gamma 3, g^{\mu\nu}, Z, i$

$$\gamma 0 = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & -1 \end{bmatrix} \quad \gamma 1 = \begin{bmatrix} 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \\ 0 & -1 & 0 & 0 \\ -1 & 0 & 0 & 0 \end{bmatrix} \quad \gamma 2 = \begin{bmatrix} 0 & 0 & 0 & -I \\ 0 & 0 & I & 0 \\ 0 & I & 0 & 0 \\ -I & 0 & 0 & 0 \end{bmatrix} \quad Z = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

$$\gamma 3 = \begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & -1 \\ -1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \end{bmatrix} \quad \gamma 4 = \begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \end{bmatrix} \quad g_{\mu\nu} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & -1 \end{bmatrix} \quad i = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

For these matrices the following standard commutation relations are correct:

$$\gamma^{\mu}\gamma^{\nu} + \gamma^{\nu}\gamma^{\mu} = 2g^{\mu\nu}; \quad \mu, \nu = 0,1,2,3;$$

where $\mu, \nu, \sigma, \tau = 0, 1, 2, 3, 4$ and $g = +,-,-,-$.

From these basic matrices 10 supplementary bloc matrices can be constructed - $\lambda^{01}, \lambda^{02}, \lambda^{03}, \lambda^{04}, \lambda^{12}, \lambda^{13}, \lambda^{14}, \lambda^{23}, \lambda^{24}, \lambda^{34}$, which have a clear appearance:

$$\Lambda_{01}=\begin{bmatrix} i & Z & Z & Z & Z & Z & Z & Z \\ Z & i & Z & Z & Z & Z & Z & Z \\ Z & Z & i & Z & Z & Z & Z & Z \\ Z & Z & Z & i & Z & Z & Z & Z \\ Z & Z & Z & Z & -i & Z & Z & Z \\ Z & Z & Z & Z & Z & -i & Z & Z \\ Z & Z & Z & Z & Z & Z & -i & Z \\ Z & Z & Z & Z & Z & Z & Z & -i \end{bmatrix}$$

$$\Lambda_{02}=\begin{bmatrix} Z & Z & Z & Z & i & Z & Z & Z \\ Z & Z & Z & Z & Z & i & Z & Z \\ Z & Z & Z & Z & Z & Z & -i & Z \\ Z & Z & Z & Z & Z & Z & Z & -i \\ i & Z & Z & Z & Z & Z & Z & Z \\ Z & i & Z & Z & Z & Z & Z & Z \\ Z & Z & -i & Z & Z & Z & Z & Z \\ Z & Z & Z & -i & Z & Z & Z & Z \end{bmatrix}$$

$$\Lambda_{03}=\begin{bmatrix} Z & Z & Z & Z & Z & Z & i & Z \\ Z & Z & Z & Z & Z & Z & Z & -i \\ Z & Z & Z & Z & i & Z & Z & Z \\ Z & Z & i & Z & Z & -i & Z & Z \\ Z & Z & Z & -i & Z & Z & Z & Z \\ Z & Z & Z & Z & Z & Z & Z & Z \\ i & Z & Z & Z & Z & Z & Z & Z \\ Z & -i & Z & Z & Z & Z & Z & Z \end{bmatrix}$$

$$\Lambda_{04}=\begin{bmatrix} Z & Z & Z & Z & Z & Z & Z & \gamma_0 \\ Z & Z & Z & Z & Z & Z & \gamma_0 & Z \\ Z & Z & Z & Z & Z & \gamma_0 & Z & Z \\ Z & Z & Z & Z & \gamma_0 & Z & Z & Z \\ Z & Z & Z & \gamma_0 & Z & Z & Z & Z \\ Z & Z & \gamma_0 & Z & Z & Z & Z & Z \\ Z & \gamma_0 & Z & Z & Z & Z & Z & Z \\ \gamma_0 & Z & Z & Z & Z & Z & Z & Z \end{bmatrix}$$

$$\Lambda_{12}=\begin{bmatrix} Z & Z & Z & Z & Z & Z & Z & \gamma_1 \\ Z & Z & Z & Z & Z & Z & \gamma_1 & Z \\ Z & Z & Z & Z & Z & \gamma_1 & Z & Z \\ Z & Z & Z & Z & \gamma_1 & Z & Z & Z \\ Z & Z & Z & \gamma_1 & Z & Z & Z & Z \\ Z & Z & \gamma_1 & Z & Z & Z & Z & Z \\ Z & \gamma_1 & Z & Z & Z & Z & Z & Z \\ \gamma_1 & Z & Z & Z & Z & Z & Z & Z \end{bmatrix}$$

$$\Lambda_{13}=\begin{bmatrix} Z & Z & Z & Z & Z & Z & Z & \gamma_2 \\ Z & Z & Z & Z & Z & Z & \gamma_2 & Z \\ Z & Z & Z & Z & Z & \gamma_2 & Z & Z \\ Z & Z & Z & Z & \gamma_2 & Z & Z & Z \\ Z & Z & Z & \gamma_2 & Z & Z & Z & Z \\ Z & Z & \gamma_2 & Z & Z & Z & Z & Z \\ Z & \gamma_2 & Z & Z & Z & Z & Z & Z \\ \gamma_2 & Z & Z & Z & Z & Z & Z & Z \end{bmatrix}$$

$$\Lambda_{14}=\begin{bmatrix} Z & Z & Z & Z & Z & Z & Z & \gamma_3 \\ Z & Z & Z & Z & Z & Z & \gamma_3 & Z \\ Z & Z & Z & Z & Z & \gamma_3 & Z & Z \\ Z & Z & Z & Z & \gamma_3 & Z & Z & Z \\ Z & Z & Z & \gamma_3 & Z & Z & Z & Z \\ Z & Z & \gamma_3 & Z & Z & Z & Z & Z \\ Z & \gamma_3 & Z & Z & Z & Z & Z & Z \\ \gamma_3 & Z & Z & Z & Z & Z & Z & Z \end{bmatrix}$$

$$\Lambda_{23}=\begin{bmatrix} Z & Z & Z & Z & Z & Z & Z & -i \\ Z & Z & Z & Z & Z & Z & i & Z \\ Z & Z & Z & Z & Z & -i & Z & Z \\ Z & Z & Z & Z & i & Z & Z & Z \\ Z & Z & Z & -i & Z & Z & Z & Z \\ Z & Z & i & Z & Z & Z & Z & Z \\ Z & -i & Z & Z & Z & Z & Z & Z \\ i & Z & Z & Z & Z & Z & Z & Z \end{bmatrix}$$

$$\Lambda_{24}=\begin{bmatrix} Z & Z & Z & Z & Z & Z & -i & Z \\ Z & Z & Z & Z & Z & Z & Z & -i \\ Z & Z & Z & Z & Z & i & Z & Z \\ Z & Z & Z & Z & Z & Z & i & Z \\ Z & Z & -i & Z & Z & Z & Z & Z \\ Z & Z & Z & -i & Z & Z & Z & Z \\ i & Z & Z & Z & Z & Z & Z & Z \\ Z & i & Z & Z & Z & Z & Z & Z \end{bmatrix}$$

$$\Lambda_{34}=\begin{bmatrix} Z & Z & Z & Z & -i & Z & Z & Z \\ Z & Z & Z & Z & Z & -i & Z & Z \\ Z & Z & Z & Z & Z & Z & -i & Z \\ Z & Z & Z & Z & Z & Z & Z & -i \\ i & Z & Z & Z & Z & Z & Z & Z \\ Z & i & Z & Z & Z & Z & Z & Z \\ Z & Z & i & Z & Z & Z & Z & Z \\ Z & Z & Z & i & Z & Z & Z & Z \end{bmatrix}$$

Let us define four-velocity $u^{\mu}=(u0,u1,u2,u3)=(\frac{1}{\gamma};\frac{\mathbf{v}}{\lambda})$. The matrices in the main equation (1.4.30) will be defined as:

$$\lambda^0 = 0 + \lambda^{01}u1 + \lambda^{02}u2 + \lambda^{03}u3 + \lambda^{04}$$

$$\lambda^1 = \lambda^{01}u0 + 0 + \lambda^{12}u2 + \lambda^{13}u3 + \lambda^{14}$$

$$\lambda^2 = \lambda^{02}u0 + \lambda^{12}u1 + 0 + \lambda^{23}u3 + \lambda^{24}$$

$$\lambda^3 = \lambda^{03}u0 + \lambda^{13}u1 + \lambda^{23}u2 + 0 + \lambda_{34}$$

The equation then will look as follows:

$$i\left(\lambda^0 \frac{\partial \boldsymbol{\Phi}}{\partial x^0} + \lambda^1 \frac{\partial \boldsymbol{\Phi}}{\partial x^1} + \lambda^2 \frac{\partial \boldsymbol{\Phi}}{\partial x^2} + \lambda^3 \frac{\partial \boldsymbol{\Phi}}{\partial x^3}\right) - m\boldsymbol{\Phi} = 0 \qquad (1.4.31)$$

The mass term of this equation will then be defined by the following correlation:

$$m = \int_V \left(\boldsymbol{\Phi}^+ \boldsymbol{\Lambda}_2 u^\mu \frac{\partial \boldsymbol{\Phi}}{\partial x^\mu} - u^\mu \frac{\partial \boldsymbol{\Phi}^+}{\partial x^\mu} \boldsymbol{\Lambda}_2 \boldsymbol{\Phi} \right) \frac{dV}{\gamma}$$

because $\bar{\boldsymbol{\Phi}} = \boldsymbol{\Phi}^+ \Lambda$; $\Lambda_1 = \lambda^{04}\lambda^{14}\lambda^{24}\lambda^{34}$; $\Lambda = \lambda^{12}\lambda^{13}\lambda^{14}\lambda^{23}\lambda^{24}\lambda^{34}$; $\Lambda_2 = \Lambda\Lambda_1$

The explicit form of 4 matrices λ^μ depends on velocity, as well as of numerical matrices $\Lambda, \Lambda_1, \Lambda_2$ of the size 32x32. Using a good personal computer it is possible to prove the correctness of the correlations in (1.4.5) by making direct computations of the commutators and anticommutators with the help of symbol mathematics programs (Maple -18, Mathematica- 9).

4. Solve equations and deriving the value of the fine structure constant

There is a most profound and beautiful question associated with the observed coupling constant, e – the amplitude for a real electron to emit or absorb a real photon. It is a simple number that has been experimentally determined to be close to 0.08542455. (My physicist friends won't recognize this number, because they like to remember it as the inverse of its square: about 137.03597 with about an uncertainty of about 2 in the last decimal place. It has been a mystery ever since it was discovered more than fifty years ago, and all good theoretical physicists put this number up on their wall and worry about it.) Immediately you would like to know where this number for a coupling comes from: is it related to pi or perhaps to the base of natural logarithms? Nobody knows. It's one of the greatest damn mysteries of physics: a magic number that comes to us with no understanding by man. You might say the "hand of God" wrote that number, and "we don't know how He pushed his pencil." We know what kind of a dance to do experimentally to measure this number very accurately, but we don't know what kind of dance to do on the computer to make this number come out, without putting it in secretly! Richard P. Feynman (1985). "QED: The Strange Theory of Light and Matter", p. 129.

The attempts to solve equation of the (1.4.30), (1.4.31) type gave no result. However, [7, 8, 182, 196, 200, 201] an interesting was found for a modified scalar version of the integro-differential equation (1.4.30), which may be written down as follows:

$$\left(\frac{\partial}{\partial t}+\frac{\partial}{\partial x}+\frac{\partial}{\partial y}+\frac{\partial}{\partial z}\right)\Phi\left(x,y,z,t\right) = -2i\Phi\left(x,y,z,t\right)\int_0^x\int_0^y\int_0^z \Phi^*\left(x,y,z,t\right)\frac{\partial\Phi\left(x,y,z,t\right)}{\partial t}dxdydz \tag{1.4.32}$$

We will seek the solution of this equation in the form

$$\Phi(x,y,z,t)=F(x,y,z)exp(-i(\omega t-kx-ky-kz)),$$

where

$$F(x,y,z)=X(x)Y(y)Z(z)$$

and ω, k are some constant parameters. Substituting these expressions in (1.4.32), we obtain under condition $\omega = 3k$ following equation w. r. t X, Y, Z:

$$\frac{X'(x)}{X(x)}+\frac{Y'(y)}{Y(y)}+\frac{Z'(z)}{Z(z)}=-2\omega\int_0^x X^2(x)dx\cdot\int_0^y Y^2(y)dy\cdot\int_0^z Z^2(z)dz$$

Differentiating the left-hand and right-hand sides w. r. t. x, y, z successively, we obtain three equations for $X(x), Y(y), Z(z)$:

$$\left(\frac{X'(x)}{X(x)}\right)'=-2\omega X^2(x)\int_0^y Y^2(y)dy\cdot\int_0^z Z^2(z)dz$$
$$\left(\frac{Y'(y)}{Y(y)}\right)'=-2\omega Y^2(y)\int_0^x X^2(x)dx\cdot\int_0^z Z^2(z)dz, \qquad (1.4.33)$$
$$\left(\frac{Z'(z)}{Z(z)}\right)'=-2\omega Z^2(z)\int_0^x X^2(x)dx\cdot\int_0^y Y^2(y)dy.$$

Putting

$$U(x)=\int_0^x X^2(x)dx,\quad V(y)=\int_0^y Y^2(y)dy,\quad W(z)=\int_0^z Z^2(z)dz,$$

we obtain the system of ordinary differential equations for $X(x), Y(y), \ldots W(z)$:

$$X''-\frac{(X')^2}{X}=-2\omega X^3VW, U'(x)=X^2(x),$$

$$Y''-\frac{(Y')^2}{Y}=-2\omega Y^3UW, V'(y)=Y^2(y), \tag{1.4.34}$$

$$Z''-\frac{(Z')^2}{Z(z)}=-2\omega Z^3UV, W'(z)=Z^2(z).$$

Further, we have put the numerical value of ω, namely, $\omega=\frac{1}{2}$ and integrated numerically (with the help of Maple-18) this system under following initial conditions (reasonable from physical point of view):

$$X(0)=Y(0)=Z(0)=1, X'(0)=Y'(0)=Z'(0)=U(0)=V(0)=W(0)=0.$$

According to obtained solution X(x), Y(y), Z(z) are identical rapidly decreasing functions of following type:

$$X(x)\propto exp(-x^p),\quad Y(y)\propto exp(-y^p),\quad Z(z)\propto exp(-z^p),\quad 1<p<2. \tag{1.4.35}$$

The plot of X(x) is shown in Fig. 1.4.1. The basic equation (1.4.32) can be reduced to the scalar equation [6, 7, 8, 200, 201] for the density of the space charge of the space charge of the bunch, which represents the particles:

$$\frac{1}{c}\frac{\partial\Phi(r,t)}{\partial t}+\frac{\partial\Phi(r,t)}{\partial r}+\frac{4\pi i\Phi(r,t)}{\hbar}\int_0^r\left\{\Phi^*(s,t)\frac{\partial\Phi(s,t)}{\partial t}-\frac{\partial\Phi^*(s,t)}{\partial t}\Phi(s,t)\right\}s^2ds=0 \tag{1.4.36}$$

Let us solve this equation together with the Poisson equation [6, 7, 8]

$$\text{divgrad}\,\varphi=-4\pi\rho$$

We seek the solution in the form

$$\Phi(r,t)=\bar{F}(r)\exp\left[-i(\omega t-kr)\right] \tag{1.4.37}$$

We get the following system of equations if the condition

$$\omega = kc$$

is fulfilled:

$$\frac{d\bar{F}(r)}{dr} + \frac{8\pi\omega\bar{F}(r)}{h}\int_0^r s^2\bar{F}^2(s)ds = 0,$$

$$\frac{d^2\bar{\phi}(r)}{dr^2} + \frac{2}{r}\frac{d\bar{\phi}(r)}{dr} = -4\pi\rho(r) = -\frac{1}{2}\sqrt{\frac{c^3}{h}}\bar{F}^2(r), \qquad (1.4.38)$$

where

$$\rho(r) = \frac{1}{8\pi}\sqrt{\frac{c^3}{h}}\bar{F}^2(r)$$

is the electrical charge density. Let us suppose

$$x = \frac{r}{R}, \quad f(x) = \frac{\bar{F}(r)}{\bar{F}(0)}, \quad \bar{F}(0) \neq \infty$$

$$\rho(x) = \frac{2}{R^2\bar{F}(0)}\sqrt{\frac{h}{c^3}}\bar{\phi}(r)$$

$$K = \frac{8\pi\omega R^4\bar{F}^2(0)}{h}$$

System (1.4.38) can be expressed in dimensionless form:

$$\frac{d^2 \ln f(x)}{dx^2} + Kx^2 f^2(x) = 0 \qquad (1.4.39)$$

$$\frac{d^2\rho(x)}{dx^2}+\frac{2}{x}\frac{d\rho(x)}{dx}=-f^2(x)$$

As long as potential ρ with the accuracy up to an additive constant and its value does not affect the intensity of electrical field $\boldsymbol{E}=-grad\phi$, let us choose $\phi=0$. Due to the spherical symmetry in the centre of the particle, the condition $\boldsymbol{E}=0$ is fulfilled. Solving numerically the Cauchy problem for the system (1.4.39), taking the value $K=16\pi$ or (2x2x4π) and the initial conditions

$$f(0)=1,\quad f'(0)=0,\quad \phi(0)=0,\quad \phi'(0)=0 \tag{1.4.40}$$

we obtain the following integrals

$$I_Q=\int_0^\infty x^2 f^2(x)dx=8.5137256105758897351\cdot 10^{-2};\ I_Q^2={}^{1}\!/_{137.9623876} \tag{1.4.41}$$

$$I_E=\frac{1}{2}\int_0^\infty x^2 E^2(x)dx=5.6857305\cdot 10^{-3} \tag{1.4.42}$$

$$I_\mu=\int_0^\infty x^4 f^2(x)dx=3.2493214\cdot 10^{-2} \tag{1.4.43}$$

The quantity I_Q is a dimensionless electrical charge, which is brought to the following dimensional form of electrical charge Q:

$$Q=\sqrt{\hbar c}I_Q=4.78709\cdot 10^{-2}CGSE$$

This value is less than the modern experimental value of the electron's charge by only 0.3%. This is a fairly accurate number for the first theoretical attempt of the charge calculation. The plot of f(x) is shown in Fig. 1.4.1.

Thus it is not unusual to bring out the “corrections” of the J. Schwinger type to the integral (1.4.41)

$$I_e = I_Q + \frac{I_Q^2}{8\pi} - \frac{I_Q^3}{64\pi^2} = 8.5424692 \cdot 10^{-2},$$

which corresponds to the value of charge e = 4.803 2514 • 10^{-10} CGSE and the value of fine-structure constant $\alpha = 1/137.03552$.

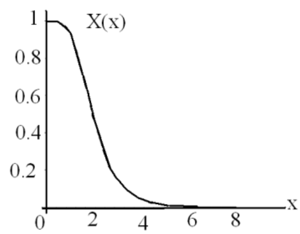

Fig. 1.4.1 *Density of the charge as function of the radius.*

This results is very important. There are some opinions: *"The mystery about α is actually a double mystery. The first mystery – the origin of its numerical value α ≈ 1/137 has been recognized and discussed for decades. The second mystery – the range of its domain – is generally unrecognized."* — Malcolm H. Mac Gregor, M. H. MacGregor (2007). The Power of Alpha. World Scientific.

"If alpha were bigger than it really is, we should not be able to distinguish matter from ether and our task to disentangle the natural laws would be hopelessly difficult. The fact however that alpha has just its value 1/137 is certainly no chance but itself a law of nature. It is clear that the explanation of this number must be the central problem of natural philosophy". — Max Born, A. I. Miller (2009). Deciphering the Cosmic Number: The Strange Friendship of Wolfgang Pauli and Carl Jung. W. W. Norton & Co.

Calculation spectrum masses all elementary particles see section 1.8.

The quantization of the electrical charge and masses seems to be the consequence of the balance between the dispersion and nonlinearity, which determines stable solutions.

The found density distribution for the particle's electrical charge allows us to determine the electrical form factor for the same particle

$$F(q) = \int_V \rho(x) \exp[-iqx] dV \tag{1.4.44}$$

We regret that we have not succeeded in finding an analytical solution of Eq. (1.4.39), but we are able to give a decent approximation. Let us look for a solution of Eq. (1.4.39) in the form

$$f(x) = \operatorname{sech} R(x) \tag{1.4.45}$$

Substituting Eq. (1.4.45) into Eq. (1.4.39) and taking into account that for small R we have

$$\frac{1}{2}\sinh 2R \approx R$$

we obtain

$$(RR')' = 16\pi x^2 ; \quad R = \sqrt{\frac{8\pi}{3}} x^2 \tag{1.4.46}$$

$$f(x) = \operatorname{sech} \sqrt{\frac{8\pi}{3}} x^2 \tag{1.4.47}$$

It is interesting to note that if the particle’s 4-velocity is assumed to be zero at matrix Λ, then system (1.4.30) will reduce to eight similar Dirac equations.

5. Problems

In our view, although the Dirac equation describes the hydrogen atom spectrum absolutely correctly, it is not properly a fundamental equation. It has two weak points: the correct magnitude of the velocity operator's proper value is absent. It is known that in any problem of this type the proper value of the velocity operator is always equal to the velocity of light! In fact, Russian physicist and mathematician V. A. Fok regarded this as an essential defect of the Dirac theory.

The equations of the Unitary Quantum Theory we are proposing are more correct and fundamental. For this reason, a transition from correct fundamental equations to the incompletely accurate Dirac equation needs such a strange requirement as

$$u_{\mu} = 0$$

However, this requirement is absolutely unsatisfactory both from the physical and the mathematical points of view. Four-velocity has 4 components, of which three are usual components of the particle velocity along three axes, and they really can tend to zero. But the same cannot be done with the fourth component.

In the second paragraph of the preface of the book A History of the Theories of Aether and Electricity, by Sir Edmund T. Whittaker (Edinburgh, Scotland, April, 1951) was written the following: *"A word might be said about the title 'Aether and Electricity'. As everyone knows, the aether played a great part in the physics of the nineteenth century; but in the first decade of the twentieth, chiefly as a result of the failure of attempts to observe the Earth's motion relative to the aether, and the acceptance of the principle that such attempts must always fail, the word 'aether' fell out of favour, and it became customary to refer to the interplanetary spaces as 'vacuous'; the vacuum being conceived as mere emptiness, having no properties except that of propagating electromagnetic waves. But with the development of quantum electrodynamics, the vacuum has come to be regarded as the seat of 'zero-point' oscillations of the electromagnetic field, of the* *'zero-point' fluctuations of electric charge and current, and of a 'polarization' corresponding to a dielectric constant different from unity. It seems absurd to retain the name 'vacuum' for an entity so rich in physical properties, and the historical word 'aether' may be fitly retained."* Of course, now aether is not old aether of the nineteenth century, maybe it is Higgs field?

The question is that the main relativistic relation between energy, impulse, and mass

$$E^2 = P^2 + m^2 \tag{1.4.48}$$

has been still beyond any doubt. In particular, all of the previous equations are based on relativistic invariance. Nevertheless, we shall ask ourselves once again about what is happening with that relation at the exact moment when the wave packet disappears being spread over the space. At that moment the particle does not exist as a local formation. This means that in the local sense there is no mass, local impulse, or energy. The particle in that case, within sufficiently small period of time, is essentially non-existent, for it does not interact with anything. Perhaps this is why the relation (1.4.48) is average and its use at the wavelength level is equal or less than the De Broglie wavelength, which is just illegal. The direct experimental check of that relation at small distances and short intervals is hardly possible today. If the relation (1.4.48) is declined, then it may result in an additional conservation of energy and impulse refusal; but, as we know, according to the Standard Quantum Theory, that relation may be broken within the limits of uncertainty relation.

On the other hand, the Lorenz's transformations appeared when the transformation properties of Maxwell's equations were analyzing. However electromagnetic waves derived from solutions of Maxwell's equations move all in vacuum with the same velocity, i.e. are not subjected to dispersion and do not possess relativistic invariance. Our partial waves, which form wave packet identified with a particle, possess always the linear dispersion. Under such circumstances, it would be quite freely for authors to spread the requirement of relativistic invariance to partial waves. Such requirement has sense in respect only to wave packet's envelope, which appears if we observe a moving wave packet and his disappearance and reappearance. May be the origin of relativistic invariance would be connected in future with the fact that an envelope remains fixed in all inertial reference frames; only the wave's length is changed.

It's quite complicated [174-178, 186, 187]. The special relativity – is in fact Lorentz transformations (1904) derived by V. Vogt (1887) in the century before last. These transformations followed from the properties of Maxwell equations which are also proposed in the nineteenth century (1873). One of these equations connecting electrostatic field divergence and electric charge (Gauss' law of flux), in fact is just another mathematical notation of Coulomb's law for point charges.

But today anybody knows that Coulomb's law is valid for fixed point charges only. If charges are frequently moving Coulomb's law is not performed. Besides everybody knows that lasers beams are scattered in vacuum one over another, absolutely impossible in Maxwell equations. That means that Maxwell equations are approximate - and for the moving point charges experimental results essentially differs from the estimated ones in the case charges areas are overlapping.

Few people think about the shocking nonsense of presenting in any course of physics of point charge electric field in the form of a certain "sun" with field lines symmetrically coming from the point. But electric field – is a vector, and what for is it directed? The total sum of such vectors is null, isn't it?

There are no attempts to talk about, but such idealization is not correct. We should note that Sir Isaak Newton did not used term of a point charge at all, but it's ridiculous to think that such simple idea had not come to him! As for Einstein, he considered *"electron is a stranger in electrodynamics"*. Maxwell equations are not ultimate truth and so we should forget, disavow the common statement about relativist invariance requirement being obligatory "permission" for any future theory.

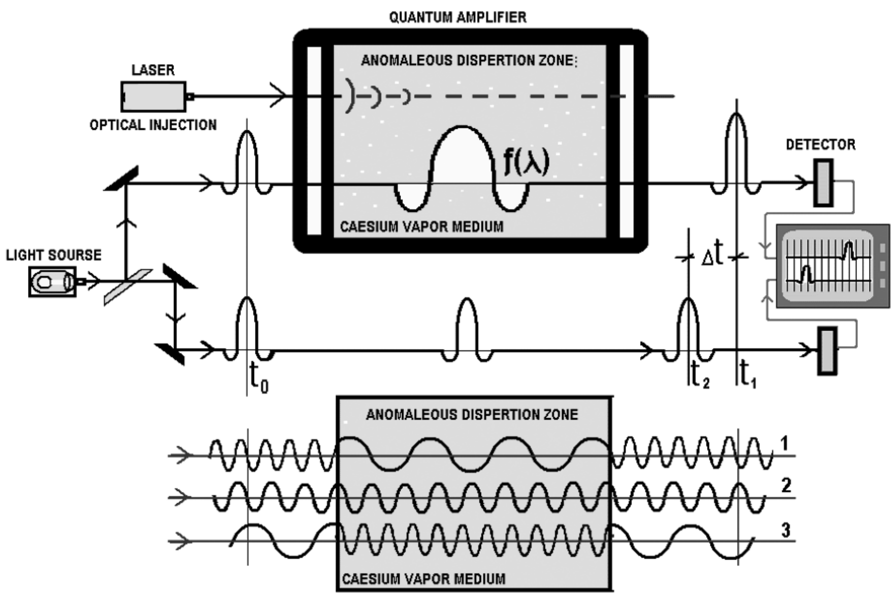

Fig. 1.4.2 *Wang experiment [169].*

To reassure severe critics we should note that UQT is relativistically invariant, it allows to obtain correct correlation between an energy and impulse, mass increases with a rate, while relativistic invariance just follow of the fact that the envelope of moving packet is quiet in any (including non-inertial) reference systems. To be honest we should note that subwaves the particles consist of are relativistically abnormal, at the same time envelope wave function following from their movement confirms terms of Lorentz transformations.

The success of Maxwell equations in description of the prior-quantum view of world was very impressing. Its correlation of the classical mechanics in forms of requirement to correspond Lorentz transformations was perfectly confirmed by the experiments that all these had resulted in unreasoned statement of Maxwell equations being an ultimate truth…

Other reasons for this were later very carefully investigated by a disciple of one of the authors (L. S.), Professor Ratis Yu. L. (S. Korolev Samara State Aero-Space University), who has formulated the modern spinor quantum electrodynamics from the UQT point of view:

1. Maxwell equations contain constant c, which is interpreted as phase velocity of a plane electromagnetic wave in the vacuum.

2. Michelson and Morley have never measured the dependence of the velocity of a plane electromagnetic wave in the vacuum on the reference system velocity as soon plane waves were mathematical abstraction and it was impossible to analyze their properties in the laboratory experiment in principle.

3. Electromagnetic waves cannot exist in vacuum by definition. A spatial domain where an electromagnetic wave is spreading – is no longer a vacuum. Once electromagnetic field arises in some spatial region at the same moment such domain acquires new characteristic – it became a material media. And such media possesses special material attributes including power and impulse.

4. Since electromagnetic wave while coming through the abstract vacuum (the mathematical vacuum) transforms it in a material media (physical vacuum) it interacts with this media.

5. The result of the electromagnetic wave and physical vacuum interaction are

compact wave packets, called photons.

6. The group velocity of the wave packet (photon) spreading in the media with the normal dispersion is always less its phase velocity.

The abovementioned allows to make unambiguous conclusion:

the main difficulties of the modern relativistic quantum theory of the field arise from deeply fallacious presuppositions in its base. The reason for this tragic global error was a tripe substitution of ideas – velocity of electromagnetic wave packets ‘c’ being transformed in numerous experiments physics have construed as constant ‘c’ appearing in Maxwell equations and Lorentz transformations. Such blind admiration of Maxwell and Einstein geniuses (authors in no case do not doubt in the genius of these persons) had led XX century physics up a blind alley. The way out was in the necessity of revision of the entire fundamental postulates underlying the modern physics. Exactly that was done by UUQFT [165, 166].

Some time ago CERN has conducted repeated experiments of the neutrino velocity measurement that appeared to be higher than velocity of the light. For UUQFT they were like a balm into the wounds. In fact the movements in excess of the light velocity were discovered earlier by numerous groups of researches. The most interesting were experiments of [169] (Wang, 2000, Princeton, USA), they had disclosed velocities 310 times higher than the light.

Nearly everybody disbelieved it. And now the neutrino movements exceeding the velocity of the light were disclosed in CERN. The importance of these experiments for UUQFT is settled in the article [166] where at the page 69 it is written that “this should be considered as direct experimental proof of UUQFT principle”.

There are also other ideas [190, 191]. For example, at «New Relativistic Paradoxes and Open Questions», by Florentin Smarandache, shows several paradoxes, inconsistencies, contradictions, and anomalies in the Theory of Relativity. According to the author, not all physical laws are the same in all inertial reference frames, and he gives several counter-examples. He also supports superluminal speeds, and he considers that the speed of light in vacuum is variable depending on the moving reference frame.

The author explains that the red shift and blue shift are not entirely due to the Doppler Effect, but also to the medium composition (i.e. its physical elements, fields, density, heterogeneity, properties, etc.). Professor Smarandache considers that the space is not curved and the light near massive cosmic bodies bends not because of the gravity only as the General Theory of Relativity asserts (Gravitational Lensing), but because of the Medium Lensing.

In order to make the distinction between "clock" and "time", he suggests a first experiment with a different clock type for the GPS clocks, for proving that the resulted dilation and contraction factors are different from those obtained with the cesium atomic clock; and a second experiment with different medium compositions for proving that different degrees of red shifts/blu shifts would result. To regret, the authors today have no decisive position to these complicate questions.

Note, this question is terribly complicate and probably is to be leaved to next generations. From one side, the time in UQT exists, so to say, in our head only. From other side, the Lorenz Transformations describe correctly some experimental facts, for example, the mass growing with velocity. Otherwise, all atomic accelerators would be out of order. Thereafter, it is a big mistake to consider all Special Relativity Theory as erroneous. The attitude to the Special Relativity Theory is today highly vague and may be compared in full with the discussion among painters about significance of the Malevitch picture "The black square".

It is curios but from another side the Special Relativity Theory declares that the spreading velocity of the information and of the signals cannot exceed the light velocity. At the same time today it is well known that the gravity interaction spreads with the velocity exceeding many times the light velocity. Laplace has obtained corresponding estimates long ago. But this problem is not discussed somehow in Special Relativity.

As soon relativistic invariance underlies every of the numerous quantum theories of the field, it leaves a devilish imprint at everything. Nevertheless relativistic ratio between energy and impulse although being absolutely correct in fact are not obligatory follow from relativistic invariance only and can result from another mathematical reasons that will be discovered in future. Nowadays Standard Model (SM) combines the most elegant mathematical miracles of researches which hands were tied with relativistic strait-jacket and it not so bad describes these experimental data. Amazing that it was possible to think it out at all.

1.5 Interpretation of Unitary Quantum Theory

"…There is not now, has not been, nor will there be from now on knowledge more certain to affect you than that I'm going to give you, because it will send you out of your mind - so strikingly simple, bright, and immense is it."

- from Oriental folklore

1.5.1 Non-relativistic Case

The envelope of the wave function $\Phi(x,t)$ describes a wave packet's field transformation within its motion. There are points at which the packet/particle disappears, $\Phi(x,t) = 0$, yet particle energy remains in the form of harmonic components that produce field vacuum fluctuations at some point in space-time. Neither the value nor moment of these fluctuations' appearance nor the background flux at that point depends on the apparent distance to such a vanished particle. This precept does not violate the principles of relativity, however, in that the apparent background does not transfer any information.

Our real 'world' continuum consists of enormous quantity of particles moving with different velocities. Partial waves of the postulated vanishing particles create real vacuum fluctuations that change in a very random way. Certain particles randomly appear in such a system, owing to the harmonic component energy of other vanished particles. The number of such "dependant particles" changes, though; they suddenly appear and vanish forever, as the probability of their reappearance is negligibly small, and so we do not expect that all particles are indebted to each other for their existence.

Yet, if some particles are disappearing within an object, other particles are arising at the same moment in that object due to the contribution of those vanishing particles' harmonic components – and vice versa. The simultaneous presence of all of the particles within one discrete macroscopic object is unreal. Some constituent particles vanish within the object while others appear. In general, a mass object is extant overall, but is not instantaneously substantive and merely a 'false' image. It is clear that the number of particles according to such a theory is inconstant and all their ongoing processes are random, and their probability analysis will remain always on the agenda of future research.

In reality, the hypothetical measurements considered before (in section 1.2) are impossible, because all measuring instruments are macroscopic. Since the sensor of any such device is an unstable-threshold macro-system, only macroscopic events will be detected, such as fog drops in a Wilson chamber, blackening of photo-emulsion film, photo-effects, and the formation of ions in a Geiger counter. Within macro-devices of any type, the sensor's atomic nuclei and electron shells are in close proximity, creating a stable system which is far from being able to take on all arbitrary energy configurations that might be imagined.

The nature of that stable condition is allowed for a series of numerous but always-discrete states only, and the transition from one state to another is a quantum jump. This is why absorption and radiation of energy in atomic systems takes place by quanta, and is a consequence of subatomic structure. In other words, quantization appears because of bound states arising, with 'substance' being the richest collection of an enormous number of bound states. However, it is known that free particles may vary their energy continuously.

However, this does not mean that while passing from one quantum-mechanical system to another, the quantum or particle remains as something invariable and indivisible. Particle energy can be split up and changed due to vacuum and external field fluctuations, but the measuring conditions of our devices are such that we are able to detect quite definite and discrete particles only.

The wave packet/particle exhibits periodicity following our UQT approach, and the mass of a moving particle such as a proton changes from its maximal value to zero and back again – running the series of intermediate values corresponding to the masses of mesons. For example, it might be said that the proton takes, during some intervals of time, the form of a π-meson. This phenomenon is confirmed by numerous experiments, which are explained in classical quantum theory in another way: the proton is permanently surrounded by a cloud of π-mesons, an explanation which is in essence equivalent to our model.

Any 'normal' measurement, in the long run, is based on the interchange of energy and is an irreversible process. That is why the particle interferes in the state of macro-device giving up (or acquiring in the case of devices with inversion) quantum of energy Θ. The best measuring instrument will be one wherein the discrete threshold energy Θ which characterizes device instability is absolutely minimal. With a hypothetical measurement $\Theta = 0$, such that the researcher does not influence the particle with his sensor, then such a device would have 100% effectiveness and could detect vacuum fluctuations.

The measuring instrument should be so that eventually only its classical characteristics are used for its work; in other words, Planck's constant should not play any role in it after the initiation. Such a device is as much as possible (but not totally) free from statistical effects. Thus in measuring processes particle detectors are those reference frames in what respect according to the quantum theory the system’s state is to be determined.

Let us consider the process of particle – macro-device interaction. Particle energy periodically changes with frequency ω_B and vacuum fluctuations (additionally changing the energy) are imposed at it in a random way. To detect the particle, the macro-device has to wait until particle total energy $|\Phi|^2$ and vacuum fluctuations ε exceed the operation threshold Θ of the device:

$$\varepsilon + |\Phi|^2 \geq \Theta \tag{1.5.1}$$

The energy of vacuum fluctuation ε depends on the total number of the particles in the Universe and is created thanks to the particles disappeared. As far the contribution of each partial wave in every point is infinitesimal (its distribution law may be any) in accordance with central limit theorem of Alexander Lyapunov the summary background to be formed by tremendous number of particles and their partial waves will have a normal distribution with maximal entropy. The probability P of vacuum fluctuations with the energy more than ε_0 is equal to

$$P = \frac{1}{\sqrt{(2\pi)}\sigma}\int_{\varepsilon_0}^{+\infty}\exp\left(-\frac{\varepsilon^2}{2\sigma^2}\right)d\varepsilon \tag{1.5.2}$$

and the value σ (dispersion), depending on the particles' number within the Universe is considered in our case as constant. *The theory under consideration requires finiteness of* σ*, and then finiteness of the Universe.* By using (1.5.2) and the Moivre-Laplace formula, we obtain for the probability of the particle detecting the following expression [4, 5]:

$$P = \frac{1}{2}erfc\left(\frac{\Theta - |\Phi|^2}{\sigma^2}\right) \tag{1.5.3}$$

It is evident from the last formula that the probability of the particle's detecting depends on the sensitivity of the measuring instrument. A more rigorous approach to the theory of quantum measurements will be considered in the next sect.1.6.

The developing point of view results in the conclusion that relation $E = \hbar\omega$ is fulfilled at the atomic level only. Thus the particles may exist (after fragmentation on the mirror) with similar frequency ω_B, but with different wave amplitudes f, and so with different probabilities to be detected. One of the particles being split up at the mirror or grid may be detected in a few points at once. The other particle may disappear completely, making its contribution in vacuum fluctuations without any marks.

Following P. Dirac, the photon may interfere only on its own and so the translucent mirror splits it into two parts. According to standard quantum theory, the photon is not able to split with frequency conservation, so it is assumed that two separate photons may interfere at terms they belong to one mode, which occurs in the case of the translucent mirror. However, according to UQT, photons are constantly splitting at the translucent mirror with frequency conservation, but the probability to detect such splitting photons is reduced.

An uncertainty relation results from the fact that energy and impulse are not fixed values, but periodically change due to the appearance and disappearance of the particle. That question is examined in detail in sect. 2.13. Due to the statistical measuring laws, it is impossible to measure energy and impulse by macro-devices especially because of principal and not-foreseen vacuum fluctuations. On the other hand, for the hypothetical researcher the centre of the wave packet has exact coordinates, impulse, and energy at the given moment of time. However, neither we nor the hypothetical observers are able to predict exactly its value at the following moment. Moreover, we (macro-researchers) do not have even a method of accurate measuring, for the process of macro-devices measuring is statistical.

The presence of vacuum fluctuations makes microcosm laws for each researcher statistical in principle. The exact prediction of the events requires the knowledge of the vacuum fluctuation's exact value in any point and at any moment of time. This is impossible, because it requires the information about behaviour and structure of all various wave packets within the Universe and also the possibility to control their motion.

Werner Heisenberg wrote [27]: *"If we would like to know the reason why α - particles are emitting at an exact moment we must, apparently, know all microscopic states of the whole world we also belong to, and that is, obviously, impossible."*

This is why the conclusion that Laplace determinism is lost within the modern and future physics of microcosm shall be considered ultimate. The same point of view about the reason of the arising of probability approach in quantum mechanics was expressed by R. Feynman [18]: *"There is almost no doubt that it (probability) results from the necessity to intensify the effect of single atomic events up to the level detectable with the help of big systems."*

It is good to remember the deep and remarkable words of J. Maxwell: *"The calculation of probabilities is just the true logic of our world."*

The most impressive demonstration of the random chaotic nature of all quantum processes can be seen at the start of a nuclear reactor. Chaos of micro-effects at a low level of average power results in enormously huge fluctuations of chain reactions, which exceed to a considerable extent the average level. Atomic chaos manifestations always exasperate the participants and sometimes create a threatening impression of the processes' uncontrollability with all following consequences. However, cadmium rod removal precipitates smoother fluctuations.

The envelope of partial waves appearing in the result of linear transformations of wave packet as well as in the result of it splitting and fragmentation satisfies the C. Huygens principle. This explains the way of possibility to connect the formally moving particle and plane monochromatic de Broglie wave as it spreads in the line of motion and all the wave properties of particles (such as interference and diffraction) also.

For example, let the wave packet run up to the system with two slots. Each of the wave packet of harmonic components interferes at these slots. There would be an interference pattern of each harmonic component at the screen (since harmonic components amplitudes are extremely small, it may be not possible to see it). However, above this interference pattern the other interference patterns of an infinite large number of the other harmonic components are superimposed. The general composition results in the long run interference pattern of the de Broglie wave envelope.

For the total reversibility of quantum processes, it is necessary while exchanging +t for -t not only to reproduce the amplitude and form of the packet at +t, but also to restore the background fluctuation. The equations of quantum mechanics permit formal exchange of +t for -t under the condition of simultaneous exchange Φ for Φ^*, i.e. formal reversibility (the amplitude and form of the packet reproduction). Actually, such reversibility does not exist in nature even for the hypothetical observer, as for reproduction of the former vacuum fluctuations the reversibility of all processes in the Universe is required, and that is impossible. *However, one can to think that in terms of Unitary Quantum Theory the reversibility has a statistic character (single processes may be reversible with define probability).*

Introduced function Φ has a strictly monochromatic character, but does not exist as a real plane running wave. Although this function corresponds to the particle's energy, other notions may also agree with it: "Waves of probability", "informational field", and "waves of knowledge". As stipulated by A. D. Alexandrov and V. A. Fok [28] a wave function has sense for a separate system, but we can pick it out only by numerous similar experiments and after averaging, though the hypothetical researcher is able to measure this wave function for one particle. It is interesting that the envelope remains fixed within all inertial coordinates systems (only the wave length is changed).

Function Φ may also be connected with wave function Ψ of quantum mechanics describing the plane wave moving in the space. However, the value Φ^2 differs from $\Psi\Psi^*$ not only by presence of frequent oscillations. With Φ^2 the particle's energy is connected, but with $\Psi\Psi^*$ only the probabilities connect.

In standard quantum theory it is not so easy. When comparing mathematical expressions for the density matrix in quantum mechanics and the correlation function of random classical wave field, we find them quite similar, although they describe absolutely different physical objects. In the simplest cases the wave function relates to a single particle and has any sense in the presence of the particle only. Wave function has no sense in those areas where particle is absent. More formally, according to quantum theory, physical values can be obtained in the result of either one or other operators' acts on wave function. Then the average values may be computed by averaging with some weight. That is why notions of absolute phases and amplitudes have no physical sense and may be selected arbitrary for usability only. Large relative changes of the amplitude in far situated points do not result in physical values changes if the wave function gradient is being transformed slightly. So $|\Psi|^2$ have a probability distribution sense but not the sense of real wave motion density as it were in the case of classic fields.

In contrast to ordinary quantum theory the phase plays quite essential role according to our approach. For example, if a particle reaches the potential barrier being in phase of completely vanishing ($\Phi(x,t)$=0), then due to linear character and superposition at small $|\Phi|$ it penetrates the quite narrow barrier without any interactions (Fig. 1.5.1).

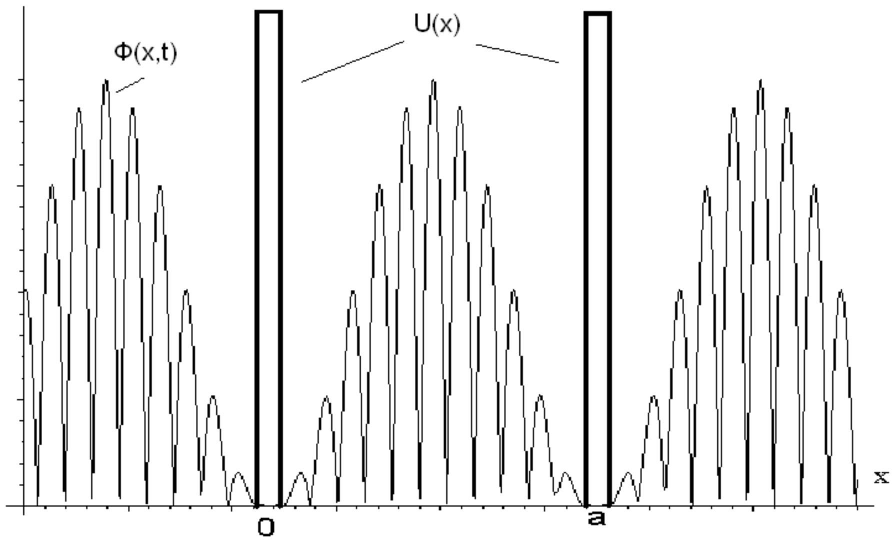

Fig. 1.5.1 *Particle penetrates the quite narrow barriers without any interactions.*

At the other hand, if the phase is so that value of $|\Phi(x,t)|$ is maximal, then due to non-linear character interactions would began and the particle might be reflected. That idea results in new effect: if there is a chain of periodical (with period a), narrow enough (in comparison with λ_B) potential barriers, bombarded with monochrome particles flux, then abnormal tunneling is to be considered at λ_B =2a, but that does not exist(?) in standard quantum theory [29].

Mathematically the process of the packet's appearing and vanishing without changing its character is possible as it is shown at Fig. 1.5.1. It enables formally to understand the fundamental fact of two different amplitude interference rules: for bosons when amplitudes interfere with equal signs and for fermions – with different signs (Fig. 1.2.1).

1.5.2 Relativistic Case

It may be all is vain,

Just un-experienced soul illusion …

A. S. Pushkin

Analyzing (1.3.1) one can see that wave packet Φ contains oscillations term with frequency $\omega_s = \dfrac{mc^2}{\hbar\gamma}$ that corresponds to Schroedinger vibration. The physical meaning of that very quick oscillating process is as follows: after "Creator" having stirred up "the medium" created wave packet the last begins oscillating like membrane or string with frequency ω_s. Within the motion de Broglie vibrations is arising with frequency $\omega_B = \dfrac{mv^2}{\hbar\gamma}$ due to dispersion. At small energies $\omega_s >> \omega_B$ and in the presence of quick own oscillations have no influence on experiment and all quantum phenomena result from de Broglie oscillations. The value of frequency ω_B tends to ω_s with growth of energy and resonance phenomenon appears that result in oscillating amplitude increase in mass growth also (Fig. 1.5.2). Thus the well-known graph of particle mass dependence on the velocity approaching to light's velocity constitutes actually a half of usual resonance curve for forced oscillation of harmonic oscillator if energy dissipation is absent.

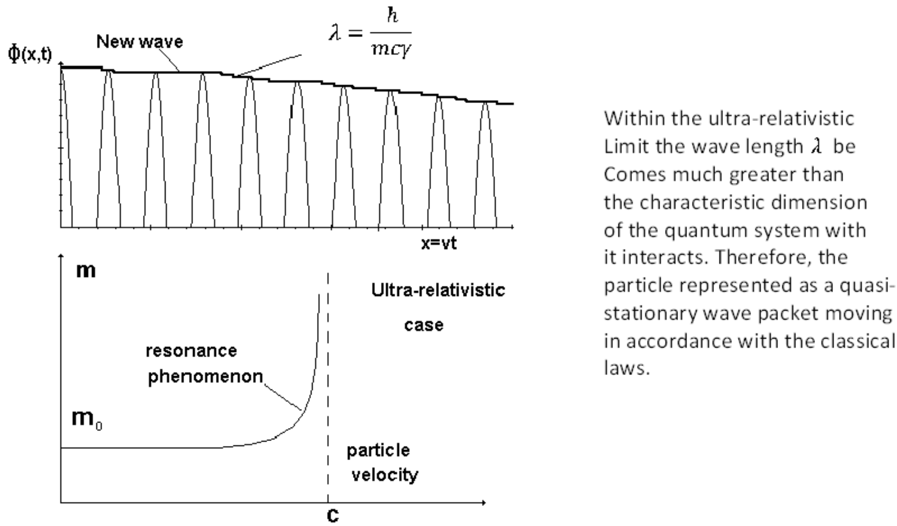

Fig. 1.5.2 *Appear of the New Wave in the ultra-relativistic limit.*

In the case when $v \to c$, frequency $\omega_B \to \omega_s$ $\gamma \to 0$ beats appear with resonance frequency $\omega_d = \omega_s - \omega_B \approx \frac{mc^2\gamma}{\hbar}$, and particle will obtain absolutely new low-frequency envelop with wave length $\Lambda = \frac{h}{mc\gamma}$ (new wave). In ultra-relativistic limit case the value of Λ becomes much greater as typical dimension of quantum system it (new wave) interacts with. Now the length of new wave grows with energy contrary to de Broglie wave length slowly decreasing, and particle requires the form of quasi-stationary wave packet moving in accordance with classical laws. That explains the success of hydrodynamics fluid theory concerning with numerous particle birth when the packet having extremely big amplitude is able to split into series of packets with smaller amplitudes. But such splitting processes characterize not only high-energy particles. Something like this takes place at small energies also, but overwhelming majority of arising wave packets is under the barrier and so will not be detected. It would be perfect to examine by experiments at future accelerators the appearance of such new wave with the length growing together with energy.

But there is one more sufficiently regretting consideration. Due to our point of view relativistic invariance of equations should be apparently changed for something else. In fact the classical relativistic relation between energy and impulse

$$E^2 = P^2 + m^2$$

is doubly true for extra short intervals of time and small particle's displacement (equal to parts of de Broglie wave length). This relation is the result of averaging. What happens with particle impulse and mass when the packet is spread all over the Universe? Possibly they go to zero, but particle's energy as integral of all harmonic components squares sum remains constant (no wave dissipation) and the above-mentioned relation breaks. And probably the fundamental equation (1.4.30) should be written in any other form. But to be sure that equation should be solved first.

1.5.3 Possible Experimental Tests and Results

All ideas that have significance consequences are always simple

Leo Tolstoy

The developed theory will remain a freak of the imagination if following effects will not be experimentally confirmed:

1. Let very weak source emits by parallel bunch of N particles per 1 sec. If place in front of it gate will be opened during the experiment for short interval

$\tau << \frac{1}{N}$, then most probably that no one particle will penetrate, or they will be able to do it one by one. Let these particles fall down on the angle 45 degrees at translucent mirror (Fig. 2.13.1). According to ordinary quantum mechanics the particle will either penetrate the mirror or reflect. In accordance with the point of view described at that monograph the bunch will be split up at the mirror into two, three… of smaller bunches that depends on bunch phase in front of the mirror and on structure of mirror in given place. In general we will get two non-similar wave packets (under-thresholds particles or particles converted into state of phantoms) with smaller amplitudes. There is no change of frequency ω in formula $E = \hbar\omega$ (reddening), because all processes are linear, i.e. do not depend on amplitude. Besides the particle energy $|\Phi|^2$ is decreasing, that results in reducing of detection probability (for detection considerable vacuum fluctuation is necessary, but the probability of it appearance is too small). So, sometimes during process of measuring some particles should disappear or visa versa two particles should appear instead of one. The appearance of two particles from one does not contradict to energy conservation law, as far as the energy of under threshold particle may be increased up to the necessary level due to fluctuations.

For the first time such experiment over photons was carried out by Kozins [30]. He placed photo-multiplier tubes within each bunch and had detected few cases when a coincidence took place. He assumed these to be resulted from activity of independent photons being accidentally almost near and following each other in short time intervals. Unfortunately he did not carry out statistical verification of that assumption.

For the time being a spicy situation is arisen. A lot of experiments have been carried out similar to Kozins' one (for example first R. Hanbury Brown and R. Q.

Twiss experiments, J. F. Clauser [31-33]) resulted in conclusions that particles always had distinct tendency to reach detectors in correlated pairs (!). That result confirms the one we mentioned above. Amusingly, that some physicists had invented special devices of coherent state type for explanation of these experiments refuting standard quantum mechanics.

Late the experiments with delayed choice were carried out also confirming the developing in our book point of view. The description of these experiments can be found at "Scientific American" magazine under the title "Quantum philosophy". And quite recently the effect of electron division into two electrons (!) has been experimentally detected [34-35].

If those results were true, then it would be the most direct confirmation of UQT and total disaster for the ordinary quantum theory. Unfortunately till now nobody has taken into his head to interpret the results of all such experiments in this way, because energy conservation law formally prohibits it. The last is thoroughly checked at very high levels of energy, and since the energy in that case considerably exceeds the energy of vacuum fluctuation, everything is held true. But at small energies nobody studied that question directly. We should repeat once again that any result to be obtained at small energies for one definite particle is random; more over the indeterminateness principle gives no opportunity to detect something precisely for separate particles.

We should specially dwell on J. Bell inequalities (or theorem). There is a perfect review made by J. F. Clauser and A. Shimony [36] that most likely proves our point of view. Such approach is absent in the researches of many physicist and they, to make both ends meet, are obliged to assume over-light velocities [37] and even fantastic processes of "teleportation" [38] and "telepathy" (in connection with this see theorem of Kochen and Specker [39]).

2. Let us assume that monochrome particles with energy $E > \Theta$ participate diffraction experiments. If only one separate particle diffracts, then it creates some interference pattern, but it can not show itself in i maximums because packet energy within it $E_i < \Theta$. If at the same moment n coherent particles interfere, then the energy in the maximums can increase due to superposition of different particle's fields, and the device will be able in this case to detect it. Thus interference pattern of particles with small energies while transforming into a flux of separate particles should disappear. That effect was studied experimentally [40], till now it does not have any satisfactory explanation. In the case $\mathrm{E} >> \Theta$, as it were in experiments [41], that effect will not take place.

3. The coefficient of passing of any coherent particles with small energies ($\lambda_B \cong 0.5A$), through the series of periodical potential barriers (mono-crystal) will be maximal at ($\lambda_B = 2a$), where a is the target grid mono-crystal constant (Fig. 1.5.1). The same, but less weaker effect should becomes appeared again at ultra-relativistic energies, when $\Lambda = 2a$. To run such experiments the flux of mono-energetic and synchronous in phase particles is required. It can be obtained by selecting narrow packet of particles reflected from mono-crystal.

4. In connection to the fact that slowly changing part of space-time generates a field, and local hump of that field is a periodically disintegrating and appearing particle, the theory cannot consider processes not satisfying the field laws. Then un-removable vacuum fluctuations really existing will be in such theory non-invariant relative to rotations, transmissions, space and time reflections and so on [42], and, therefore, conservation laws concerned with them will be non-local and approximate. Such infringements easily arise when particle energy $|\Phi|^2$ is of the same range as dispersion σ of vacuum fluctuations.

Unfortunately, these processes will arise near the threshold and therefore they are difficult for investigation.

5. Since every particle with very small probability can spontaneously arise from vacuum or vanish, all chemical elements are subjected to absolutely new type of nuclear transformations: any element may be transformed into his isotope or into one of his nearest neighbour in periodic table. Upon a time (1905), E. Rutherford pointed it out [43], and these processes were really discovered in geology, but they do not have any explanations yet [44] (within standard quantum mechanics).

6. At collision of any particles of the processes of mutual penetration without any other interaction are to be detected in the case when in the point of collision one of particles or both will spread. It seems, s –state of hydrogen atom is a good illustration of that. We should note that the same phenomena have appeared in Bohr-Sommerfeld model (pendulum orbits) too, but were rejected at once by standard quantum theory as quite preposterous.

It is quite appropriate to quote one more statement of one of quantum theory founders (quite disavowing this theory, but almost unknown – why? – among broad scientific community):

"There are many experiments that we are just not able to explain if we don't consider the waves as namely waves exerting its influence upon all region, where they spread, and assume the location of these waves being "possibly here, possibly there according to probabilistic viewpoint". E. Schroedinger, Brit. J. Philos. Sci., vol. 3, page 233, section 11, 1952.

The offered picture of unitary quantum mechanics for a single particle from the position of united field is rather simple and obvious from hypothetical observer's point of view. If a hypothetical observer usually can measure the value of the wave function amplitude, we can not do it at all. We have to be satisfied with its probability interpretation keeping in mind that rather very simple mechanism is hidden behind and this mechanism open the way for explanation of quality transformations of quantum phenomena, and allows to reduce the description of the whole nature to description of some united field, and the continuous transformations of that field show the astonishing variety of phenomena being under observation.

In spite of mathematical complexity quantum theory will stop being paradoxical and frank words of Richard Feynman [45] *"I can easily say that nobody understands quantum mechanics"* will become the property of history.

In conclusion we would like to quote extremely acute words of Louis de Broglie: *"Those who say that new interpretation is not necessary I would like to note that new interpretation may have more deep roots and such theory in the long run will be able to explain wave-particle dualism, but that explanation will not be received either from abstract formalism, modern nowadays, or from vague notion of supplementary. But I think that the highest aim of the science is always to understand. The history of the science shows if any time somebody succeeded in deeper understanding of physical phenomena class, new phenomena and applications appeared. Hope that many researchers will study that enthralling question casting aside preconceived opinions and not overestimating the importance of mathematical formalism, whatever beautiful and essential it was, because that may result in loss of deep physical sense of phenomena"* (Louis de Broglie, Compt. Rend, 258, 6345, 1964)

1.6 The Theory of Optimal Detector and Quantum Measurements

The truth is too fine a matter and our instruments are rather blunt to touch the truth without any damage. While reaching the aim they crush it and move aside rather false than true.

Blaise Pascal.

The problem of the measuring device MD in any quantum theories may be reduced to the following formula [4, 5, 200, 201]:

$$MD=A+D$$

where A is an analyzer and D a detector. The analyzer performs the spectral decomposition into pure states of the measured dynamical variable L. This role may be played by the magnetic field, various diffractive systems, and polarisers. The theory of this device will not be considered here. The detector changes its state under the influence of the particle and this change is always a microscopic phenomenon. The role of detectors is played usually by highly complex macroscopic systems, such as the sensitive grain of photo emulsion, super cooled gas in cloud chamber, an electron avalanche in Geiger and so on.

Let us denote by Q the set of dynamical variables of the detector, with the help of which the states of the detector and the changes of these states are described. Since the detector is a macroscopic system, it is better to describe it not by means of wave functions $\Psi(Q)$, but by means of the density matrix $\rho_D(Q,Q')$. That is why the particle interacting with the detector is better described by the density matrix $\rho_m(x,x')$ also instead of the wave function $\Psi_m(x)$.

During the interaction between particle and detector, both density matrices should be combined into one common density matrix and this now depends on time:

$$\rho_{D+M} = \rho_{D+M}\left(Q, x, Q', x', t\right)$$

and satisfies the equation of motion

$$H = H_D(Q) + H_\mu(x) + W_{D\mu}(Q,x) \qquad (1.6.1)$$

where $H_D(Q)$ is the Hamiltonian of the detector, $H_\mu(x)$ the Hamiltonian of the particle and $W_{D\mu}(Q,x)$ - the operator describing the interaction between the detector and the particle.

The common density matrix without any restrictions may be represented in the form

$$\rho_{D+M}\left(Q, x, Q'', x', t\right) = \sum \Psi_m^*(x)\,\rho_{mn}\left(Q, Q'\right)\Psi_n\left(x'\right)'$$

where $\Psi_n\left(x'\right)$ are the eigenfunctions of the measured quantity - L. In general, this matrix is nondiagonal in respect to L. At work by $t \to \infty$ detector and its dynamical variables Q lie in some interval

$$Q_n' < Q < Q_n''$$

elements of the matrix are zero:

$$\rho_{mn}\left(Q, Q', t\right) = 0$$

besides

$$\rho_{mn}\left(Q,Q',t\right)\neq 0$$

when

$$Q_n' < Q\,,\ \ Q' < Q_n''$$

These equations are describing the interference of separate particular states of microsystem $\Psi_n(x)$ and their destruction by corresponding changed value of dynamic variable $L = L_n$ for Q state of detector. The stated measurement technique is primarily general in quantum mechanics and includes not only the microsystem itself but also both other parts of the device, the analyzer and the detector. However, all these equations can be easily written down. On the other hand, the solution is rather difficult.

Measurement problem with standard quantum theory is based on two different points of view:

The results of quantum effects' measuring are random and the theory deals with probabilities proportional to wave function amplitudes' squares. The amplitude will be depends on device and macro conditions exactly. This general point of view traces back to N. Bohr.

It is assumed that random measuring results conceal more complicated physical situation, and there are numerous variants of approaches using hidden parameters. Nowadays after the experimental verification of Bell's inequalities the first point of view is winning.

In the case of particle representation as a wave packet bunch and the detector as to some extended as a threshold device, one can evolve the approach proposed in [4-5] something further.

A general approach to the solution of this problem is described in 1.5. Now we proceed to its precise mathematical solution and to define the requirements that the macro instrument should meet if measurements are to be made with minimal errors. Note therewith that a similar need in identification of the useful signal from noise arose in radiolocation and was initially resolved in [46] by W. W. Peterson, T. G. Birdsall, and W. C. Fox.

Without entering into details of the interaction between quantum particles with macro instruments, which have been partially discussed in sections 1.2-1.5, the problem of particle recording or detection can be stated as follows:

On a wave packet with value $|\Phi|$ a vacuum fluctuation with value ε is additively imposed. For simplicity, let us regard the problem as single-dimensional and the eigenregion of the field as a segment of the numerical axis. Mark on that axis x a certain threshold value (Fig. 1.6.1)

$$\theta < a = |\Phi|$$

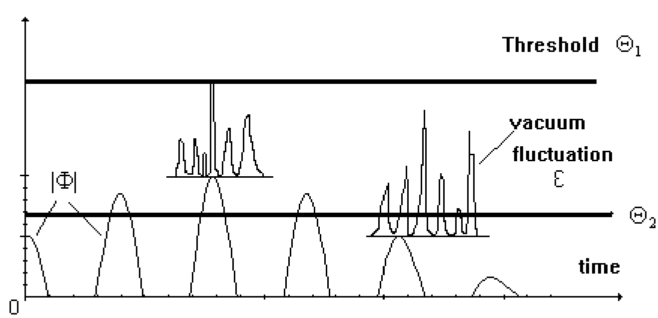

Fig. 1.6.2 *The distribution of the vacuum fluctuations.*

and let the eigenregion of the acting field be $\theta < x < \infty$. The measuring macro instrument distinguishes two situations. If there is a particle, then the value of the field which acts on the instrument is a + ε; if there is no particle, the value is ε. The instrument responds (the particle is recorded) when the value of the acting field exceeds a certain threshold θ, and then θ^2 is the minimal quantum energy for the macro-instrument to respond (sensitivity). Let us find the probability of error of the instrument. Let the distribution of vacuum fluctuations $W_a(x)$ be the distribution of the sum of the particle field and vacuum fluctuations $W_0(x)$ The conditional probability of failing to detect a particle when this goes through the macro instrument is (it is the case of $\theta = \theta_1$ in Fig. 1.6.1)

$$p_a(0) = p\{a + \varepsilon < \theta\} = \int_{-\infty}^{\theta} W_a(x)dx$$

and the conditional probability of detecting a particle when it is not there is

$$p_0(a) = p\{\varepsilon > \theta\} = \int_{\theta}^{\infty} W_0(x)dx$$

Let p(a) and p(0) be a priori the probabilities of particle flight or absence. Then the total probability of error is

$$p_{error} = p(a)p_a(0) + p(0)p_0(a) = p(a)\int_{-\infty}^{\theta} W_a(x)dx + p(0)\int_{\theta}^{\infty} W_0(x)dx$$

An instrument whose p_{error} is minimal can be viewed as optimal. When the threshold θ is lowered, the instrument sensitivity increases and thus the number of undetected particles is reduced but vacuum fluctuations increase the number of false recordings. When the threshold θ is increased, the number of false recordings decreases, but the number of undetected particles increases. It is intuitively clear that, at some value of the threshold θ, the value must have a minimum (Fig. 1.6.2). Let us find that

$$\frac{dp_{error}}{d\theta} = p(a)W_a(\theta) - p(0)W(\theta) = 0$$

Assuming for simplicity that $p(a) = p(0)$, $a = Const$ we have

$$W_a(\theta) = W_0(\theta), \; W_a(x) = W_0(x-a) \tag{1.6.2}$$

and

$$W_0(\theta) = W_0(\theta - a)$$

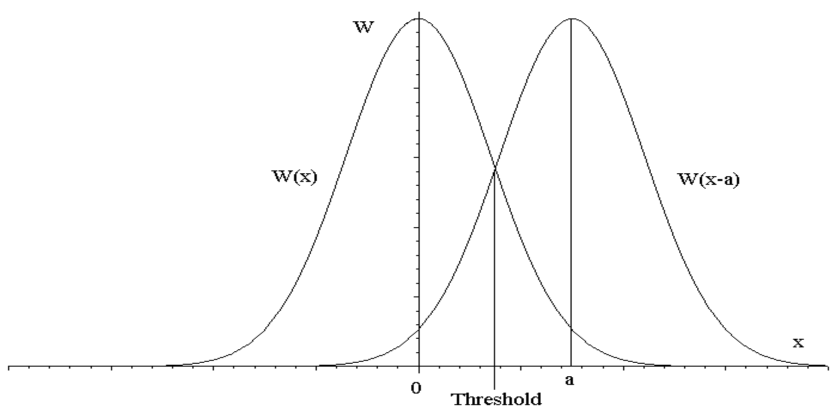

Fig. 1.6.2 *The distribution of the vacuum fluctuations.*

Since $W_0(x)$ is an even function,

$$W_0(\theta) = W_0(a - \theta)$$

hence

$$\theta = \frac{a}{2} = \frac{|\Phi|}{2}; \;\; \theta^2 = \frac{1}{4}|\Phi|^2.$$

Consequently, for the optimal quantum detector the threshold energy should be one-fourth of the particle energy. Usually this relation is not hold and inequality is true $\theta^2 << \frac{1}{4} Re^2 \Phi$ or the number of false recording is very high. In compliance with relation (1.6.2) the normalizing condition

$$\int_{-\infty}^{+\infty} W_0(x)dx = 1$$

and by assuming that the flight of the particle or its absence are equiprobable events $p(a) = p(0) = \frac{1}{2}$ expression (1.6.2) can be transformed:

$$p_{error} = \frac{1}{2}\left(\int_{-\infty}^{\frac{a}{2}} W_a(x)dx + \int_{\frac{a}{2}}^{+\infty} W_0(x)dx \right) = \int_{\frac{a}{2}}^{\infty} W_0(x)dx = \frac{1}{2} - \int_0^{\frac{a}{2}} W_0(x)dx$$

After introducing a new variable $y = x/\sigma$, where σ is the r. m. s. of vacuum fluctuations, being normally distributed, we obtain

$$p_{error} = \frac{1}{2} - \int_0^{\frac{a}{2\sigma}} V_0(y)dy,$$

$$V_0(y) = \frac{1}{\sqrt{2\pi}} exp\left[-\frac{y^2}{2}\right].$$

Thence,

$$p_{error} = \frac{1}{2} - \frac{1}{\sqrt{\pi}} \int_0^{\frac{a}{8\sigma}} exp\left(-z^2 dz\right) = \frac{1}{2}\left(1 - erf\sqrt{\frac{a^2}{8\sigma^2}}\right)$$

Then the error of the detectors is small and expressed as a fraction of the form

$$p_{error} = 10^{-P}$$

where $P = 0 \cdot\cdot 6$ for most existing instruments. Denoting $\rho = \frac{a^2}{\sigma^2}$ we have the probability of detecting the particle, if it exists, in the form

$$P = -log \frac{1}{2}\left(1 - erf\sqrt{\frac{\rho}{8}}\right) = -log \frac{1}{2}\left(1 - erf \frac{Re\Phi}{\sqrt{8\sigma^2}}\right)$$

This is the interpretation of a wave function in unitary quantum theory. The relation $P(\rho)$ does not make an impression until a plot of $P(\rho)$ is seen which is well approximated, in a wide range

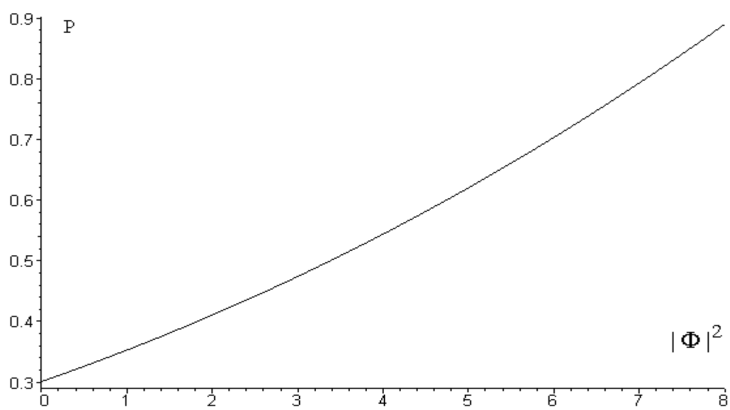

Fig. 1.6.3 *Probability of regular detection of particle as a function of* $|\Phi|^2$

as a straight line (Fig. 1.6.3). In ordinary quantum mechanics it is postulated that $P = \Psi^*\Psi$, but nothing is said about the kind of detectors that are used for the measurement. In unitary quantum mechanics the statistical interpretation is obtained from the mathematical formalism of the theory. The latter includes the consideration of the problem of the statistical interaction between the particle and the detector and the sensitivity of the latter is accounted for.

Since $\rho \approx |\Phi|^2$ and in the ordinary formulation of quantum mechanics $P = \Psi^* \Psi$ then $|\Phi|^2$ and $\Psi^* \Psi$ are seen to coincide with an accuracy of terms of the second order. This correction can be verified experimentally as deflections that appear in the contrast of interference and diffraction pictures should be visible. The position of maxima and minima in such pictures cannot, of course, be affected. The most enterprising experimentalists who want to see the light at the end of the tunnel will hopefully check this.

We can easily paraphrase A. Einstein's words about *"God playing dice"*. Now it is quite evident that God does not play each quantum event creating that or another vacuum fluctuation with only one aim: To force the Geiger counter to detect the particle. It is not so absolutely clear if God can do it at all, because for this He should be able to tug at all the threads all over the Universe and moreover He would need an Ultra-Super-Computer. Apparently God is a perfect mathematician, for He knows Alexander Lyapunov's Central Limit Theorem. That is why He may have decided to make a simple normal distribution of vacuum fluctuations caused by vanishing particles all over the Universe.

Two questions remain, however: Was it God who created that Chaos and how did He manage to do it?

1.7 The Connection of UQT Equations with Telegraph Equations

Just look how magic is the world,

Philosophize, your mind be turned

A. Griboyedov

It is known that the current and tension of alternating electric current in pare lines satisfy the telegraph equation that was definitely derived for the first time by Oliver Heaviside from the Maxwell equation. That equation is a relativistic non-invariant which nevertheless lets us see how it corresponds to Quantum mechanics. The question is that the main relativistic relation between energy, impulse, and mass

$$E^2 = P^2 + m^2 \tag{1.7.1}$$

is still beyond any doubt. In particular, all of the previous paragraphs are based on relativistic invariance. Nevertheless, we shall ask ourselves once again about what will happen with that relation at the exact moment if the wave packet disappears being spread over the space. At that moment the particle will not exist as a local formation. This means that in the local sense there is no mass, local impulse, or energy. The particle in that case, within sufficiently small period of time, is essentially non-existent, for it does not interact with anything. Perhaps this is why the relation (1.7.1) is average and its use at the wavelength level is equal or less than the De Broglie wavelength, which is just illegal. The direct experimental check of that relation at small distances and short intervals is hardly possible today. If the relation (1.7.1) is declined, then it may result in an additional conservation of energy and impulse refusal; but, as we know, according to the Standard Quantum Theory, that relation may be broken within the limits of uncertainty relation. On the other hand, the Lorenz's transformations have appeared when the transformation properties of Maxwell's equations were analyzing. However electromagnetic waves derived from solutions of Maxwell's equations move all in vacuum with the same velocity, i.e. are not subjected to dispersion and do not possess relativistic invariance. Our partial waves, that form a wave packet, is identified with a particle, possess always the linear dispersion. Under such circumstances, it would be quite freely for authors to spread the requirement of relativistic invariance to partial waves. Such requirement has sense in respect only to wave packet's envelope, which appears if we observe a moving wave packet and his disappearance and reappearance. May be the origin of relativistic invariance would be connected in future with the fact that an envelope remains fixed in all inertial reference frames; only the wave's length is changed.

If we resigned the relativistic invariance, then we get quite simple relativistic non-invariant second-order equations for the wave packet in scalar field, viz., the telegraph equation. At first, let us examine the telegraph equation and some of its properties. It looks like the following:

$$\frac{\partial^2 \Upsilon(x,t)}{\partial x^2} = LC\frac{\partial^2 \Upsilon(x,t)}{\partial t^2} + (RC + GL)\frac{\partial \Upsilon(x,t)}{\partial t} + GR\Upsilon(x,t)\,, \qquad (1.7.2)$$

where $\Upsilon(x,t)$ is the current and the tension on line is within x range from some fixed point, and values C, R, L, G - are capacity, active resistance, inductance, and line escaping isolation accordingly.

Let us introduce the next more suitable relations:

$$a_0 = LC\,,\quad 2b_0 = RC + GL\,,\quad c_0 = GR\,.$$

Then the equation will be following:

$$\frac{\partial^2 \Upsilon(x,t)}{\partial x^2} = a_0\frac{\partial^2 \Upsilon(x,t)}{\partial t^2} + 2b_0\frac{\partial \Upsilon(x,t)}{\partial t} + c_0\Upsilon(x,t) \qquad (1.7.3)$$

After transformation

$$exp(b_0 t)Y(x,t) = u(y,z) \quad y = x + ct\,,\quad z = x - ct\,)$$

equation (1.7.3) results in

$$\frac{\partial^2 u}{\partial y \partial z} + \lambda u = 0\,, \qquad (1.7.4)$$

where

$$\lambda = \frac{(RC - GL)^2}{16LC}.$$

That equation belongs to the class of second-order hyperbolic equation. The most important role in its solution plays the Bernhard Riemann function. In the case of equation (1.7.4) this function has the form:

$$R(y,z) = \mathrm{J}_0\left(\sqrt{4\lambda(y-\xi)(z-\eta)}\right),$$

where $J_0(v)$-Bessel function. However, if we introduce function:

$$\Upsilon(x,t) = \exp\left(-\frac{b_0}{a_0}t\right)\Psi(x,t), \tag{1.7.5}$$

then equation (1.7.3) results in the Klein-Gordon equation

$$\frac{\partial^2\Psi(x,t)}{\partial t^2} - V^2\frac{\partial^2\Psi(x,t)}{\partial x^2} - M^2\Psi(x,t) = 0, \tag{1.7.6}$$

where

$$V = \frac{1}{\sqrt{a_0}}, \quad M = \frac{\sqrt{b_0^2 - a_0 c_0}}{a_0}.$$

O. Heaviside obtained the condition under which linear signal propagation would be free from distortion:

$$\frac{G}{C} = \frac{R}{L}$$

If using this relation, equation (1.7.6) may be written as a simple wave equation:

$$\frac{\partial^2 U(x,t)}{\partial t^2} = W^2 \frac{\partial^2 U(x,t)}{\partial x^2},$$

where

$$W = \frac{1}{\sqrt{LC}}.$$

Using the general solution of wave equation and also (1.7.5), we obtain the general solution of telegraph equation [165, 166, 200, 201]:

$$Y(x,t) = \exp\left(-\frac{R}{L}t\right)\left[\varphi(x - Wt) + \phi(x + Wt)\right], \tag{1.7.7}$$

where $\varphi(x - Wt)$ and $\phi(x + Wt)$ are arbitrary functions. Now it is easy to see that solution of (1.7.7) type may be considered as a wave packet running in opposite directions and periodically modulated with an exponential factor on condition that its index is imaginary. As a result, the considered solutions of (1.7.7) type give us an opportunity to look for an analogy between UQT and telegraph equations. As a matter of fact, such an analogy is physically suggested itself as far as in the long Lecher wire in standing-wave mode there exist periodical with the wavelength points. This may be either short-circuited or blocked because of either the current or tension equal to zero (points, where packets vanish). This can be experimentally carried out in a perfect way. Usually such an experiment is a lecture-demonstration for the students of universities.

Expression (1.7.7), in the case of periodical vanishing and appearing of wave packet (UQT new wave function), taking into account mass oscillation, may be rewritten in the form:

$$F(x,t) = \exp\left(i\frac{mv^2}{\hbar}t\right)\left[\varphi(x - vt) + \phi(x + vt)\right], \tag{1.7.8}$$

where packets running in both positive and negative directions $\varphi(x,t)$ and $\phi(x,t)$ are totally arbitrary. For function $F(x,t)$ telegraph equation can be written in the form:

$$\frac{\partial^2}{\partial x^2}F(x,t)-\frac{1}{v^2}\frac{\partial^2}{\partial t^2}F(x,t)+2i\frac{m}{\hbar}\frac{\partial}{\partial t}F(x,t)+\frac{m^2v^2}{\hbar^2}F(x,t)=0 \qquad (1.7.9)$$

Equations resembling (1.7.9) may be obtained from Maxwell equations by making a supposition about imaginary resistance of the conductor and using Oliver Heaviside reasoning while deriving from the telegraph equation (1.7.2). However, the equation (1.7.9) has another solution matching the UQT main idea about the appearing and vanishing packet. That solution [1] has the following form:

$$F(x,t)=\exp\left(\pm i\frac{mv}{\hbar}x\right)\varphi(x\mp vt) \qquad (1.7.10)$$

where we should take the top or bottom sign. Let us write function (1.7.8) or (1.7.10) in the form:

$$F(x,t)=\exp\left(i\frac{mv^2}{\hbar}t\right)\Psi(x,t) \qquad (1.7.11)$$

or

$$F(x,t)=\exp\left(i\frac{mv}{\hbar}x\right)\Psi(x,t) \qquad (1.7.12)$$

By substituting function (1.7.11) into the equation (1.7.9) we get

$$\exp\left(i\frac{mv^2}{\hbar}t\right)\left(v^2\frac{\partial^2}{\partial x^2}\Psi(x,t)-\frac{\partial^2}{\partial t^2}\Psi(x,t)\right)=0$$

Reducing the exponential function we get the wave equation. So in the new quantum equation (1.7.9) O. Heaviside conditions are automatically satisfied (absence of distortion in telegraph equation solution).

Let us insert in our equation (1.7.9) potential U(x) in a general way (here we get an unsolved problem as far as the particle is oscillating and her parameters are changing, but let us temporarily shut our eyes). The velocity of the particle with the energy E in a field with potential $U(x)$ may be written as follows:

$$v = \sqrt{\frac{2\left(E - U(x)\right)}{m}}$$

Substituting it into the equation (1.7.9) and rejecting imaginary terms, we get:

$$\left[-2\hbar^2 E \frac{\partial^2}{\partial x^2} + 2\hbar^2 U(x) \frac{\partial^2}{\partial x^2} + \hbar^2 m \frac{\partial^2}{\partial t^2} - 4mE^2 + 8mEU(x) - 4mU(x)^2\right] F(x,t) = 0 \quad (1.7.13)$$

Let us divide variables in the equation (1.7.13) in accordance with the standard Fourier technique, assuming that

$$F(x,t) = \Psi(x)T(t)$$

After a common substitution in (1.7.13) and dividing by the product of sought functions we get:

$$\frac{\hbar^2}{\Psi(x)}\left(U(x) - E\right)\frac{\partial^2 \Psi(x)}{\partial x^2} + \frac{m\hbar^2}{2T(t)}\frac{\partial^2 T(t)}{\partial t^2} - 2mE^2 + 2mU(x)\left(2E - U(x)\right) = 0 \quad (1.7.14)$$

After coordinate function $\Psi(x)$ separation and after simple transformations we get the following equation

$$\frac{U(x) - E}{\Psi(x)}\left[2mU(x)\Psi(x) - 2mE\Psi(x) - \hbar^2 \frac{\partial^2 \Psi(x)}{\partial x^2}\right] = 0$$

and we obtain easily the Schroedinger equation:

$$\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2}\Psi(x) = (U(x) - E)\Psi(x)$$

Now substitute function (1.7.12) into equation (1.7.9). We obtain

$$\exp\left(i\frac{mv}{\hbar}x\right)\left[-2imv^3\frac{\partial\Psi}{\partial x} - \hbar v^2\frac{\partial^2\Psi}{\partial x^2} + \hbar\frac{\partial^2\Psi}{\partial t^2} - 2imv^2\frac{\partial\Psi}{\partial t}\right] = 0\,.$$

By rejecting imaginary terms and reducing we get the wave equation and Heaviside conditions for the absence of distortion are again satisfied. It is curious that while rejecting imaginary terms and requiring $v \to c$, equation (1.7.9) is automatically transformed into the Klein-Gordon type equation. All previous reasoning can be easily generalized into a three-dimensional case.

The obtained results are quite amazing. It is well known that nearly any equation of theoretically non-quantum physics can result from Maxwell equations. That is why Ludwig Boltzmann said about Maxwell equations: *"It is God who inscribed these signs, didn't He?"* Modern science has changed not a semi-point in these equations, and now it appears that even non-relativistic quantum mechanics in the form of the Schroedinger equation may also be extracted from the Maxwell equation. The same can be said about the Klein-Gordon relativistic equation.

It is possible to write down (for the invariance-lover) the following two variants of our telegraph equations:

$$\frac{1}{v^2}\frac{\partial^2 F(x,t)}{\partial t^2} - \frac{\partial^2 F(x,t)}{\partial x^2} + \frac{2imc^2\sqrt{1-\frac{v^2}{c^2}}}{\hbar v}\frac{\partial F(x,t)}{\partial x} + \frac{m^2c^4}{\hbar^2 v^2}\left(1-\frac{v^2}{c^2}\right)F(x,t) = 0 \qquad (1.7.15)$$

and

$$\frac{1}{v^2}\frac{\partial^2 F(x,t)}{\partial t^2}-\frac{\partial^2 F(x,t)}{\partial x^2}-\frac{2imc^2\sqrt{1-\frac{v^2}{c^2}}}{\hbar v^2}\frac{\partial F(x,t)}{\partial t}-\frac{m^2c^4}{\hbar^2 v^2}\left(1-\frac{v^2}{c^2}\right)F(x,t)=0 \quad (1.7.16)$$

These two equations are satisfied exactly by relativistic invariant solutions in the form of a standard planar quantum-mechanical wave and also in the form of disappearing and appearing wave-packet, viz.

$$F(x,t)=exp\left(\frac{i}{\hbar}\frac{mc^2t-mvx}{\sqrt{1-\frac{v^2}{c^2}}}\right)$$

$$F(x,t)=exp\left(\frac{i}{\hbar}\frac{mc^2t-mvx}{\sqrt{1-\frac{v^2}{c^2}}}\right)\phi(x-vt)$$

This circumstance is extremely striking, but the analysis of our equations is very complicated and we will leave it aside now.

The next natural step is an attempt to calculate mass spectrum for scalar particles: for the spherically symmetric case, the Schroedinger equation, after angle and radial variables separation, is (Plank constant $\hbar=1)$:

$$\frac{\partial^2 f(r)}{\partial r^2}+\frac{2}{r}\frac{\partial f(r)}{\partial r}+8\pi m f(r)-\frac{L(L+1)}{r^2}f(r)=0, \quad (1.7.17)$$

where L takes the value 0, 1, 2, 3, 4…

The general solution of this equation may be expressed with the help of Bessel functions, which has the following form:

$$f(r) = \frac{C_1 J_{L+\frac{1}{2}}(2\sqrt{2\pi mr})}{\sqrt{r}} + \frac{C_2 Y_{L+\frac{1}{2}}(2\sqrt{2\pi mr})}{\sqrt{r}} \tag{1.7.18}$$

Now we can calculate the particle mass as an integral of packets Module Square over infinite range:

$$m = \frac{4\pi}{c^2} \int_0^\infty \left| f(r) \right|^2 r^2 dr \tag{1.7.19}$$

Note that we have not be able to do it before, as according to the standard quantum theory, the particles are not considered as wave packets.

After substitution of solution (1.7.18) into (1.7.17) we obtain the equation for different masses (mass spectrum) at different values of L. Unfortunately, integral (1.7.19) diverges either at null or infinity, and all masses result as infinite for every value of constants C_1, C_2. The reason of it lies in wrong choice of the class of the decisions of the equation Schrodinger. The causes of divergences that worried quantum physics nearly one century ago remain obscure, including using the approach described in this section.

1.8 Elementary Particle Mass Spectrum Within Unitary Quantum Theory

There at unknown paths,

The tracks of mysterious beasts are…

A. S. Pushkin

The mass spectra problem of elementary particles in a standard quantum theory currently faces a number of insurmountable obstacles, as it is in fact absolutely unclear how to set and solve such a problem from the conceptual viewpoint.

Within the Unitary Quantum Theory (UQT), this problem is simpler to some extent: Elementary particles are viewed as stable wave packets, which while moving, retain their dimensions and shapes, but periodically emerge and disappear at the de Broglie wavelength [162, 164].

As is commonly known in a non-linear media case, the influence of non-linearity and dispersion is destructive. In a general case, the former deform, distort, and smear out over space this localized wave-packet-type formation. Yet for some kinds of wave packets there may be an unstable balance between the contradictory effects of non-linearity and dispersion, which leads to the existence of stable wave packets (particles) and the electric charge quantizing. It is only natural that such a balance is valid only for some specified types of dispersion equations, non-linearity, and wave packets. Further on it will be shown that in our model the number of such packets may be rather numerous, but always limited.

We will show that Eq. (1.7.16) (considered in the case of 3-dimension coordinate space (r,θ,φ)) allows, namely, to determine theoretically the mass spectrum of elementary particles.

Such equation for the function $u = u(r,\theta,\varphi)$ is following:

$$\frac{1}{v^2}\frac{\partial^2 u}{\partial t^2} - \frac{1}{r^2 sin\theta}\left(2r\,sin\theta\frac{\partial u}{\partial r} + r^2 sin\theta\frac{\partial^2 u}{\partial r^2} + cos\theta\frac{\partial u}{\partial \theta} + sin\theta\frac{\partial^2 u}{\partial \theta^2} + \frac{1}{sin\theta}\frac{\partial^2 u}{\partial \phi^2}\right), \quad (1.8.1)$$
$$-\frac{2iMc^2\sqrt{1-\frac{v^2}{c^2}}}{v^2\hbar}\frac{\partial u}{\partial t} - \frac{M^2c^4}{v^2\hbar^2}(1-\frac{v^2}{c^2})u = 0$$

(the symbol m is replaced by M).

We will use the natural system of units and put $\hbar=1, c=1$, and will seek the solution of Eq. (1.8.1) inthe following form:

$$u=\frac{f}{r}\exp\left(\frac{iMt}{\sqrt{1-v^2}}-\frac{iMvr}{\sqrt{1-v^2}}\right), \tag{1.8.2}$$

where $f=f(r,\theta,\varphi)$ is some function not depending on t. This function represents as hardened wave packet in coordinate space (r,θ,φ). Substituting (1.8.2) in Eq. (1.8.1), we get

$$\begin{gathered}2iMvr^2\cos^2\theta\frac{\partial f}{\partial r}-2iMvr^2\frac{\partial f}{\partial r}+r^2\sqrt{1-v^2}\frac{\partial^2 f}{\partial r^2}\sin^2\theta\\+\sqrt{1-v^2}\frac{\partial^2 f}{\partial\theta^2}\sin^2\theta+\sqrt{1-v^2}\left(\frac{\partial^2 f}{\partial\phi^2}+\sin\theta\cos\theta\frac{\partial f}{\partial\theta}\right)=0\end{gathered}. \tag{1.8.3}$$

We will seek the solution of Eq. (1.8.3) in form:

$$f=R(r)Y_{Lm}(\theta,\varphi), \tag{1.8.4}$$

where

$$Y_{Lm}(\theta,\phi)=\frac{\sqrt{(2L+1)(L-m)!}}{2\sqrt{\pi(L+m)!}}P_L^m(\cos\theta)\exp(\pm im\phi), \tag{1.8.5}$$

$P_L^m(\cos\theta)$ is the Legendre function, $Y_{Lm}(\theta,\varphi)$ is the Spherical Harmonic and L,m are nonnegative integers L=0, 1, 2, 3,…, $m=0\pm1\pm2\pm3$.. besides $m\le L$. Substituting (1.8.4) in Eq. (1.8.3), we come to the following equation with respect to the function $R(r)$:

$$\left(\frac{d^2R(r)}{dr^2}r^2\sqrt{1-v^2}-2i\frac{dR(r)}{dr}Mvr^2\right)-R(r)L^2\sqrt{1-v^2}-R(r)L\sqrt{1-v^2}=0 \tag{1.8.6}$$

The solution $R(r) = R_L(r)$ of this equation depends on parameter L and we obtain the family of solutions $u_{Lm}(r,\theta,\varphi,t)$ of equation (1.8.3) depending on parameters L,m and describing corresponding partial wave-packets. It is natural to suppose that the modulus of every solution u_{Lm} describes the amplitude of the world unitary potential Φ_{Lm} determined by this equation, and the world potential itself is represented by the quadrate of amplitude modulus, i.e.

$$\Phi_{Lm} = |u_{Lm}|^2 = \left|\frac{R_L(r)}{r} Y_{Lm}(\theta,\varphi)\right|^2. \tag{1.8.7}$$

Further, we consider the gradient of this potential as the tension of corresponding field (it is the custom in electrodynamics) of the partial wave packet and consider the quadrate of the tension as the density W_{Lm} of the energy or of the wave packet's mass distributed continuously in space. So, the mass $M = M_{Lm}$ of our partial wave packet may be determined as the integral of density W_{Lm} over all space (r,θ,φ):

$$M = \int_0^\infty \int_0^\pi \int_0^{2\pi} W_{Lm}\, r^2 \sin\theta dr d\theta d\varphi, \tag{1.8.8}$$

where $W_{Lm} = |\text{grad}\,\Phi_{Lm}|^2$. We rewrite the equation (1.8.6) in form:

$$2ivM = \frac{1}{r^2 R'(r)}(R''(r)r^2 - L(L+1)R(r))\sqrt{1-v^2}, \quad (' = \frac{d}{dr}). \tag{1.8.9}$$

We consider the mass of the wave packet as its inner (proper) characteristic not depending on the velocity of its movement. So, we set $v = 0$ and obtain the following differential equation for $R(r)$:

$$R'' - \frac{L(L+1)}{r^2} R = CR' , \qquad (1.8.10)$$

where C is some constant. This equation possesses the analytical general solution:

$$R(r,C_1,C_2) =$$

$$C_1 \exp(\frac{C}{2} r)\sqrt{r}\, J(L+\frac{1}{2},\frac{1}{2}\sqrt{-C^2} r) + C_2 \exp(\frac{C}{2} r)\sqrt{r}\, Y(L+\frac{1}{2},\frac{1}{2}\sqrt{-C^2} r), \qquad (1.8.11)$$

where $\tilde{N}_1, C_2$ arbitrary constants and J and Y are the Bessel functions. Since we seek the finite solution $R(r)$ for $r \to 0, r \to \infty$ and tending to zero for, $r \to \infty$ we set $C_2 = 0$ and can set some positive value for C_1 and some negative value for the constant C in Eq. (1.8.11). The calculations show the choice of these constants has influence only on the absolute value of the masses calculated below but the ratios of these masses remain the same. We have chosen the simplest values

$$C_1 = 1, C = -2$$

and have obtained following solution

$$R(r) = \sqrt{r}\exp(-r)\mathrm{J}(L+\frac{1}{2}, ir)), \qquad (19.12)$$

where $\mathrm{J}(L+\frac{1}{2}, ir)$ is the Bessel function of 1st type with imaginary argument, or

$$R(r) = i^{L+\frac{1}{2}}\sqrt{r}\exp(-r)\mathrm{I}(L+\frac{1}{2}, r), \qquad (1.8.13)$$

where $\mathrm{I}(L+\frac{1}{2},r)$ is the modified Bessel function of 1st type. So, we obtain the following expression for the world unitary potential Φ_{Lm} (taking into consideration (1.8.2; 1.8.4; 1.8.5; 1.8.7) :

$$\Phi_{Lm} = \frac{e^{-2r}}{4\pi r}\left|\frac{(2L+1)(L-m)!\,\mathrm{I}(L+\frac{1}{2},r)^2\,\mathrm{P}_L^m(\cos\theta)^2}{(L+m)!}\right| \qquad (1.8.14)$$

Now, we form $\mathrm{grad}\,\Phi_{Lm}$ considered as the tension of the field and form also the quadrate of its modulus considered as the mass density W_{Lm}. We obtain:

$$W_{Lm} = 2e^{-4r}\left(\frac{(L-m)!^2\,\mathrm{I}(L+\frac{1}{2},r)^2\left((L+r+1)\,\mathrm{I}(L+\frac{1}{2},r)-r\,\mathrm{I}(L-\frac{1}{2},r)\right)^2\mathrm{P}_\mathrm{L}^\mathrm{m}(\cos\theta)^4(L+\frac{1}{2})^2}{\pi^2 r^4(L+m)!^2}+\right.$$

$$(1.8.15)$$

$$\left.+\frac{(L+\frac{1}{2})^2\,\mathrm{I}(L+\frac{1}{2},r)^4(L-m)!^2\,\mathrm{P}_\mathrm{L}^\mathrm{m}(\cos\theta)^2\left((m-L-1)\,\mathrm{P}_{L+1}^\mathrm{m}(\cos\theta)+(L+1)\cos\theta\,\mathrm{P}_\mathrm{L}^\mathrm{m}(\cos\theta)\right)^2}{\pi^2 r^4(L+m)!^2\sin^2\theta}\right)$$

The integrals of W_{Lm} over all spherical space (r,θ,ϕ) for different $\mathrm{L}=0,1,2,\ldots$ and $\mathrm{m}=0,\pm1,\pm2,\ldots,\mathrm{m}\le\mathrm{L}$ is equal to required different masses M_{Lm} of elementary particles, i.e.

$$M_{Lm} = \int_0^\infty\int_0^\pi\int_0^{2\pi} W_{Lm}r^2\sin(\theta)\,dr\,d\theta\,d\varphi \qquad (1.8.16)$$

Since W_{Lm} does not depend on φ and the Legendre functions in expressions of W_{Lm} may be integrated analytically, we calculated, at first, analytically (with help of Mathematics-9) the integrals

$$U_{Lm} = \int_0^{\pi} Wr^2 \sin(\theta)d\theta \int_0^{2\pi} d\phi = 2\pi \int_0^{\pi} Wr^2 \sin(\theta)d\theta \qquad (1.8.17)$$

and then calculated numerically (with the help of Mathematics-9) the integrals

$$M_{Lm} = \int_0^{\infty} U_{Lm} dr \qquad (1.8.18)$$

For example, we have obtained for L=0 и m=0:

$$U_{00} = \frac{8e^{-4r}\sinh(r)^2}{\pi^3 r^4}\left\{(r^2 + \frac{1}{2} + r)\cosh(r)^2 - r(1+r)\sinh(r)\cosh(r) - \frac{(1+r)^2}{2}\right\}$$

and

$$M_{00} = \int_0^{\infty} U_{00} dr = 0.003944364169$$

For $L = 1, m = 1$

$$U_{11} = \frac{8e^{-4r}}{\pi^3 r^8}\left[\left(r^6 + 5r^5 + \frac{93}{8}r^4 + 13r^3 + \frac{61}{4}r^2 + 2r + \frac{17}{8}\right)cosh^4 r - \right.$$

$$-r\,sinh\,r\,cosh^3\left(r^5 + 5r^4 + 11r^3 + \frac{33}{2}r^2 + 8r + \frac{17}{2}\right) -$$

$$-cosh^2 r\left(\frac{1}{2}r^6 + 3r^5 + 10r^4 + 14r^3 + \frac{71}{4}r^2 + 4r + \frac{17}{4}\right) +$$

$$\left. + r\,sinh\,r\,cosh\,r\left(r^4 + 3r^3 + 8r^2 + 8r + \frac{17}{2}\right) + \frac{1}{2}r^4 + r^3 + \frac{5}{2}r^2 + 2r + \frac{17}{8}\right]$$

and

$$M_{11} = 0.00006798678730.$$

The calculations for small values of L are sufficiently simple. But for large L, the quantities U_{Lm} are represented by long polynomials in r and $\cosh(r), \sinh(r)$ with enormous numerical coefficients and the integration of these polynomials meets serious technical difficulties.

We consider the ensemble $L+1$ particles (masses) with given L and $m = 0 ... \pm L$ to be one family and we will use the notations $M_{L,0}$, $M_{L,1}$, ..., $M_{L,L}$ for particles (masses) of the family with given L. We have calculated and analyzed in full the masses of 49 families *(L=0,1...48)*,, i.e. of 1225 particles. Our PC with $3\text{GHz}, \text{RAM} = 4\text{GB}$ has required for these calculations nearly 3 weeks of computing time. All calculations were checked by Maple-18.

We have compared our theoretical spectrum for 1225 masses with known experimental spectrum for elementary particles measured in MeV. The zero-point for the matching of both spectra was required. We have taken for such matching the quotient of the muon mass to the electron mass. As we know, this quotient for observed muons and electrons is measured experimentally [15] with the most precision and is equal 206.76884(10). Each our calculated mass was divided consecutively by all other 1224 masses and the resulting quotients were compared with the mentioned number. It turned out that the quotient of our masses $M_{16,10} / M_{48,45}$ is equal to 206.7607796 (with relative divergence 0.0039%) and we have taken our mass $M_{48,45}$ equal to 0.2894982442536304 $\cdot 10^{-10}$ for zero-point, i.e. for our electron mass. After, there were divided all other 1224 masses $M_{L,m}$ by $M_{48,45}$ and we have obtained our theoretical spectrum in electron masses which may be compared (after expressing in MeV)

with known experimental masses. Here is the table with our masses M_{Lm} for 34 cases of the well coincidence with well known experimental values (relative errors are less than 1% in 30 cases and between 1.3% and 1.8% in three cases).

Table 1.8.1 *Table of some well known experimental masses of elementary particles.*

$M_{L,m}$	Theory	Experiment	Notation	*Error %*
$M_{48,45}$	0.51099906	0.51099906	e	--
$M_{16,10}$	105.6545640	105.658387	μ	*0.0036*
$M_{18,4}$	135.8958708	134.9739	π^0	*0.683*
$M_{23,0}$	137.2902541	139.5675	π^+, π^-	*1.62*
$M_{14,1}$	541.7587460	548.86	η	*1.29*
$M_{7,7}$	894.0806293	891.8	K^{*+}, K^{*0}	*0.25*
$M_{12,1}$	936.3325942	938.2723	p	*0.206*
$M_{10,4}$	957.1290490	957.2	ω	*0.0083*
$M_{9,5}$	1110.473414	1115.63	Λ	*0.462*
$M_{8,6}$	1224.151552	1233	b_1^0	*0.71*
$M_{11,1}$	1271.916682	1270	K^*	*0.14*
$M_{9,4}$	1331.705434	1321.32	Ξ^-	*0.78*
$M_{10,2}$	1378,127355	1382.8	Σ^0	*0.33*
$M_{12,0}$	1524.617683	1520.1	Λ_2	*0.29*
$M_{8,5}$	1549.444919	1540 ± 5	F_1	*0.28*
$M_{7,6}$	1595.510637	1594	ω_1	*0.094*
$M_{9,3}$	1601.282953	1600	ρ'	*0.08*
$M_{6,6}$	1718.917400	1720	N_0^3	*0.06*
$M_{10,1}$	1774.917815	1774	K_3^{*+}	*0.051*

$M_{L, m}$	Theory	Experiment	Notation	*Error %*
$M_{8, 4}$	1906.842877	1905	Δ_5^+	*0.096*
$M_{9, 2}$	1965.115639	1950	Δ_4	*0.77*
$M_{11, 0}$	2092.497779	2100	Λ_4	*0.35*
$M_{7.5}$	2195.695293	2190	N(2190)	*0.25*
$M_{7, 4}$	2818.645188	2820	η_c	*0.048*
$M_{10, 0}$	2954.549810	2980	η	*0.85*
$M_{6, 5}$	3082.979571	3096	J/ψ	*0.42*
$M_{7, 3}$	3543.664516	3556.3	χ	*0.35*
$M_{5, 5}$	3687.679612	3686.0	ψ'	*0.04*
$M_{7, 2}$	4496.650298	4415	ψ'''	*1.84*
$M_{6, 4}$	5642.230394	5629.6	Ξ_b	*0.8*
$M_{5, 3}$	9499.927309	9460.32	$\Re$`	*0.41*
$M_{6, 1}$	10075.78271	10023.3	$\Re$``	*0.523*
$M_{7, 0}$	10533.15222	10580	$\Re$```	*0.442*
$M_{2, 2}$	131517	125000-140000	Higgs	
$M_{0, 0}$	*6962274*	*?*	*Dzhan*	*?*

(e – electron, μ - muon, π^0 - π -meson, $p-$ proton etc.)

Note, the ratio of our proton mass $M_{12,1}$ and our electron mass $M_{48,45}$ is equal 1832.355 with relative error 0.207% in comparison with well known experimental ratio 1836.152167. Our calculated spectrum containing 169 masses from muon to the heaviest mass approximates also others well known particles and, although the coincidences with experimental data are worse but quite acceptable (with relative divergences not more than several per cent). The mass values for negative m coincides with the mass valued for positive m (antiparticles?).

On the whole, this table shows the striking coincidence of our theoretical values with essential quantity of the known experimental masses and, by no means, such coincidence may be called occasional. The probability of such occasional coincidence is less 10^{-60}. Note, the choice of the nominee for the electron's mass is not unique and may be further calculations of families with $L = 60....100$ would allow obtaining the better result. Our calculated theoretical spectrum contains also the values near to the masses of quarks. The experimental data for quarks are not so precise and are determined in an indirect way. We give the separate table with the calculated and experimental quark masses:

Table 1.8.2 *Table calculated and experimental masses of quarks.*

$M_{L,m}$	**THEORY**	***Experiment***
$M_{38,16}$	5.003455873	*3-7*
$M_{30,25}$	2.75072130	*1.5-3.0*
$M_{20,4}$	94.4251568	95 ± 25
$M_{11,1}$	1271.9166	1250 ± 90
$M_{6,4}$	4300.86662	4200 ± 70
$M_{3,0}$	*179100*	178000 ± 4300

We have carried out also the series of calculations M_{Lm} for L exceeding 48 including L=60. The ratio of maximal $M_{00} = 0.0039443641689$ to minimal $M_{60,60} = 0.3909395521 \cdot 10^{-11}$ is of order 10^9. The ratio of maximal M_{00} to the mass $M_{12,1} = 0.5304640719 \cdot 10^{-7}$ of proton is equal 74400. This number does not contradict the known the experimental data.

Note, the radial function $U_{Lm}(r)$ being the density mass as function of r, is equal zero always for r=0 and for all L, m, and, at first, increases very swiftly on the right from for r=0 and then very swiftly decreases. The plot of $U_{Lm}(r)$ reminds for large L quasi delta-function approaching to coordinates origin as L increases (very simplified analogy is shown on Fig. 1.9.1).

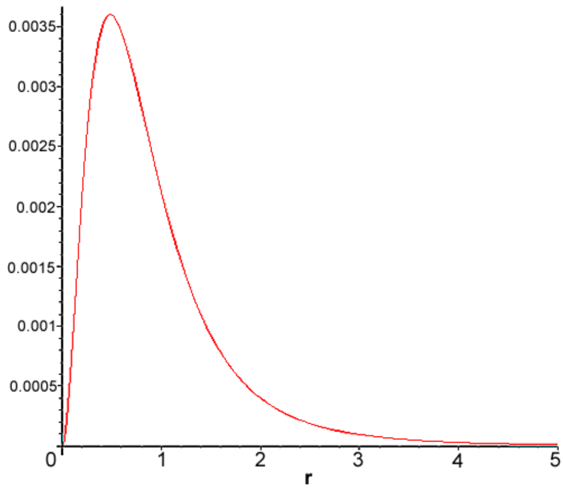

Fig. 1.8.1 *The plot for* $U_{00}(r)$.

Such theoretical model describes a particle as very small bubble in space-time continuum cut by spherical harmonics. Curious, such model, namely, was considered by A. Poincare [161].

Certainly, we do not intend to assert that our results are adequate in full to the known experimental mass spectrum of elementary particles. The divergences are present. Our theoretical spectrum contains the large quantity (1053) of masses between electron mass and muon mass (dark matter?) but such real particles are not observed till now. Our spectrum contains many light particles $M_{L,m}(L>48)$ with masses differing extremely little one from another. It may be supposed there is exists quasi-continuous distribution of lightest particles not affirmed till now by experiments. We suppose that this region of our calculated spectrum contains also the values corresponding to masses of all 6 neutrinos, and it will be possible to discover their theoretical masses after sufficiently precise experimental determination of their masses.

Our spectrum contains of 169 particles from the muon to the heaviest particle $M_{0,0}$ but there are a large quantity of particles in this interval with short "life-time" (so called "resonances") of order $10^{-22}\,sec$. These divergences require the further researches. With respect to light particles, it may be supposed the existence of some selection principles (not discovered till now theoretically) for such particles and these principles lead to essential decreasing of particles quantity between muons and electrons. We suppose that such principles arise theoretically from some relations between the tensors of different valences (ranks) and spherical functions for different L, m and leave this complicate problem for future researches. May be these light particles constitute the dark matter.

There is a question arose with respect to the particles with short "life-time": may we take all these particles for elementary? Our Unitary Quantum Theory allows formulating the following criterion. *If the way which the particle (which we identify with appearing and disappearing wave packet) passes from the moment of its appearing to the moment of its destruction is much longer than de Broglie wave, then such particle may be called elementary.* Have we reason to call "elementary" the particle with life-time of order $10^{-22}\,sec$?

Let us point to following essential circumstance. Viz., if we use the Schrödinger equation in spherical coordinates (relativistic-noninvariant) or Klein—Gordon equation (relativistic-invariant) instead of our initial equation (5), then we will come to the same theoretical mass spectrum. Really, the mention Schrödinger equation is following:

$$\frac{\hbar^2}{2}\frac{\left(2r\sin\theta\frac{\partial u}{\partial r}+r^2\sin\theta\frac{\partial^2 u}{\partial r^2}+\cos\theta\frac{\partial u}{\partial\theta}+\sin\theta\frac{\partial^2 u}{\partial\theta^2}+\frac{1}{\sin\theta}\frac{\partial^2 u}{\partial\phi^2}\right)}{Mr^2\sin\theta}+i\hbar\frac{\partial u}{\partial t}=0, \quad (1.8.19)$$

where M is the particle's mass. We will seek the solution of this equation in form of unitary wave packet f :

$$u=\frac{f}{r}exp(-i\frac{Mv^2}{2\hbar}t+i\frac{Mv}{\hbar}r) \quad (1.8.20)$$

where $f=f(r,\theta,\varphi)$ is the function of coordinates and does not depend on the time. The function u is considered as the amplitude of the world unitary potential Φ. Substituting (1.8.20) in (1.8.19), we obtain (after simplification) the following equation

$$\hbar r^2\sin^2\theta\frac{\partial^2 f}{\partial r^2}-2iMvr^2\sin^2\theta\frac{\partial f}{\partial r}+\frac{\hbar}{2}\sin 2\theta\frac{\partial f}{\partial\theta}+\hbar\sin^2\theta\frac{\partial^2 f}{\partial\theta^2}+\hbar\frac{\partial^2 f}{\partial\phi^2}=0. \quad (1.8.21)$$

This equation coincides with our equation (1.8.3) if we put $\sqrt{1-\mathrm{v}^2}$ instead $\hbar$. The further study described above remains without changes.

Let us consider Klein—Gordon equation in spherical coordinates and in natural units system ($c=1,\hbar=1$):

$$\frac{\left(2r\sin\theta\frac{\partial u}{\partial r}+r^2\sin\theta\frac{\partial^2 u}{\partial r^2}+\cos\theta\frac{\partial u}{\partial\theta}+\sin\theta\frac{\partial^2 u}{\partial\theta^2}+\frac{1}{\sin\theta}\frac{\partial^2 u}{\partial\phi^2}\right)}{r^2\sin\theta}-\frac{\partial^2 u}{\partial t^2}-M^2u=0, \quad (1.8.22)$$

where M is the particle's mass. We will seek the solution

$$u = \frac{f}{r} exp\left(\frac{iMt}{\sqrt{1-v^2}} - \frac{iMvr}{\sqrt{1-v^2}} \right), \tag{1.8.23}$$

where $f = f(r,\theta,\varphi)$ is the function of coordinates not depending explicitly on t. Substituting (1.8.23) in (1.8.22), we obtain the following equation after simplification

$$r^2 \sin^2\theta \sqrt{1-v^2} \frac{\partial^2 f}{\partial r^2} - 2ivr^2 M \sin^2\theta \frac{\partial f}{\partial r} + \sin^2\theta \sqrt{1-v^2} \frac{\partial^2 f}{\partial \theta^2} + \sqrt{1-v^2} \frac{\partial^2 f}{\partial \phi^2} + \frac{\sqrt{1-v^2}}{2} \sin 2\theta \frac{\partial f}{\partial \theta} = 0 . \tag{1.8.24}$$

This equation coincides in full with our equation (1.8.3) and we will come to the same results.

Here is the table with all our theoretical masses from the muon to the heaviest $M_{0,0}$ (MeV).

Table 1.8.3 *Table all theoretical masses from muon to the heaviest particle with name Dzhan.*

105.655, 105.94, 106.241, 108.291, 108.997, 109.597, 110.133, 112.784, 117.054, 118.136, 120.31, 121.826, 122.664, 125.522, 125.71, 127.187, 127.237, 127.306, 131.445, 133.013, 135.896, 137.29, 142.287, 144.326, 145.96, 147.309, 147.698, 149.62, 149.905, 153.765, 153.827, 159.796, 162.135, 162.192, 165.33, 172.249, 177.091, 178.559, 178.758, 180.585, 180.895, 187.69, 192.661, 192.917, 195.832, 199.852, 203.297, 205.588, 209.097, 218.681, 219.639, 221.135, 224.061, 225.089, 231.432, 231.656, 241.805, 249.092, 252.972, 253.184, 269.993, 270.91, 276.443, 280.151, 281.016, 289.488, 300.299, 301.848, 304.024, 314.364, 318.997, 335.848, 339.955, 341.136, 342.52, 349.235, 357.381, 366.838, 373.402, 402.126, 408.316, 423.36, 423.429, 432.83, 445.413, 459.388, 461.593, 472.253, 504.945, 521.772, 529.951, 531.566, 539.326, 541.759, 560.236, 571.51, 606.559, 619.012, 672.537, 686.757, 705.247, 705.477, 730.141, 738.98, 812.354, 828.374, 866.997, 894.081, 897.982, 915.038, 936.333, 957.129, 996.316, 1110.47, 1135.57, 1137.9, 1224.15, 1271.92, 1331.71, 1378.13, 1524.62, 1549.43, 1595.51, 1601.28, 1718.92, 1774.92, 1906.84, 1965.1, 2092.5, 2195.7, 2334.9, 2557.69, 2818.65, 2906.6, 2954.55, 3082.98, 3543.66, 3687.68, 3832.21, 4300.87, 4315.87, 4496.65, 5642.23, 6026.01, 6570.85, 6666.64, 7358.75, 9219.36, 9499.93, 10075.8, 10533.2, 12941.1, 16897., 18035.6, 18261.3, 25000.7, 28935.4, 33698.9, 36955.4, 54518.8, 71060.4, 87704.5, 131517., 179100., 266419., 601983., 1.20005e6 3.4545e6, 6.96227e7.

So, different initial equations (1.8.1), (1.8.19), (1.8.21) (the last is relativistic invariant and the other two are relativistic non-invariant) lead to the same theoretical mass spectrum. Note the following remarkable fact: the standard theory allows detecting spectra by using always the quantum equations with outer potential and as corollaries to geometric relations between de Broglie waves' length and characteristic dimension of potential function. The quantum equation of our theory does not contain the outer potential and describe a particle in empty free space; the mass quantization arises owing to the delicate balance of dispersion and non-linearity which provides the stability of some wave packets number. It is the first case when spectra are detected by using the quantum equations without outer potential.

In view of all said above, we are bold, nevertheless, to say that our results represent the substantial advancement on the way of solution for the extremely complicated theoretical problem of the mass spectrum for elementary particles and to underline that this advancement is owing to our Unitary Quantum Theory. We hope that further analysis with the help of exact equation (1) of our theory will allow to obtain more precise results.

We would like to propose the name "Dzhan-particle" for our heaviest particle $M_{0,0}$ in honor of the general Air Force RF cosmonaut V. A. Dzhanibekov. As we know, particles with mass of such order are observed in cosmic rays.

Nowadays to confirm SM (Standard Model) one should find a Higgs boson and for this purpose the governments of some countries assigned essential sums for the construction of Large Hadron Collider (LHC). For entire SM the interaction with Higgs field is extremely important, as soon without such a field other particles just will not have mass at all, and that till lead into the theory destruction.

To start with we should note that the Higgs field is material and can be identified with media (aether) as it was in former centuries. But SM authors as well as modern physics have carefully forgotten about it. We would not like to raise here once again the old discussion about it. It's a quite complicated problem and let us leaves it to the next generation.

But another problem of SM has never mentioned before: in the interaction with Higgs field any particle obtains mass. As for Higgs boson itself, it is totally falling out of this universal for every particle mechanism of mass generation! And that is not a mere trifle, such "mismatching" being fundamental fraught with certain consequences for SM.

After Higgs boson discovery nothing valuable for the world will happen except an immense banquet. Of course boson will justify the waste of tens billions of Euros… But even now some opinions in CERN are expressed that probably boson non-disclosure will reveal a series of new breath-taking prospects… and where were these voices before construction, we wonder? But that's not the point! If this elusive particle were the only weakness of SM! To our regret today this theory cannot compute correctly the masses of elementary particles including the mass of Higgs boson. More worse, that SM contains from 20 to 60 adjusting – arbitrary! - parameters (there are different versions of SM). SM does not have theoretically proved algorithm for spectrum mass computation – and no ideas how to do it!

All these bear strong resemblance to the situation with Ptolemaic model of Solar system before appearance of Kepler's laws and Newton's mechanics. This earth-centered model of the planets movement in Solar system at the moment of appearance had required introduction of 40 epicycles, specially selected for the coordination of theoretical forecasts and observations. Its description of planets positions was quite good; but later to increase the forecasts accuracy it had required another 40 additional epicycles…

Good mathematicians know that epicycles are in fact analogues of Fourier coefficients in moment decomposition in accordance with Kepler's laws; so by adding epicycles the accuracy of the Ptolemaic model can be increased too. However that does not mean that the Ptolemaic model is adequately describing the reality. Quite the contrary…

The Unitary Quantum Theory allows computing the mass spectrum of elementary particles without any adjusting parameters. By the way computed spectrum has particle with mass 131.51711 GeV (L=2, m=2). Once desired it can be called Higgs boson, it lies within declared by the CERN+Tevatron mass interval 125-140 GeV expected to contain Higgs boson. CERN promises to obtain more precise mass value by December 2014.

When editing of the book was closed find 3 pentaquarks. The significance of each of these masses is more than 9 standard deviations. One has a mass of 4380±8±29 MeV and a width of 205±18±86 MeV (our theory $M_{9,0}$=4315,87 *MeV* while the second is narrower, with a mass of 4449.8±1.7±2.5 MeV and a width of 39±5±19 MeV (our theory $M_{7,2}$=4496,65), third Θ^+ barion has mass 1522±3 *MeV* (our theory $M_{12,0}$=1524.62 *MeV*). It masses were calculated in 2008! [162,164].

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2

Equation with Oscillating Charge

2.1 Heuristic Premises and "Derivaton" of the Equation with Oscillating Charge for a Single Particle; Theorem on "Hidden" Parameters

I think it is quite possible that in the long run Einstein was right that the current form of quantum theory should not be considered as final… I think it is quite possible that in the future a new improved quantum mechanics appears containing a return to the determinism and confirming Einstein's point of view. But such return to the determinism is possible only at the cost of rejection of some fundamental ideas, which we accept now without any doubts. If we return to the determinism we shall have to pay for it in some way, although it is difficult to foresee how.

P. A. M. Dirac, 1978 [164]

In the sect.1.4 we have found the solution of the simplified scalar integro-differential equation resulted in the localized solution for the wave packet/particle. It appeared that the integral of bi-linear combination of such solution over the whole volume is equal to the value of the dimensionless elementary electric charge with the precision up to 0.3% [7, 8]. As we tried to solve the problem in the form of a periodically appearing and vanishing wave packet it was easy to associate such solution with simple space electric charge oscillation that has a double-charge amplitude. Later that packet may be replaced by an oscillating point charge. This movement may be described by the general Newton equation. But we should take into consideration the changes of point' characteristics within process of movement. In the essence, it is simply the next step in the theory of material point's motion. It is not a new idea for ordinary mechanics. There are well known equations of I. Metchersky for the motion of variable mass bodies and K. E. Ciolkowski equations for rockets motion. But until now according to standard quantum theory, a particle has the fixed set of characteristics in space-time field.

It is important to note that Sir Isaac Newton did not apply the conception of material point at all, although it is ridiculous to imagine that such a natural and trivial idea could not come into his mind. We do not know the way of thinking of that great man. But we know about his marvellous and it may be quite probable that Newton felt and foresaw intuitively all difficulties which the physics science should meet when using the conception of a material point, and he wanted to warn the physicists of future generations: "Be careful! The notion of a material point is dangerous!"

Really, we see today- after more then two and a half century - that the biggest troubles of the quantum theory arise if a particle is considered as a material point. A rich bouquet of divergences is the result of this approach. Nevertheless, such an approach is very convenient if it should be used correctly. Let us remember that in accordance with the Newton corpuscular theory, beams of light should be considered as a flow of certain particles. They are emitted in all directions by a luminous body and move in empty space or homogeneous medium uniformly and linearly. In other words, in the same way as usual ordinary material particles do in the absence of any external forces. Newton explained the phenomena of reflection and refraction of light beams on the interface between two homogeneous mediums as a result of the certain forces action directed orthogonally to this interface. These forces, according to Newton, change the normal velocity component, but do not touch the tangential one, and the analysis of this effect has allowed to derive the laws of reflection and refraction. However, the inability of his theory to explain the effects of partial reflection and passage phenomena as well as Newton rings (his own discovery) brought him to almost forgotten but quite modern today theory of bouts (fits). Newton thought that to make complete explanation of all the processes it was necessary to assume that particles of light may experience bouts of reflection and bouts of passage as well. Assume the light falling on to a flat surface. Some part of beams passes and other is reflected. Following quantum description of that effect the particle connected with the incident wave at the moment of impact has a certain probability to pass or to be reflected. In this situation Newton just used the word "bouts" instead of "probability".

It is absolutely clear that ideas set forth below will be crude approximation, because no one equation of particle's motion is able to describe even the most simple interference process in the case of translucent mirror. During that process material particle is divided into two parts, that later shall destroy each other in destructive interference. If we would like to make correct description of single particle, then situation from viewpoint of standard quantum mechanics becomes dismal and purely probabilistic. At any moment of time a particle may be in only one non-coherent state: no one particle can move in two different directions simultaneously. Nevertheless, it seems there is a whole class of processes where such description has certain sense.

The equation with oscillating charge was derived soon after the thin structure constant value estimation was obtained. For the first time this equation was just postulated [53, 54, 172, 183] and used for description of cold nuclear fusion process due to mutual deuteron interaction (see sect.3.1).

This equation has the following form

$$m\frac{d^2\mathbf{r}}{dt^2} = -2Q\,\mathrm{grad}\,U(\mathbf{r})\cos^2\left(\frac{mt}{2\hbar}\left(\frac{d\mathbf{r}}{dt}\right)^2 - \frac{mr}{\hbar}\frac{d\mathbf{r}}{dt} + \phi_0\right), \qquad (2.1.1)$$

where m is the mass, **r** the radius vector, *U(r)* the external potential, the initial phase and Q the constant part of particle's charge.

As soon as $\mathbf{E} = -gradU$, and there exists a magnetic field for every electro-magnetic field one should take into account the Lorentz force $\mathbf{F} = \frac{Q}{c}[\mathbf{v}\times\mathbf{H}]$. In electromagnetic mode ***E*** and ***H*** are similar, for small energies value $\frac{\mathbf{v}}{c} \to 0$ and force **F** may be neglected.

The multiplicator 2 in (2.1.1) is needed for correct transition to equation of classical mechanics because the averaged charge will be two times smaller.

The transition from quantum mechanics to classical mechanics is usually rigorous and overcome many difficulties. But there are some serious problems. For example, the conception of spin has led to some problem. G. Uhlenbeck and S. Goudsmit propose the notion of spin in 1925 after analysis of spectroscopic data. In order to explain these data it was necessary to suppose the existence of eigen mechanics momentum $\frac{\hbar}{2}$ and connected with it magnetic momentum equal to Bohr magneton $\mu_B = \frac{e\hbar}{2mc}$. The same quantities were obtained later by Dirac's equation. Then the ratio of spin magnetic momentum to mechanics momentum equals $\gamma = \frac{e}{mc}$. This value of γ is anomal and should be two times smaller because in the case of orbital motion of electron and of any classics system motion of charged particles' system have given ratio $\frac{e}{m}$ equal to $\frac{e}{2mc}$. The reason of such disaccord is not explained but we understand now that it is connected with oscillation and averaging of charge. Any problem dissappear after accepting this fact.

Besides, there is another anomaly not mentioned before in physical literature and connected with kinetic energy of particle. Let the particle with mass m and moving with velocity V to possess the de Broglie wave length λ and energy E equal to

$$\lambda = \frac{h}{mV}, \quad E = \hbar\omega,$$

where $\hbar = \frac{h}{2\pi}$. Then the particle with velocity V will pass the way equal λ during interval of time equal to T (period):

$$T = \frac{\lambda}{V} = \frac{h}{mV^2} \qquad \nu = \frac{1}{T}$$

It is possible now to find the energy of particle:

$$E = \hbar\omega = h\nu = mV^2,$$

This value is two times more than ordinary value of kinetic energy. So, the averaging of oscillations process causes the above-mentioned disaccord.

And still great dissatisfaction remains because equation (2.1.1) is only postulated. More over, the fact that not every particle is charged strictly restricte the use of equation. A little bit later [55-58] that equation was "derived" from Schroedinger equation it was understood the specific character of charge oscillation. However, for more simplicity we are going to use “oscillating charge” term. It was H. Poincare [161] who noticed for the first time that if the charge or mass of the particle were equally decreased it would not influence equations of motion and could not be experimentally detected.

Let us notice at the same moment that quantum mechanics is the more fundamental science than classical mechanics. As it approaches the limit quantum mechanics results in classical mechanics. However, that fact had not prevented Schroedinger to “deriving” his “famous” equation from relations obtained within Newton mechanics. Schroedinger himself (and many other researchers) considered it not as rigorous deduction but a peculiar illustration because it was impossible to derive this equation strictly from classical mechanics, and this equation was, in fact, postulated. Quite similarly, the equation with oscillating charge is not contained in Schroedinger equation, and further we propose some illustration of correspondence between these two equations.

We will “derive” equation (2.1.1) from Schroedinger equation in the following way [200, 201]. Let us do it for one-dimensional case, since 3-dimensional generalization is too complicated.

Complete Schroedinger equation with potential $U(x)$ is following:

$$\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2}\Psi(x,t)+i\hbar\frac{\partial}{dt}\Psi(x,t)=U(x)\Psi(x,t) \tag{2.1.2}$$

We will seek the solution of this equation in non-traditional form:

$$\Psi(x,t)=\cos(kx)\int\exp(itg(\phi))dt\ , \tag{2.1.3}$$

where

$$\phi = \frac{mt}{2\hbar}\left(\frac{dx(t)}{dt}\right)^2 - \frac{mx(t)}{\hbar}\frac{dx(t)}{dt} + \phi_0 \qquad (2.1.4)$$

The x(t) function is some function of time and is not connected in any way with independent variable x. By substituting (2.1.3) in equation (2.1.2) we get:

$$i\hbar^2 k^2 \int exp\left(itg(\phi)\right)dt + 2imU(x)\int exp\left(itg(\phi)\right)dt + 2\hbar m\,exp\left(itg(\phi)\right) = 0 \qquad (2.1.5)$$

For the very small kinetic energies the following relation always holds true:

$$\hbar^2 k^2 << 2mU(x).$$

Then we may neglect the first integral in (2.1.5). Differentiating the remnant part in time and reducing general exponential factor we obtain:

$$2U(x)cos^2(\phi) + 2mt\frac{dx(t)}{dt}\frac{d^2x(t)}{dt^2} - m\left(\frac{dx(t)}{dt}\right)^2 - 2mx(t)\frac{d^2x(t)}{dt^2} = 0 \qquad (2.1.6)$$

If we use the relation

$$x(t) \approx t\frac{dx(t)}{dt},$$

that may be considered true for short time-intervals, then in equation (2.1.6) items 2 and 4 are canceled and we obtain:

$$U(x)\cos^2(\phi) = \frac{m}{2}\left(\frac{dx(t)}{dt}\right)^2 \qquad (2.1.7)$$

In the equation (2.1.7) left side is oscillating potential energy, right is kinetic energy. Unfortunately, we do not observe mutual transformation of kinetic energy into potential one and back (as it is in classical mechanics of different conservative systems). It seems that potential energy oscillate because the whole packet appears and disappears together with the charge. At the other side, kinetic energy apparently is connected with Fourier harmonic components of moving packet that results in appearance and disappearance of mass due to dispersion in the process of moving. Then we shall assume that independent variable x should be replaced by x(t) in the potential; we have no other simple idea. In that case we get the following equation:

$$U\left(x(t)\right)cos^{2}(\phi)=\frac{m}{2}\left(\frac{dx(t)}{dt}\right)^{2}, \tag{2.1.8}$$

which may be considered as typical Lagrangian like:

$$L=\frac{m}{2}\left(x^{'}\right)^{2}-U\cos^{2}\left(\phi\right), \tag{2.1.9}$$

where x depends on time and following shorter symbols are used:

$$\mathrm{x}=\mathrm{x(t)},\ \mathrm{x}^{'}=\frac{\mathrm{dx(t)}}{\mathrm{dt}},\ \mathrm{x}^{''}=\frac{\mathrm{d}^{2}\mathrm{x(t)}}{\mathrm{dt}^{2}},\ \mathrm{U(x)}=\mathrm{U}$$

If we integrate that Lagrangian, then we obtain the expression for the action. Further, we can find Euler-Lagrange equation; that will be the equation of motion. For this purpose we integrate Lagrangian (2.1.9) in respect to time and obtain the action functional, and compile the variation of this functional. We get the equation:

$$\begin{aligned}
&-U^{'}\cos^{2}\left(\phi\right)+\frac{2}{\hbar}Umx^{'}\cos\left(\phi\right)\sin\left(\phi\right)-mx^{''}-2U^{'}x^{'}\cos\left(\phi\right)\sin\left(\phi\right)\left(\frac{mx^{'}t-mx}{\hbar}\right)\\
&+2U\sin^{2}\left(\phi\right)\left(\frac{mx^{'}tx^{''}-mx^{''}x}{\hbar}-\frac{mx^{'2}}{2\hbar}\right)\left(\frac{mx^{'}t-mx}{\hbar}\right)\\
&-2U\cos^{2}\left(\phi\right)\left(\frac{mx^{'}tx^{''}-mx^{''}x}{\hbar}-\frac{mx^{'2}}{2\hbar}\right)\left(\frac{mx^{'}t-mx}{\hbar}\right)\\
&-\frac{2}{\hbar}Umx^{''}\cos\left(\phi\right)\sin\left(\phi\right)=0
\end{aligned} \tag{2.1.10}$$

If we agreed that within infinitesimal time interval the velocity and acceleration of particle are nearly constant, i.e.

$$x \approx x' t \,,\, x' \approx x'' t \,,$$

then only the first and the third items remain. Thus, we can rewrite (2.1.10) in habitual form:

$$\frac{dU(x)}{dx} cos^2(\phi) = m\frac{d^2 x(t)}{dt^2} \qquad (2.1.11)$$

In 3-dimensional case we obtain the same result. Notice, equation (2.1.11) is non-autonomous according to expression (2.1.4) for φ.

Our autonomous equation in form (2.1.11) can “be derived” from Schroedinger equation also. For this purpose we will seek the solution of equation (2.1.2) in form (2.1.3), but with another phase:

$$\varphi = \frac{mc^2 t}{\hbar} + \frac{mt}{2\hbar}\left(\frac{dx(t)}{dt}\right)^2 - \frac{mx(t)}{\hbar}\frac{dx(t)}{dt} + \phi_0 \,. \qquad (2.1.12)$$

Then after substitution at Shroedinger equation and after the same transformationsas previous one we will get new first-order equation called Lagrangian:

$$U\left(x(t)\right) cos^2(\varphi) - \frac{m}{2}\left(\frac{dx(t)}{dt}\right)^2 + mc^2 = 0 \,. \qquad (2.1.13)$$

After integrating (2.1.13) in respect to time and compiling the variation we get equation in form (2.1.11), but with the phase in form (2.1.12). In expression (2.1.12) there are terms with slow and fast oscillation that satisfy following inequality:

$$\frac{mc^2}{\hbar} >> \frac{m}{2\hbar}\left(\frac{dx(t)}{dt}\right)^2$$

Now we may first of all neglect the smaller term in comparing to the bigger one, and then reject fast oscillating term, as far as it has no influence on final result. Thus we have the autonomous equation that may be written as follows:

$$m\frac{d^2\boldsymbol{r}}{dt^2} = -QgradU(\boldsymbol{r})cos^2(-\frac{m\boldsymbol{r}}{\hbar}\frac{d\boldsymbol{r}}{dt} + \phi_0) \qquad (2.1.14)$$

Of course, this method doesn't delight anybody, but it differs a little from generally accepted cancellation of divergences in quantum field theory, when infinities being subtracted one from the other are canceled.

It should be noticed that autonomous equation (2.1.14) may be obtained after substituting relations (2.1.10) into (2.1.4). It should be especially underlined that resulted first-order equations like (2.1.8) and (2.1.13) won't be primary integrals of the second-order equations (2.1.1) and (2.1.14) and last equations are crude approximations. More over the entire "derivation" may be a subjected to criticism. Our main task, however, is to illustrate that the above-mentioned equations have certain relation with Schroedinger equation. By the way, in "hidden parameters" theorem it was logically proven that within rigorous Schroedinger equation there was no place for such hidden parameter as initial phase. That is why the rigorous deduction of our equations from Schroedinger equation is absolutely impossible. Hereafter we will try to explain how it should be understood at all.

We deal in quantum theory with pure probabilities and such approach is based not upon our inability to control or exactly measure different parameters of the existing processes, but upon accidental character of many parameters by its nature. In other words, the chance that observed probability reflects the influence of uncontrolled hidden parameters may be excluded from consideration, if these parameters are not clearly detected or are not included into theory. According to that quantum mechanics assume that alternative events have equal probabilities and consider it as a physical fact. More generally, it is considered as a basic thesis limited reproduction of the atomic events to be occured in thoroughly controlled similar experimental conditions.

The main aim of the Science is the understanding of outward things and description of all going processes by means of Mathematics. One way is gaining experimental information and putting it in good order in our mind. That process requires considering as fundamental or initial some minimal quantity of facts, and the other facts as their logical corollaries. Such division into fundamental facts and their logical corollaries depends on analytical abilities as well as on existing in Science of an overaching paradigm and some times on our preferences as well. For example, it is unnecessary to consider mathematical beauty of a theory as truth criterion (P. A. M. Dirac). As alternative example we can use Lorentz fundamental transformations (at our point of view they are quite not good-looking) or Maxwell equations, which beauty till introduction of mono-field (P. A. M. Dirac again) was rather doubtful.

Newton mechanics, uniquely, allows the prediction (in a determined way) the future of a system if the initial data is known. Statistic mechanics arises from the necessity of complicated mechanical systems' analysis, when small and even uncontrollable inexactitude of initial data results in almost unforeseen consequences and so makes concessions to very complicated computational processes. Nevertheless, determined process remain the base of statistical mechanics.

Within standard quantum mechanics the situation absolutely differs. According to it, dynamics and statistics are indivisible, and not even the most genius mathematician with the most powerful super computer principally can avoid a statistical description. And here an atavistic thought appears that in reality quantum description is incomplete, and in future, when new “hidden” parameters yet unknown for quantum mechanics will be introduced, the descriptions of predicted determined dynamic regularity may arise. For the first time that challenge was strictly issued and solved by mathematician John von Neumann for the Schroedinger equation: there were no such “hidden” parameters in standard quantum theory with Schroedinger equation.

The equation with oscillating charge has such “hidden” parameter – the initial phase. Naturally, the question arise, how to reconcile it with von Neumann proof. Here we can notice that equation with oscillating charge is a crude approximation at very small energies and therefore, formally, it is not strict quantum-mechanical equation and results of von Neuman theorem [170] can not be applied.

It is quite understandable that equation with oscillating charge can not strictly describe interference processes since according to it moving particle should have bifurcation’s states (particle should physically divide). This is absolutely impossible in the case of motion equations in classical mechanics. That is why using our equation is apparently limited to cases of small energies and cases when there is evidently no interference or strong diffraction. In other words, in the case, when the wave packet is being reflected or dispersed as a whole only, then the use of equation with oscillating charge is possible.

Moreover, according to such approach the question about particle’ photon emission when particle starts moving with acceleration remains unclear. Generally speaking, intimate mechanism of photon emission remains a big mystery. We assume the picture of such a process in images and movements exists and we hope it will be discovered in future.

There is very interesting parallel between Schroedinger equation and equation with oscillating charges. It is known that in the case of charged particle movement in plane condenser with the constant tension to be applied classical uniformly accelerated motion $x = at^2$ appears. For the equation with oscillating charge such analytical solution exists (see sect. 2.2-2.4). Let show that Schroedinger equation has physically similar solution also. Viz., let potential in Schroedinger equation be equal to $U(x) = rx$. Then complete Schroedinger equation as follows:

$$\frac{\hbar^2}{2m}\frac{\partial^2\Psi(x,t)}{\partial x^2} - rx\Psi + i\hbar\frac{\partial\Psi(x,t)}{\partial t} = 0 \tag{2.1.15}$$

We will seek the solution in rather unusual form:

$$\Psi(x,t) = b\exp\left(i\frac{ma^2t^3}{2\hbar} - i\frac{matx}{\hbar}\right) \tag{2.1.16}$$

By substituting (2.1.16) in (2.1.15) we get (after reducing):

$$-2ma^2t^2 + (ma - r)x = 0.$$

This relation will be fulfilled if

$$x = \frac{2ma^2}{ma - r}t^2. \tag{2.1.17}$$

This result confuse untrained reader, because in equation (2.1.15) x and t are independent from each other variables. Such idealization is inherent and convenient in mathematics, but the real situation is slightly others: during motion the truly independent variable is time only. Generally speaking, coordinate is dependent variable and at given velocity is connected with time by means of the relation (2.1.17).

If in (2.1.17) impose the requirement $r \to 0$ (potential vanishes), then absolutely strange particular solution appears where the particle is able to move with constant acceleration and to generate energy of an unknown origin (!!!) Of course, it is out of understanding how such initial conditions could be created. That effect remains valid even if we put $r \to 0$ directly in equation (2.1.15).

From the point of view of standard physics the motion of quantum particle within the field of constant potential never differs from the motion in empty space free from any field, because, as a rule, potential is determined up to arbitrary constant (well known calibration) and that constant may be always selected so as potential would be equal zero. Such a solution of the equation (2.1.15) for wave function with increasing frequency (energy) has been discovered independent from us by Dr. Bill Page - USA (particular report) in the form of combinations of Airy functions. The same solutions can be obtained for Dirac equation.

Curious, but we have similar situation in classical electrodynamics. If during acceleration of a charge one takes into account force acting on a charge itself, then the braking due to radiation arises. In different works this effect is called in different way: bremsstrahlung, Lorenz frictional force or Plank's radiant friction. That force is proportional to third derivative of coordinate x relative to time and is experimentally proved many years ago. If we write the equations of motion for the charge moving in space free from impact of external fields and if the only force acting on the charge is the "Plank radiant friction", then we will obtain the following equation:

$$m\frac{d^2x}{dt^2} = \frac{2e^2}{3c^3}\frac{d^3x}{dt^3}$$

It is evident that equation in addition to trivial and natural particular solution

$$v = \frac{dx}{dt} = \text{Const}$$

has general solution where particle acceleration is equal

$$a = \frac{d^2 x}{dt^2} = C_1 \exp(\frac{3mc^3 t}{2e^2}),$$

i.e. it is not only unequal to zero, but more over it unrestrictedly exponentially increases in time for no reason whatever!!! For example, L. Landau and E. Lifshits in their classical work "Theory of the field" wrote apropos of this: *"A question may arise how electrodynamics satisfying energy conservation law is able to give rise to such an absurd result in accordance to which a particle was able to unrestrictedly increase its energy. The background of that trouble is, actually, in infinite electromagnetic "eigen mass" of elementary particles. If we write in equations of motion finite charge mass, then we, in essence, arrogate to it formally an infinite, formally, negative "eigen mass" of not electro-magnetic origin that together with electro-magnetic mass should result in finite mass of particle. But as far as subtraction of one infinity from another is not mathematically correct, that leads to troubles as described above".*

We are going to tell about such astonishing solutions, where excess energy appears in further chapters of our book. We think that processes of energy generation in nature have left their signs both in quantum theory and electrodynamics. We should note that such traces are fully absent in classical mechanics.

2.2 Autonomous Equations and Some Their Properties

To learn a secret one needs much to guess

A. S. Griboyedov

The vector equation of the motion of charged particle in the field under some forces has in our autonomous model general form (2.1.14). Let us write that equation in simplified form assuming that $m = 1, \hbar = 1$ [200, 201]:

$$\frac{d^2 r}{dt^2} = -2Q \operatorname{grad} U(r) \cos^2(-r \frac{dr}{dt} + \phi_0), \tag{2.2.1}$$

where Q is the charge of particle, $U(r)$ is the potential of external forces, φ_0 is the initial- phase. In one-dimensional case (motion along coordinate axis OX) the equation has the form:

$$\ddot{x} = -2QU'(x)\cos^2(-x\dot{x} + \varphi_0) \tag{2.2.2}$$

That equation may be simplified if we put $\dot{x} = v$ and consider v, i.e. $\dot{x}$ as a function of x. The equation for v is following:

$$v\frac{dv}{dx} = -2QU'(x)\cos^2(-xv + \phi_0) \tag{2.2.3}$$

and it determines velocity $\dot{x}$ as the function of x - so called phase curve. Sometimes that equation may be useful in investigations of the character of particle motion. The equation (2.2.2) does not possess the energy integral. But the following relation can be obtained with the help of (2.2.2):

$$\frac{1}{2}\dot{x}^2(t) - \frac{1}{2}\dot{x}^2(t_0) = -Q[U(x(t)) - U(x(t_0))] - Q\int_{t_0}^{t} \cos[2(-x\dot{x} + \phi_0)]dU \tag{2.2.4}$$

The energy integral for corresponding classical equation

$$\ddot{x} = -QU'(x)$$

may be expressed in form

$$\frac{1}{2}\dot{x}^2(t)-\frac{1}{2}\dot{x}^2(t_0)=-Q\left[U\left(x\left(t\right)\right)-U\left(x\left(t_0\right)\right)\right] \tag{2.2.5}$$

The comparison of (2.2.4) with (2.2.5) allows obtaining some results about behaviour of velocity $\dot{x}(t)$ for solution of equation (2.2.2).

In the case of two-dimensional motion the equations in coordinates system OXY are following:

$$\begin{aligned}\ddot{x}&=-2QU'_x(x,y)\cos^2(-x\dot{x}-y\dot{y}+\phi_0),\\ \ddot{y}&=-2QU'_y(x,y)\cos^2(-x\dot{x}-y\dot{y}+\phi_0).\end{aligned} \tag{2.2.6}$$

In three-dimensional case (in coordinate system XYZ) the equation of motion is analogous but the third similar equation for z and term $-z\dot{z}$ are added to the cosine angle.

Analysis of equations in the coordinate system XYZ shows that they possess the area integral. Therefore, the particle is moving in some plane. That is why it may be considered as two-dimensional case only, i.e. equations (2.2.6).

Equations (2.2.6) possess the area integral that can be written in the form:

$$x\dot{y}-y\dot{x}=Const. \tag{2.2.7}$$

If the potential $U(x,y)$ and, consequently, the force F depend on distance r only, then equations (2.2.6) may be simplified with the help of (2.2.7) as it is usually done in celestial mechanics. Viz., we shall pass from rectangular coordinates to the polar coordinates. If radius vector is denoted by r and polar angle by s, then equation for inverse distance $u=\frac{1}{r}$ becomes more simple:

$$\frac{d^2u}{ds^2}+u=-\frac{2Q}{c^2u^2}F(u)\cos^2(c\frac{du}{ds}\cdot\frac{1}{u}+\phi_0), \tag{2.2.8}$$

where F(u) is expression of acting force as a function of a variable u and c is the constant of area integral. $F(u)<0$ corresponds to attractive force and $F(u)>0$ corresponds to repulsive force. The relation between inverse distance u and angle s is described by equation

$$\frac{ds}{dt}=cu^2. \tag{2.2.9}$$

Equation (2.2.8) for any force F(u)<0 has the stationary solution $u=u_0=Const.,$ that can be obtained from functional equation

$$u_0=-\frac{2Q}{c^2u_0^2}F(u_0)\cos^2(\phi_0), \tag{2.2.10}$$

if that equation has positive solutions. Then each positive solution $u_0=u_0(\varphi_0)$ corresponds to the stationary solution (circular orbit) depending on phase φ_0. Hereinafter in section 2.9 you can see examples of such solutions.

The equations (2.2.2) and (2.2.6) possess particular solutions in the case of attractive force $F(r)$ proportional to $\frac{1}{r^3}$. Viz.,

$$x(t)=a\sqrt{t}, \text{ and } \{x(t)=a\sqrt{t}, y(t)=b\sqrt{t}\}, \tag{2.2.11}$$

where a,b are some constants that may be obtained from corresponding functional equations.

We obtain

$$\frac{a}{4} = 2Q\frac{\mu}{a^3}\cos^2(-\frac{a^2}{2}\phi_0)$$

in the case of Eq. (2.2.2) (if attractive force $F(x) = -\frac{\mu}{x^3}$) and two analogous equations in the case of Eq. (2.2.6).

It may be noticed that equations (2.2.2), (2.2.6) do not possess such partial solutions in the case of analogous repulsive force.

We have not found any other particular solution of equation (2.2.2) and (2.2.6) or any integrals of these equations, so we have to use numerical integration for specific qualitative and quantitative analysis of motion characteristics.

2.3 Non - Autonomous Equations and Some Their Properties

I just hardly can believe that usually nobody knows the details.

"Shaggy" thoughts. Stanislav Yezzy Lets.

Particle motion equation in the field under some power influence in non-autonomous model of our theory has general view (2.1.1) [200, 201]. Being simplified it differs from autonomous equation (2.2.1) in term $\frac{1}{2}\frac{dr}{dt}t$ to be added to cosine angle only. In one- and two-dimensional cases equations are formulated as follows:

$$\ddot{x} = -2QU'(x)\cos^2\left(\frac{1}{2}\dot{x}^2 t - x\dot{x} + \phi_0\right), \tag{2.3.1}$$

$$\ddot{x} = -2QU'_x(x,y)\cos^2\left(\frac{1}{2}\dot{x}^2 t + \frac{1}{2}\dot{y}^2 t - x\dot{x} - y\dot{y} + \phi_0\right), \qquad (2.3.2)$$

$$\ddot{y} = -2QU'_y(x,y)\cos^2\left(\frac{1}{2}\dot{x}^2 t + \frac{1}{2}\dot{y}^2 t - x\dot{x} - y\dot{y} + \phi_0\right) \quad . \qquad (2.3.3)$$

Motion equation in coordinate area XYZ has areas integrals like in autonomous case (2.2), so we can always consider motion in some field XY and use (2.3.2) equations. The latter also have area integral

$$x\dot{y} - y\dot{x} = Const.$$

If potential U(x, y) depends on distance r only, we may pass to polar coordinates (r, s). Equation for $u = \frac{1}{r}$ is the follows:

$$\frac{d^2u}{ds^2} + u = -\frac{2Q}{c^2u^2}F(u)\cos^2\left(\frac{1}{2}c^2\left(u^2 + \left(\frac{du}{ds}\right)^2\right)t + \frac{c}{u}\frac{du}{ds} + \phi\right), \qquad (2.3.4)$$

where F(u)- agent expression, as function u, and value c – constant of area integral. As far as time t belongs to the right part of equation, equation for t as s function should be added:

$$\frac{dt}{ds} = \frac{1}{cu^2} \qquad (2.3.5)$$

Equations (2.3.4) and (2.3.5) represent system of two third -order equations in respect to variables u(s) and t(s) that can be numerically integrated. Equation (2.3.5) allows to correspond polar angle s changes lengthwise motion path with time t. Computations we made for some specific potentials underline that the character of autonomous and non-autonomous equation solutions some times are close in general, but in some cases they differ essentially. Hereafter you can see numerous examples of that fact (see sect.2.8).

Equations (2.3.1), (2.3.2) do not possess the energy integral. But it is possible to compile the expressions analogues to (2.2.4) for autonomous equation and to derive some information about behavior of velocities $\dot{x}(t), \sqrt{\dot{x}^2(t)+\dot{y}^2(t)}$ (see also sect.2.4).

It is of interest that considered equations have in the case of constant force field the particular solutions corresponding to the uniformly accelerated (decelerated) motion. Really, let be

$$\mathrm{U}'(\mathrm{x}) = -\mathrm{F}_0 = \mathrm{Const.}$$

and

$$U'_x(x,y) = -F_{0x} = Const., \quad U'_y = -F_{0y} = Const.,$$

Where F_0 is acting force in the case of equation (2.3.1) and F_{0x}, F_{0y} are components of acting force in the case of equations (2.3.2). Then the function

$$x = at^2, \tag{2.3.6}$$

where $a = 2QF_0 cos^2(\varphi_0)$, and the functions

$$x = at^2, y = bt^2, \tag{2.3.7}$$

where

$$\mathrm{a} = 2\mathrm{QF}_{0\mathrm{x}} \cos^2(\phi_0), \quad \mathrm{b} = 2\mathrm{QF}_{0\mathrm{y}} \cos^2(\phi_0),$$

satisfy our equations. If $F_0 < 0$ (attractive force), then $a < 0, b < 0$ and if $F_0 > 0$ then a>0, b>0. Solution (2.3.7) describes a linear motion.

Also, equations (2.3.1), (2.3.2) have particular solutions in the case of external attractive force being proportional to $\frac{1}{r^3}$. Really, then

$$F(x) = -U'(x) = -\frac{\mu}{x^3} \qquad \text{(in (2.3.1))}$$

and

$$F_{0x} = -U'_x(x, y) = -\frac{\mu x}{r^4}, F_{0y} = -U'_y(x, y) = -\frac{\mu y}{r^4}, \qquad \text{(in (2.3.2))}$$

and mentioned particular solutions are following:

1)
$$x = a\sqrt{t} \qquad (2.3.8)$$

where a is a real root (>0 or <0) of finite equation

$$a^2 = \sqrt{8Q\mu}\left|\cos(-\frac{3a^2}{8} + \phi_0)\right|, \qquad (2.3.9)$$

2)
$$x = a\sqrt{t}, y = b\sqrt{t} \qquad (2.3.10)$$

where

$$a^2 + b^2 = d^2, d^2 = \sqrt{8Q\mu}\left|\cos(-\frac{3d^2}{8} + \varphi_0)\right| \qquad (2.3.11)$$

It is necessary to make also two remarks about the structure of cosine argument in the above non-autonomous case.

1) The influence of terms $\frac{1}{2}t\dot{x}^2$ and $x\dot{x}$ must be always opposite, so it is more correct to write

$$\frac{1}{2}t\dot{x}^2 - |x\dot{x}| + \varphi_0 .$$

2) The quantity φ_0 is the initial phase and consequently the value of cosine argument at initial moment t=0 must be equal φ_0, i.e.

$$\frac{1}{2}t\dot{x}^2 - |x\dot{x}| + \varphi_0\Big|_{t=0} = \varphi_0 . \qquad (2.3.12)$$

If $x(0) \neq 0, \dot{x} \neq 0$, then the additional parameter is to be introduced and we must use instead (2.3.12) the following expression

$$\frac{1}{2}(t + t_*)\dot{x}^2 - |x\dot{x}| = \varphi_0 , \qquad (2.3.13)$$

where t_* is additional parameter (some global time?) satisfying t he relation

$$\frac{1}{2}t_*\dot{x}^2(0) - |x(0)\dot{x}(0)| = 0. \qquad (2.3.14)$$

2.4 Connection Between Equations with Oscillating Charge and Equations of Classical Mechanics

All this looks like when the tail wags the dog.

A. Einstein.

The equations of motion for a particle with oscillating charge have general form (2.1.1) or (2.1.14) [200, 201]. Assuming $m = 1, \hbar = 1$ we obtain following equation in vector form:

$$\frac{d^2 r}{dt^2} = -2Q \operatorname{grad} U(r) \cos^2(\varphi), \qquad (2.4.1)$$

where Q is the main part of particles' charge, U(r) is the potential of external forces and

$$\phi = \frac{t}{2}\left(\frac{dr}{dt}\right)^2 - r\frac{dr}{dt} + \phi_0 \quad \text{(non-autonomous-model)} \tag{2.4.2}$$

or

$$\varphi = -r\frac{dr}{dt} + \phi_0 \quad \text{(autonomous model)} \tag{2.4.3}$$

Let consider the simple case of motion along x-axis and put $Q = 1$. The corresponding equations are as follows:

$$\ddot{x} = 2F(x)cos^2\left(\frac{t}{2}\dot{x}^2 - x\dot{x} + \varphi_0\right) \tag{2.4.4}$$

or

$$\ddot{x} = 2F(x)\cos^2(-x\dot{x} + \phi_0), \tag{2.4.5}$$

where F(x) is an external force (F(x)<0 if attractive, F(x)>0 if repulsive). The corresponding equation of classical mechanics is following:

$$\ddot{x}^0 = F(x^0). \tag{2.4.6}$$

It is of interest to compare solutions of these equations if $F(x) \equiv F_0 = Const.$ (Constant field of force; for example, the field of plane condenser with the constant tension). Classical equation (2.4.6) describe in that case uniformly accelerated (decelerated) motion:

$$x^0(t) = \frac{1}{2}at^2, \tag{2.4.7}$$

where $a = F_0$ (under zero initial values). We do not have the general solution (in analytical form) of equation (2.4.4) even if $F(x) \equiv F_0$. Such solution has, apparently, sufficiently complicated form. But this equation possesses partial solutions

$$x(t) = \frac{1}{2} q t^2, \tag{2.4.8}$$

where

$$q = 2F_0 \cos^2(\phi_0). \tag{2.4.9}$$

Such solution describes uniformly accelerated motion also, but the acceleration depends on value of initial phase φ_0 and varies from zero to $2F_0$ (redoubled classical acceleration F_0). If we observe the ensemble of particles with different initial phases φ_0 distributed uniformly on interval $(0, \pi)$, their averaged over ensemble acceleration is, apparently, near to classical. Besides, every classical solution (2.4.7) has its, so to say, the twin-solution (2.4.8), of equation (2.4.4) with correspondingly matched initial phase φ_0.

It may be noticed that autonomous equation (2.4.5) does not possess partial solutions of form (2.4.8).

Non-autonomous equation has also the partial solution if attractive force $F(x)$ is proportional to $\frac{1}{x^3}$. If $F(x) = -\frac{\mu}{x^3}$, then (see sect.2.3) this particular solution is following:

$$x(t) = a\sqrt{t}, \tag{2.4.10}$$

where a is a real root of finite equation

$$a^2 = \sqrt{8\mu} \left| cos(-\frac{3a^2}{8} + \varphi_0) \right| \tag{2.4.11}$$

The same particular solution of form (2.4.10) has the autonomous equation (2.4.5) (See sect.2.2) and also classical equation

$$\ddot{x} = -\frac{\mu}{x^3}. \tag{2.4.12}$$

In classical case $a = \sqrt[4]{\mu}$.

As was mentioned above, equations of form (2.4.4), (2.4.5) do not possess the energy integral, but is valid relation of form (2.2.4). Hence, if we write the classical energy integral in form (2.2.5), then it is possible to affirm following: velocity $v^2(t)$ determined by equations (2.4.4), (2.4.5) differ from square of velocity $v_0^{\ 2}(t)$ at the same moment in solution of classical equation by following quantity:

$$\int_{t_0}^{t} F(x(t)cos(\phi)dt, \tag{2.4.13}$$

where $\varphi = \varphi(t)$ is equal to cosine argument in (2.2.4) or (2.2.5) correspondingly. Hence, value of $v(t)$ may be more, than value of $v_0(t)$ at the same moment and may be less or equal. It remains unclear, what will be the averaged velocity $\tilde{v}(t)$ of ensemble of particles moving in accordance to equations (2.4.4), (2.4.5) with different initial phases uniformly distributed on segment $(0, \pi)$. Will be $\tilde{v}(t) > v_0(t)$ or $\tilde{v}(t) < v_0(t)$, or $\tilde{v}(t) = v_0(t)$?

Apparently, may be possible different variants in different scheme of motion and neither of these variants is not to be excluded.

Let us to determine some relations between classical equation and equations with oscillating charge of our theory in the case of harmonic oscillator and to consider only the autonomous model. The analysis of non-autonomous model leads to analogues results, but all formulas are quite more complicated.

The standard equation of harmonic oscillations with frequency ω is following:

$$\ddot{x} + \omega^2 x = 0 \tag{2.4.14}$$

Its solution

$$x(t) = a\cos(\omega t) \tag{2.4.15}$$

represents standard harmonic oscillation with zero initial phase. Let us consider the autonomous equation (2.4.5), i.e.

$$\ddot{x} = 2F(x)\cos^2(-x\dot{x} + \phi_0) \tag{2.4.16}$$

Certainly, function (2.4.15) does not satisfy this equation. We will set the inverse problem: what will be the force F(x) in (2.4.16) (and corresponding potential U(x)) for its solution will be identical to (2.4.14)? For this purpose, we substitute (2.4.15) into (2.4.16) and obtain following expression for $F(x)$:

$$F(x) = \frac{-a\omega^2\cos(\omega t)}{2\cos^2(\frac{a^2\omega\sin(2\omega t)}{2} + \phi_0)} \tag{2.4.17}$$

Using (2.4.15) we obtain the following expression for F(x);

$$F(x) = \frac{-\omega^2 x}{2cos^2(-signum(\dot{x})x\omega\sqrt{a^2 - x^2} + \varphi_0)} \tag{2.4.18}$$

Hence, if the forces field F(x) is represented by (2.4.18), then equation (2.4.16) possess the solution $x(t) = acos(\omega t)$. It is possible to expand (2.4.18) in powers series in x provided $|x| < a$. In the simplest case $\varphi_0 = 0$ we obtain up to x^5

following development:

$$F(x) = -\frac{1}{2}\omega^2 x - \frac{\omega^4 a^2}{2} x^3 - \frac{\omega^4}{6}(2\omega^2 a^4 - 3)x^5 - \cdots \qquad (2.4.19)$$

Corresponding expression for potential U(x) we obtain after integrating –F(x) in respect to x:

$$U(x) = \frac{1}{4}\omega^2 x^2 + \frac{1}{8}\omega^4 a^2 x^4 + \frac{1}{36}\omega^4 (2\omega^2 a^4 - 3)x^6 + \cdots \qquad (2.4.20)$$

Certainly, these series converge sufficiently slowly for values of |x| near to a.

Let us to note that classical equation

$$\ddot{x} = F(x), \qquad (2.4.21)$$

where F(x) is expressed by (2.4.18), does not possess the solution $x(t) = a\cos(\omega t)$. This equation possess the solution near to $x(t) = a\cos(\frac{\omega}{\sqrt{2}} t)$. But if we choose corresponding value of initial phase φ_0, then equation (2.4.21) will possess a solution near to $x(t) = a\cos(\omega t)$. Viz., if we set $\varphi_0 = \frac{\pi}{4}$, then up to x^3

$$F(x) = -\omega^2 x + 2\omega^3 a\,\mathrm{signum}(\dot{x})x^2 - 4\omega^4 a^2 x^3. \qquad (2.4.22)$$

The equation (2.4.21), where F(x) is expressed by last formula, possess a solution near to $x(t) = a\cos(\omega t)$ provided a is sufficiently small. It may be said in this case that theoretical motion of particle in some small neighbourhood of $x = 0$ is nearly the same either described by classical equation (2.4.21) or by our equation (2.4.16). In particular, such motion near x=0 described by our equation could satisfy approximately the integral of energy.

Certainly, if the value of initial phase φ_0 is far from $\frac{\pi}{4}$, then particles' motion corresponding to classical and to our model may be quite different. It is natural because classical mechanics has suffered, as is well known, a failure by describing processes of micro-world, and we hope our model being more adequate.

2.5 Passage of Potential Step

The language of truth is simple.

Seneca, Lucius Annaeus

Overcoming the potential step is one of the simplest problems of Quantum Mechanics, especially in the case of a right-angle step. The standard quantum theory affirms following: if the kinetic energy of a particle is less than the potential energy of the barrier, then this particle is always reflected. At the same, there is always within standard quantum mechanics the probability of detecting this particle at some distance on the other side of the barrier (i.e. located on the top of the step) and that probability decreases exponentially with distance tending to zero. In other words, there is always some probability that the particle dives at first deep into barrier and later returns.

But the mentioned process is not well understood from the physical point of view. One may ask what causes the particle to return if it is located already on the horizontal top of the barrier. Nothing is affecting the particle; nothing prevents it from advance with constant speed. The reason and logic seem to be violated.

Our UGT removes such question. Let's consider the behavior of a particle using our theory and the equation with oscillating charge [172, 183, 200, 201].

The numerical mathematical simulation of a right-angle potential is rather complicated. More over there is no such a real potential in the microcosm. So let us investigate that problem in more real case (Woods-Sacson modified potential):

$$U(x) = \frac{U_0}{1 + exp\left(-\frac{x}{a}\right)},$$

where $U_0 > 0$, $a > 0$ (Fig. 2.5.1).

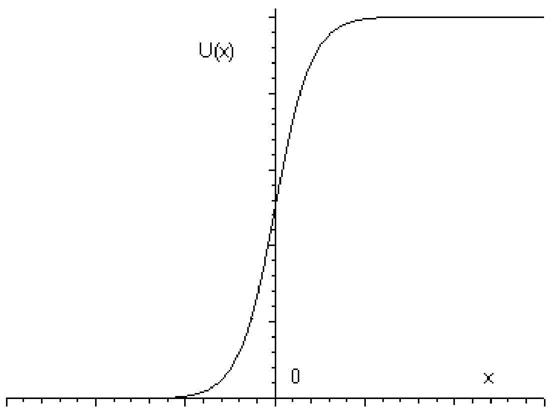


Fig. 2.5.1 *The step's potential U(x).*

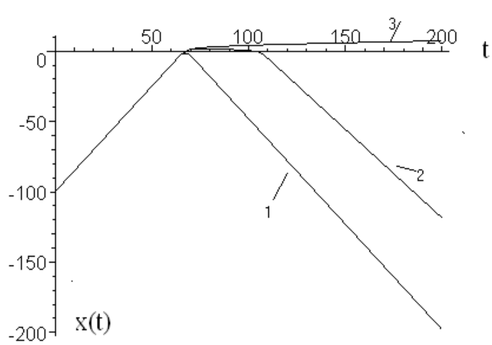


Fig. 2.5.2 *Reflection (1 and 2) and passage (3) of particles for different values of initial phase.*

The equation of motion (if a = 1) is as follows:

$$m\frac{d^2x}{dt^2}+\frac{2U_0\exp(-x)}{(1+\exp(-x))^2}\cos^2\left(m\frac{dx}{dt}x+\phi_0\right) \tag{2.5.1}$$

in autonomous case or

$$m\frac{d^2x}{dt^2}+\frac{2U_0\exp(-x)}{(1+\exp(-x))^2}\cos^2\left(\frac{m}{2}\left(\frac{dx}{dt}\right)^2t-m\frac{dx}{dt}x+\phi_0\right) \tag{2.5.2}$$

in non-autonomous case. The attempts to construct analytical solutions of these equations (including the cases of potentials like $arctan(x)$ or $th(x)$) were not successful, and we used numerical integration for various initial data and initial phases. We calculated the trajectories (x as the function of time t) for more, than 10 000 particles. Some trajectories are shown in Fig. 2.5.2. The trajectory 1 corresponds to straight reflection. The trajectory 2 can be explained as follows: the particle does not overcome the barrier but penetrates inside, some time moves within barrier, and later returns. The trajectory 3 shows that the particle penetrates into the barrier after the same interval of time as the particles 1 and 2, but thereafter moves away with very low speed and a vanishing charge. It is not the particle now but miserable remainders. From UQT wave packet point of view the particle is nearly absolutely spread throughout the cosmos, becomes a mathematical phantom.

We calculated also the number (the percentage) of all particles passing the barrier with respect to initial velocity (Fig. 2.5.3). The curve may be approximated well by an exponent. There was derived also the distribution curves (Fig. 2.5.4) for velocities and charges of passed particle. The calculations have revealed also the following features. Viz., at first, there is quite narrow interval of initial phase φ_0 values allowing a particle to penetrate a high barrier. With the increase of barrier height that interval is narrowing around $\frac{\pi}{2}$. At second, if the particle overcomes the barrier it comes away with very low speed and a vanishing small charge with the distance away and becomes a phantom (the example of the curve 3 in Fig. 2.5.2).

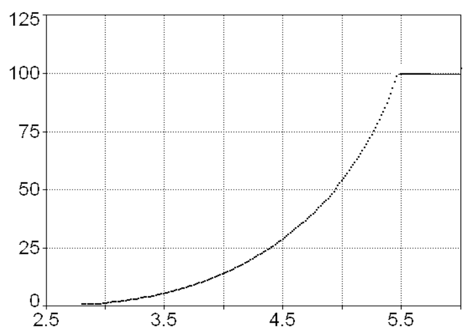


Fig. 2.5.3 *Number (percentage) of passed particles having uniform distributed initial phase as a function of their velocity.*

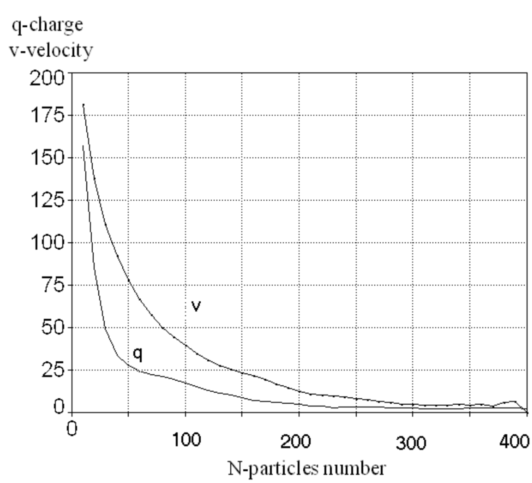


Fig. 2.5.4 *Distribution of velocity v and charges q of passed particles. Number of particles is plotted on x-axis; quantities q and v are plotted on y-axis.*

During our mathematical investigations we have not detected any fundamental difference in qualitative behavior in autonomous and non-autonomous models. Mathematical simulation of other potential barriers (namely, for $arctg(x)$ and $th(x)$) resulted the same qualitative behavior.

We have obtained also the results of mathematical modeling of particle passing over potential barrier of following form:

$$U(x) = \frac{U_0\left(arctg(x) + \frac{\pi}{2}\right)}{\pi}$$

One-dimensional non-autonomous equation for the motion of the particle with mass m and with the constant part of charge Q is following:

$$m\frac{d^2x}{dt^2} + \frac{2QU_0}{(1+x^2)\pi}cos^2\left(\frac{mt}{2\hbar}\left(\frac{dx}{dt}\right)^2 - \frac{m}{\hbar}\frac{dx}{dt}x(t) + \varphi_0\right) = 0$$

The plot of numerical solution of that equation for starting values: $Q = \frac{\pi}{2}$, $\phi_0 = 1.55$, $x_0 = 10$, $U_0 = 3/2$, $\dot{x}_0 = 1.3$, $\hbar = m = 1$ is shown in Fig. 2.5.5.

One can see typical horizontal steps at the left part of particles' velocity curve. There are seen the intervals, where the charge becomes vanishing small, no forces affect the particle, and it mechanically moves with nearly constant velocity. When the charge increases, the particle brakes and so on. That is why the oscillations of velocity can be seen. While approaching to the barrier the oscillating charge of particle abruptly decreases and the particle penetrates the barrier. Just after the barrier its velocity and its oscillating charge continue to decrease (exponentially) and further the particle may even disappear or becomes a phantom. In other words, according to our model, the particles do not turn back, as usual quantum mechanics theory explains, but become a phantom and less detectable with moving away from the barrier.

However we did not detected the above-barrier reflection, well known within standard quantum mechanics. If the particle's energy is more than barrier potential then it always passes the barrier. Analytical evaluations for this problem in the cases of various steep curves of real steps (Heaviside's function is the limits case) will be very much appreciated.

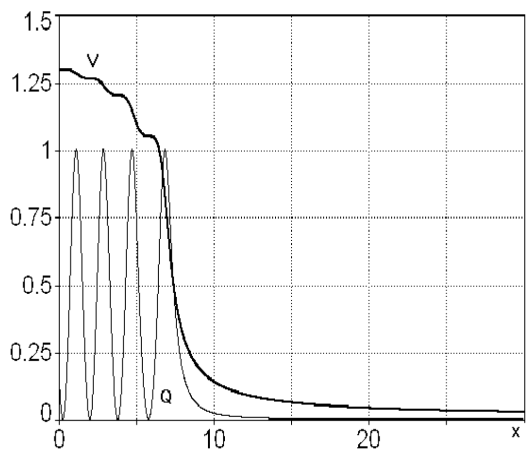


Fig. 2.5.5 *Dependence of particle's velocity and its charge on distance from barrier.*

2.6 Tunneling Effects

Nature is unsophisticated and does not tolerate the splendid magnificence of needless reasons.

Copernicus Nicolaus

Any course of the quantum mechanics delves into details of that purely quantum effect. As we hope our audience is not restricted to specialists in quantum mechanics we will undertake a short excursion into general classical mechanics [172, 183, 200, 201]. If there are two fields where particle potential energy is less within than at the interface dividing these areas, then the interface is called potential barrier. The most simple type of one-dimensional barrier is shown at Fig. 2.6.2, where datum line is potential energy in function of x axis coordinate. The point x_0 potential energy is at its maximum U_0 divides the whole interval $(-\infty, \infty)$ in two domains, $(-\infty, x_0)$ and (x_0, ∞), where $U < U_0$ always. Total energy of particle E equals the sum of it kinetic and potential energies

$$E = \frac{p^2}{2m} + U(x),$$

where m and p are the particle mass and impulse, respectively. Solving that equation with respect to momentum we get:

$$p = \pm\sqrt{2m\left(E - U(x)\right)}$$

The sign must be chosen in accordance with the direction of particle motion. If p>0, then the particle will approach the barrier from left to the right or if p<0 then in the opposite direction. Let us examine the particle moving from left to the right with total energy $E < U_0$. Then at some point x_1 it potential energy will be $U(x_1) = E$, momentum will equal zero and, consequently, the particle will be stopped. The whole particle energy will be transformed in potential, and at pivot point x_1 particle will start moving in opposite direction, unable to penetrate into the second area. Consequently, such potential energy fields (Fig. 2.6.1) are known as barriers as they prevent passage of a particle with $E < U_0$. The barrier is always transparent (or semi-transparent) in case $E > U_0$. For nuclear interaction, the specific term is Coulomb barrier the source of repulsive forces is the charge of nucleus.

The Quantum Mechanics adds a new element to the picture. At $E > U_0$ some particles may be reflected from the barrier and at $E < U_0$ some particles can still pass the barrier. The effect is paradoxical for other reasons as well. If particle with $E < U_0$ gets inside the barrier, it should have negative kinetic energy or imaginary momentum. However, that is the paradox of classical mechanics. Within quantum mechanics, the particle spends nearly no energy in overcoming the potential barrier; it seems to "tunnel" under the barrier. The details of exactly how the particle does this are unknown. The standard quantum mechanical "explanation" is that the particle' behavior follows a wave probability and there exist the probability that the particle may be partially reflected and partially pass. That results in the appearance of probabilities of particle tunneling or reflecting. We are not going to show solutions of Schroedinger equation for tunnel effect you can find them in any course of quantum mechanics, we will only write the result for a barrier with the height U_0 and width a. Probability of passing P is proportional to the following exponential function:

$$P \approx exp\left(-\frac{2}{\hbar}a\sqrt{2m\left(U_0 - E\right)}\right) \tag{2.6.1}$$

Such approximate dependence remains for many types of barriers, although exact analytical solutions usually do not exist, but there are various opinions. One can see that contrary to the classical mechanics at $E < U_0$ probability of barrier passage still exist. We should also note that in all events wave function amplitude in potential barrier area between points x=0 and x=a is extremely small. Tunnel effect is significant when the power of the exponent in (2.6.1) close to unity.

$$\left(\frac{2}{\hbar}a\sqrt{2m\left(U_0-E\right)}\right)\approx 1 \tag{2.6.2}$$

Suppose we have observed a particle $E<U_0$ from inside the potential barrier, as particles penetrate it in accordance with (2.6.2). Then to detect the particle inside the barrier one should accurately fix its coordinates with the accuracy $\Delta x<a$. But in this case a mistake in calculating momentum is inevitable $\Delta p^2>\frac{\hbar^2}{a^2}$.

Replacing the value a from (2.6.2) will yield

$$\frac{\Delta p^2}{2m}>2\left(U_0-E\right)$$

In other words, measuring particle kinetic energy inside the barrier macro-device has an associate error that is twice the energy needed to escape the barrier. So, Nature preserves her building and tunneling secrets.

However, it is possible to make the situation clearer if using the equation with oscillating charge. When the particle approaches the barrier (particle energy is less than the barrier potential) while in a phase when its charge amplitude is very small, the barrier's repellent power is also small, and the particle is able to pass over such barrier. Fig. 2.6.1 illustrates the event. That phenomenon is unknown for standard quantum mechanics because according to it the phase of wave function does not play any essential role.

Examine passage of potential barrier in form of the Gaussian hat by the particle. Both autonomous and non-autonomous variants have been analyzed. One-dimensional potential and corresponding motion equations are the follows:

$$U(x) = U_0 \, exp\left(-\frac{x^2}{\sigma^2}\right)$$

$$m\frac{d^2x}{dt^2} + \frac{4U_0}{\sigma^2} Qx \, exp\left(-\frac{x^2}{\sigma^2}\right) cos^2(\phi) = 0 \, ,$$

where

$$\phi = \frac{mt}{2\hbar}\left(\frac{dx}{dt}\right)^2 - \frac{mx}{\hbar}\frac{dx}{dt} + \phi_0$$

for the non-autonomous case, $\phi = -\frac{mx}{\hbar}\frac{dx}{dt} + \phi_0$ for the autonomous case.

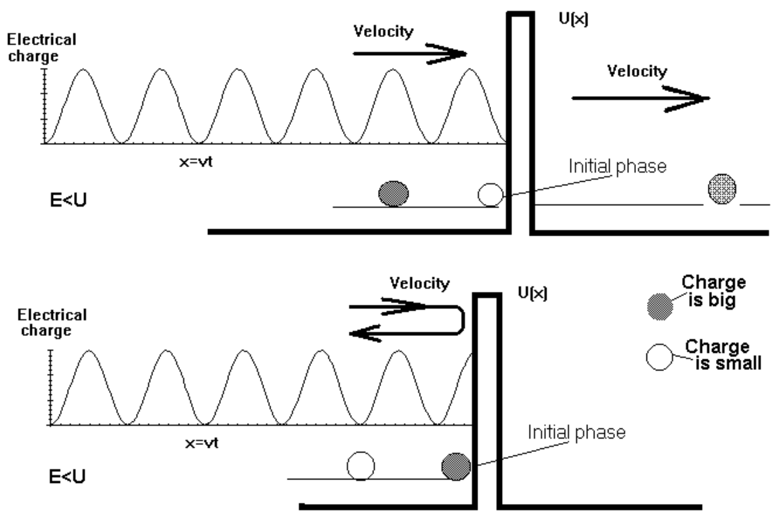


Fig. 2.6.1 *Visual picture of tunnel effect.*

Both equations were solved numerically at $m = Q = \hbar = 1, \; U_0 = 0.5$. The number of the particles passing the barrier was calculated (equivalent to the probability of barrier tunneling) depending on barrier width for randomly, uniformly distributed values of the initial phase within the interval $\varphi_0 = 0 \div \pi$

and fixed velocity. In Fig. 2.6.3 we can clearly see that the periodicity of tunneling probability depends on barrier width. Barrier back wall' reflection is an astonishing feature of nonlinear motion equations, because by intuitive form the particles' motion in monotone potential point of view the appearance of such effect is incomprehensible. It seems as though a nonlinear equation "remembers" what potential the particle have been moving against some time ago and "foreseen" what will be in future.

Then we considered the dependence of tunneled particle's number on its initial velocities and initial phases uniformly distributed the interval $0 \div \pi$ for the same initial parameters. Plots in Fig. 2.6.4 are perfectly approximated by exponential functions of velocity corresponding with high precision to (2.6.1) or (2.6.4). That means that H. Heiger-J. Nuttall experimental law connecting the α-disintegration constant with the velocity of emitted α-particle disintegration may be theoretically derived from the evolved approach.

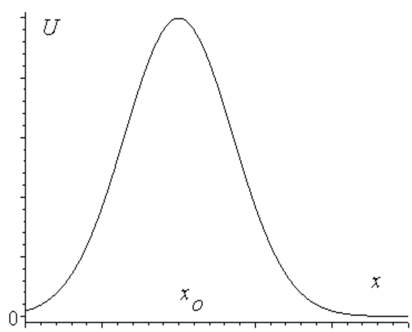


Fig. 2.6.2 *Potental barrier.*

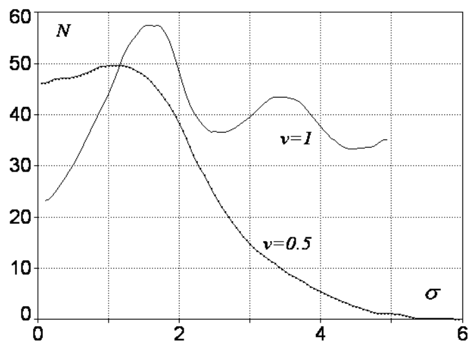


Fig. 2.6.3 *Dependence of number of particles passed barrier on barrier's width σ for different velocities.*

Since the barrier transparency index is described by exponential function, it is possible to create a theory about the nature of α -decay. According to it, when tunneling is of an extremely small probability (10^{-15} or less), that probability should sharply depend on the energy. Thus, let's change the particle's velocity approaching the barrier by a factor of four changes the probability of tunneling by 23 orders. We can now see that taking into account nuclear decay law [59] we will have an exponent with the other exponent as index that result in such strong dependence (H. Heiger-J. Nuttall law).

For a long time, the nature of alpha-decay was a mystery. Lord William Thomson Kelvin was the first to assume that particles emitted by radioisotope behave as if boiling inside "potential" crater. Statistically from time-to-time one of the particles receive enough energy to overcome the barrier, which is above the average energy of the particles inside. As it leaves, the particle is accelerated by potential field of the barrier, giving it even more energy. But E. Rutherford in his classical experiment disproved that view. During experiments uranium nuclei were bombarded by $13 \cdot 10^{-6}$ erg alpha-particles from a thorium source. Alpha-particles propagation strongly depended on Coulomb law and according to the Rutherford evaluations nuclear forces “came into play” at distances less then Rnucl= $3{\cdot}10^{-12}$ centimeter. It is clear that alpha particles are in the potential hole of uranium nucleus, which dimensions are at least less then Rnucl. But the uranium itself is radio-active and emits alpha particles with the energy $6.6{\cdot}10^{-6}$ erg, so according to Kelvin’s model, $13{\cdot}10^{-6}$ erg should be enough to overcome the Coulomb barrier and result in α-capture by the uranium nuclei. Thus the experiment results in strange dilemma: either the Coulomb forces act differently upon incident and emitted alpha particles, or conservation of energy and momentum is entirely absent from these nuclear interactions. From our point of view that problem does not exist at all because the energy gained by the alpha-particle depends on its initial phase, as illustrated in Fig. 2.6.5.

Dependence on barrier width σ is not so simple. Let’s cite exact values of barrier transparency index D for the exact solution of the problem with rectangular barrier of width a to compare with general quantum mechanics results:

$$D = \frac{4E\left(E-U_0\right)}{4E\left(E-U_0\right)+U_0^2 \sin^2\left(ka\right)} \quad \text{if } E>U_0 \text{ and } k=\sqrt{E-U_0} \qquad (2.6.3)$$

$$D = \frac{4E\left(U_0-E\right)}{4E\left(U_0-E\right)+U_0^2 sh^2\left(\gamma a\right)} \quad \text{if } E<U_0 \text{ and } \gamma=\sqrt{U_0-E} \qquad (2.6.4)$$

The expression (2.6.3) describes periodicity of the energy-tunneling index (sine function in denominator). That phenomenon is called over-barrier reflecting, but we have not found any over-barrier reflecting at $E>U_0$ in the process of mathematical modeling. Vice versa, the expression (2.6.4) shows monotonous dependence of transparence index on the energy (hyperbolic sine function in denominator), at the same time our mathematical modeling shows oscillations (see Fig. 2.6.3). That amazing result encourages, because from the Schroedinger wave equation point of view even now it is impossible to understand the reason of transparent index monotonous dependence on the barrier width a at $E < U_0$, when some periodicity is expected, and at the other side transparency index should become constant and equal to 1 at $E > U_0$, but it starts oscillating.

Later we analyzed the velocity of passed and reflected particles in comparison with velocity of incident particles. Input data for autonomous equation were the following:

$$x_0 = -10, v_0 = 0.8, U_0 = 20, \sigma = 0.5, m = 2, \hbar = 1.$$

Initial phases were $\phi_1 = 1.6, \phi_2 = 1.7, \phi_3 = 1.5, \phi_4 = 0, \phi_5 = 2.3$. As it were expected, the particles velocities after passing or reflecting were smaller, equal or greater than those of incident particles. The results are shown in Fig. 2.6.5. Particle 1 passes and particle 5 is reflected with a higher velocity as they approached the barrier. Particle 2 passes and particle 4 is reflected with approximately the same velocity as they approached. Particles 3 are reflected by the barrier with a much smaller velocity.

That illustrate the fact that for single processes, described with the oscillating charge equation the conservation laws do not exist and they apparently appear after averaging over all initial phases. But the conservation law for the ensemble is rather complicated question, as far as the impulse sum before and after interactions do not equal each other but depend on potential. In the case of one or other potentials the value of impulse sum differs from each other and that question is still open.

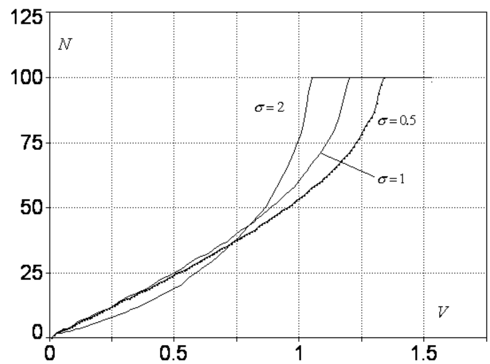


Fig. 2.6.4 *Dependence of barrier transparence on velocity for different barrier width.*

Amazingly, qualitative results in autonomous and non-autonomous cases appear to be similar

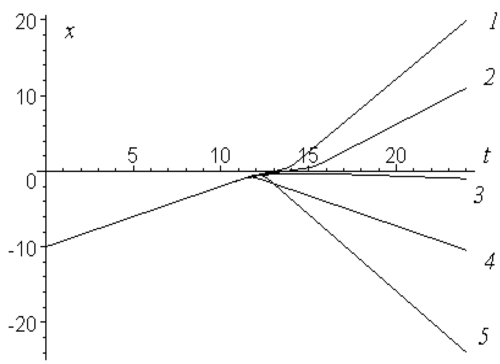


Fig. 2.6.5 *Coordinates of particle as function of time for different initial phases (1, 2-passing, 3, 4, 5-reflecting).*

There exists an initial phase interval about $\frac{\pi}{2}$, where the high barrier is permeable even for particles with small energies. Here we have nearly the same problem as with the step barrier. Even the particles possessing very small energy and having the initial phase near $\frac{\pi}{2}$ are able to pass (tunnel) the extremely high barrier, but do it too long because they, so to say, snail inside the barrier. The charge is too small, the same is the acting on particle force and the motion with low velocity near to inertial motion may continue during very long period. It is quite natural to call that effect “snail”. That fact has been surely confirmed by numerous experiments (for example, [114]) and in different cases. Coulomb potential transparence exists (see sect.3.1), because in the other case it is impossible to explain the existing of pendulum orbits passing through the nucleus of Bohr-Sommerfeld atomic model (these orbits were simply excluded before from consideration as preposterous), and the atom s-states also.

Generally we have come from the analysis of the oscillating charge equations to some predicted physical conclusions.

Usually while solving the Shroedinger equation for the rectangular barrier it is assumed that only transmitted waves exist behind the barrier, because formally it does not have anything to be reflected from. But that idealization is not quite correct, because up to now whether the Universe is closed or not has been vague. And in the case of its insularity the reflected wave should exist. A rigorous mathematical approach requires the existence behind the barrier of transmitted and reflected waves that produce together spatial oscillation of the frequency function. Although absent from the general point of view, this requirement appears with our rigorous approach.

In that part conclusion we would like to state new version of Shroedinger equation solution (in the network of classical quantum mechanics) of the problem of charged particle passing through a potential barrier.

Assume that rectangular potential barrier has width a and height V_0. There is a particle with the energy E, less V_0 and a mass moving towards the barrier.

Let us pick out on the axis OX three areas:

- I (*x<0*)- before the barrier,
- II (0<x<*a*)- inside the barrier,
- III (x>*a*)- behind the barrier. In each area Schroedinger equation is different.

Within the area I (particle does not reached the barrier jet) Schroedinger equation for the wave function, that we denote by $\psi_1 = \psi_1(x)$, is follows

$$\psi_1'' + k^2 \psi_1 = 0, \tag{2.6.5}$$

where

$$k^2 = \frac{2m_0 E}{\hbar^2}. \tag{2.6.5*}$$

At some real initial value $\psi_1(x_0), \psi_1'(x_0)$ in the point $x_0 < 0$ that equation solution is usually written in the following view:

$$\psi_1(x) = A_1 e^{ikx} + B_1 e^{-ikx}, \tag{2.6.6}$$

where $A_1, B_1 -$ constants, expressed with the initial values, and terms $A_1 \, exp(ikx), B_1 \, exp(-ikx)$ describe so-called direct and return waves.

The Schroedinger equation for the wave function $\psi_2(x)$ within the area II has the following view

$$\psi_2'' - \chi^2 \psi_2 = 0, \tag{2.6.7}$$

where

$$\chi^2 = \frac{2m_0}{\hbar^2}(V_0 - E) > 0. \qquad (2.6.7^*)$$

According to quantum mechanics literature the late equation solution analysis was done taking into account direct wave only in (2.6.6), return wave was excluded, considering reflected from the barrier and non-influencing onto the $\psi_2(x)$ function. By the way, if we were trying to solve equation for $\psi_2(x)$ from strongly mathematical base it would not be permitted to reject term $B_1 exp(-ikx)$. The matter is that in terms of real initial values $\psi_1(x_0), \psi'_1(x_0)$ function $\psi_1(x)$ represents real harmonic oscillation. So coefficients A_1, B_1 are complex conjugate. Assume that

$$A_1 = s + ir, B_1 = s - ir, \qquad (2.6.8)$$

where $s, r -$ real numbers. Then $\psi_1(x)$ will be written in the following view

$$\psi_1(x) = 2M_1 cos(kx + \phi), \qquad (2.6.9)$$

where

$$M_1 = \sqrt{s^2 + r^2} = |A_1| = |B_1| \ ,$$
$$tg(\phi) = \frac{r}{s}, M_1 cos(\phi) = s, M_1 sin(\phi) = r, \qquad (2.6.10)$$

Note that φ phase may belong to any of trigonometric circle quarters. In particular, if φ belongs to third quarter then s, r are negative.

General solution of the equation (2.6.7.) for $\psi_2(x)$ in the area II is

$$\psi_2(x) = A_2 e^{-\chi x} + B_2 e^{\chi x} \qquad (2.6.11)$$

However it is resulted from the physical point of view that rising exponent

$B_2 \exp(\chi x)$ will not be in the equation for $\psi_2(x)$. Wave function module is enable to rise inside the barrier. So the equation for $\psi_2(x)$ in the view of:

$$\psi_2(x) = A_2 e^{-\chi x}. \tag{2.6.12}$$

By virtue of the process continuity at the border $x = 0$ between the areas I and II the following conditions of functions $\psi_1(x)$ and $\psi_2(x)$ joining should be met:

$$\psi_1(0) = \psi_2(0), \psi'_1(0) = \psi'_2(0) \tag{2.6.13}$$

or

$$A_1 + B_1 = A_2, \quad ikA_1 - ikB_1 = -\chi A_2 \tag{2.6.14}$$

Evidently it is impossible to match that correlation if $B_1 = 0$. In the case $B_1 \neq 0$, further calculations are possible. In other words, previous correlation result in

$$A_2 = \frac{2ik}{ik - \chi} A_1 = \frac{2ik}{ik + \chi} B_1, \tag{2.6.15}$$

consequently

$$\frac{A_1}{B_1} = \frac{ik - \chi}{ik + \chi}, \tag{2.6.15*}$$

and taking into account (2.6.8), we have got the following correlation between s, r, k, χ:

$$\frac{s^2 - r^2}{s^2 + r^2} = \frac{k^2 - \chi^2}{k^2 + \chi^2}, \quad \frac{sr}{s^2 + r^2} = \frac{k\chi}{k^2 + \chi^2}. \tag{2.6.16}$$

If we set

$$\frac{s}{r} = u, \frac{k}{\chi} = n, \tag{2.6.17}$$

and take into account (2.6.5 *), (2.6.7 *)

$$\mathrm{n} = \sqrt{\frac{\mathrm{E}}{\mathrm{V}_0 - \mathrm{E}}}, \tag{2.6.17*}$$

then the result from (2.6.16) (leave out calculations) would be $u = n.$ So values s, r should meet the requirement

$$\frac{s}{r} = \frac{k}{\chi} = \sqrt{\frac{E}{V_0 - E}} > 0. \tag{2.6.18}$$

The cases when both values s, r are more and less zero are permitted. Just while meeting the requirements of the last correlation for s, r we can find coefficient A_2 in solution (2.6.12) for the function $\psi_2(x)$.

As far as $|A_1{}^2| = |B_1{}^2| = s^2 + r^2,$ so from (2.6.18) follows that

$$r = \frac{1}{\sqrt{1+n^2}}|A_1|, \quad s = \frac{n}{\sqrt{1+n^2}}|A_1| \tag{2.6.19}$$

or

$$r = -\frac{1}{\sqrt{1+n^2}}|A_{1,}| \quad s = -\frac{n}{\sqrt{1+n^2}}|A_1|. \tag{2.6.19*}$$

From (2.6.15) further follows (leaving out calculations), that

$$A_2 = \pm \frac{2n}{\sqrt{1+n^2}} |A_1| = \pm \frac{n}{\sqrt{1+n^2}} \max|\psi_1(x)|, \qquad (2.6.20)$$

where the signs correspond to the signs of s, r.

Thus in order to make the solution $\psi_2(x)$ in the area II in the form (2.6.12), the values s, r should meet relation (2.6.18) (according to (2.6.8), the coefficients A_1, B_1 are to be expressed through these values).

Considering function $\psi_1(x)$ as real harmonic oscillation expressed by formula (2.6.9), we obtain the same result. In particular, if $\mathrm{tg}(\varphi)$ meets the requirements of correlation (similar to (2.6.18))

$$\mathrm{tg}(\phi) = \frac{\chi}{k} = \sqrt{\frac{V_0 - E}{E}}, \qquad (2.6.21)$$

then we will get the following expression (similar to (2.6.20)) for A_2:

$$A_2 = \pm \frac{1}{\sqrt{1+\mathrm{tg}^2(\phi)}} \max|\psi_1(x)| \qquad (2.6.22)$$

If the requirement (2.6.18) (or equal condition (2.6.21)) was not fulfilled, then it would be impossible to find the coefficient A_2 using the joining condition (2.6.14) of the solutions $\psi_1(x), \psi_2(x)$, i.e. solution $\psi_2(x)$ in the form of (2.6.12) could not exist. That fact may be construed as follows: particle with wave function $\psi_1(x)$ being within the area I cannot penetrate in that case into the barrier (interval II), in other words it cannot tunnel it. Note, that condition (2.6.21) of the barrier tunneling by the particle is the phase restriction for the harmonic wave accompanying particle motion.

So, let assume that the mentioned requirement has been fulfilled; the particle has penetrated inside the barrier with a width and is moving near internal barrier wall. Wave function $\psi_2(x)$ expressed with the formula (2.6.12), is exponentially decaying in module with x growth from zero to a. If $x = a$

$$\psi_2(a) = A_2 e^{-\chi a}, \quad \psi_2'(a) = -\chi e^{-\chi a} \tag{2.6.23}$$

and according to (2.6.20)

$$|\psi_2(a)| = \max|\psi_1(x)| \frac{n}{\sqrt{1+n^2}} e^{-\chi a}. \tag{2.6.24}$$

Let us now analyze function $\psi_3(x)$ - Schroedinger equation solution in interval III ($x > a$). Usually that equation for the function $\psi_3(x)$ within interval III is written in the same form as equation (2.6.5) for function $\psi_1(x)$ within area I:

$$\psi_3'' + k^2 \psi_3 = 0. \tag{2.6.25}$$

Note. Frankly speaking such equation does not correspond to the physical sense of the particle motion process within interval III. The fact is during particle tunneling the barrier it charge is decreasing. The decrease is more tangible the wider the barrier is. That corresponds to exponential decrease of wave function $\psi_2(x)$ in module. So, it would be better to accept another value of particle energy for interval III, $E_1 < E$ and consequently another value of frequency $k_1 < k$. However, it is unclear how this change should be determined. In any case, it is impossible to derive them from Schroedinger equation for intervals I and II. So we cannot exceed equation (2.6.25), but we should remember that this equation describes only an approximate model of the motion.

Let us write the general solution of the equation (2.6.25) in following form:

$$\psi_3(x) = A_3 e^{ik(x-a)} + B_3 e^{-ik(x-a)}, \qquad (2.6.26)$$

where A_3, B_3 - are coefficients to be determined so that functions $\psi_2(x), \psi_3(x)$ meet at the boundary between interval II and III. These conditions are:

$$A_2 e^{-\chi a} = A_3 + B_3, \quad -\chi A_2 e^{-\chi a} = ikA_3 - ikB_3. \qquad (2.6.27)$$

They coincide with correlation (2.6.14), if A_3, B_3 interchanged with A_1, B_1 and $A_2 \exp(-\chi a)$ is exchanged for A_2. These substitution yield two equations in two unknown A_3, B_3, as far as A_2 is already known. We will get the following expressions:

$$A_3 = \frac{1}{2}(1 + i\frac{\chi}{k})A_2 e^{-\chi a}, \quad B_3 = \frac{1}{2}(1 - i\frac{\chi}{k})A_2 e^{-\chi a} \qquad (2.6.28)$$

or

$$A_3 = s_3 + ir_3, \quad B_3 = s_3 - ir_3, \qquad (2.6.29)$$

where

$$s_3 = \frac{1}{2} A_2 e^{-\chi a}, \; r_3 = \frac{1}{2}\frac{\chi}{k} A_2 e^{-\chi a}. \qquad (2.6.29^*)$$

It is important that s_3, r_3 meet the correlation:

$$\frac{s_3}{r_3} = \frac{k}{\chi} = n = \sqrt{\frac{E}{V_0 - E}}, \qquad (2.6.30)$$

in other words – correlation coinciding with (2.6.18) for s_1, r_1. Then we get following formula for $\max|\psi_3(x)|$

$$\max\left|\psi_3(x)\right| = 2\sqrt{s_3^2 + r_3^2} = \left|A_2\right|\sqrt{1+\frac{1}{n^2}}e^{-\chi a}$$

or (taking into account formula (2.6.20) for A_2)

$$\max\left|\psi_3(x)\right| = \max\left|\psi_1(x)\right|e^{-\chi a} \qquad (2.6.31)$$

Function $\psi_3(x)$, in the view (2.6.26) contains both direct and return waves and has the similar structure as function $\psi_1(x)$. We can also represent function $\psi_3(x)$ as harmonic oscillation

$$\psi_3(x) = 2M_3\cos\left[k(x-a)+\phi\right], \qquad (2.6.32)$$

where

$$2M_3 = \max\left|\psi_1(x)\right|e^{-\chi a} \qquad (2.6.32^*)$$

Therefore, particle transmission index D equals

$$D = \frac{\max\left|\psi_3(x)\right|^2}{\max\left|\psi_1(x)\right|^2} = e^{-2\chi a} \qquad (2.6.33)$$

Let us investigate the situation when on the way of the particle motion there is another, second, potential barrier with the same height V_0 and width a_1, distanced from the first barrier at d_1. Then we should construct additional wave functions for the areas IV-inside the second barrier, V-behind the second barrier.

Function $\psi_3(x)$ of the area III is expressed by formulas (2.6.26) or (2.6.32). At the second barrier border $x = a + d_1$ that function equals

$$\psi_3(a+d_1) = A_3e^{ird_1} + B_3e^{-ikd_1}, \qquad (2.6.34)$$

where A_3, B_3 are expressed by the formulas (2.6.28) – (2.6.29).

In the area IV equation for the function $\psi_4(x)$ is to be written in the view similar to (2.6.7) with the same parameter χ, i.e.

$$\psi_4'' - \chi^2\psi = 0, \tag{2.6.35}$$

where

$$\chi^2 = \frac{2m_0}{\hbar^2}(V_0 - E).$$

Let us do the solution of that equation in the view similar to (2.6.12):

$$\psi_4(x) = A_4 e^{-\chi(x-a-d_1)}. \tag{2.6.36}$$

The relations joining conditions $\psi_3(x), \psi_4(x)$ at the point $x = a + d_1$ are similar to (2.6.14), i.e. are following:

$$A_3 e^{ikd_1} + B_3 e^{-ikd_1} = A_4, \quad ikA_3 e^{ikd_1} - ikB_3 e^{-ikd_1} = -\chi A_4. \tag{2.6.37}$$

Using the analysis made before in the case of (2.6.14), we may assert that conditions (2.6.37) are the same, in principle, and it is possible to determine the coefficient A_4 ,if A_3, B_3 satisfy the following requirements. Viz., assume that

$$A_3 e^{ikd_1} = \tilde{s}_3 + i\tilde{r}_3, \quad B_3 e^{-ikd_1} = \tilde{s}_3 - i\tilde{r}_3, \tag{2.6.38}$$

then $\tilde{s}_3, \tilde{r}_3$ should fulfill the following relations analogues to (2.6.18):

$$\frac{\tilde{s}_3}{\tilde{r}_3} = \frac{k}{\chi} = n = \sqrt{\frac{E}{V_0 - E}}. \tag{2.6.39}$$

Values $\tilde{s}_3, \tilde{r}_3$ should be expressed according to (2.6.38) in s_3, r_3 with next formulas:

$$\tilde{s}_3 = s_3 \cos(kd_1) - r_3 \sin(kd_1),\ \tilde{r}_3 = s_3 \sin(kd_1) + r_3 \cos(kd_1). \quad (2.6.40)$$

As far as in accordance with (2.6.30) $\frac{s_3}{r_3} = n,$ relations (2.6.39) will be fulfilled only in the case $\sin(kd_1) = 0,$ i.e. if the distance d_1 between the first and the second barriers is divisible by $\frac{\pi}{k}$:

$$d_1 = j\frac{\pi}{k},\ \ j = 1, 2, 3, \ldots, \quad (2.6.41)$$

where

$$k^2 = \frac{2m_0 E}{\hbar^2}.$$

In other case the particle will not be able to penetrate inside the barrier.

If condition (2.6.41) is met, then the conditions (2.6.37) are simplified:

$$A_3 + B_3 = A_4,\ \ ikA_3 - ikB_3 = -\chi A_4 \quad (2.6.42)$$

or

$$A_3 + B_3 = -A_4,\ \ ikA_3 - ikB_3 = \chi A_4, \quad (2.6.42^*)$$

These equations are totally congruent (second variant – to the sign A_4) in structure with conditions (2.6.14). Values $s_3, r_3,$ A_3, B_3 expressed according to (2.6.29), meet relations (2.6.30), coincident with relation (2.6.18) for $s, r.$ So, conditions (2.6.42) и (2.6.42^*) are compatible, now we derive as it were done above, the following formula for A_4:

$$A_4 = \frac{n}{\sqrt{1+n^2}} \max\left|\psi_3(x)\right| \quad \text{or} \quad A_4 = -\frac{n}{\sqrt{1+n^2}} \max\left|\psi_3(x)\right|. \qquad (2.6.43)$$

Then while examining function $\psi_5(x)$ within interval V and subordinating it to the equation

$$\ddot{\psi}_5 + k^2\psi_5 = 0 \qquad (2.6.44)$$

(with the same frequency k -- see above our note to the equation (2.6.25)), we obtain $\psi_5(x)$ in form:

$$\psi_5(x) = A_5 e^{ik(x-a-d_1-a_1)} + B_5 e^{-ik(x-a-d_1-a_1)} \qquad (2.6.45)$$

or

$$\psi_5(x) = 2M_5 \cos[k(x-a-d_1-a_1)+\varphi], \qquad (2.6.46)$$

where the phase φ remains constant, and for $A_5, B_5 M_5, \max\left|\psi_5(x)\right|$ we got the following formulas:

$$A_5 = \frac{1}{2}(1+i\frac{\chi}{k})A_4 e^{-\chi a_1}, \quad B_5 = \frac{1}{2}(1-i\frac{\chi}{k})A_4 e^{-\chi a_1}, \qquad (2.6.47)$$

$$M_5 = \left|A_5\right| = \left|B_5\right|, \quad \max\left|\psi_5(x)\right| = \max\left|\psi_3(x)\right| e^{-\chi a_1}. \qquad (2.6.48)$$

The barrier transmission index D equals

$$D = \frac{\max\left|\psi_5(x)\right|^2}{\max\left|\psi_1(x)\right|^2} = e^{-2\chi(a+a_1)} \qquad (2.6.49)$$

Thus the probability of tunneling through two equal potential barriers depends on the particle’s initial phase, energy and distance between barriers.

2.7 Passage of Potential Wells

There are happen amazing adventures in the world…

A. S. Griboyedov

In this section we will consider only one-dimensional problems. In classical mechanics the problem of rolling a particle into a finite-depth well is very simple from the physical point of view. Classical solutions of motion equations in the case of a potential well with symmetrical sides correspond to situation when a particle always rolls into the well and then leaves it at the same initial velocity. Moreover, in classical mechanics it is impossible to roll a particle into a well with symmetric sides in such a way that it remains there. It could be true but not for friction.

For the mechanics of a particle with an oscillating charge there are three possible modes of behavior, which, as it was found out, do not depend on the type of the potential well; it must only be finite and have equal sides:

1. A particle at small initial velocity and having certain initial phase can roll into the well and start oscillating there for a long time with damping, it charge will be constantly reduced, and finally this particle turns into "a phantom". From our theory point of view, the wave packet representing this particle is spread all over the Universe. Moreover, there appears to be a certain threshold for the energy. If the energy is below this threshold, the particle will not roll out of the well at all. The value of the energy threshold depends on the type of potential. Oscillations without loss of energy and charge are also possible.

2. A particle can roll into the well and roll out at a speed higher, equal or lower than the initial speed. In other words, a particle passing the well can either

increase or reduce its energy. The energy conservation law for a single particle is not always valid. For details see Section 3.2.

3. A particle rolls into the well and starts oscillating there, and its energy will increase until it rolls out of the well with a much higher energy. It can even roll out in the direction opposite to the initial movement (reflection). Such processes seem to explain multiple experiments made by J. Griggs, Yu. Potapov, T. Misuno, A. Samgin, N. Tesla, R. Tandberg, P. Correa, etc. [60-69], but these phenomena will be discussed in Chapter 3.

The autonomous movement equation in the case of a potential well in the shape of hyperbolic secant [172, 183, 200, 201]

$$U(x) = -U_0 \operatorname{sech}(x^2) \tag{2.7.1}$$

will look like:

$$m\frac{d^2x}{dt^2} + \frac{4U_0 Qx \cos^2\left(mx\frac{dx}{dt} + \phi_0\right)\sinh(x^2)}{\cosh^2(x^2)} = 0 \tag{2.7.2}$$

where t, m, Q, ϕ_0 are mass, charge and initial phase of a particle respectively.

The plots below represent the results of a numerical solution of equation (2.7.2) by the Runge-Kutta-Merson method under following starting conditions:

$$U_0 = 1;\ m=1;\ Q=1;\ x_0 = -1; v_0 = 1/20.$$

The resulting modes of the particle's behavior under equal starting conditions greatly depend on the initial phase, and its variations result in a very rich behavior. Let us demonstrate this fact. A particle with $\phi_0 = 0.1$ is rolling into the well and back (is reflected) with a higher energy (Fig. 2.7.1). Under the same starting conditions and with an initial phase value of φ_0 =0.2 passage of the particle through the well can be observed with nearly the same energy (Fig. 2.7.2.) and increasing oscillations inside the well is observing at φ_0 =3.2 (Fig. 2.7.3), where a particle can accumulate energy (a "Maternity Home" solution, for details see Section 2.8).

Certainly, such a process is not characteristic only in the case of the hyperbolic secant potential. Numerical researches of our problem with other potentials have been made, yielding similar results. (Remark: It was recently found out that hyperbolic secant potential plays a special role in quantum mechanics, and it turned out that barriers of this type are in general non-reflective [70], but for solutions of equation with an oscillating charge all this is not valid.)

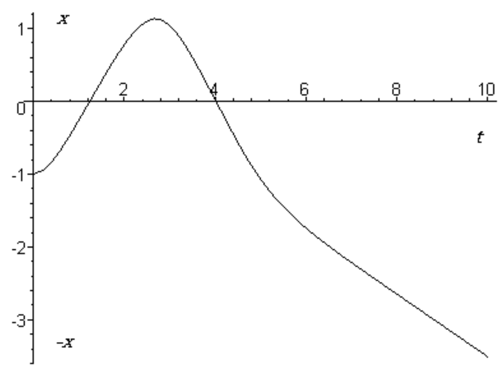


Fig. 2.7.1 *Reflection from potential well with a certain speed increase.*

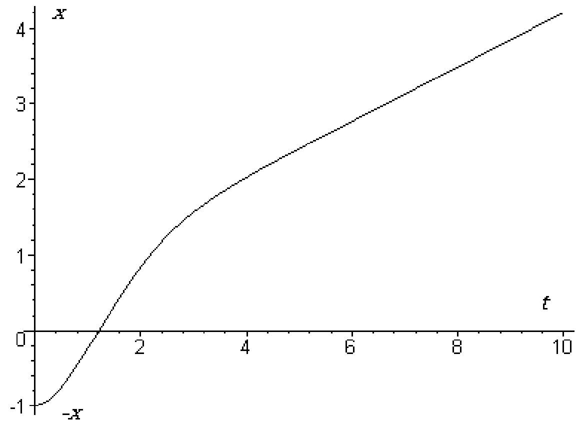


Fig. 2.7.2 *Passage of the well without reflection with a small energy change.*

Let us take as an example a potential of the Gauss bell-curve:

$$U(x) = U_0 \exp\left(-\frac{x^2}{\sigma^2}\right) \quad (2.7.3)$$

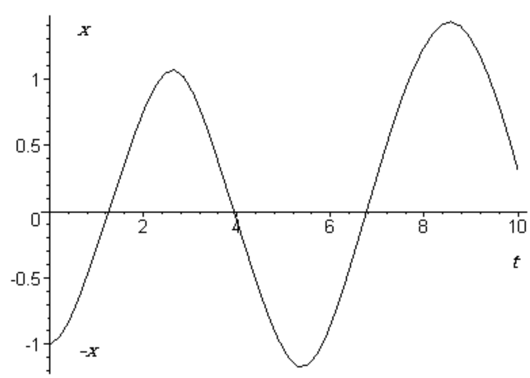


Fig. 2.7.3 *Oscillation in well with energy growth.*

The movement equation is following:

$$\frac{d^2x}{dt^2} + \frac{2Qx \exp\left(-\frac{x^2}{\sigma^2}\right)\cos^2\left(mx\frac{dx}{dt} + \phi_0\right)}{m\sigma^2} = 0$$

where m, Q, ϕ_0 are mass, charge and initial phase respectively. This equation has been solved under starting conditions Q=8, $\sigma = 1$, m=1, $x_0 = 0.1$; $v_0 = 0.5$ and for different initial phases. When initial phase φ_0 =0.1 the particle oscillates, its energy increases and it overcomes the potential barrier, as can be seen in Fig. 2.7.4.

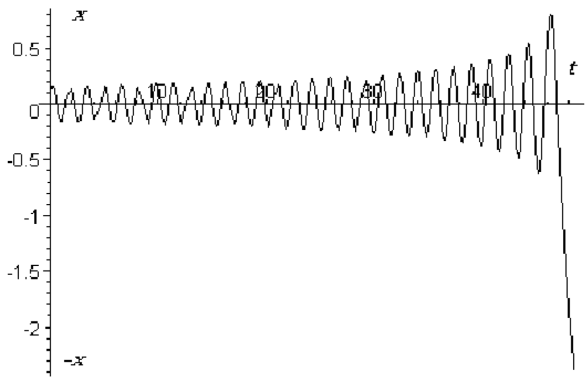


Fig. 2.7.4 *Passage of well with oscillations and energy growth.*

For other starting conditions $x_0 = -4, v_0 = 0.01, \varphi_0$ =2 we get a process where the particle is spread all over the Universe, and not only its energy, but also its charge is reduced, and it turns into a "phantom". Fig. 2.7.5 serves as an illustration.

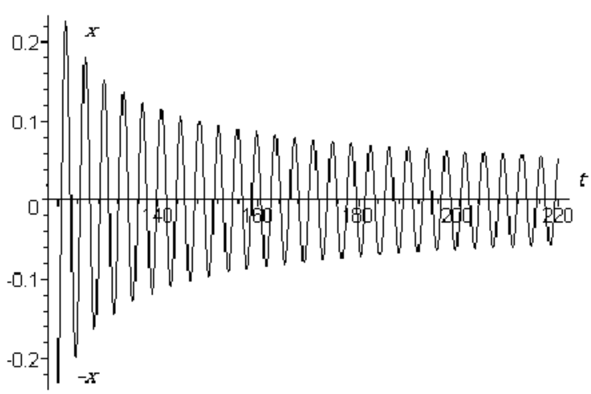


Fig. 2.7.5 *Particle oscillation in well and its gradual disappearance.*

Conditions under which the particle in the well does not disappear, but loses almost all its kinetic energy when leaving the well also exist. Thus, under the following starting conditions and parameters of the particle: m=5, Q=10, $\sigma = 1$, $\phi_0 = 1.57$, $x_0 = -5, v_0 = 0.1$ our simulation yields the result illustrated in Fig. 2.7.6.

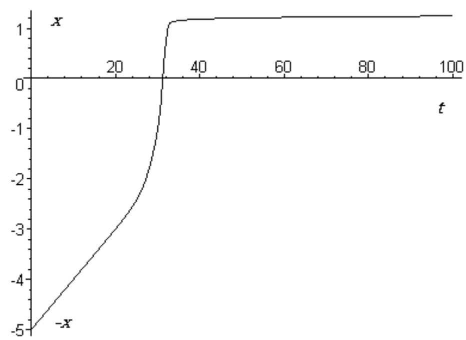


Fig. 2.7.6 *Passage of well with nearly full loss of energy.*

Such processes, however, are observed only in finite-depth wells, i.e. those having a bottom. In wells of the coulomb type or H. Yukawa type these processes do not take place, and no oscillations are observed (this does not mean, however, that they are totally absent there). The particle simply falls to the bottom of the well. In the Coulomb potential the fall happens approximately in accordance with the law:

$$x \sim at^{2/3}$$

Of course, the relativistic effect of mass accumulation will lead to the following relation in the limit:

$$x = ct\ .$$

If non-autonomous equations are used for modeling, the qualitative behavior results will look the same, so we omitted them.

2.8 Harmonics Oscillator

In fact, the chandelier in the Great Cathedral of Pisa was the first harmonic oscillator examined by Galileo Galley.

From newspapers

Let us examine two variants of equations in the scalar case:

$$\ddot{x} = -2qx\cos^2(-x\dot{x}+\phi) \tag{2.8.1}$$

(autonomous equation) and

$$\ddot{x} = -2qx\cos^2(\frac{1}{2}\dot{x}^2 t - x\dot{x}+\phi) \tag{2.8.2}$$

(non-autonomous equation), where q is the constant part of particle's oscillating charge and ϕ is the initial phase, that may be represented as $\phi = \pi/2 + \varepsilon$, where ε - phase deviation from $\pi/2$. As far as cosine is squared, it is quite enough to examine different values of ϕ and ε within intervals from 0 to π or from $-\pi/2$ to $\pi/2$.

The character of the particle motion to be described by these equations essentially depends just on ε. So we substitute equations (2.8.1), (2.8.2) for the following:

$$\ddot{x} = -2qx\sin^2(-x\dot{x}+\varepsilon), \tag{2.8.1*}$$

$$\ddot{x} = -2qx\sin^2(\frac{1}{2}\dot{x}^2 t - x\dot{x}+\varepsilon). \tag{2.8.2*}$$

The numerical integration of these equations yielded four types of solutions:

1. damped oscillations with amplitude, tending to zero; meanwhile particles sometimes assume a “phantom” state; in that case their wave packets are spread all over Universe;

2. irregular oscillations, remaining constant over a long period of time, thus yielding a quasi-stable situation;

3. oscillations with monotone increasing amplitude. In some cases these oscillations may abruptly enter a trajectory towards infinity; meanwhile cosine argument and the particle’s charge approach zero. It may be said that in that case the particle abruptly assumes a “phantom” state;

4. the particle almost immediately enters an escape trajectory and rapidly approaches the “phantom” state without any preliminary oscillations (it can be said without “preliminary doubts”).

In summary, only four variants of particle motion are possible: energy increase or decrease, stable and with vanishing particle (transformation into the “phantom” state).

Now we will consider only one-dimensional problems. In classical mechanics the problem of rolling a particle into a finite-depth well is very simple from the physical point of view. Classical solutions of motion equations in the case of a potential well with symmetrical sides correspond to situation when a particle always rolls into the well and then leaves it at the same initial velocity. Moreover, in classical mechanics it is impossible to roll a particle into a well with symmetric sides in such a way that it remains there. If not for friction this would be true.

There are allowed in the mechanics of a particle described by the equation with an oscillating charge solution with very different properties, i.e. allowed very different possible modes of particle’s behavior which greatly depend on the value of initial phase in corresponding equations. There are very interesting from the standpoint of our UQT following modes of particle's behavior.

1. A particle can roll into the well and roll out (after certain period of oscillations ore without oscillations) with higher (even much higher) velocity and energy than initial velocity and energy. We call the corresponding solutions as "Maternity home solutions" because the well takes in such case the part of "Maternity Home", where are restored in essence to life new particles. The existence of such solutions seems to explain theoretically multiple experiments (Y. S. Potapov, 1993, 1998, A. Samgin, A. Baraboshkin et al., 1994, A. Samgin, 1995, T. Mizuno, M. Enio, T. Akimoto, K. Azumi, 1994, A. Patterson, 1996, C. Tinsley, 1995, J. Griggs, 1994, M. Huffman, 1995 and last Andrea Rossi.

2. A particle can roll out (after or without oscillations) or can remain to oscillate inside the well with much decreasing velocity and energy tending to zero. The corresponding solutions we call as "Crematorium solutions". Such particles turn out into "phantom" and wave packets representing such particles are spread over the Universe.

3. A particle can also preserve stationary oscillations with constant amplitude of classical type inside the well.

The plots below (Fig. 2.8.1 - Fig. 2.8.7) illustrate these modes of particle's behavior. These plots have been obtained after numerical integration of the autonomous equation

$$m\frac{d^2x}{dt^2}+\frac{4U_0Qx\cos^2\left(mx\frac{dx}{dt}+\phi_0\right)\sinh\left(x^2\right)}{\cosh^2\left(x^2\right)}=0 \qquad (2.8.3)$$

in the case of the potential well in the shape of hyperbolic secant

$$U(x) = -U_0 \operatorname{sech}(x^2) \tag{2.8.4}$$

where m, Q, φ_0 are mass, charge and initial phase of a particle respectively.

Numerical solutions in all six cases were obtained under following values of m, Q, φ_0 and initial data:

$$m=1,\ Q=1,\ U_0 = 1, x_0 = -0.5, \dot{x}_0 = 1/20$$

The trajectories on Fig. 2.8.2, Fig. 2.8.4, Fig. 2.8.5 represent the "Maternity Home" solutions. Velocity of particles after they rolled out the well are at t=0, $\dot{x}(0)\sim$ 0.9, i.e. almost 20 times greater than initial $\dot{x} =$ 1/20.

The trajectory on Fig. 2.8.2 represents also the "Maternity Home" solution although the increase of velocity is not so essential: $\dot{x(0)}$ =0.094 at t=100 only nearly two times more.

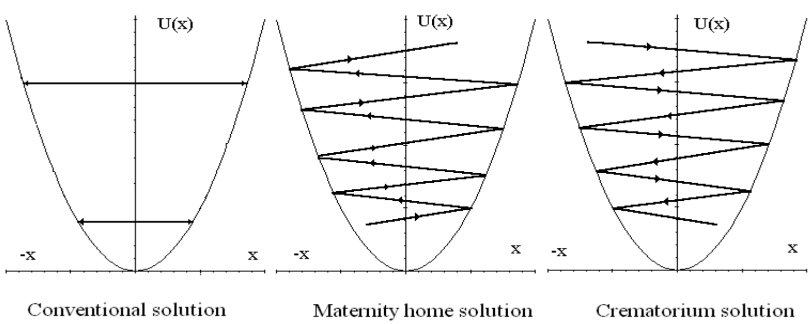


Fig. 2.8.1 *Possible solutions for the harmonic oscillator.*

The trajectories on Fig. 2.8.3, Fig. 2.8.6 represent the "Crematorium" solutions. The first $\dot{x(0)}$ particle leaves the well and moves away with monotonously decreasing velocity and spread out over all Universe. The second particle is oscillating inside the well with slowly decreasing and tending to zero velocity.

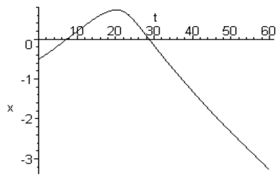


Fig. 2.8.2 *"Maternity home" solution.*

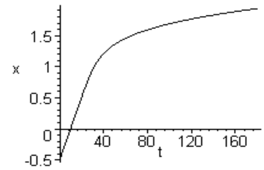


Fig. 2.8.3 *"Maternity home" solution.*

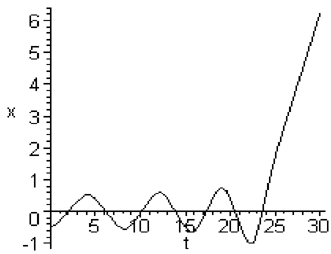


Fig. 2.8.4 *"Maternity home" solution.*

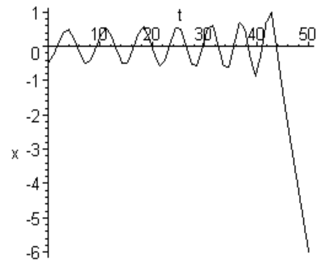


Fig. 2.8.5 *"Maternity home" solution.*

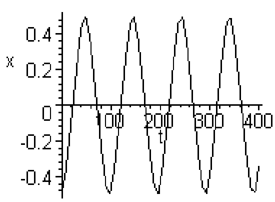


Fig. 2.8.6 *Classical-stable solution.*

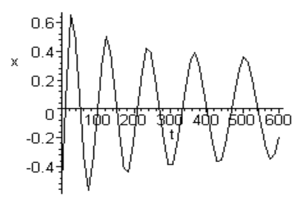


Fig. 2.8.7 *"Crematorium" solution.*

These solutions have been reported for the first time by one of the authors at the conference ICCF5 taking place in Monte-Carlo [83] and published in [55-57, 82-86, 104, 123-125], and called: «Maternity Home», «Crematorium», stable and "Ghostly". The first three solutions correspond, in general, to Fig. 2.8.1. The solution passing into "Phantom" or "Ghostly" state has analogous to solutions of Shroedinger's equation containing Hermite functions, because the exponential "tails" of the wave function exist always out of parabolic well.

Such solutions become possible only because the Energy Conservation Law for the case under consideration does not work for such motion equations that result in deep sequence, more detailed examination of which will be done in parts 3.2, 3.3 and 3.4.

2.9 Kepler Problem

In 50es N. Bohr recollected with smile the event when after one of the lecturesthe student asked him: "Were there in reality such morons to think that electronrotating by orbit?"

Let us examine the motion of the particle with oscillating charge (its constant part is equal to q) around attractive (according to Coulomb law) fixed central nucleus with the charge (of opposite sign) q_0 [172, 183, 200, 201]. The motion of such particle is flat due to area integral existence, so we may examine the motion equations on the plane OXY. For the autonomous model these equations are following:

$$\ddot{x} = -\frac{2\mu x}{r^3}\cos^2(-x\dot{x} - y\dot{y} + \phi), \ddot{y} = -\frac{2\mu y}{r^3}\cos^2(-x\dot{x} - y\dot{y} + \phi), \qquad (2.9.1)$$

where phase φ varies within the interval $[0, \pi)$ and μ depends on q and q_0.

For the particle motion process examining we consider expediential to change coordinates for polar r (radius-vector), s (azimuth) and handle the equation relative to polar inverse distance u = 1/r. The equation relative to u has the following view:

$$u'' + u = \frac{\mu}{c^2}, \quad (') = d/ds, \qquad (2.9.2)$$

and u, u', integral constants are connected with $x, y, \dot{x}, \dot{y}$ by the following formulas of celestial mechanics:

$$x\dot{y} - y\dot{x} = c, x\dot{x} + y\dot{y} = -c\frac{u'}{u}, \dot{s} = cu^2. \qquad (2.9.3)$$

Within our theory the equation with oscillating charge relative to u has the following view:

$$u'' + u = \frac{2\mu}{c^2}\cos^2(c\frac{u'}{u} + \phi) \qquad (2.9.4)$$

As it is known the equation (2.9.2) has stationary solutions u=Const., corresponding to stationary motion in a circle orbit, as well as solutions $u = u(t)$ corresponds to motion (also stationary) along elliptic orbits. Each of these motions is orbital stable. Small change of initial conditions corresponds, with rare exception, to small changes of the orbit value. The solutions of the equation (2.9.2) can be represented in simple analytical form. Our equation (2.9.4) describes much more complicated motions and representation of its solution in analytical form is scarcely possible. But it is quite interesting that this equation also has stationary solution $u = Const.$ corresponding to motions in a circle orbit, namely,

$$u = u_0 = \frac{2\mu}{c^2}\cos^2\varphi. \qquad (2.9.5)$$

Each initial phase φ answers its own circle orbit. Besides, we are able to examine the stability of this solution with the help of so-called variation equation. If we set

$$\mu / c^2 = a$$

and

$$u = u_0 + w,$$

then the variation equation (in respect to w) has the following view

$$w'' + a\frac{2c}{u_0}\sin(2\phi)w' + w = 0. \qquad (2.9.6)$$

From that equation it is obvious that for $\sin(2\varphi) > 0$, i.e. for $0 < \varphi < \pi/2$. the solution $u = u_0$ is stable, and for $\sin(2\varphi) < 0$, i.e. for $\pi/2 < \varphi < \pi$ is unstable. For $\varphi = 0$ и $\varphi = \pi/2$ variation equation results in nothing (does not have any result). But at $\varphi = \pi/2$ we have $u_0 = 0$ (according to (2.9.5) and $r_0 = \frac{1}{u_0} = \infty$, i.e. for $\varphi \to \pi/2$ the circle orbit radius tends to infinity.

Such results are confirmed by the plots calculated with the help of numerical integration of equation (2.9.4). We have assumed that in (2.9.4) $\mu = 0.5$ and at the initial moment t = 0 the particle is placed on the right side of the center (s = 0) at the distance $r_0 = 1$ and had the velocity $v_0 = 1$, upward polar axis. If using coordinates x, y, then their initial values are follows:

$$x(0) = 1, y(0) = 0, \dot{x}(0) = 0, \dot{y}(0) = 1.$$

Using formulas (2.9.3), we will get the initial values for u, u' and the value of the area constant c:

$$u(0) = 1, u'(0) = 0, c = 1.$$

We have numerically integrated the equation (2.9.4) under that initial data and different values of the phase φ. In Fig. 2.9.1, …, 2.9.5 there are plots for r as s function at $\varphi = 0, 0.1, \pi/3, \pi/2, 1.8$, constructed not within the polar coordinates but within rectangular one, where abscissa axis corresponds to s, and ordinate axis corresponds to r.

First plot (for $\varphi = 0$) shows that apparently stationary solution at terms that φ is stable. The next four plots replay to our conclusions about stability and instability of stationary solutions. Elliptical stationary solutions have not been found yet, however that does not mean they are not exist at all.

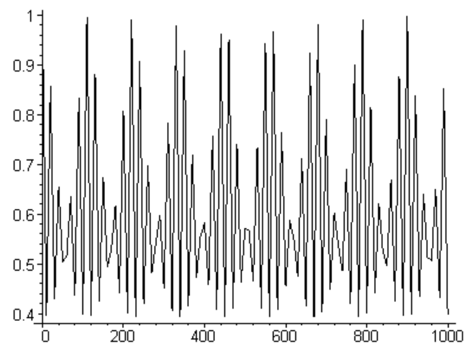


Fig. 2.9.1 $\varphi = 0$.

Within the non-autonomous model the motion equations differ from the equation (2.9.1) in terms $\frac{1}{2}t(\dot{x}^2 + \dot{y}^2)$ added to argument $-x\dot{x} - y\dot{y} + \varphi$ of cosine.

We have made a lot of numerical integration of these equations under numerous initial conditions and initial phases. In general the obtained solutions are close by its character to solutions of autonomous equations, but we were not lucky to find stationary solutions. The same problem has been studied in part 1.3 above.

It is well know that Bohr-Sommerfield model perfectly describes the hydrogen atom spectrum. In one very serious book regarding that problem (we are specially do not mention in which exactly) it is written that this fact is “a result of conflicting concept and spin absence compensating each other (!!!)”.

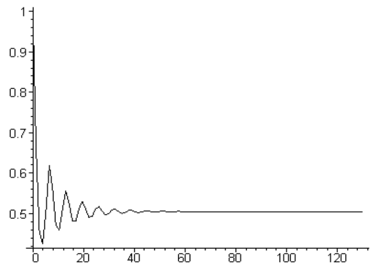


Fig. 2.9.2 $\phi = 0.1$

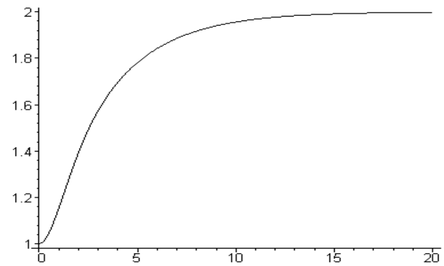


Fig. 2.9.3 $\phi = \pi/3$

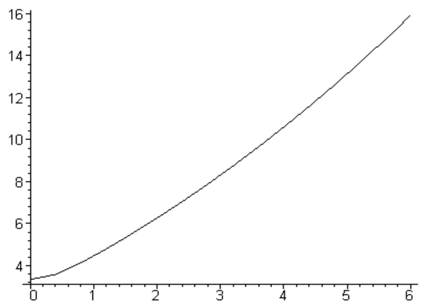


Fig. 2.9.4 $\phi = \pi/2$

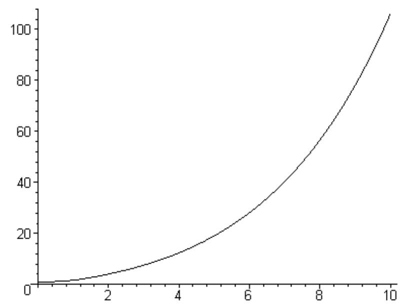


Fig. 2.9.5 $\phi = 1.8$

2.10 Kepler Problem (Scattering of Particle on Coulomb Potential)

What were, that will be, what were done, that will be done; there is nothing new under the sun. There is something speaking about "look that is new"; but that was already in the ages before us. There is no memory of the former, and those who will be after us will not keep memory.

Ecclesiast, 9, 10, 11

The study of the process of the particles scattering is the main method of the elementary particles physics study. Rutherford was the first who applied such analysis and discovered the existence of heavy nucleus in the atoms. By using common Coulomb's law and Kepler equation he derived formula for the dependence of the scattering angle from the sighting distance and speed of a flying particle:

$$tg\left(\frac{\theta}{2}\right) = \frac{zZe^2}{mv^2b} \tag{2.10.1}$$

The same correlation was obtained in Quantum theory. Experiments made by Rutherford confirmed the validity of this scattering formula, and he was very proud of this because formula was derived on the basis of classical points without any quantum theory ideas.

It should be noted that Coulomb potential had been already known from the other independent experiments, and the scattering problem became leading in the process of interaction potential determining. But in spite of the numerous measuring of the hadrons scattering processes the potential of the strong interaction has not been rendered yet. This is not simply by coincidence, because the modern quantum theory couldn't compute either electron charge or elementary particles masses while it is possible with UQT [1-15].

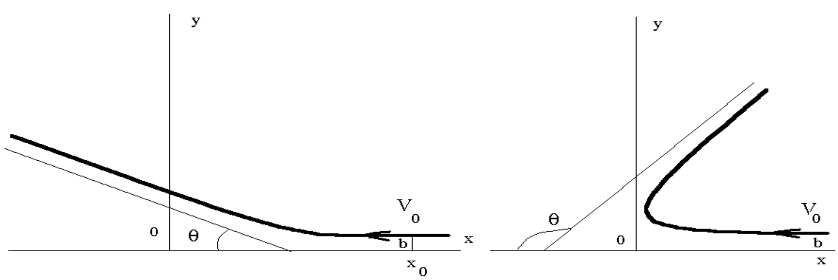


Fig. 2.10.1 *Particle Path after Scattering.*

Moreover no low-energy nuclear reactions are possible in standard quantum theory even they have been confirmed by experiments long ago [16]. The phenomenon of chemical catalysis well explained in UQT [17] is also incomprehensible. The proper solution of the problem of a wave packet scattering at another wave packet is a too distant future due to nonlinear nature, today we cannot even imagine how we can come to grips with the strong settings of this problem. Below we are going to solve the classical problem of scattering of the particles at Coulomb and short-range potentials for the oscillating charge equation, that is by the authors opinion is more adequate.

First of all we should demonstrate that application of the equation with oscillating charge does not conflict with the formula (1). Equation with oscillating charge may be written in both autonomous and non-autonomous forms. The properties of such equations are discussed in details in [172, 183, 200, 201]. Further we are going to discuss the solution for autonomous equations as far as solution of the problem of scattering for the non-autonomous equation has similar results but more intricate. Autonomous equation with oscillating charge for arbitrary potential has the following form [195]:

$$m\frac{d^2\boldsymbol{r}}{dt^2} = 2Q\,gradU(\boldsymbol{r})cos^2(-m\frac{dr}{dt}\mathrm{r}+\varphi) \tag{2.10.2}$$

$$\frac{d^2x}{dt^2} = 2Q\frac{x}{r^3}cos^2(-x\frac{dx}{dt} - y\frac{dy}{dt} + \varphi);$$

$$\frac{d^2y}{dt^2} = 2Q\frac{y}{r^3}cos^2(-x\frac{dx}{dt} - y\frac{dy}{dt} + \varphi) \tag{2.10.3}$$

where $r = \sqrt{x^2 + y^2}$.

The same equations can we written for the classical charge:

$$\frac{d^2x}{dt^2} = Q\frac{x}{r^3};\ \frac{d^2y}{dt^2} = Q\frac{y}{r^3} \tag{2.10.4}$$

The systems 2.10.3 and 2.10.4 were numerically solved for similar initial terms:

$$Vx_0 = 5, x_0 = -1000, b = 0 \div 1, \varphi = 0 \div \pi, Vy_0 = 0,\ \Delta T = 1000,$$

number of particles N=10000. Each calculation is made for randomly chosen initial phase and sighting distance. The Fig. 2.10.2 and Fig. 2.10.4 show the dependence of the number of scattered particles on the scattering angle and they are practically coincident. The Fig. 2.10.3 and Fig. 2.10.5 demonstrate the dependence of $btg\frac{\theta}{2}$ for 500 randomly chosen particles; it should be constant for the solution of equations 2.10.3 and 2.10.4. As we can see from the diagrams this condition is fulfilled. But it’s quite amazing as for the equation 2.10.4 the deviation angle θ depends on the sighting distance and the energy only, while for the solution of the equation 2.10.3 the angle θ depends on the initial phase also. The coincidence appears because the Coulomb potential varies very slowly. Thus the scattering at the Coulomb potential is correctly described by the equation with the oscillating charge.

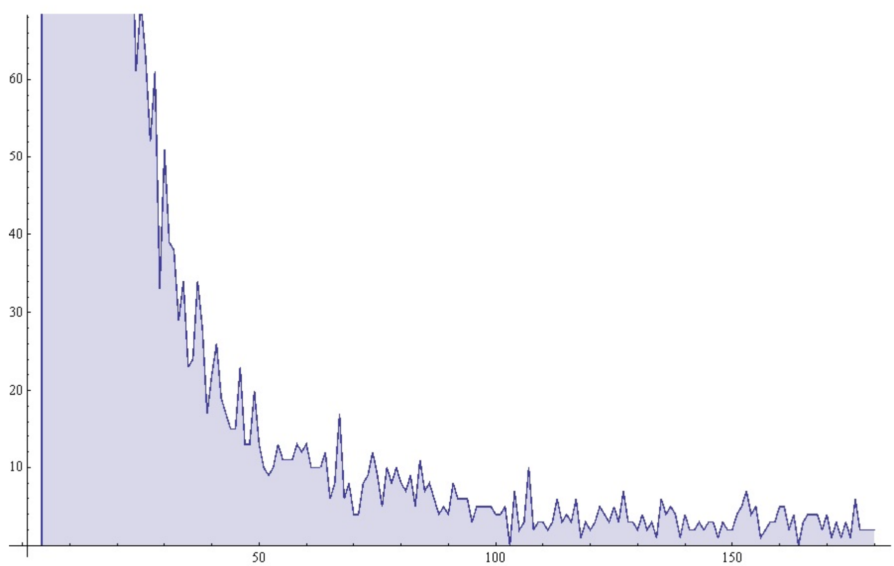


Fig. 2.10.2 *Dependence of Scattered Particles Number from the Angle for the Equations (2.10.3).*

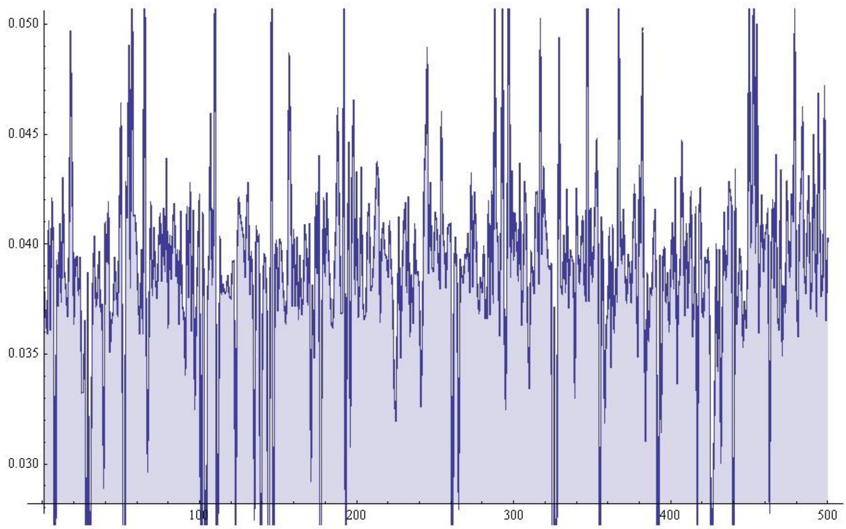


Fig. 2.10.3 *Value* $btg\left(\frac{\theta}{2}\right) \sim \frac{1}{v^2}$ *for the Equation (2.10.3) for 500 Random Particles.*

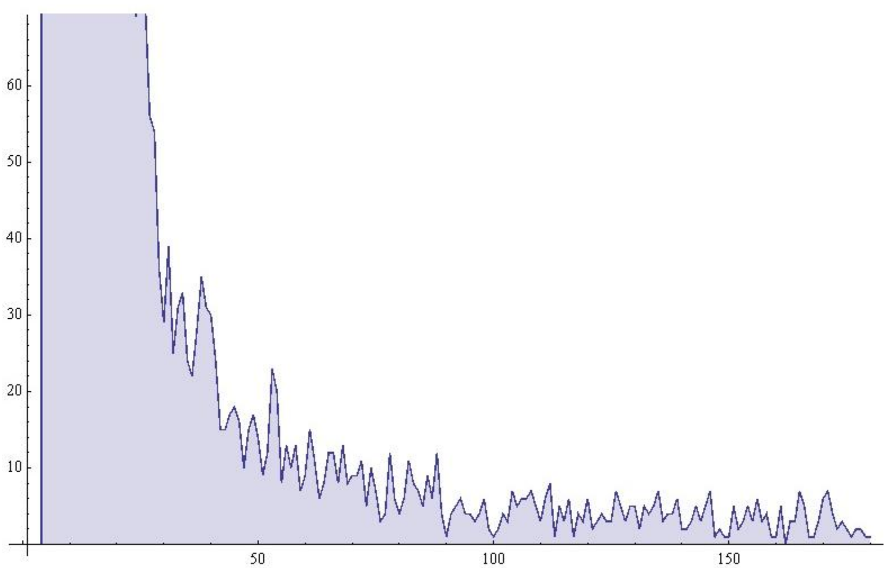


Fig. 2.10.4 *Dependence of the Scattered Particles Number from the Angle for the Equations (2.10.4).*

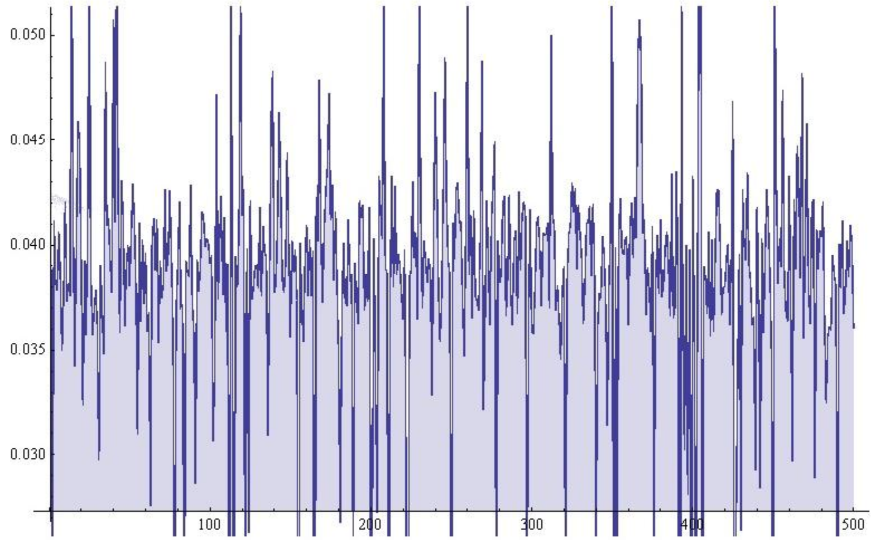


Fig. 2.10.5 *Value* $\boldsymbol{btg}\left(\frac{\theta}{2}\right) \sim \frac{1}{v^2}$ *for the Equation (2.10.4) for 500 Random Particles.*

2.11 Scattering of Particles on Short-Range Potential (Potentials of Yukawa Type)

"I recollect our discussions with Bohr. At the end of one of them I walked in the nearest park and asked myself once and again the same question: whether it is possible the nature being so absurd as we fancy in our atomic experiments".

Werner Heisenberg

Usual scattering of particles on Coulomb potential at different angles corresponds to monotonic dependence on particle's velocity. However, if potential is short-range (for example like Yukawa one), then the scattering maximums appear in different angles and scattering now has resonance character. The first deeply studied phenomenon of such a type was Ramsauer-Townsend effect. At the first years of quantum theory development that phenomenon attracted everybody interest. There was experimentally detected the abnormal large-scale penetration of gas molecules or atoms for low-velocity electrons. In more general sense there was discovered non-monotonic dependence of effective cross- section of low-velocity electrons scattering on their velocity. Such dependence was at deep contradiction with classical idea, because according to it scattering monotonically decreased with electron velocity growth. But it were appeared for Ar, Kr, Xe that with the energy growth the effective cross-section of scattering run up to its maximum near 12 eV and then smoothly decreased. Deep minimum of full efficient section was in the area of energies of range 0.7 eV. Later the same effect had been proved within researches of electron mobility in gas. The length of electron free path was calculated on the basis of measuring. This length with velocity growth from $4 \cdot 10^{7}$ up to sm./sec decreased abruptly.

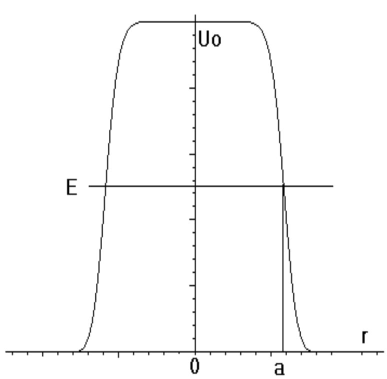


Fig. 2.11.1 *Short-range potential.*

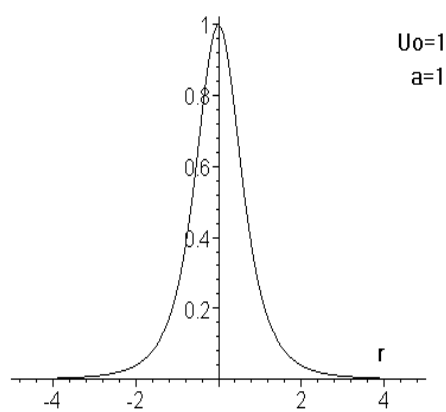


Fig. 2.11.2 *Polynomial potential.*

Let have a look at that effect from the viewpoint of standard quantum theory. Assume that scattering takes place on arbitrary steeply dropping potential with strong repulsive core. In Fig. 2.11.1 values U_0 and a are barrier height and width correspondingly, and the energy of the approaching particle $E << U_0$. At potential boundary we have $\Psi(a) = 0$. In the spherically symmetric case at r>a the wave function Ψ of the particle will be written as sum of incident and divergent spherical wave:

$$\Psi = \exp(ikz) + f(\theta)\frac{\exp(ikr)}{r}$$

where $f(\theta)$ is the scattering amplitude. Usual flat wave contains spherically symmetric part that results from its expansion in polynomials of Legendre:

$$\exp(ikz) = \exp(ikr\cos(\theta)) = \sum_{l=0}^{\infty} f_l P_l(\cos(\theta)).$$

Then

$$f_0 = \frac{1}{2}\int_0^{\pi} \exp(ikr\cos(\theta))\sin(\theta)d\theta = \frac{\sin(kr)}{kr}$$

and

$$\int \Psi \frac{d\Omega}{4\pi}\bigg|_{r>a} = \frac{\sin(kr)}{kr} + \frac{f}{r}\exp(ikr)$$

By using boundary condition $\Psi(a) = 0$, we obtain:

$$\frac{\sin(ka)}{k} + f\exp(ika) = 0$$

Now we can write f in the form of

$$f = -\frac{\sin(ka)}{k}\exp(-ika).$$

At energies of the particle to be equal $E = \frac{\hbar^2 \pi^2}{2a^2} n$, and if n is an integer, then the resonance effect is evident. In these cases the cross-section of scattering s equals zero. But in the case of repulsive potential the effect relaxes by participation of waves with $l \neq 0$ in the processes of scattering at $ka > 1$ and so full cross-section differs from zero. The biggest cross-section is obtained provided $ka = (2n+1)\frac{\pi}{2}$, $\sigma = 4\pi\hbar^2$ and at small values of k (ka<<1), the cross-section is equal to $\sigma = 4\pi a^2$. The similar resonance phenomena are well known in optics – enlightenment of lenses for optical devices. For that the surface of the lens is covered with the special film of such a thickness and the index of refraction to obtain such a difference in phases of waves reflected from film and glass that the waves are able to suppress each other. In that case the reflected wave does not exist at all. That effect is similar to full transparency of one-dimensional barrier at definite energies considered in sect. 2.6 above.

In general, the mathematical modeling of considered processes with the help of the equations with oscillated charge has confirmed the existence of the phenomena said above. It remains valid for the equations with oscillating charge too. Since the use of potentials containing exponents (for example, of the Yukawa or Gauss potentials) have led to computational difficulties because of their rapid grow and possible overflowing with further stopping of calculations, we have used the following spherically symmetric polynomial potential (see Fig 2.11.2):

$$U(r) = \frac{U_0}{\left(1 + \left(\frac{r}{a}\right)^2\right)^2},$$

Assume that the immovable source of scattering potential $U(r)$ is time-constant and is placed at the origin of fixed coordinate system OXY. Then the non-autonomous system of equations with oscillating charge describing the particles' motion on coordinate plane OXY has the form [195]:

$$m\frac{d^2x}{dt^2}=\frac{8QU_0a^4x}{\left(a^2+x^2+y^2\right)^3}\cos^2\left(\frac{mt}{2\hbar}\left(\left(\frac{dx}{dt}\right)^2+\left(\frac{dy}{dt}\right)^2\right)-\frac{m}{\hbar}\left(x\frac{dx}{dt}+y\frac{dy}{dt}\right)+\varphi_0\right),$$

$$m\frac{d^2y}{dt^2}=\frac{8QU_0a^4y}{\left(a^2+x^2+y^2\right)^3}\cos^2\left(\frac{mt}{2\hbar}\left(\left(\frac{dx}{dt}\right)^2+\left(\frac{dy}{dt}\right)^2\right)-\frac{m}{\hbar}\left(x\frac{dx}{dt}+y\frac{dy}{dt}\right)+\varphi_0\right),$$

where m, Q are mass and charge's constant part of particle. In non-autonomous case the first term of cosine argument is absent. We have put, for the sake of simplicity, $Q=m=a=\hbar=1,\ U_0=5$, and these equations were solved numerically by Runge-Kutta-Fehlberg method under initial values $x(0)=100,\ \dot{x}(0)=0$, different initial $y(0)\in(0,6)$ (sighting distances), and different initial velocities $v_0=\dot{y}(0)=0.25,\ 0.5,\ 1,\ 2,\ 4.$ Calculations were stopped when the values of $|x|$ or y for outgoing particle reached 100 and the scattering angle was computed by formula $\theta=\mathrm{arctg}(\frac{\dot{y}}{\dot{x}})$ if $\dot{x}>0$ or $\theta=\pi-\mathrm{arctg}(\frac{\dot{y}}{\dot{x}})$ if $\dot{x}<0$. We have derived five curves (Fig. 2.11.3 – 2.11.7) expressing the relations between the scattering angle θ and the quantity N of particles having given θ. Each of these curves is based on 10000 trajectories corresponding to random, uniformly distributed initial phases with range $0-\pi$, to sighting distances in interval (0, 6), and to different above mentioned initial velocities. At some of them we can clearly see the influence of resonance effects.

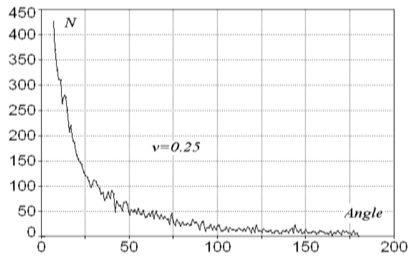


Fig. 2.11.3 *The scattering angle θ and the quantity N of particles for velocity v=0.25.*

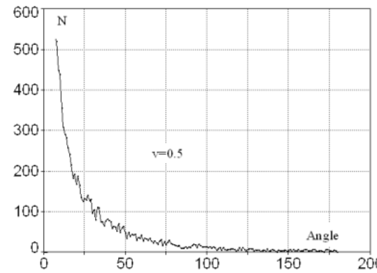


Fig. 2.11.4 *The scattering angle θ and the quantity N of particles for velocity v=0.5.*

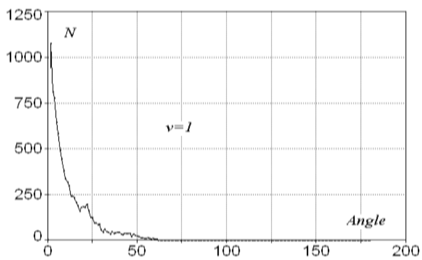


Fig. 2.11.5 *The scattering angle θ and the quantity N of particles for velocity v=1.*

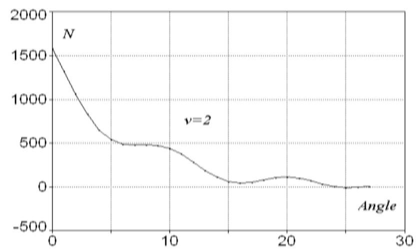


Fig. 2.11.6 *The scattering angle θ and the quantity N of particles for velocity v=2.*

The obtained curves allow to affirm that at small energies the character of scattering starting from angles about 50 degrees does not depends almost on angle (almost isotropic scattering), but in the area of small angles differential cross-section is distinctly anisotropic. One can see that with the increase of energy the scattering is manifested in the areas of more and more reducing angles. Rather crude estimation of these angles can be obtained from the following considerations: in the case of interaction of the fast particle, for example, of nucleon having kinetic energy T>>U, with other nucleon its impulse is able to change at value not more then ΔP, related with well depth U as follows:

$$\frac{\Delta P^2}{2m} = U$$

Now we can obtain the scattering angle θ :

$$\theta \approx \frac{\Delta P}{P} = \sqrt{\frac{2mU}{2mT}} = \sqrt{\frac{U}{T}} = \sqrt{\frac{25}{400}} = 0.25 \approx 15^{\circ} \qquad (2.11.1)$$

That consideration should not be taken as inconsistency because all violations of conservation law should take place at very small energies.

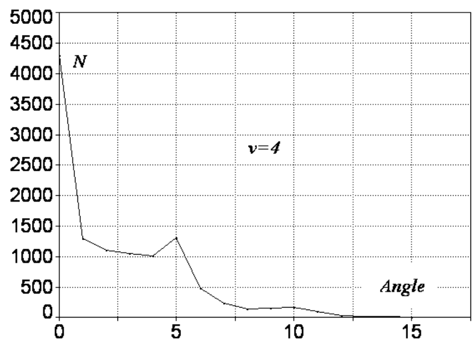


Fig. 2.11.7 *The scattering angle θ and the quantity N of particles for velocity v=4.*

It can be easily seen from the relation (2.11.1) that the scattering angle is inversely proportional to velocity. We can easily get the same result at the obtained numeric data.

The processes with looking like diffraction scattering begin with the growth of energy. In general theory of diffraction scattering it is studied the scattering on opaque or gray disk or sphere. According to Babine principle, diffraction pattern caused by disk (potential barrier) coincides with diffraction pattern caused by screen with whole (potential well)) to be equal in dimensions to the disk. It is astonishing but potential sign inversion (change of barrier for the potential well) does not practically influence curves of differential cross-section, although it cannot be considered as strict mathematical fact because equations are nonlinear.

In Fraunhofer approximation the amplitude of scattering and curve of differential effective cross-section (diffraction was studied on black disk with R_0 radius) are described by Bessel functions:

$$f(\theta) = ikR_0^2 \frac{J_1(kR_0\theta)}{kR_0\theta}$$

$$\frac{d\sigma}{d\Omega} = \left(kR_0^2\right)^2 \left(\frac{J_1(z)}{z}\right)^2, \qquad (2.11.2)$$

where $z = kR_0\theta$. The first null of the function $J_1(z)$ arise at value z=3.84. Then the first minimum of diffraction pattern appears at

$$\theta_{min} = \frac{3.84}{kR_0} = 0.61\frac{\lambda}{R_0} = 0.61\frac{h}{mvR_0}$$

The location of the first minimum at scattering curve is inversely proportional to velocity v.

Classical approach has one more specific feature. Viz., as far

$$\lim_{z\to 0}[J(z)] = \frac{z}{2},$$

differential effective cross-section of elastic scattering forward will be following

$$\frac{d\sigma(\theta^0)}{d\Omega} = \frac{1}{4}k^2R_0^4 \qquad (2.11.3)$$

It may be seen that with tending of falling particle energy to infinity the differential cross section of scattering in direction of the angle θ^0 increases as k^2.

But till now it is the viewpoint of classical waves physics only. In physics of elementary particles the same conclusions will be written in more usual form. In system with origin in mass center of bumping particles the transmitted momentum q at small angles of elastic scattering is written in the form:

$$|\mathbf{q}| = 2\hbar k \sin\left(\frac{\theta}{2}\right) \approx \hbar k\theta$$

In standard symbols

$$-t \equiv q^2$$

Then

$$-dt = 2\hbar^2 k^2 \theta d\theta$$

Equation (2.11.2) can be rewritten

$$\frac{d\sigma}{dt} = -\frac{\pi}{\hbar^2 k^2}\frac{d\sigma}{d\Omega} = \frac{\pi R_0^4}{\hbar^2}\frac{J_1^2\left(\sqrt{-\frac{tR_0^2}{\hbar^2}}\right)}{\frac{tR_0^2}{\hbar^2}}$$

And then equation (2.11.3) can be rewritten in the form:

$$\frac{d\sigma}{dt}(t=0) = -\frac{\pi}{4\hbar^2}R_0^4$$

So, $\frac{d\sigma}{dt}$ depends on t, i.e. on square of transmitted momentum only, but not on the energy of incident particle, and at t=0 it does not depend on momentum at all.

Astonishing is the fact of approximate coincidence of the first minimum of the scattering curve offsets depending on velocity. Thus at curve in Fig. 2.11.5 the first minimum arises at 16 degree. At Fig. 2.11.6 first minimum is near 8 degree that answers two times changing of the velocity. The more impressive comparison gives Fig. 2.11.6 and Fig. 2.11.7, where minimums' and maximums' offsets submit to equation (2.12.2) and detect regularity that scattering angle is inversely proportional to velocity. We should admit that we have not expected such results at all because of the current opinion that diffraction scattering can be seen only in the cases when strong inelastic interaction presents and scattering particles wave length is small in comparison with radius of interaction (neutrons scattering on nuclei and pions scattering on nucleons). We should note that in accordance with the strict Unitary Quantum Theory the division of scattering processes into elastic and inelastic ones is a kind of idealization. That conclusion can be also extended at equations with oscillating charge. More over the most amazing is the fact of discovery of wave character of the mention process described by non-linear equations.

It was carried out also the modeling of particles' scattering on some others potentials of Yukawa or Gauss types and the general pattern of the processes were the same. The only difference was the more sharp appearance of resonance peaks at higher energies.

We have carried out the same calculations in the case of the autonomous equations. The results are practically congruent with the above-mentioned ones. We are not going to analyze large quantity of experimental data dealing with differential cross-sections of various scattering processes. It is a problem for future. That is why we even have not integrated the differential cross-sections to get the full picture.

The approach examined can be easily extended to the scattering caused by object consisting of few connected particles (Glauber approximation).

In general there is nothing strange or new in such pictures of scattering.

In unitary quantum theory mass spectrum of numerous elementary particles were obtained [162, 181]. It appeared that in terms of mass density any particle can be presented as a bubble parted by spherical harmonic. For simplicity the heaviest Dzhan particle can be presented as a potential Fig. 2.11.8 [195]:

$$U(r) = r^2 e^{-r^2}$$

Our system of equations would look like:

$$\frac{d^2x}{dt^2} = 2Q\frac{(1-x^2-y^2)x}{e^{x^2+y^2}}cos^2\left(-x\frac{dx}{dt} - y\frac{dy}{dt} + \varphi\right) \tag{2.11.4}$$

$$\frac{d^2y}{dt^2} = 2Q\frac{(1-x^2-y^2)y}{e^{x^2+y^2}}cos^2\left(-x\frac{dx}{dt} - y\frac{dy}{dt} + \varphi\right) \tag{2.11.5}$$

For initial values

$$Vx_0 = \frac{1}{3}, x_0 = -1000, b = 0 \div 100,$$
$$\varphi = 0 \div \pi, Vy_0 = 0, Q = 5, \Delta T = 3000, N = 10000$$

can see Fig. 2.11.8

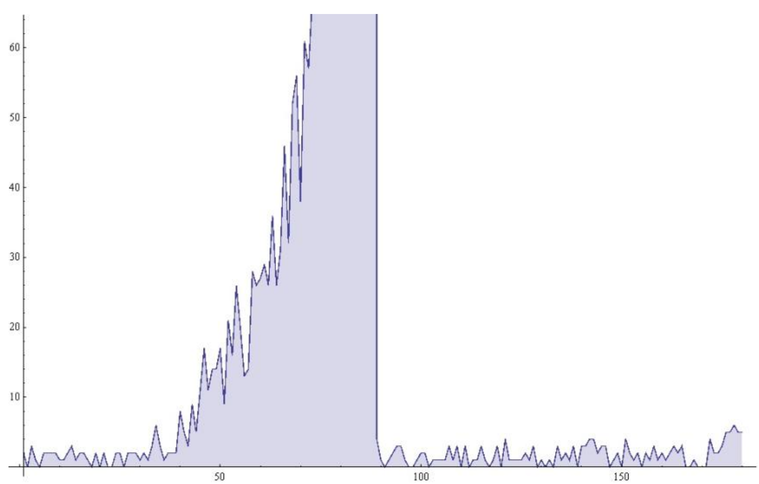


Fig. 2.11.8 *Dependence of the Scattered Particles Number from the Angle for Eq.2.11.4, 2.11.5.*

If we change slightly the velocity and take $Vx_0=0.3344$ then scattering change sharply (Fig. 2.11.9). Obviously striking resonant phenomena appears inside the bubbles. It looks like hadronic streams, but

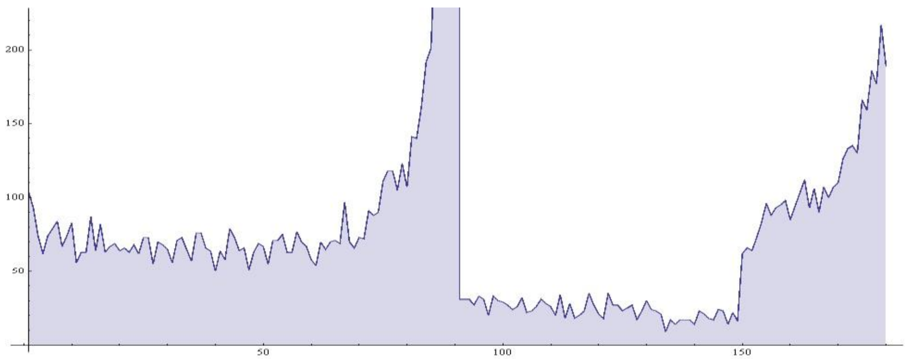


Fig. 2.11.9 *Dependence of the Scattered Particles Number from the Angle for the Eq.2.11.4, 2.11.5.*

this diagram does not concern that phenomenon anyhow. Probably it can be observed at high energies but it's a question of far future. The method discussed here can be helpful in future for the construction of scattering potentials corresponding to different scattering pictures.

We should admit that we have not expected such results at all because of the current opinion that diffraction scattering can be seen only in the cases when strong inelastic interaction presents and scattering particles wave length is small in comparison with radius of interaction (neutrons scattering on nuclei and pions scattering on nucleons). We should note that in accordance with the strict Unitary Quantum Theory the division of scattering processes into elastic and inelastic ones is a kind of idealization [195]. That conclusion can be also extended at equations with oscillating charge. More over the most astonishing is the fact of discovery of wave character of the mention process described by non-linear equations. In general, the results of mathematical modeling are coinciding with intuitively expected ones on the base of qualitative analysis. For example, Ramzauer-Townsend effect is totally understandable. Really, if the length of de Broglie wave is much bigger than atom dimensions, and if the incident electron has the phase corresponding to very small charge, then appears the effect of irregular atom transparency. These electrons pass through atom. Similar situation exists in the s-state of the atom [172, 183, 200, 201].

As de Broglie wave length is very slowly decreases with the energy, such effects of high transparency should take place for any particles at head-on collision. It is evident from the analysis of experimental data that in modern physics the said effect is detected for any particles of counter-current bunches at head-on collision.

It was carried out also the modeling of particles' scattering on some others potentials of Yukawa or Gauss types and the general pattern of the processes were the same. The only difference was the more sharp appearance of resonance peaks at higher energies.

We have carried out the same calculations in the case of the autonomous equations. The results are practically congruent with the above-mentioned ones. We are not going to analyze large quantity of experimental data dealing with differential cross-sections of various scattering processes. It is a problem of future. That is why we even have not integrated the differential cross-sections to get the full picture.

The approach examined can be easily extended to the scattering caused by object consisting of few connected particles (Glauber approximation).

2.12 Particle with Oscillating Charge and Periodic Chain of Barriers

Well, he has breached the blank wall he was up against.

And now what will he do in that next-door ward?

"Shaggy thoughts" Stanislav Ejy Letz

Interesting phenomena may be observed in the case of potential barriers series. From the pure qualitative UQT positions it is evident that if there are two high but quite narrow potential barriers situated at some distance one from another, then the first barrier will be penetrated by those particles only which phase is so that at the moment of the first barrier reaching the particle charge is very small. In that case the particle will pass the first barrier. The second barrier will be also is passed by the particles having in front of the barrier again the phase corresponding to the very small charge. Such a system of two or more periodic barriers results in the fact that a monochromatic correlated in phases flow will be cut out of the particles flow with various energies and phases. In cross- section of that flow there will be particles in one phase only. All this will look like the military favorable training: soldiers are marching, keeping the step and its dimension for all soldiers is strictly equal.

The same considerations relative to barrier's chain exists within standard quantum mechanics but from the viewpoint of that theory one can say nothing about the wave's phase and about the physical sense of observed phenomena. Let us consider in details that quite interesting situation [172, 183, 200, 201]. First clear up how it happens in accordance with standard quantum mechanics.

2.12.1 Two Barriers

Consider the problem of particle's passing through the system of two potential barriers described by Dirac's unit-impulse functions and situated at some distance a one from the other. The potential of such system is following (Fig. 2.12.1):

$$U(x) = a\left[\delta(x) + \delta(x-a)\right]$$

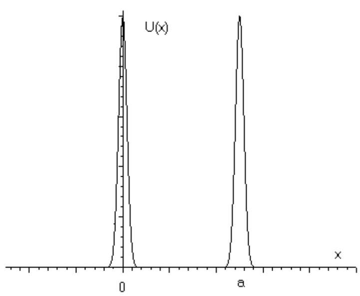


Fig. 2.12.1 *Potential of two-barriers system.*

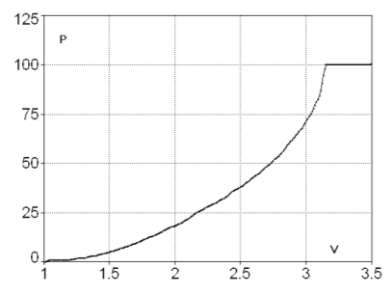


Fig. 2.12.2 *The numbers of particles (percentage p) passing two barriers in respect to particles velocity (autonomous equation).*

Assume the particle's flow moving from left to the right. Let's determine the particle's energy E required for passing both barriers. The Schroedinger equation for the wave function is following:

$$-\frac{\hbar^2}{2m}\Psi'' + a\left[\delta(x) + \delta(x-a)\right]\Psi = E\Psi \tag{2.12.1}$$

At once we can write it solution for the area 1 (x<0) before the barrier, where according to common approach the incident wave exists only. The solution for the area 2 (0<x<a) between the barriers contains both right and reversed waves. The solution for the area 3($(x > a)$ behind the second barrier contains the passed wave only. Therefore, we have the following solutions:

$$\Psi_1(x) = \exp(ikx), \quad x < 0, \quad k = \sqrt{\frac{2mE}{\hbar^2}} > 0,$$

$$\Psi_2(x) = A\sin(kx) + B\cos(kx) \quad 0 < x < a,$$

$$\Psi_3(x) = C\exp[ik(x-a)] \quad x > a,$$

The continuity of the wave function and discontinuous character of the derivative in points $x = 0, x = a$ leads to the equalities:

$$\Psi'(+0) - \Psi'(-0) = \frac{2ma}{\hbar^2}\Psi(0)$$

$$\Psi(+0) = \Psi(-0)$$

Joining in a standard way the wave functions and their derivatives in the points x=0, and x=a and taking into account the above equalities, we get the system of four algebraic equations:

$$B = 1$$

$$kA - ik = \frac{2ma}{\hbar^2}$$

$$A\sin(ka) + B\cos(ka) = C$$

$$ikC - kA\cos(ka) + kB\sin(ka) = \frac{2maC}{\hbar^2} \qquad (*)$$

The given system is predefined and has solution only under following condition:

$$\mathrm{tg}(ka) + \frac{\hbar^2 k}{ma} = 0.$$

[*] We have obtained (see sect.2.6) the full and mathematically rigorous solution of discussed problem. The results are, generally speaking, another but they lead to the analogues conclusions.

If $k_1, k_{2,...}$ are the roots of this equation, then using the expression for k (written at the beginning of this sect.), we are able to determine the energy values at which a particles penetrate (we say, tunnels) two-barrier's system:

$$E_s = \frac{\hbar^2 k_s^2}{2m}, s = 1, 2, ...,$$

It is evident from the solution of transcendental equation that periodic dependence in energy while tunneling two barriers appears because of tangent curve that have be periodically crossed by straight line emergent on some angle from the origin of coordinate system. It is evident that barriers will be passed by the particles with de Broglie wavelength being multiple to a. That phenomenon bears a strong resemblance to processes appearing in the cases of antireflecting optic lenses.

We should note an interesting circumstance. If the same problem were solved in other order, i.e. to determine first the portion of the particles flux penetrated (tunneled) the barrier and to consider the passed portion as incident flux in respect to the second barrier, the result would be absolutely different. The multiplication of two exponents to be given by each barrier just suppresses everything. It is very difficult to understand such double game directive for an unprejudiced physician with mentality non-perverted by "quantum" logic.

There is one more amazing consideration. Assume the particle does not penetrate the barrier but just going to tunnel it or to be reflected, but it "decision" depends on the distance to the second barrier. But how could it know what will be happened and what is the distance to the second barrier. Does the second barrier exist at all? Here we can recollect the perfect words of R. Feynman. May be the particle "sniffs out" the second barrier? And again violence over logic and mind.

Similar phenomena but in more tangible and totally understandable form takes place if we analyze the solutions of the equation with oscillating charge.

To our regret numerical modeling is embarrassing in the case of barriers system (2.12.1) described by delta functions, and that is why we have replaced (2.12.1) by the sum of two Gauss "bells":

$$U(x) = U_0\left[\exp\left(-\frac{x^2}{\sigma^2}\right) + \exp\left(-\frac{(x-a)^2}{\sigma^2}\right)\right]$$

The one- dimensional equation with oscillating charge describing the particle's motion and corresponding to last potential were solved numerically in autonomous and non-autonomous cases. As far as the results obtained are slightly different we show them separately with further comparison.

2.12.2 Autonomous Model

The one-dimension equation of motion has the following form:

$$m\frac{d^2x}{dt^2} - 4U_0Q\left[x\exp\left(-\frac{x^2}{\sigma^2}\right) + x\exp\left(\frac{(x-a)^2}{\sigma^2}\right) - a\exp\left(\frac{(x-a)^2}{\sigma^2}\right)\right]\frac{\cos^2(\varphi)}{\sigma^2} = 0, \quad (2.12.2)$$

where

$$\phi = -\frac{m}{\hbar}\frac{dx}{dt}x + \phi_0, \quad (2.12.3)$$

$x = x(t)$, φ_0 -initial phase, a-distance between the barriers, σ, U_0 are the width and height of barrier respectively, Q, m are the constant part of particle's charge and mass respectively. The equation was solved numerically by Runge-Kutta-Merson method. The numbers of particles tunneled with respect to initial velocity and to initial phases uniformly distributed in interval from 0 to π

were calculated. The following starting data were used: Q=1, m=1, $\hbar = 1$, $U_0 = 5$, a=4, $\sigma = 1/8$, $V_0 = 1 - 3.5$. For each initial velocity value we computed variants for 101 values of initial phase (the case of $\phi_0 = \frac{\pi}{2}$ was excluded from calculations). The total number of the particles equals 20502. The results of calculations are shown in the Fig. 2.12.2, Fig. 2.12.3. The relation between numbers (percentage) of particle and the initial velocity (Fig. 2.12.2) can be well approximated by simple exponent. The distribution of particle's number in respect to the velocity after passing two barriers (Fig. 2.12.3) does not show a resonance effect.

From the other side, particles' grouping in respect to velocity exists as it was described in the beginning of that section and expected from the most general considerations. It can be seen in Fig. 2.12.3, where x -axis indicates particles' velocities and y- axis indicates the number of particles. It is curious that within the velocities interval (1, 2.27) and (3, 3.25) there is no particles at all (forbidden zones). We will discuss it in details later.

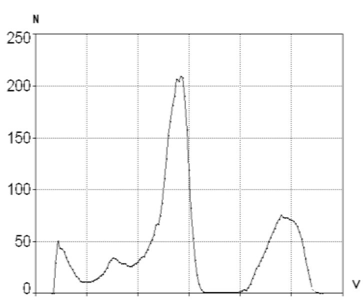


Fig. 2.12.3 *Distribution of particles in respect to velocity after passing two barriers (autonomous equation).*

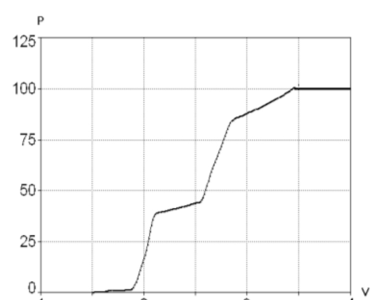


Fig. 2.12.4 *Probability of passing two barriers in respect to velocity of particles (non-autonomous equation).*

2.12.3 Non-autonomous Model

Non-autonomous equation has the same form (2.12.2), but with the other expression of φ:

$$\phi = \frac{mt}{2\hbar}\left(\frac{dx}{dt}\right)^2 - \frac{m}{\hbar}\frac{dx}{dt}x + \phi_0 \tag{2.12.4}$$

The numerical integration was made by Runge-Kutta-Merson method using following data: Q=1, m=1, $\hbar = 1$, $U_0 = 5$, a=4, $\sigma = 1/8$, $V_0 = 1.5 - 4$. The full number of particles N=20502. Now, as it can be seen in Fig. 2.12.4, the expected resonant dependence of barrier's tunneling on the initial velocity exists. But that resonance effect is slightly suppressed because tunneling probability is increasing with the velocity thus compensating the drop in probability at moving away from resonance point (horizontal steps at curve). We have plotted particles' exit velocity distribution after tunneling (Fig. 2.12.5). It is evident from the plot that the forbidden zones within the area of velocity equal to 2 are outlined and also may be seen the particles' grouping in respect to velocities.

We calculated also with the help of numerical integration of the same equation the probability of barrier tunneling with respect to distance between the barriers a, to fixed initial velocity of particles, and to the initial phases uniformly distributed from 0 to π. Starting data were the following: Q=1, m=1, $\hbar = 1$, $U_0 = 5$, a=0.25-12.5, $\sigma = 1/8$, $V_0 = 2.5$.

Total number of particles N=20502. The obtained dependence may be estimated as expected from quite general viewpoint. Really, the first barrier is to be passed by all particles which phase is so that the particle charge in front of the barrier is small. If further on particle's way the second barrier were appeared, then it would be penetrated without any problem by particles with the phase corresponding to the small charge in front of the barrier again. If the distance between the barriers is variable, the tunneling effect will have periodical character. That is illustrated in Fig. 2.12.6.

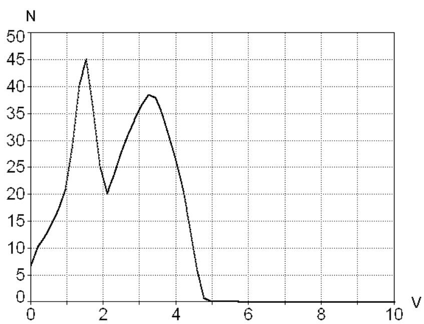


Fig. 2.12.5 *Distribution of particles in respect to velocities after passing two barriers (non-autonomous equation).*

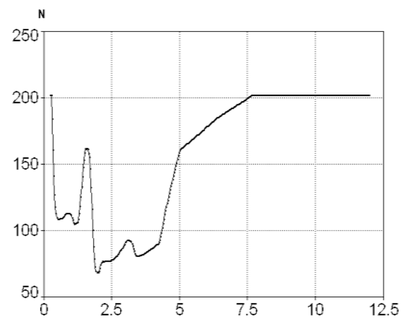


Fig. 2.12.6 *Number of particles passing the barriers in respect to distance between barriers (non-autonomous equation).*

In general the character of solutions for both types of equations is similar, there are appeared the forbidden zones, but the fact that one can see both increasing and decreasing velocity in comparison with initial velocity is more interesting. Thus, in Fig. 2.12.3 it can be seen that there are many particles with velocity a little bit more than initial maximum velocity equal to 3.5. We can see the same phenomenon in Fig. 2.12.5, where the number of particles with the velocity more than 4 – initial maximum velocity is enough. It is also evident that in both cases there are many particles with velocity less than the minimal initial one. In any case we do not think that some particles give its energy to other particles and reduce its velocity and visa versa what is a cause of Maxwell-Boltzmann statistical distribution. The modeling is made each time for one particle only (!) and equation does not mean any interaction with the other particles. We would like to think that additional energy of obtained ensemble owing to fast particles is just exactly equal to the energy lost by slow ones. Of course it is pure aesthetic consideration which etymology descends from atavistic nostalgia in conservation law, but we have not checked this circumstance. Besides, such reasons are based on energy and momentum conservation laws that are not fulfilled for both equations.

2.12.4 Three Barriers

Let's clear up the particle's behavior in the case of a periodical potential according to standard quantum mechanics. We will use the general perturbation theory and examine the changes of free particle motion caused by perturbing periodic potential

$$V = V_0\left[exp(ikx) + exp(-ikx)\right]$$

The wave function for free undisturbed motion equals $\Psi_p = \exp(ikx)$. Average value V over any undisturbed state equals zero; following matrix elements differ from zero only:

$$V_{p,p-k} = V_{p,p+k} = V_0$$

Let us consider the length of potential hole equal to 1. According to standard perturbation theory energetic level shift equals

$$E_p = \varepsilon_p + \frac{V_0^2}{\varepsilon_p - \varepsilon_{p-k}} + \frac{V_0^2}{\varepsilon_p - \varepsilon_{p+k}}, \text{ where } \varepsilon_p = \frac{p^2}{2m}.$$

Of course that expression will be true, provided

$$V_0 << \left|\varepsilon_p - \varepsilon_{p-k}\right|,$$

when p is far from $\pm\frac{k}{2}$. If $p \to \frac{k}{2}$, then states Ψ_p and Ψ_{p-k} possess close values of energy, and wave function is to be sought in the form

$$\Psi = C_1\Psi_p + C_2\Psi_{p-k}\,.$$

If $p \to -\frac{k}{2}$, then states Ψ_p и Ψ_{p+k} have near values of energy again and wave function is to be sought in the form

$$\Psi = C_1\Psi_p + C_2\Psi_{p+k}\,.$$

Basing on the perturbation theory [19], we get following proper values of energy:

$$E_p = \frac{\varepsilon_p + \varepsilon_{p-k}}{2} \pm \sqrt{\frac{\left(\varepsilon_p - \varepsilon_{p-k}\right)^2}{4} + V_0^2}\,. \tag{2.12.5}$$

The sign in expression (2.12.5) is determined by the condition that $E_p \to \varepsilon_p$ if $|\varepsilon_p - \varepsilon_{p-k}| >> V_0$. Viz., if $p < \frac{k}{2}$, then

$$\sqrt{\left(\varepsilon_p - \varepsilon_{p-k}\right)^2} = \left|\varepsilon_p - \varepsilon_{p-k}\right| = \varepsilon_{p-k} - \varepsilon_p\,,$$

and if $p > \frac{k}{2}$, then $\sqrt{\left(\varepsilon_p - \varepsilon_{p-k}\right)^2} = \varepsilon_p - \varepsilon_{p-k}$. Hence, for $p < \frac{k}{2}$ one sign is to be taken and for $p > \frac{k}{2}$ the other. For E_p we obtain the well-known curve having the jump (Fig. 2.12.7). The value of the jump is equal

$$E_{\frac{k}{2}+0} - E_{\frac{k}{2}-0} = 2V_0\,.$$

Thus, in the case of periodical potential the spectrum of free particles has an energy forbidden zone equal to $2V_0$.

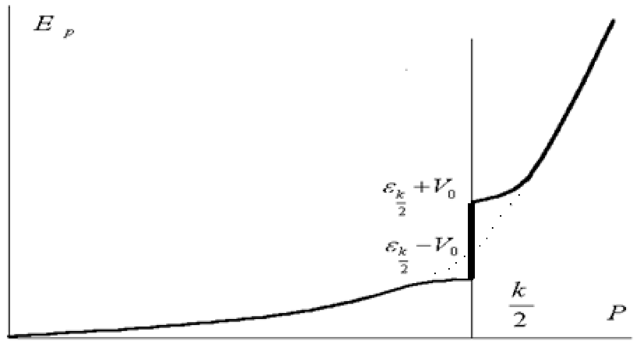


***Fig. 2.12.7** Appearing of energetic jump Further, there was modeling the particles behavior while tunneling three Gauss "bells". Plot of potential is shown in Fig. 2.12.8.*

The expression for the three - barriers potential function is following:

$$U(x) = U_0\left[\exp\left(-\frac{x^2}{\sigma^2}\right) + \exp\left(\frac{(x-a)^2}{\sigma^2}\right) + \exp\left(-\frac{(x-b)^2}{\sigma^2}\right)\right]$$

The equation of particles' motion has the form:

$$m\frac{d^2x}{dt^2} - \frac{4U_0Q}{\sigma^2}\left[x\exp\left(-\frac{x^2}{\sigma^2}\right) + (x-a)\exp\left(-\frac{(x-a)^2}{\sigma^2}\right) + (x-b)\exp\left(-\frac{(x-b)^2}{\sigma^2}\right)\right]\cos^2(\varphi) = 0,$$

where

$$\phi = -\frac{mx}{\hbar}\frac{dx}{dt} + \phi_0 \quad \text{in the autonomous case}$$

and

$$\phi = \frac{m}{2\hbar}\left(\frac{dx}{dt}\right)^2 t - \frac{mx}{\hbar}\frac{dx}{dt} + \phi_0 \quad \text{in the non-autonomous case.}$$

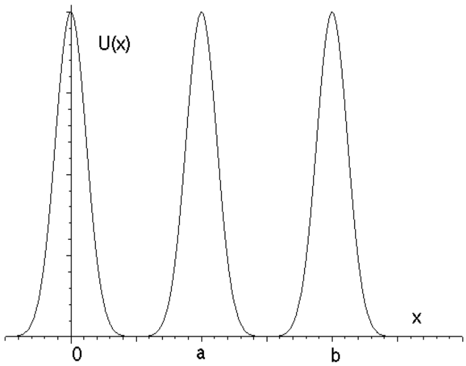


Fig. 2.12.8 *Potential of three barriers.*

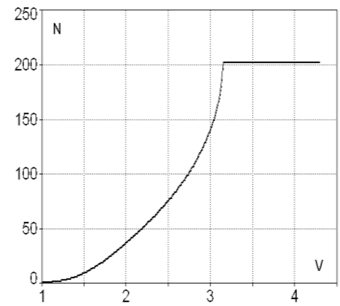


Fig. 2.12.9 *Number of passed particles in respect to initial velocity.*

Particles are flying from left towards the barriers from distance more than 4a along x- axis. The equation was integrated numerically in autonomous and non-autonomous cases by using Runge-Kutta-Merson method. If there had been oscillation appearing between the barriers (velocity sign changing) then such particles were eliminated. The initial data were following:

$$U_0 = 5, \sigma = 1/8, \hbar = 1, Q = 1, \quad m=1.$$

There were chosen 201 different values of initial phase for each value of velocity, and intervals of velocities (from 1 to 4.3 in autonomous case and from 1.6 to 4.5 in non-autonomous case) were divided by 400. Thus, the motion of more than 80000 particles was analyzed for each case.

2.12.5 Autonomous Case

There is shown in Fig. 2.12.9 the number of particles passed all the barriers in respect to velocity in autonomous case, but it is not detected the expected periodic dependence of tunneling coefficient on velocity. The character of the curve corresponds to the dependence in the case of two barriers. The curve itself is very well approximated by exponent. There are represented in Fig. 2.12.10 and Fig. 2.12.11 distributions of particles' number in respect to velocities and charges after passing three barriers.

The distribution in respect to velocities shows the presence of 6 evident forbidden zones. It can be also seen that width and the number of forbidden zones are increasing with the growth of the barriers' number. However, width of the zones in the cases of 2 and 3 barriers problems is not equal to $2U_0$. Apparently, it is because of small number of barriers.

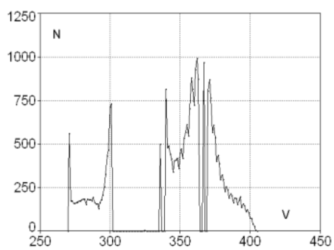


Fig. 2.12.10 *Distribution of particles' number in respect to velocity after passing 3 barriers.*

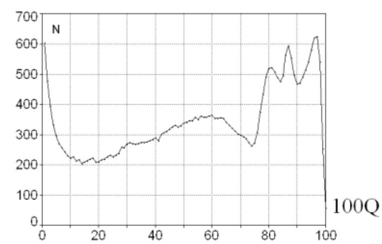


Fig. 2.12.11 *Distribution of particles' number in respect to charge value after passing 3 barriers.*

It may be said, that our expectations based on simple physical reasons are confirmed. The particles' grouping in respect to velocities and charges are intensifying in the case of three barriers in comparison with two barrier' case. However non-autonomous equation shows the other and possible more interesting results

2.12.6 Non-autonomous Equation

The plot for the number of passed particles in respect to the initial velocity is presented in Fig. 2.12.12.

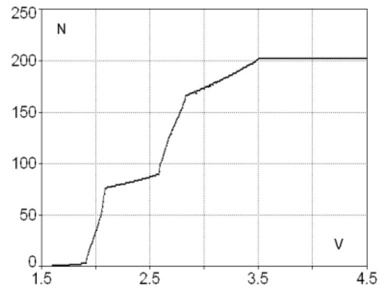


Fig. 2.12.12 *Number of passed particles in respect to velocities (non-autonomous case).*

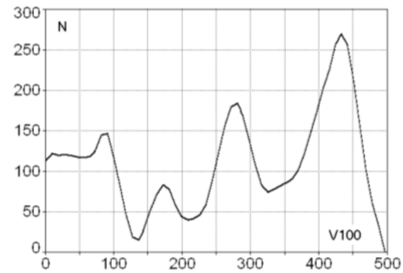


Fig. 2.12.13 *Distribution of particles' number in respect to velocities after passing of 3 barriers (non-autonomous case).*

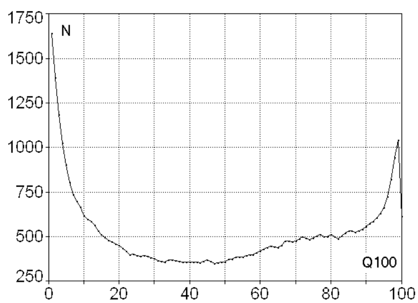


Fig. 2.12.14 *Distribution of particles number in respect to charges after passing 3 Barriers.*

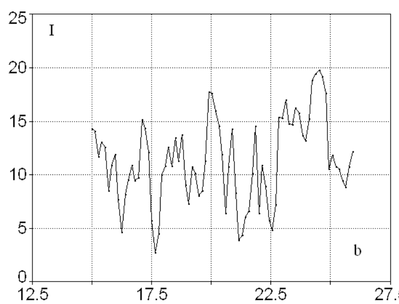


Fig. 2.12.15 *Electric current I as the function of coordinate b of third bar (non-autonomous case).*

The plots in Fig. 2.12.4 and Fig. 2.12.13 are very similar. We can see the resonance dependencies at some values of velocity. At the other side, it can be seen in Fig. 2.12.14 outlining forbidden zones (curves minima), but they are not so strongly pronounced as the same in the case of autonomous case; besides, it is clear enough the depth and number of minima being increase in comparison with Fig. 2.12.5 (two-barriers case).

As the tunneling probability according to Unitary Quantum Theory depends on initial phase, the following nontrivial effect should take place: after two barriers tunneling by incident particles with different velocities and initial phases, it appears the flow correlated in respect to velocities and charges. If now the third potential barrier were placed on the way of such correlated flow at such a distance that all approaching particles have the phase corresponding to small charge, then each particle would penetrate. But if we were moving the barrier nearer or farther, then the phase of each particle would be another and all particles should be reflected. In other words it may be outlined a fundamentally new possibility of extremely effective control of so correlated particles' flow. Such conclusions do not follow from standard quantum mechanics because according to it the initial phase is, so to say, unessential parameter. Note, the considered particles correlation in respect to velocities and charges looks in respect of the particles passed several barriers like output of photon flow from the laser. Additionally it offers, in principle, a series of perspective practical applications.

Further modeling of processes in the case of the three barriers was done using the algebraic potential as Gaussian potential restricts the effectiveness of numerical computation for sufficiently big values of variables. There was used the following potential corresponding to system of three barriers:

$$U(x) = U_0\left[\frac{1}{\left(1 + x^2\right)^2} + \frac{1}{\left(1 + (x-a)^2\right)^2} + \frac{1}{\left(1 + (x-b)^2\right)^2}\right]$$

That equation of motion is following:

$$m\frac{d^2x}{dt^2} - 8QU_0\left[\frac{x}{\left(1+x^2\right)^3} + \frac{x-a}{\left(1+(x-a)^2\right)^3} + \frac{x-b}{\left(1+(x-b)^2\right)^3}\right]cos^2(\varphi) = 0,$$

where φ is expressed by (2.12.3) or (2.12.4) for autonomous and non-autonomous cases respectively.

The results of numerical integration of last equation in autonomous and in non-autonomous cases are presented in Fig. 2.12.15 and Fig. 2.12.16. The electric current in any fixed point is calculated as the product of particles' number, of velocity and charge.

It is important to notice that the value of electric current depends strongly on the distance to the third barrier. Fig. 2.12.15 shows the points, where the current is nearly vanishing. Such theoretical curves hardly may be obtained within standard quantum theory because particles charges, according to it, are strictly constant and the corresponding curves will be quite different.

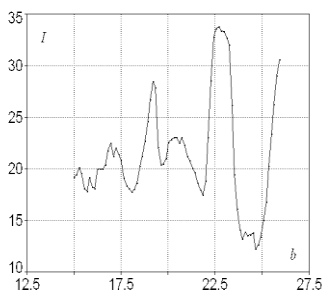


Fig. 2.12.16 *Electric current I as function of coordinate b of third barrier (autonomous equation).*

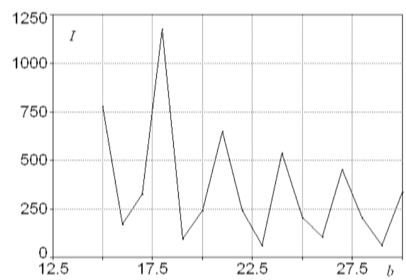


Fig. 2.12.17 *Electric current I as function of coordinate b of third barrier (nonautonomous equation).*

But there is another effect appearing in the three-barrier problem that does not exist at all according to standard quantum mechanics. The wave function for a particle passed through three barriers has the form $\Psi = \exp(ikx)$ and no current spatial oscillations arise after three barriers as $\Psi \cdot \Psi^* = \mathrm{Const}$. But we can see in Fig. 2.12.17 the plot of estimated current value as function of distance to the third barrier (i.e. distance from barrier to particle passed already this barrier) and it may be easily seen the cyclic changes of electric current and some exponential fall of it along x- axis caused, apparently, by long polynomial tail of the third barrier

The same phenomenon may be observed in long experimental lines (so called, Lechers wires). It is so popular that is shown in any respectable universities at lectures. During the experiment one can easily see that in so long lone there are points where the electric current is absent at all, and the other where tension equals to zero. During accurate demonstrations the line is cut in that points and insert thin isolating laying or is even abridged and nevertheless the lamp at the end of the line continues to shine. That phenomenon is often used for construction of modern ultrahigh frequency devices.

But it remains still incomprehensible how electrons penetrate through thick isolating laying, if the electric current is caused by motion of electrons? Conventional explanation is that wires of long line acts like a guide (like rails) in electromagnetic field and it is the field transmits the energy, not the wires. But then irremovable paradox appears: at extreme frequency reduction we will have to do with constant electric current and the energy of such current is transmitted by wires together with electrons flow.

Unitary Quantum Theory explains that paradox perfectly. Note that according to ordinary electrical and radio engineering the electron-drift velocity has the order of mm/sec. Then de Broglie electron’s wavelength becomes a macroscopic value, in any case, many times more than the thickness of isolating laying used by experiments. We have to deal, in essence, with usual tunneling effect, but in macroscopic scale only. Nobody drew attention to such possible approach. The using of our results relative to barriers passage problem in the case of quantum wire accompanied by modern experimental data may help to make a choice in favor of Unitary Quantum Theory. More detailed analysis of that problem will be done in the section 3.6. dealing with quantum wires.

2.13 Uncertainty Relation and Principle of Complementarily Within UQT and Mechanics with Oscillating Charge

I discard the main idea of modern statistic quantum theory… I do not believe such principal conception being an appropriate base for physics in general…I am quite sure that existing essentially statistic character of modern quantum theory should be ascribed to the fact that theory operates with incomplete description of physical systems.

A. Einstein

As far as many nonsense have been announced concerning the uncertainty relation we would like to give more detailed of their obtaining first by W. Heisenberg then by N. Bohr and of not quite adequate their interpretation. So, Heisenberg derived the uncertainty relation on well-known way, now called the method of Heisenberg's microscope and based on the analysis of conditions when microparticle's position and motion can be experimentally detected. In principle, the particle's position can be determined by observations of light rays reflected, diffused or emitted by the particle. The particle is considered as a source of light and the results of its observation will be always the diffraction circle with radius equal to the wave length λ of this light rays. So the particle position can be determined with precision of order λ.

The most primitive idea to improve the accuracy of measurements is to use light rays with λ being as small as possible. We can use, for example, gamma sources, technical implementation of that idea for the time being is not so important. But at the same time we faces A. Compton effect; in the process of measuring the gamma quantum is scattered by the particle and the impulse of the particle is changed for the value equal $\hbar/\lambda$. It is paradoxical, but, for example, we will get the same result, for example, in the case of atom while being allocated with the help not of scattered light but of light emitted by atom itself. If the light is emitted in the form of quantum $\hbar\omega$, then atom will receive recoil momentum $\hbar/\lambda$, and again the study of atoms position will depend on its velocity changes. In both cases the accuracy of atom position determined with the help of scattered or emitted light equals to the wavelength of the light, and momentum change connected with it will be inversely λ. Increasing the measurements accuracy of particle position, we enlarge the error of definition of its momentum. In the result it is impossible to determine the particle momentum at the exact moment of time, when the position of particle is determined since the momentum of particle sharply changes at that moment. The same considerations would be taken into account at determining of velocity also, that resulted in famous Heisenberg relations.

The following philosophical problem appears: is it possible, in principle, to observe any phenomenon without changing it or interfering in it? This problem is no doubt quite old and banal. Anybody agrees that, for example, measuring the electric potential of any matter should change this potential to a certain degree. Any innovations of that measuring apparatus have dealt mainly with tendency to enlarge voltmeter internal resistance and with unachievable idea to make it equal to infinity. Every experimentalist has learned to take into account such non-ideal characteristics of instruments in the process of measuring. And nobody was thrown into confusion with that.

It was proudly announced at the outset of quantum theory that micro-particle does not have at the same moment of time the exact values of co-ordinate and momentum and their values are connected by relation:

$$\Delta x \cdot \Delta p \geq h \text{, } (*)$$

and that statement as well as inequality was called as corresponding to nature of micro-worlds objects and quite not caused by lack of appropriate measuring instruments. But the following question may be put: what will happen if within future decades indirect methods possible to use for measuring purposes will be opened? Nowadays even the problem of mass spectrum is infinitely far from solution and nobody can say whether there is or not any indirect methods. Who is able to foreseen the future?

Shortly after that another relation was derived, viz. between energy and moment of time, when that energy being measured:

$$\Delta E \cdot \Delta t \geq \hbar$$

That relation appeared in great number of books due to intellectual inertia of some authors. And only much later the investigators made out that such relation did not exist within strict quantum mechanics as well as the following relation

$$t \cdot \hat{H} - \hat{H} \cdot t = i\hbar$$

did not exist.

On the other hand, the operator relation

$$x \cdot \hat{p}_x - \hat{p}_x \cdot x = i\hbar$$

(*) It is the simplified form of the Heisenberg relation. The strict relation is expressed by the dispersions of the errors Δx, Δp.

exists and results in uncertainty relation for the coordinate and momentum.

To get the uncertainly relation for the energy and time, the energy operator $i\hbar\frac{\partial}{\partial t}$ should be similar to momentum operator $-i\hbar\frac{\partial}{\partial x}$ for p_x. But in reality, according to strict quantum theory, the energy operator $\hat{H}$ is an operational relation for momentum and coordinate operators, i.e.

$$\hat{H} \equiv \hat{H}\left(\hat{p}_x, \hat{p}_y, \hat{p}_z, x, y, z\right)$$

So, the energy within strict quantum theory is a quantity with quite definite value at given moment of time, but time t in contrast to coordinates x, y, z, is not an operator. That is why time plays in quantum theory quite special role.

N. Bohr have obtained the same relation after manipulating with wave packets of de Broglie waves (creating a particle from these waves packets), but he had carefully forgotten that these wave packets were spreading. To put it mildly that approach is not quite correct. More over the principle of complementarity offered by Bohr ad hoc, forbade the constructing any speculative models of particle's motion. Since that the main task of the physics became the search of mathematical expressions to be set in one experimental data to obtain the other by computations. According to it, the lack of picture in images and motions within quantum physics is not the object of anxiety.

We would like to rehabilitate the strict standard quantum theory and notice once again that, according to it, the uncertainty relation is obtained as the relation between canonically conjugate additional dynamic variables, and we have nothing to say against. In the essence, the corpuscular – wave dualism became the winner. As we can see now, the uncertainty relation is without any doubts valid but methods used at first for its obtaining were not totally adequate.

UQT overcomes the situation quite easily [172, 183, 200, 201]. As far as the particle (wave packet) is periodically appearing and vanishing at de Broglie wave length (more precisely, the packet disappears twice, and the probability of its detecting is sufficiently big in maximum region only) the position of such a packet may be detected with error

$$\Delta x \geq \frac{\lambda}{2}$$

and then

$$\Delta x \cdot P \geq \frac{h}{2}.$$

As at measuring of momentum module is inevitable the error $\Delta \mathrm{P} = 2\mathrm{P}$, then we have following inequality:

$$\Delta x \cdot \Delta P \geq h$$

The statements of standard quantum mechanics that particles do not have a trajectory become more understandable. Of course, there is a lot of truth in those words. First, it is possible to say so about intermittent (dotted) motion of the particle with oscillating charge. Second, any packet (particle) is able during its motion to split into few parts. Each of that parts being summed with vacuum fluctuation may results, in principle, in few new particles. Or vise-versa the broken particle may vanish at all and contribute to general fluctuating chaos of the vacuum. But in any case it is better to have more clear idea of particle concrete motion than operate with generally accepted nowadays-obscure sentence about lack of trajectory.

If we turn a retrospective look into all philosophic-physical mess dealing with uncertainty relation, it is impossible to throw off the idea that phenomenon of social-scientific idea were predicted by V. I. Lenin in his work "Materialism and empirical criticism" long before quantum mess:

"The really important cognitive-theoretic question, dividing philosophical tendencies, is not a degree of accuracy that our description of causality have achieved and whether these descriptions are expresses in fine mathematical formulation, but whether objective rule of nature is the source of our knowledge of these connections, or it is the property of our mind, its ability to cognize the known a priory truth inherent to it…" (italics is our).

The uncertainty relation is usually used for justification of non-determinism of quantum theory because it makes nonsensical application of Laplacian determinism to microcosm phenomenon. First of all, uncertainty relation itself has no connection with the question of truth or falsity of determinism because it only reveals the sense of quantum state concept, but neither truth nor falsity of determinism. Second, uncertainty relation really makes nonsensical the application of Laplacian determinism to microcosm phenomena. Actually, if there are no definite values of coordinate and momentum, then in this case their simultaneous definite values cannot be predicted in future too. That is a philosophical reason. Physical reason is that random non-foreseen vacuum fluctuations may change both particle's coordinate and momentum and agrees, in essence, with philosophical reason. UQT show that determinism in physics has not the Laplacian form only and, in general, has not only a form inherent to classical physics.

The whole preceding science was based on classical description of objects without taking into consideration material character of the observation process. In other words it was the description of objects or processes "in itself". Quantum science has assigned some limit of such understanding, and although UQT allows describing hypothetically the behavior of quantum objects in "images and motions" there is now either above mentioned hypothetical researchers or their hypothetical experimental devices, and we will have to be content with experimental data obtained with the help of macro-devices.

The principle of complementarity introduced by N. Bohr cannot be explained so easily as it is in the case of uncertainty relation, because it is a set of some philosophical discourses with marks of previous years fight between materialism (it is also called Marxism-Leninism) and other philosophical trends. We would like to isolate ourselves from any politics; the authors do not sympathize any politics and philosophical brawls, and try never to participate in it. Nevertheless, there are objective laws that will not be changed even authors and readers disappear, and politicians declare the collapse of materialism and of the said laws. As UQT is able to show many "intimate" sides of quantum behavior and to give the sufficient interpretation of existing quantum processes, the result is quite simple: materialism is gained.

Let us consider in details the principle of complementarity. It is hard to disjoint it from uncertainty relation. Even the origin of its name came from ordinary mechanics, where operators non-commutating with each other correspond to complementary quantities. As we have seen above the uncertainty relation descends from that also. Nevertheless, a lot of philosophical explanations had been appeared which Bohr even had not suspected of. The principle of complementarity can be stated quite popular as follows:

1. A quantum object is extremely complicated formation, not quite easily understood yet, and it corpuscular and wave characteristics are absolutely unlike and only supplement each other. We can draw rough analogy: maps of Eastern and Western hemispheres, men' photos in full and half face and so on.

2. There are two classes of experimental devices. With the help of one we can measure the coordinate, the energy and the momentum – the attributes of a particle. With other, while observing the processes of interference or diffraction, we can measure the wavelength. At any measuring (in cases of small energies) particle "is lost" or its parameters change radically in the result of macro situation effect. It is called as uncontrolled effect that is why it is impossible to measure at the same moment of time corpuscular and wave parameters.

3. We should not ask Nature questions that will not be experimentally answered.

4. It is not necessary to make attempts in constructing the quantum pictures in images and motions as it was within before-quantum science. It is quite enough to be able to solve and analyze different quantum equations mathematically and to apply the new rules derived within quantum mechanics.

The attitude of Paul Langevin to the last two items was as to something disgusting and he called the principle of complementarity as *"intellectual debauchery"*.

The other numerous statements are based on variants of uncertainty relation.

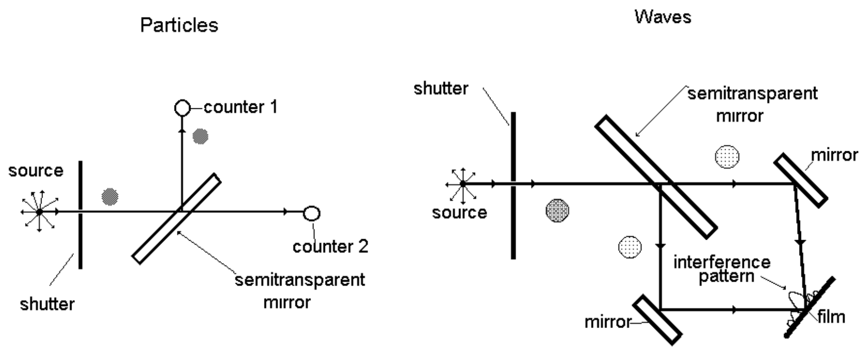


Fig. 2.13.1 *Experiments with individual photons on semitransparent mirror.*

There were many physical and philosophical discussions about photon behavior at semitransparent mirror (Fig. 2.13.1). With the help of complementarity principle it was analyzed in what flux (reflected or penetrated) the photon is located while the interference of penetrated or reflected flux is observed and how it correlate with the number of particles to be appeared in penetrated and reflected fluxes. When the flux of particles falling down on the translucent mirror one after another was observed with big exposition, then the interference picture became visible. It contradicts the fact that the particles was detected either in penetrated or reflected flux, and it is incomprehensible how could the interference picture arise. If the particle remains in reflected flux, then it could not been observed in the passed flux, and it is impossible to understand what and with what would interfere. The observed facts of rare simultaneous signals of two particle counters were explained by random appearance of two photons “nearby”, and one of them has penetrated the mirror and the other – was reflected. There were some reasons due to observations of induced radiation (the main principle the lasers are based on). There were made quite enough different experimental variations at that matter [31-41]. We should note that they do not contradict the ideas developed within UQT.

Of course not only the processes of splitting cause the phenomena of interference and diffraction. It is shown in section 2.11 that even indivisible particle described by equation with oscillating charge while spreading is able to show the behavior having seemingly a wave character. All these processes look very knotty.

N. Bohr has offered well-known interpretation of that phenomenon from the principle of complementarity viewpoint. We shall remind it shortly. The particles' flow falling down at the mirror is described by wave function (i.e. by the amplitude of probability). The particle after hitting at translucent mirror is, so to say, in a potency state: the particle may belong to penetrate or to reflected flux, it may be appeared (detected) and maybe not. Namely, that potency is interfering, i.e. possibility of particle's location here or there. These potential possibilities become actual at the finish of object and device interaction only. And though probabilities are referred to potential-possible, i.e. to non-finished experiment, but statistics based on these probabilities is a statistics of realized interactions, i.e. of finished experiments. But if an experimental device would be created being able to follow the destiny of individual particle and to detect to what flux (penetrated or reflected) the particle belong, then the particle would be absorbed or its parameters were changed at such a value that we would not be able to speak about its participation in interference process. If this process is studied, then it is impossible without violation of interference process to detect the flux, where the photon is located. Either one thing or another, they cannot exist together.

We should note, - it is worthy of astonishment that N. Bohr was able to imagine that principle and interpretation, because it turned out that if one follows strictly the prescribed principles and rules, then the right results are obtained and no contradictions arise.

All paradoxes were eliminated by simple prohibition to think about it. It stimulated a great philosophical discussion but physicists did not pay attention at.

And they were right since that discussion took the form of some talks resulted in nothing, but orthodox quantum interpretation answered every physical question to be asked within new unusual game rules and served as perfect instrument of knowledge. Nevertheless for any thinking researcher the question whether it is true is raised always. Why we could not even imagine that particle has exact values of momentum and coordinate and follow it dynamics in details? Why we could not study with any indirect methods the concrete sides of particle motion (as it takes place in other sciences)?

Absolutely new philosophical problems about "free will" and even about the existence of particles in connection with probability interpretation of wave function have appeared. Religion was also admixed due to A. Eddington.

There was quite solitary the question about the cause of quantum mechanics statistical character. In connection with that the words of A. Einstein are quoted especially frequently about his unbelief in "God is playing cards". There are so many different speculations about that. But the main is that statistical interpretation does not belong to quantum mechanics instrument and does not result from it but simply postulates. That is not so within our UQT and the probability of phenomena appears due to inner content of this theory, and, as we hope, the question about how *"God plays cards"* has disappeared for most part of our readers at the moment of reading these words.

The authors are sure that all additional philosophical quantum-mechanical images of the nature will be crushed down in the nearest future and UQT will gain, and the above mentioned problems will surprise future generation as well as now we are amazed at ancient opinions about three elephants and three whales supporting our Earth. It is astonishing but even these quite naïve ideas had relaxed or rather lulled humanity mind during very long time.

3

Nuclear Transmutations; New Sources of Energy and Some Anomalous Phenomena

3.1 Cold Nuclear Fusion and Nuclear Transmutations

"The kernels are pure emeralds,

But people, it may be, lie..."

A. S. Pushkin

3.1.1 Introduction

Let us analyze the epoch-making experiments carried out by M. Fleishman and S. Pons in the March of 1989 [71] and revealed for the first time the phenomenon called the cold nuclear fusion (or Low Energy Nuclear Reactions-LENR), i.e. the nuclear synthesis at low temperature. Notice, one of the authors of this book (prof. Leo Sapogin) has already predicted in 1983 [72] in his works the possibility of such nuclear reactions at small energies. Without going into well-known details we can say: the phenomenon of the cold nuclear fusion really exists and no one physicist can explain it clearly within the classical mechanics or within the standard quantum mechanics. The series of various mechanisms which explain this intriguing phenomenon is offered but it is hard to believe them because of the following reasons.

The curve of nuclear potential energy in the case of a charged particle interaction with a nucleus is plotted in Fig. 3.1.1, where the right top part of the curve corresponds to the mutual Coulomb repulsion that nucleus and charged particle is experienced.

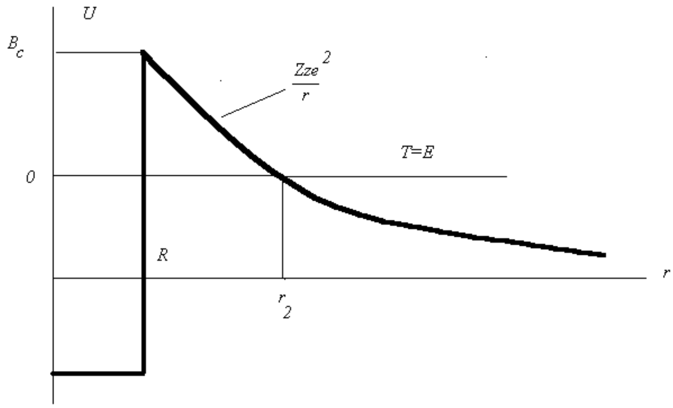


Fig. 3.1.1 *Potential corresponding to nuclear fusion.*

The repulsion potential is described by formula

$$U(r) = \frac{Zze^2}{r},$$

where Ze is the nucleus charge, z is the charge of particle moving to the nucleus, e is the electron charge; r is the distance between given particle and nucleus. At r=R the potential energy curve has a jump that can be explained by the appearance of the intensive nuclear attraction. Nowadays, we do not know any mathematical formula for the potential of the nuclear attraction. If the charged particle is able to overcome the potential barrier of the height

$$B_c = \frac{Zze^2}{R} \approx \frac{Zz}{\sqrt[3]{A}} \text{MeV},$$

then further the particle falls into the region of nuclear forces of attraction and the nuclear reaction will proceed.

Let us consider the nuclear interaction if the charged particle possesses kinetic energy $T < B_c$. From the classical mechanics point of view in that case there will no nuclear reaction at all because reaching some distance $r < R$ to the Coulomb barrier top the particle will be turned back and reflected. Deuteron energy in ordinary electrolytic cell of Fleishman-Pons is near 0.025 eV, the height of Coulomb barrier in this case is $B_c = \frac{Zze^2}{\sqrt[3]{A}} = 0.8 MeV$. It is naive to discuss the question about overcoming the barrier with the height dozens of million times more than the kinetic energy from the classical mechanics point of view.

However, from quantum mechanics point of view there is a tunneling effect and the probability of such tunneling, or potential barrier transparency D, is given by well-known formula:

$$D \approx \exp\left(-\frac{2}{\hbar} \int_{r_1}^{r_2} \sqrt{2\mu(U - T)} dr \right) \quad (3.1.1)$$

where $\mu = \frac{Mm}{M + m}$ is so called reduced mass, M is the nucleus mass, m is the particle mass. The lower limit of integration r_1 coincides with nucleus radius R, the upper limit r_2 corresponds to condition $T = \frac{Zze^2}{r_2}$. After integrating we will obtain

$$D = \exp(-2g\gamma)$$

where $g = \frac{R}{\lambda\!\!\!^{-}_{B_c}}$; $\gamma = \sqrt{\frac{B_c}{T}} \arccos\left(\sqrt{\frac{T}{B_c}} \right) - \sqrt{1 - \frac{T}{B_c}}$, and value $\lambda_{B_c} = \frac{\hbar}{\sqrt{2mB_c}}$, is de Broglie wavelength, corresponding to the particle kinetic energy equal to the barrier height $T = B_c$. If $T << B_c$, then formula (3.1.1) can be easily transformed into the form

$$D = \exp\left(-\frac{2\pi RB_c}{\hbar v}\right) = \exp\left(-\frac{2\pi Zze^2}{\hbar v}\right) \qquad (3.1.2)$$

where v is velocity.

If we estimate the values g and γ for collision of two neutrons with such energy, then we obtain following:

$$g = \frac{R\sqrt{2mB_c}}{\hbar} = 1.9; \quad \gamma = \sqrt{\frac{B_c}{T}} \arccos\left(\sqrt{\frac{T}{B_c}}\right) - \sqrt{1 - \frac{T}{B_c}} \approx 8883,$$

hence the probability of such a process equals to $\exp(-2 \cdot 1.9 \cdot 8883) \approx 10^{-7328}$ (!). The cross-section of fusion reaction can be determined as multiplication of nuclear cross-section and tunneling probability, i.e.

$$\sigma = \sigma_{nucl} D.$$

Moreover, if the deuteron sighting parameter does not equal zero, then the appearance of centrifugal potential

$$U = \frac{\hbar^2 l(l+1)}{2mr^2}$$

will lead for more reducing of interaction probability.

3.1.2 Experimental Results

The obtained values do not require a commentary. It is quite explainable that the official physical science has rejected every talk about the possibility of the LENR-Low Energy Nuclear Reactions. The experiments of M. Fleishman and S. Pons [71] were declared as some misunderstanding. For example, the most serious and responsible edition Encyclopedia Britannica 2001 could not even find a place for the cold nuclear fusion concept. Such official viewpoint can be understood only if one considers standard quantum mechanics as absolutely valid. In spite of all during last 14 years starting from the moment of experimental discovery of M. Fleyshman and S. Pons about 50 international conferences dealing with that subject were organized, there are a lot of books, Journals, and magazines discussing this problem, the number of articles written about it is near to dozen of thousand. Today the situation is changing step by step into positive direction. And the researches are slowly turning away from the high road of hot fusion that has wasted during last 60 years more than 90 billion dollars for nothing.

The LENR experimental data are extremely numerous and various, but we are going to dwell on the most important and fixed results. Thus at classical electrolysis study of the palladium cathode saturated with deuterium there is enormously great heat generation in heavy water: up to 3-kilowatt/ cм3 or up to 200 megawatt-second in a small sample. There were also detected fusion products: tritium ($10^{7}-10^{9}$ t/sec), neutrons with the energy equal to 2.5 MeV (10-100n/sec), helium. The absence in the products of the reaction He^{3} shows that heat does not the result from the reaction d+p. More over one can observe the emanation of charged particles $\left(p,d,t,\gamma\right)$. We can study similar processes at gas discharge over palladium cathode, at phase change in various crystals saturated with deuterium, at radiation treatment of deuterium mixture by strong sonic or ultrasonic flux, in cavitations micro-bubbles in heavy water, in a tube with palladium powder saturated with deuterium under the pressure of 10-15 standard atmospheres and others. In some reactions, (for example at $\mathrm{d}+\mathrm{t}\rightarrow\alpha+\mathrm{p}$) neutrons with the energy 14 MeV are absent; one can meet the same strange situation in other cases too. Thus the participation of nucleus Li^{6},Li^{7} in reactions with deuterium and protons, while the reaction

$$K^{39} + p \rightarrow Ca^{40}$$

was fixed even in biological objects. But the most intriguing fact in all these processes is the lack of fusion products that could explain the calorific effects. Thus, in some cases the number of fusion products (tritium, helium, neutrons, and quantum) should be million times more to give any explanation of the quantity of the heat evolved. So great energy liberation can be explained neither by chemical or nuclear reactions nor by changes of phase. More details about the magic source of such energy are given in the books [200, 201]

The deeply studied interaction d+d proceeds along three channels:

D + D ---> T(1.01) + p(3.03) (1 channel)

D + D ---> He(0.82) + n(2.45) (2 channel)

D + D ---> He + γ(5.5) (3 channel)

These reactions are exothermic. The third channel has very low probability. In the result of experiments it have been discovered that these reactions can take place at indefinitely small values of energies. In molecule of D_2 the equilibrium distance between atoms is 0.74A and according to standard quantum theory these two deuterons would be able to come into nuclear fusion by chance. But the value of the interaction is quite small [59] and equals $\lambda_{D_2} = 10^{-64} c^{-1}$. We know from literature [59] estimation: the water of all seas and oceans contain 10^{43} deuterons and there would be only one fusion within 10^{14} years. It is evident from the sated above that the main obstacle preventing d+d reaction is the presence of an extremely high Coulomb barrier. The approach given in the [172, 200, 201] allows solving that problem. The UQT also gives such possibility. Solutions of some UQT equations show that distance the deuterons could draw depend strongly on the phase of wave function (by the way that is absolutely evident by intuition).

3.1.3 Low Energy Nuclear Reactions (LENR) and Nuclear Transmutations at the Unitary Quantum Theory

Let us consider the motion of a charged particle to the nucleus from the viewpoint of UQT using the equation with oscillating charge in one-dimensional case [200, 201, 53-58, 172]. Assume there is an immovable nucleus with the charge Ze placed in origin $x = 0$, and the particle with the charge ze, and mass m is moving towards this nucleus with some initial velocity along axis x. Autonomous and non-autonomous equations of the particle motion are derived from Schrodinger equation for very small kinetic energy [200, 201, 53-58, 172] and have the following form for Coulomb potential :

$$m\frac{d^2x}{dt^2} = \frac{2Zze^2}{x^2}\cos^2\left(\frac{m}{\hbar}\frac{dx}{dt}x + \phi_0\right), \tag{3.1.3}$$

$$m\frac{d^2x}{dt^2} = \frac{2Zze^2}{x^2}\cos^2\left(\frac{m}{2\hbar}\left(\frac{dx}{dt}\right)^2 t - \frac{m}{\hbar}\frac{dx}{dt}x + \phi_0\right), \tag{3.1.4}$$

where φ_0 is the initial phase. These equations are numerically integrated under following starting data: Z=z=1, e=1, m=1, $x_0 = -10$, $\hbar = 1$ and different initial velocities and initial phases. As it is expected, the particle's braking and acceleration took place in the moments the oscillating charge is big. But at the final stage at some initial phases close to $\frac{\pi}{2}$ a delightful process appeared. The velocity, charge and repulsive force are very small. Due to the phase relationship small charge stay constant during the long period, and that means that nothing affects particle (or, rather, its remainder), the particle very long snails with low and constant velocity inside the other particle field ("snail effect") and may approach its center at close distance. That process bears a strong resemblance to slow inconspicuous spy penetration into the hostile camp.

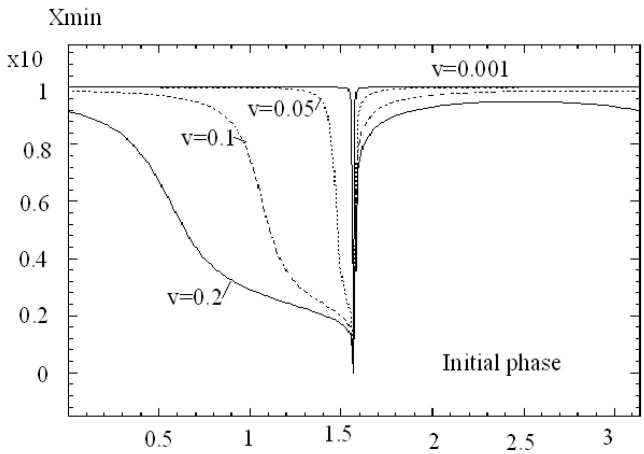


Fig. 3.1.2 *Distance to the turning point of moving charge in respect to value of initial phase for different velocities.*

That phenomenon appears within some area of phases and is convenient to call it a phase hole, which is illustrated by plots in Fig. 3.1.2 (obtained after integration of the equation (3.1.4)). Besides, it may be possible now to explain one of the anomalies of the nuclear physics (which does not exist according to physics literature). When the nucleon energy equals 1 MeV its velocity equals 10^9 cm./sec., nucleus radius equal to 10^{-12} cm., the time of flight through nucleus equals 10^{-21} sec., but time interval within which the nucleon flies out is usually anomalous huge - 10^{-14} sec, it is even out of understanding what does the nucleon do inside the nucleus for such a long time? But it can be easily explained in the frame of our theory by "snail effect". That phenomenon is studied more detailed in books [200, 201] and Section 3.1.4.

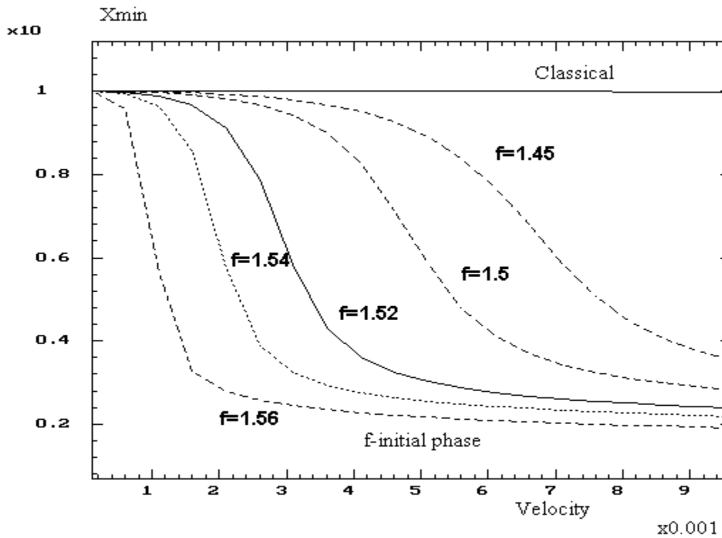


Fig. 3.1.3 *Minimal distance between charges in respect to initial velocity for different values of initial phase.*

For the same equation, the minimal distance between charges was computed depending as a function of the velocity and at various values of the initial phase. For comparison, the result of classical computation on the base of Coulomb law is shown in Fig. 3.1.2. We can see from the same plots that the minimal distance at which the particle is able to come near the nucleus does not depend on the kinetic energy. But with the decrease of velocity the width of initial phase interval corresponding to minimal distance decreases too. In other words with decrease of energy the probability of nuclear fusion also decreases. We obtain on the whole the same results for autonomous equation (3.1.3).

In accordance with the standard quantum theory the relation of fusion velocity along tritium and neutron channels should be near unity: $\frac{t}{n} \approx 1$. But the results of numerous experiments of the cold fusion show that value greatly differs from unity and equals $\frac{t}{n} \approx 10^9$. That value is reproduced in different experimental situations and by various experimental groups with a high accuracy. Till now that quite intriguing problem has not been solved. We will try to explain the possible reason for that. Neutrons are influenced at low velocity within the phase hole by forces of nuclear attraction and protons - by the forces of electrostatic repulsion. Under the influence of momentum of given forces the deuteron have enough time to turn in such a way that its neutron parts are turned to each other. After the neutrons attraction the saturation of nuclear forces appears. That weakens the connection between protons and one of them is able to leave the system. Schematically, the reaction may be rewritten in the form

$$d + d \to p + (n + d) \to p + t$$

That looks like effect of Oppenheimer-Phillips [74]. But it is precisely known that at high energies the probabilities of the first and the second channels of the reaction are similar and that phenomenon should be anyhow explained. The growth of the probability of neutron channel with the increase of the energy may deal with the secondary neutrons birth in reaction

T + D = He + n (14.1 MeV)

In medium full of heavy hydrogen the most part of being born tritons will transform into neutrons due to that reaction. The cross-section of this reaction is equal to 5 barn at energy of 70 KeV. In accordance with the estimate in [74], the numbers of so secondary neutrons for one triton are $7.9 \cdot 10^{-12}, 1.7 \cdot 10^{-9}, 2.7 \cdot 10^{-6}$ for the triton energies 10, 20 and 100 KeV correspondingly. Thus the prevalence $\frac{t}{n} > 10^6$ must be expected in those reactions only, where the birth of tritium corresponds to energies higher than 40 KeV [74].

We should not think that phenomenon of phase hole will result in nuclear reaction over the whole area of the hole. We can assume that along with decrease of Coulomb repulsion value, the value of the strong interaction decreases too. How? Today nobody knows the exact equation for strong interaction potential. Furthermore the particle reaches turning points $x_{\mathbf{min}}$ "losing flesh (charge) enough". Will the particle be able to participate in an honest nuclear reaction or just pass it through as an electron in s-states of atom does? But there are very narrow phase areas where shortly after the particle stops its charge is rapidly growing and particle velocity increases abruptly. The charge may be even maximal within the scope of nuclear forces. Apparently this narrow area is responsible for the cold nuclear fusion. And probably at strong interactions the phase hole is working too.

It was discovered long ago that nuclear transmutations are widely spread (it is especially evident for plants and biological objects), but they are faintly connected with energy liberation. The examples of such reactions are:

$$Mn^{55} + p \to Fe^{56}$$

$$Al^{27} + p \to Si^{28}$$

$$P^{31} + p \to S^{32}$$

$$K^{39} + p \to Ca^{40}$$

In reactions of such a type very slow proton (its kinetic energy is equal practically to zero) is penetrating inside the nucleus by the above-mentioned way and stays there. There is no nuclear energy liberation, because the nucleus remains stable both before and after reaction. In accordance with classical nuclear physics, the nucleus, as usual, after a charged proton with great kinetic energy gets inside it, becomes unstable and breaks to pieces, and its fragments obtain bigger kinetic energy. The reactions of above-mentioned type were considered impossible at all at small energies and therefore were not studied in the classical nuclear physics. Apparently, that is absolutely new type of nuclear transmutations unacknowledged by modern nuclear science, but experimentally discovered sufficiently long ago. Today there are a lot of experimental data confirming the mass character of nuclear transmutation. Moreover there are many projects of nuclear waste neutralization that use this method. The journals “Infinite Energy”, “New Energy”, “Cold Fusion”, “Fusion Facts” etc. and Internet is full of such projects.

Of course, if the charge of a nucleus changes, then the electron shells of atom also will re-form, but the energy dealing with that process will be of few electron-volts order and cannot be compared with in any case with the energies of nuclear reactions that are from units till hundreds of billions electron-volts. By the way, experts in nucleonic got used to that range energies in nuclear reactions. Exactly that circumstance forces them it to reject a priory the presence of any nuclear processes in biology, because at such debris’ energies dozens and hundreds of thousands of complex biological molecules will be destroyed.

Quite far ago Louis C. Kervran [75] published the book about nuclear transmutations in biology, and now nearly 20 years after it was reissued! Apparently for the first time numerous experimental data describing the above-mentioned phenomena were presented. The reaction of official science was also quite interesting. For example, the well-known physician Carl Sagan after having read the book about experimental results advised Kervran to read an elementary course of nuclear physics!

A little bit later Panos T. Pappas [154] researched one of the nuclear reaction perfectly observed within biological cells, viz.

$$Na_{23}^{11} + O_{16}^{8} = K_{39}^{19}$$

The existence of $K - Na$ balance is well known in the classical biology for the long time. The ratio between quantities of K and Na ions is kept with a great accuracy in spite of presence of any K or Na ion in the food. Later in the work [155] that nuclear reaction was called "equation of life" and M. Sue Benford proved with direct physical methods the presence of such nuclear reactions in biological objects. To our regret the number of the researches of those problems in biology is very small. We know about the existence of such groups in Japan (Komaki), India and Russia.

All programs of controlled nuclear fusion are based on meaningless heating and pressing of the respondent material. In spite of successes achieved, the head of such a group in England Dr. Alan Hibson (private communication) announces few years ago that not less than 50 should pass before the construction of reactor for demonstration can be ready. Today that point of view becomes generally accepted. Note that the reactor itself, even if it were constructed in future (the authors greatly doubt that possibility) would be extremely complicated, expensive and environmentally pollutant.

Classical approaches have not achieved positive results yet in spite of investments of many billions and huge number of physicists, engineers, maintenance staff, managers and chief-managers involved. Of course that enormous army of researches became a potential enemy of any alternative projects of fusion. It was note that "vitality" of any idea is directly proportional to the amount of persons involved and capital invested. Those were the reasons why works of M. Fleishman and S. Pons were given a hostile reception.

Each program of controlled nuclear fusion has adjective "controlled", but as a matter of fact there is no control at all. The initial quantity of respondent material is simply very small, quite providently we should say. For example a ball of lithium deuteride used for laser reduction is near 1-2mm in diameter. But nobody has at least examined the question of energy recovery to be generated in the result of that ball explosion. By the way the energy from that explosion is nearly equal to energy obtained in the result of an anti-tank grenade explosion.

Straightforward approach to nuclear fusion used by modern science is absolutely natural because there is no method in the standard quantum mechanics to influence that process. The future of systems of really controlled nuclear fusion will possibly lie not on the path of the primitive and meaningless heating and pressing of the respondent material but on the path leading to the collision of nuclei possessing a small charge and micro adjusted wave function phase.

That is possible in principle by the superposition of controlling external electromagnetic field on the reactive system containing quasi-fixed order atoms of deuterium and free deuterons. The special atomic lattice geometry may produce the same characteristics. Dispersion of a deuterons flow due to diffraction on such lattice will result in automatic selection of deuterons in energies and phases.

Apparently in electrochemical experiments carried out by M. Fleishman and S. Pons, such ordered system existed inside the Pd-D lattice and as the result appeared weak phasing able to explain the results of experiments raised [77, 78].

We suppose that in future models of the reactors in contrast to all existing projects will react in any moment of time only the smallest part of deuterons automatically selected relative to initial phases. It could be possible to obtain in result the small energy generating during long period of time until the reserve of light reacting nuclei will not be exhausted. That fusion does really have the right to be called “controlled”.

Today we can imagine that in the future the processes of cold fusion will be adopted probably not in energy production but for atomic wastes utilization and isotopes manufacture.

Many experimentalists [77, 78] discovered that the quantity of the heat generated in the common water electrolysis over nickel electrodes (in that system we cannot even expect nuclear fusion presence) were the same as in the case with electrolytic lattice with heavy water. That fact confirms the results of other experiments in the process of which it was discovered that the number of fusion products was in millions times less than it was necessary for that quantity of generated heat, and its origin was mysterious. We had examined the question of heat origin in books [200, 201, 66].

The thermal cell CETI (created by James Patterson in 1995 [66]), where electrolyze of specially manufactured nickel bolls in common water is going on, has shocked scientists in USA. American newspaper «Fortean Times» No 85, 1995, wrote about it: “December the 4th, 1995 will go down to history!” At that day the group of independent experts from five American Universities tested the work of new energy source with stable output heat rating 1.3 kWatt. The electric energy input was 960 times less.” All experts noted that generated heat had enigmatic origin and could be explained neither by chemical or nuclear reactions nor by phase transitions. By American ABC TV there were two telecasts at 7th and 8th of February, 1996 in cycles «Nightline» and «Good Morning America» about Patterson creation of new source of energy, able to generate in hundred times more energy than it had consumed. And again it were accentuated that the origin of generated heat remains mysterious. It is interesting that American Company Motorola made attempts to buy the patent for cell CETI for US$ 20.000.000, but was rejected (private communication). We are sure that Motorola Company had spent a certain sum for the study of that problem before making so serious an offer. All processes within the Patterson cell do not concern nuclear reactions (although Patterson thinks otherwise), and at our opinion can be explained with the same processes used here above [200, 201, 83-86] for the description of proton-conductive ceramics.

3.1.4 Dynamic Processes in Low Energy Nuclear Reactions

Further we will give certain concrete data demonstrating the phase values of a deuteron with an oscillating charge, under which the deuteron can approach the nucleus to a critical distance of 10^{-12} cm or less, i.e. giving the data for estimating the value of the above-mentioned phase hole in the interval (0, π) of the phase change.

Assume that the stationary nucleus with the charge q is placed at the coordinate origin x=0 and a deuteron with the same charge q is placed at the initial moment t=0 at the point $x_0 < 0$ on the x-axis, and the deuteron velocity equals $\dot{x}_0 = v_0 > 0$. Charge q is equal to dimensionless electron charge 0.085137266 (see Chap1.8). The units of mass, length and time are chosen in such a way that m=1, $\hbar = 1, c = 1$ $(m -$deuteron mass, $c -$ light velocity). According to

International unity system SI (kg, m, s) m =3.34734$* 10^{-27}$ kg, ħ=1.0545$*$ 10^{-34} $\frac{kg*m^2}{s}$ We take velocity the value $3 * 10^8$ m/s. Our units are connected (up to 4 significant figures) with the system (kg, m, s) as follows:

$$1 \text{ mass unit} = 3.347 \cdot 10^{-27} \text{ kg},$$

$$1 \text{ length unit} = 1.050 \cdot 10^{-16} \text{ m},$$

$$1 \text{ time unit} = 3.500 \cdot 10^{-25} \text{ s}.$$

The electron velocity corresponding to its energy of 1 eV equals 5.931 10^7 cm/s.

The deuteron velocity corresponding to such energy will be assumed to be 3675 times less, and in our units it will be $5.380 \cdot 10^{-7}$ cm/s. Then the deuteron movement towards the nucleus is described by the equation

$$\ddot{x} = -\frac{2q^2}{x^2}\cos^2(\frac{1}{2}(t+t_*)\dot{x}^2 + x\dot{x} + \varphi_0), \qquad (3.1.5)$$

where the parameter t_* is defined under the condition that the argument of cosine equals φ_0 for $t = 0, x = x_0, \dot{x} = \dot{x}_0$ (thus $t_* = -(2x_0)/\dot{x}_0$), and this parameter may be considered as the initial moment of so called local time.

We are particularly interested in solutions of (3.1.5) under very small deviation ε from the phase $\varphi_0 = \frac{\pi}{2} + \varepsilon$ and rewrite (3.1.5) in the following form:

$$\ddot{x} = -\frac{a}{x^2}\sin^2(\frac{1}{2}(t+t_*)\dot{x}^2 + x\dot{x} + \varepsilon), \qquad (3.1.6)$$

where $a = 0.0144967$. Let the initial x_0 be equal -500000 of our length units (i.e. approximately $5 * 10^{-9}$ cm) and the initial deuteron velocity v_0 be equal to the velocity v_{00} corresponding to the deuteron energy of 1 eV or less. But it turned out that the precision of numerical integration of this equation under such initial conditions and under values $|\varepsilon|$ $=10^{-6}$and less is small and besides the interval of the integration must be very large. That is why this equation also had to be transformed by passing to “slow” time $\tau = |\varepsilon| t$ to the equation with respect to the variable $w = \left(\frac{dx}{d\tau}\right)^2$ as a function of x:

$$\frac{dw}{dx}=-\frac{2a}{x^2}\left\{\frac{1}{\varepsilon^2}\sin^2\left[\left[|\varepsilon|(\frac{1}{2}(\tau+\tau_*)w+x\sqrt{w}\pm 1)\right]\right]\right\}, \qquad (3.1.7)$$

where $\tau_*=-(2x_0)/\sqrt{w(x_0)}$ and +1 if ε>0, and -1 if $\varepsilon<0$. It must be added also the equation for τ as a function of x:

$$\frac{d\tau}{dx}=\frac{1}{\sqrt{w}}. \qquad (3.1.8)$$

The system of equations (3.1.7, 3.1.8) is, so to say, a "model" system describing fairly accurately (from viewpoint of quantities data) the deuteron movement under all values of | ε | from 10^{-24} to 10^{-6}. The numerical integration of this system was carried out under different values of ε and under following initial conditions:

$$w(x_0)=2.103, \tau(x_0)=0, x_0=-500000, \tau=689573.18 \qquad (3.1.9)$$

It may be noted that the initial deuteron velocity v_0 equals 1.450172*|ε| (following the relation $\dot{x}_0=|\varepsilon|\sqrt{w(x_0)}$) and for $|\varepsilon|=10^{-7}$ such velocity is approximately 3.7 times less than velocity v_{00} corresponding the deuteron energy of 1 eV. If $|\varepsilon|=10^{-6}$ then the velocity v_0 is approximately 2.7 times greater than velocity v_{00}.

It turned out that the numerical tables for values of w,τ obtained under different values of ε<0 in the interval (-10^{-24},-10^{-6}) don't differ essentially from each other. The following table is true up to three-four significant figures for τ and $\dot{x}/|\varepsilon|=\sqrt{w}$:

x	τ	$\dot{x}/\lvert\varepsilon\rvert$
-500 000	0	1.450
-50 000	$1.426 \cdot 10^{6}$	0.0493
-500	$1.002 \cdot 10^{7}$	0.000489
-200	$1.067 \cdot 10^{7}$	0.000440
-100	$1.090 \cdot 10^{7}$	0.000425
-80	$1.100 \cdot 10^{7}$	0.000423.

If reducing the table values of x to centimeters, we obtain the following corresponding approximate values:

$$5 \cdot 10^{-9}, 5 \cdot 10^{-10}, 5 \cdot 10^{-12}, 2 \cdot 10^{-12}, 10^{-12}, 0.8 \cdot 10^{-12} \ \text{cm}$$

The time interval ΔT, in which the deuteron reaches the critical distance 10^{-12}cm from the center is $1.090 \cdot 10^{7} / \lvert\varepsilon\rvert$ of our time units or $(1.090 \cdot 10^{7} / \lvert\varepsilon\rvert) \cdot 3.500 \cdot 10^{-25}$ seconds. If nuclear forces are not taken into account then the deuteron may approach the distance less $10^{-12} cm$. We present here for illustration the table, where the initial deuteron velocities v_0 in velocities shares v_{00} and the corresponding time intervals ΔT (in seconds) for different values of ε are listed.

ε	$\mathbf{\frac{v_0}{v_{00}}}$	**ΔT (s)**
-10^{-6}	2.7	$3.82 \cdot 10^{-12}$
-10^{-7}	0.27	$3.82 \cdot 10^{-11}$
-10^{-22}	$0.27 \cdot 10^{-15}$	$3.82 \cdot 10^{4}$ (≈ 10.6 hours)
-10^{-23}	$0.27 \cdot 10^{-16}$	$3.82 \cdot 10^{5}$ (≈ 106 hours)

Let us note that the given data changes essentially under positive values of ε (10^{-6}, 10^{-7}, etc.) There is some asymmetry of solutions behavior under negative and positive values of ε. The calculations show the minimal distance $|x|_{\min}$ more than 500 of our lengths units even for relative big initial $w(x_0)$ = 10000. Thus, if we limit ourselves to the condition that the deuteron energy is not over $0.27v_{00}$ at a distance of $5 \cdot 10^{-9}$ cm from the central nucleus, and the whole process of deuteron movement towards the nucleus does not exceeds approximately 10.6 hours, then the interval $(\frac{\pi}{2}-10^{-7}, \frac{\pi}{2}-10^{-22})$ is approximately the sought phase hole in the whole interval $(0,\pi)$ of phase change φ_0 in Eq. (3.1.5).

If many deuterons with velocity not more than $0.27\,v_{00}$ at the distance $5 \cdot 10^{-9}\,cm$ from the nucleus are equally distributed along their phases φ_0, the ratio of the length of this hole to π, equaling approximately $0.3 \cdot 10^{-7}$, is equal to the share (or the respective percentage of $0.3 \cdot 10^{-5}$) of deuterons overcoming the Coulomb barrier.

The above figures express at least the order of probability of the LENR occurrence, and this order is absolutely incompatible with the figures in the standard quantum mechanics mentioned above. Let us note once again that a one-dimensional problem was solved, and in case of an accurate analysis (not zero sighting distance will be taking into account) this probability will be lower. Let us also pay attention to the large time intervals ΔT calculated if $|\varepsilon|$ is very small. It explains well the effect (observed by many researchers) of continuation of cold fusion reactions even many hours after disconnection of the voltage in the electrolytic cells. This effect was named even “life after death”.

As for the analysis of the deuteron movement with the help of the autonomous equation, the calculations lead to initial velocities v_0, exceeding the above mentioned numbers, although the general motion picture is the same. But the autonomous equation is interesting, because in the area of those values $x, \dot{x}$, under which the product $x\dot{x}$ has a small modulo, it is possible to replace $\sin(x\dot{x})$ with $x\dot{x}$, and consider under ε = 0 the following equation (describing the deuteron motion from initial point $x_0 > 0$ to the center)

$$\ddot{x} = a\frac{(x\dot{x})^2}{x^2} = a\dot{x}^2$$

This equation has a very simple analytical solution. Without giving very simple calculations, we will present the final formulas.

Let us take the following initial conditions:

$$x(0) = x_0 > 0, \quad \dot{x}(0) = -v_0 < 0$$

Then

$$\dot{x}(t) = -\frac{v_0}{1 + av_0 t}, x(t) = x_0 - \frac{1}{a}\ln(1 + av_0 t).$$

It follows from these formulas that the velocity of a particle moving in accordance with the initial equation never turns to zero, and under

$$t = t_* = \frac{\exp(ax_0) - 1}{av_0}$$

$x(t_*) = 0,$ i.e. the particle reaches the center of the nucleus, its velocity at this moment being

$$\dot{x}(t_*) = \frac{-v_0}{1 + av_0 t_*} = -v_0 \exp(-ax_0),$$

so that it passes through the nucleus and moves further!

For example, let a=0.0144967, $x_0 = 1000$ ($\approx 10^{-11}$cm), $\dot{x}(0) = 5.37 \cdot 10^{-10}$ (≈ 16 cm/s). Under such initial data, the product $x\dot{x} = -0.0000537$, so it is quite possible to replace $\sin(x\dot{x})$ with $x\dot{x}$. In this case,

$$t_* \approx 2.3 \cdot 10^7 \quad (\approx 8 \cdot 10^{-18}\text{s}),$$

$$\dot{x}(t_*) \approx -29.9 \cdot 10^{-17} \quad (\approx 9 \cdot 10^{-6}\text{cm/s})$$

These figures fit well into the reasonable framework, so the autonomous model can also be used for the movement analysis in the problem under review. The phenomenon of particle passage through the Coulomb potential accounts very well for the existence of pendulum orbits in the Bohr-Sommerfeld model, when in states 1s, 2s, 3s etc. the electron passes through the nucleus. Such states in the strict theory and experiment have no impulse, so in the Bohr-Sommerfeld model they were discarded as absurd. Now they have a right to exist. Further, the experimental data for angular distribution of non-elastic scattering by nuclear reactions (including reactions with heavy ions) reveal the big amplitude of the scattering forward. It is impossible to explain such effect by the formation of intermediate nuclei but it may be explained from the viewpoint of our UQT.

3.1.5 Transmutation of Isotopes in Biosystems

Discussing LENR problems, it seems to be a good idea to pay some attention on dramatic story of extremely interesting results in biological investigations of transmutation of isotopes in biosystems. The problem of transformation of the matter became perfectly real. Some words from Russian scientists V. Vysotskyj and A. Kornilova in their book "Nuclear fusion and transmutation of isotopes in biological systems" [203]: ... - On the grand scale, life itself, realized as a form of existence of protein objects, is a big mystery. It is an anti anthropic process, maintaining order in the world of chaos. Its explanation from the point of view of a big fluctuation cannot, essentially, explain anything... Stability of DNA, giving the probability of mutation of no more than 10^{-7} regardless of local conditions and the makeup of nutrient media, is one such mystery.

The objective of conducted experiments was detection and study of the possibility of running a low-temperature transmutation of isotopes in growing microbiological cultures. Having acknowledged the need for simple registration, we made the decision to use the Messabauer effect on the basis of isotope Fe^{57} in our first experiments. Iron is the integral part of the majority of live organisms. Importantly, for most biological objects, the regular isotope Fe^{57} and the rare Mossbauer isotope Fe^{57} are identical. From the point of view of nuclear physics, they are completely different nuclei. Those experiments were based on the expected synthesis reaction of the Mossbauer isotope Fe^{57}

$$Mn^{55}+D^{2} = Fe^{57}$$

in a microbiological culture, that grows in the iron-poor water-salt nutrient medium based on the heavy water D_2O containing manganese salt. Among the undisputable advantages of using manganese is its single stable isotope Mn^{55}. This circumstance makes interpretation of experimental results unambiguous. The result of the expected synthesis reaction is formation of a rare stable isotope Fe^{57}, concentration of which in natural iron is very small and equals 2.2%. The apparent advantage of this reaction is Fe^{57}- the most studied Mossbauer isotope, it can be easily identified using the Mossbauer effect. Accumulation of this isotope with increasing of the reaction's efficiency and its duration makes possible (at least in perspective) to study temporary patterns of transmutation process.

Above all, since natural concentration of Fe^{57} isotope is small, its synthesis can be easily registered by traditional mass-spectrometry based on the analysis of changes in relative distribution of isotopes of iron. In the course of conducting the experiments, a thorough check for artifacts was performed.

The experimental data has shown that:

Isotope Fe^{57} is not found in significant quantities in the ingredients of the nutrient medium;

Isotope Fe^{57} is not present in heavy water and cannot be extracted from glass or air during the microbiological culture's growth. The structure of the gamma-absorption specter of Fe^{57} isotope in cultures grown in the media based on light and heavy water is the same.

Therefore, Fe^{57} isotope, detectable after completion of the microbiological cultures' growth in the optimal nutrient medium is not related to artifacts and is generated in the low-temperature reaction of nuclear transmutation

$$Mn^{55}+D^{2} = Fe^{57}$$

in the process of these cultures' growth.

Finally, we shall examine thermodynamic consequences of the given reaction. Since the reaction of synthesis

$$Mn^{55}+D^{2} = Fe^{57}$$

is energetically efficient and should run with energy emission, the average power, which could be generated in the dish with the optimal nutrient medium, can be calculated from the difference of mass defects of the nuclei participating in the reaction $Mn^{55} + D^2 = Fe^{57}$. The difference of mass defects of the isotopes participating in the reaction of transmutation is equal 15.605 MeV. Using the experimentally obtained values, authors [203] calculated that the average power, generated during the process of transmutation in a dish with volume V= 10 cm3, does not exceed the value of 75--40 mWt.

Leaving aside the special question of distribution of this energy among products of the reaction, we note, that this power — even if fully converted into heat — could not significantly alter the thermal regime of culture's growth (especially provided that the growing process was performed in an automatic thermostat).

Numerous experiments with the LENR (including the latest of Andrea Rossi - Italy) have shown that nuclear reactions do exist but the nuclear reactions products by themselves are not enough for the explanation of huge amount of heat being produced. It is the responsibility of the UQT solutions “Maternity home” [183, 195, 200, 201]. So it looks like catalysis mechanism described in [173, 185]. Besides all the equation with oscillating charge is quite good in describing the wave properties of the particle. We predict that experiments on the diffraction reflection of electrons from the lattice (classical experiments of Davisson-Germer) can be simulated by supercomputer, but authors do not have such possibility.

There are especially many such facts in the fringe areas, where different sciences are closely and unusually intertwined (for example, biology, physics, chemistry). On the grand scale, life itself, realized as a form of existence of protein objects, is a big mystery. It is an anti anthropic process, maintaining order in the world of chaos. Its explanation from the point of view of a big fluctuation cannot, essentially, explain anything.

Other phenomena occurring in living objects are not less mysterious. Stability of DNA, giving the probability of mutation of no more than 10^{-7} regardless of local conditions and the make up of nutrient media, is one such mystery. This fantastic procreative consistency throughout the whole specter of external conditions cannot be explained by the effect of a DNA polymerase controlling that process. In a nutrient environment, some necessary chemical elements may be missing, external conditions may change, and yet the process of undistorted and non-mutating procreation prevails with constantly high efficiency! Even super powerful radiation fields cannot disrupt it. The bacterial culture "Deinococcus Radiodurans" comfortably lives multiplies and does not mutate in radiation fields with the dose exceeding 10 Mrad.

Many structural materials cannot sustain such dose of radiation (not to mention such materials as crystallized silicon, which is the basic material for all microelectronic devices, and which completely degrades in such conditions), but a biological object, maintained by the rules of genetic information can successfully live and develop! It appears that biological objects have an internal source of high stability and reliable self-regulation, which inanimate objects do not have. How does it happen? Where is that internal source of stability? What are the limits of self-regulation? Can these processes be controlled?

Why can a living system, seemingly fragile and sensitive to external conditions, perform the process, which is practically impossible to achieve (at least with a comparable degree of efficiency) in inanimate objects? How does it do it? Why does it do it?

When answering these questions, we proceed strictly from solid facts and methods of modern science. We are not inventing new myths, but basing our deliberations on the principle of "not to create any substance in excess of the necessary" and trying to explain all facts using the tested methods, without introducing (as it is often done) a new radical theory to explain each fact. In this respect we are definite conservatives.

For this reason, we don't think, that the totality of the effects being analyzed can be called "biological transmutation". That name would give it a semi-mystical flavor, which, by no means, reflects the essence. In reality, it is transmutation of nuclei (isotopes) in biological systems occurring according to strict laws of physics, but induced by certain features of biological objects' structure, functioning as stimulators and intrinsic in dynamic living systems.

The series of works by Louis C. Kervran [75] holds a special place in the chronology of transmutation of chemical elements and isotopes in biological objects. Effectively, he was the first scientist of the post-nuclear era, who conducted systematized research of possible transmutational processes of chemical elements in biological objects. In his works Kervran gave numerous examples of unusual changes in the chemical composition of various biological objects, which occurs during their growth. He explained these changes on the basis of existing concepts of transmutation of chemical elements.

For example, among the most important, he investigated the reaction of potassium transmutation into calcium in the biological system containing hydrogen (with a participating proton). His works contain reasonably convincing experimental results. This data corresponds to changes in potassium and calcium content in the process of growing seeds and were obtained from the analysis of 840 seeds and 403 sprouts. It can be seen that the decrease in the amount of potassium (K = -0.033 g) and the increase in the amount of calcium (K= 0.032 g) are approximately equal. Meanwhile, the amount of magnesium stays practically unchanged.

Kervran also investigated many other reactions of transmutation of isotopes, among which several should be specifically noted for their vital activity importance in producing essential elements Ca, K, Mg, P.

$$Mg^{24} + O^{16} = Ca^{40},$$

$$Si^{28} + C^{12} = Ca^{40},$$

$$Na^{23} + O^{16} = K^{39}$$

The objective of conducted experiments was detection and study of the possibility of running a low-temperature transmutation of isotopes in growing microbiological cultures.

With other hand, may be, there is no nuclear energy liberation, because the nucleus remains stable both before and after reaction. Apparently, that is absolutely new type of nuclear transmutations unacknowledged by modern nuclear science, but experimentally discovered sufficiently long ago.

3.2 Conservation Laws and Unitary Quantum Theory; Perpetuum Mobile and Modern Science

E. Rutherford disdained complicated theories and considered any theory being good for nothing if it cannot be told to a barmaid.

Hans Frauenfelder&Ernest M. Henley. Subatomic Physics.

Inventors and swindlers of every stripe and range many years tried to construct or even to design perpetuum mobile, i.e. imaginary mechanism able to work without outside energy supply. Peter the First (Russian Emperor Peter Great) had even established Russian Academy of Science for such researches (see. V. L. Keerpechev, “Talks about mechanics”, Gostechisdat, 1951, page 289), but today persons from modern Russian Academy of Science would like to forget that circumstance. At the other side French Immortals have decided in 1775 to consider no projects of perpetuum mobile, and it seems they have not been mistaken jet. However one mistake is known: Daniel Bernoulli was awarded a prize by French Academy for mathematical proof that a boat with engine and screw propeller would never have faster speed than sailing ship!

Magnificent successes of classical thermodynamics have strengthened Humanity confidence in Divine Infallibility of Conservation Laws. Today it is considered nearly indecent to call in question these laws.

First of all let us clarify the origin of conservation laws in classical mechanics [158, 159]. Nearly each textbook contains a statement that Energy Conservation Law (ECL) results from homogeneity of time, Momentum Conservation Law results from homogeneity of space, and Angular Momentum Conservation Law – from isotropy of space. And so many people are impressed that Laws themselves result from space-time properties that nowadays are no doubt a relativistic conception. But for example angular momentum is not a relativistic conception already. Therefore such restricted approach is not totally correct; Newton's second law of motion or relativistic dynamics equation and concept of system closeness should be attracted. More over the requested space-time properties themselves are usually wrongly being interpreted. For example, it is assumed that time homogeneity means simple equivalence among all moments of time and homogeneity and isotropy of space means equivalence of all its points and absence of preferential direction in space (all directions are equal) correspondingly.

But these statements are sensu stricto wrong. For example, within many mechanical systems the Earth center direction and horizontal direction differ in principle (for example, pendulum clock located in horizontal plane will not work at all). We can say the same about the body being at the top of the hill, it is able to roll dawn independently, but according to classical mechanics it never climbs by itself. And for a person, being young or old, these moments of time are not equal at all. Hereinafter we would like to explain in what way all that should be understand.

Time homogeneity implies that, if at any two moments of time in two similar closed systems somebody runs two similar experiments, their results would not differ.

Space homogeneity and isotropy means that if closed system is moved from one part of the space to another or oriented in other way, nothing would be changed.

Derivation of energy and momentum conservation laws from Newton equation is quite simple in idea. Viz., let us write down the main equation of dynamics in form of

$$\mathbf{F} = \frac{d\mathbf{P}}{dt} \tag{3.2.1}$$

For closed system F=0 (there are no external forces) and the equation possess the integral

$$\mathbf{P} = \text{Const}$$

expressing the momentum conservation law.

Now let's write the main equation of dynamics in the form:

$$\mathbf{F} = m\mathbf{A} = m\frac{d\mathbf{V}}{dt}$$

and scalar-wise multiply it by V

$$\mathbf{F} \cdot v = m\frac{dv}{dt}v = \sum_{i=1}^{3} m\frac{dv_i}{dt}v_i = \sum_{i=1}^{3} m\frac{d}{dt}\left(\frac{v_i^2}{2}\right) = \frac{d}{dt}\left(\frac{mv^2}{2}\right),$$

where v is a modulus of velocity vector v. For the closed system F=0 it exists the integral

$$\frac{mv^2}{2} = \text{Const}\ v_i^2$$

expressing one of the forms of energy conservation law.

Using the definition of the angular momentum for the particle, i.e.

$$\mathbf{L} = [\mathbf{r} \times \mathbf{P}]$$

and differentiating it both parts by t, we obtain

$$\frac{d\mathbf{L}}{dt} = \left[\frac{d\mathbf{R}}{dt} \times \mathbf{P}\right] + \left[\mathbf{r} \times \frac{d\mathbf{P}}{dt}\right]$$

As the momentum vector is parallel to velocity vector, the first bracket is equal to zero. And basing on the equation (3.2.1) and on definition of central force, as one does not create a momentum, we get

$$\left[\mathbf{R} \times \frac{d\mathbf{P}}{dt}\right] = 0$$

and

$$\mathbf{L}=\text{Const.}$$

In the case of central force within unclosed system angular momentum remains constant in value and direction.

The energy and momentum conservation laws can be easily obtained within relativistic dynamics from relativistic relation between energy and momentum

$$E^2 = P^2c^2 + m^2c^4$$

The term m^2c^4 is an invariant, i.e. it is similar within all reference frames. In other words it is a kind of constant. This relation can be written in rather different form

$$E^2 - P^2c^2 = Const$$

To satisfy that relation one should admit that

$$\mathrm{E} = \mathrm{Const} \quad \text{and} \quad \mathrm{P} = \mathrm{Const}$$

And that is nothing else than energy and momentum conservation laws.

But strictly speaking in relativistic mechanics there is a law of conservation of four-momentum vector P^{μ}, but we are not going to stop at these details.

In accordance with the classical mechanics, the energy conservation law signifies that energy of closed system remains constant, hence, if at the moment t=0 the energy of such system is denoted by E_0, and at the moment t is denoted by E_t, then

$$E_0 = E_t.$$

In accordance with standard quantum theory, the energy conservation law is laid down in the same way. Within that theory we have the same integrals of motion as in classical mechanics. Some value L would be an integral of motion if

$$\frac{d\hat{\mathbf{L}}}{dt} = \frac{\partial \hat{\mathbf{L}}}{\partial t} + \left[\hat{\mathrm{H}}, \hat{\mathbf{L}}\right] = 0 \qquad (3.2.2)$$

As $\left[\hat{\mathrm{H}}, \hat{\mathbf{L}}\right]$ is determined by commutator of operator $\hat{\mathbf{L}}$ and of Hamilton's operator $\hat{H}$, so any quantity L, being not evidently dependent on time will be an integral of motion if its operator commutes with $\hat{H}$. When quantity L is not evidently dependent of time, then the first terms in (3.2.2) vanishes. As remainder we have

$$\frac{d\hat{L}}{dt} = \left[\hat{H}, \hat{L}\right], \tag{3.2.3}$$

and, as we know, the quantum Poisson bracket vanishes for the integrals of motion being not evidently dependent on time. Thus,

$$\frac{d}{dt}(L) = 0.$$

In any good work dealing with quantum theory it was shown that probability w to observe at any moment t any value of such motion integral L, does not depend on time either. We will denote below such integrals of motion L_n. As far operators $\hat{L}$ and $\hat{H}$ commuted they had common eigen-functions that were functions of stationary states. We should note that the last were obtained from solution of Schroedinger equation without time (not containing t) which is derived from full Schroedinger equation if

$$\Psi(r,t) = \Psi_0(r)\exp\left(i\frac{E}{t}\right),$$

i.e. if this equation has the periodic solutions. The solutions of Schroedinger equation not containing t satisfy conservation laws, which are, in fact, dictated by condition of total time-independence. The expansions of such solutions in eigen-functions' have the form

$$\hat{L}\Psi_n = L_n\Psi_n,$$

$$\hat{H}\Psi_n = E_n\Psi_n,$$

where

$$\Psi(x,t) = \sum_n c_n\Psi_n(x)exp\left(-i\frac{E_n}{\hbar}t\right) = \sum_n c_n(t)\Psi_n(x), \quad (3.2.4)$$

$$c_n(t) = c_n exp\left(-i\frac{E_n}{\hbar}t\right) = c_n(0)exp\left(-i\frac{E_n}{\hbar}t\right).$$

As (3.2.4) is eigen-functions' expansion of the operator L_n, the probability does not depend on time, i.e.

$$w(L_n, t) = |c_n(t)|^2 = |c_n(0)|^2 = Const$$

We should note once more that it is the probability to observe some given value that is time-independent, while, the value itself is occasional in each individual case. As far the energy is an integral of motion and probability w(E, t) so at the moment t energy value is equal to E and time-independent, then:

$$\frac{dw(E,t))}{dt} = 0$$

Quantum energy conservation law in the above mentioned form assume the possibility of energy determination at the current moment of time not taking into account its uncontrolled changes due to influence of the process of measurement itself. That situation have not risen any doubts within classical mechanics. But according to quantum theory (as we have written already in section 2.13), the energy can be measured without disturbance of its value only up to

$$\Delta E \geq \frac{\hbar}{\tau},$$

where τ - is the duration of measuring process. Formally, there are no troubles for energy conservation law, as the energy is the integral of motion and we have arbitrary large time interval to accomplish long measuring. For example, let measure within time τ, then leave the system alone for the time T, and then measure the energy once again. In standard quantum mechanics the energy conservation law states that the result of the second measuring will coincide to $\Delta E \approx \frac{\hbar}{\tau}$ with the results of the first measurement. But even according to standard quantum theory all this is not totally logical, because really existing vacuum fluctuations may meddle and they are able to change the result. Here we have evident violation of conservation law due to vacuum fluctuations, although the integrals of motion exist (contrary to UQT).

The standard quantum theory carefully avoids the question of conservation laws for single events at small energies. Usually that question either does not being discussed at all, or there are said some words that quantum theory does not describe single events at all. But these words are wrong, because the standard quantum theory describes, in fact, single events, but is able to foreseen only the probability of that or other result. It is evident that at that case there are no conservation laws for single events at all. These laws appear only after averaging over a large ensemble of events. As the matter of fact it can be easily shown that classical mechanics is obtained from quantum one after summation over a large number of particles. And for a quite large mass the length of de Broglie wave becomes many times less than body dimensions, and then we can not talk about any quantum-wave characteristics any more.

It is well known that local laws of energy and momentum conservation for the individual quantum processes are valid within all experiments at high energies only. We can not say so in the cases of law energies at least due to uncertainty relation and stochastic nature of all predictions in quantum theory.

The idea of global but not local energy conservation law is invisibly presenting in quantum mechanics and in any case is not new. From the physical viewpoint it just means that in stationary solutions with fixed discrete energies (standard quantum mechanics) the velocity of a particle reflected from the wall is equal to the velocity of an incident particle. If the particle energy decreases at each reflection, then that case corresponds to solution type "Crematorium" and if increases – to "Maternity Home" solution. The scenarios under which events will be developed depend on the initial phase of the wave function and particle energy.

In the strict Unitary Quantum Theory and in the theory of quantum measuring (chapter 1) un-removable vacuum fluctuations play a great role. It is quite clear that these fluctuations are totally unforeseen and non-invariant with respect to space and time translations. In other words, within UQT there are no habitual space-time properties. Now space-time is heterogeneous and non-isotropic. For example, if the experiment is replaced in any other point of the space or repeated at other time, then in the point where the particle's parameters were examining and particle is interacting with macro-device, another value of vacuum fluctuations would appear (differing from the previous one) that would give another result. Of course that is true for small energies and individual events (particles) only.

The Unitary Quantum Theory is much more destructive with regards to the notion of Closed System. For single events at small energies that notion is inapplicable at all because at any moment of time and in any place where the particle is located (for example, within potential hole) vacuum fluctuation may be abruptly changed. It may occur thanks to various causes; either due to the nature of vacuum fluctuations, or due to the tunneling effect of other random particle.

Few times it has been stated that energy conservation laws follow from E. Noether theorem, although those results have been contained in the works of D. Gilbert and F. Klein. For any physical system, the motion equations of which can be obtained from variational principle, every one-parameter continuous transformation, that is keeping the variation functional invariant, corresponds only one differential law of conservation and so explicitly conserved value exist. However, it can be easily seen that vacuum fluctuations being imposed on varying functional (Lagrangian) does not remain constant (in any case it seems so today) under parametrical transformations. That consideration does not work too without ensemble averaging either.

In other words, each requirement that leads to classical laws of conservation is absent now. It is hard to expect that the entire laws of conservation will remain valid in that situation for the single particles at small energies. But nowadays it seems that classical laws of energy, momentum and angular momentum conservation for the single quantum objects do not work at small energies due to the periodic appearance and disappearance of particles. All direct experimental checks of the conservation laws were carried out in the cases of great energies but in the cases of small energies for single particles probability results could be obtained only. In that case it is indecently even to recollect the idea of conservation law.

And now a bit of Philosophy for reader. Local Energy Conservation Law (LECL) for individual processes results from the Newton equations for closed systems. It is naive to think that its local formulation will remain constant forever. And it would be a gross error to transfer ECL without alterations from Newton mechanics to quantum processes inside microcosm.

Definitely speaking references to the first law of thermodynamics are baseless because it is a postulate. For example, in his letter to one inventor the famous Russian mathematician N. N. Lousin wrote: *"…first law of thermodynamics was a product of unsuccessful attempts of the humanity to create perpetuum mobile and frankly speaking did not follow from anything"*.

Today we can say with firm belief that no resourceful machines within the network of Newton mechanics are able to realize perpetuum mobile, and the decree of French Academy, accepted in 1755 to consider no projects of perpetuum mobile is still valid. We should add that is apparently true for all projects based on Newton mechanics only.

It is characteristic of the understanding of the position of ECL in modern physics that this low is bringing down, especially in theory, to the rank of second-order conclusion from the equations of motion. Some physicists reduce ECL to the statement of the first law of thermodynamics, others as for example D. I. Blochintsev [79] consider that "it is quite possible with further development of new theory ECL form will be transformed". As F. Engels wrote in his "Natural dialectics": *"…no one of physicists, in particular, consider ECL as everlasting and absolute law of the nature, as a law of spontaneous transformation of substance motion forms and quantitative permanency of that motion at its transformations."* Many of them are thinking in another manner as, for example, M. P. Bronshtein. He wrote in his work "Substance structure" ECL is one of the basic laws of Newton mechanics. And nevertheless Newton had not attributed to that law rather general character that law had in reality. The reason of that Newton mistaken point of view at ECL was quite interesting… Now it is understandable that in the light of the above mentioned such point of view was not wrong at all. And we should remind that Newton had foreseen in his "theory of bout" many things even quantum mechanics.

At the other side, the founders of quantum mechanics perfectly understood that the conservation law for the single quantum processes at small energies did not exist at all. So, the first thought that understanding of ECL on a par with the second law of thermodynamics, as statistical law, being correct on average and not applicable to the individual processes with small energies, appeared as despair and went back to Erwin Schroedinger first and then to N. Bohr, Kramers, Sleter and G. Gamov. In 1923 Bohr, Kramers and Sleter in despair tried to construct the theory according to which in the process of dispersion energy and momentum conservation laws were satisfied statistically on the average during long time intervals but were inapplicable to the elementary acts. Leo Landau even called that as “Bohr perfect idea” [79].

According to that theory, the process of dispersion should be continuous, but Compton electrons are emitted in a random way. The authors assumed both processes of wave dispersion and Compton electrons dispersion were not connected with each other (?). The main idea was to lay a bridge between quantum theory of the atom and classical emission theory. There were introduced specially so called “virtual” oscillators which generate in accordance with classical theory waves (non quantum one) enable to induce the transition from the state with lower energy to the state with higher energy. These waves did not carry the energy, but power necessary for atom transition from lower to the higher state was generated within the atom itself. Along with that the inverse process of the atom transition from excited state to the lower one could take place, but the energy was not taken away by waves but should disappear inside the atom. In other words, the increase of one atom energy was not connected with energy decrease in another one. Authors considered that these processes compensated each other on average only and that compensation was the better the more events are participated. Energy conservation law has statistical character according to that interpretation, and there is no law of conservation for single events, but they appear in processes involving large number of particles, i.e. at transition to Newton mechanics. But then it should be acknowledged that in the case of Compton effect the changes of motion direction of the light quantum and its energy to be appeared in the result of collision were happening apart from the changes of electron's state. The failure of such approach was lately experimentally proved by Bote and Geiger.

To say the truth, the authors abandoned that point of view later; moreover at that time this idea did not follow from quantum theory equations. And to get out of the tight spot it was declared that quantum mechanics did not describe single events at all. Thus the most striking paradox was removed by a simple prohibition just to think about it! But genius idea that laws of conservation are not valid for individual processes and appear in quantum mechanics after statistical averaging does not become less genius even if those for whom it "has come to mind" rejected it. May be, this idea was a little premature and should have a somewhat different shape.

Contrary to that Unitary Quantum Theory describes single particles. And the alteration of their behavior is determined not only by initial values of its position and velocity but also by initial phase of the wave function (of the wave packet). Then for the single particle local conservation laws do not exist at all. And that is quite another question how to measure the initial phase or any other parameters of a single particle.

Let us examine the following virtual experiment. For more simplicity let use in our reasoning some quantum ball-particle. If classical ball is running to the wall (for simplicity assume it as perpendicular), the velocity of the reflected ball would be equal to its initial velocity (we neglect friction and consider the ball and the walls as totally resilient). In the case of quantum ball the velocity of the reflected ball in various experiments with similar initial circumstances will have the whole spectrum of values: there will be balls reflected with the velocity higher than initial, equal to it and lower then initial. And all these will be described by means of quantum mechanics within uncertainty relation.

Let us ask what would be if we placed a second wall parallel to the first one in such a way the ball at each reflection increased its velocity? Then we would get the growth of the ball energy without any efforts from our side. The aim of future constructors of such systems in XXI century would be the necessity to create such initial conditions for the great number of particles forming the object, that is realized the sole solution “Maternity Home” and is suppressed as far as possible the other solution.

It is evident from the above-mentioned that at competent exploitation of the Unitary Quantum Theory ideas the principle prohibition for perpetuum mobile does not exist. Formally as it is shown above that prohibition does not exist even in standard quantum mechanics (there is no laws of conversation for single processes with small energies), and to get energy the particles should be selected in some way (grouping together all random processes with excess energy).

But the standard quantum mechanics refuses to describe single events and is not able to advise the way for grouping. As it seems today, the Unitary Quantum Theory gives us such an opportunity.

However, by efforts of scientific groups, interested in their own stability because of simple instinct of self-preservation the great idea of free energy generation was distorted to such a degree everybody who starts to talk about it is taken for mad.

The modern experimental physics have examined the correctness of conservation laws for huge energies in single cases and for large macro-object when ensemble averaging is used, but the area of small energies is terra incognita.

Let us show an example of the conservation laws violation for single particle reflection from Coulomb potential. Viz., we have obtained the numeric solutions of equations (3.1.3) and (3.1.4) under different values of the initial phase and following initial conditions:

$$\hbar = 1, m = 1, \quad 2Zze^2 = 1, x_0 = 100, \quad V_{x0} = -0.1$$

The plots in Fig. 3.2.1 and Fig. 3.2.2 show the distances between charges as functions of time at different initial phases.

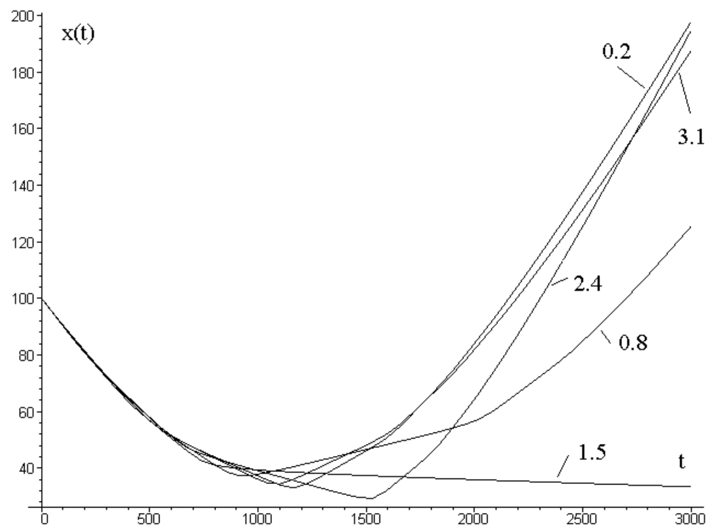


Fig. 3.2.1 *Dependence of distance between moving charges on time for solutions of equation (3.1.3).*

It is evident from calculations that the velocity of reflected particle may be equal, more or less than the velocity of incident particle. It seems that the similar situation can be observed at any potential. The calculations have been carried out for the following potentials also: harmonic oscillator, Yukawa, Gauss, doublet, hyperbolic secant and Wood-Sacson. The qualitative results are similar.

If summed the momentum of all particles falling down with different phases and compared it with summary momentum of the reflected particles, then, for example for the Coulomb potential, the summary reflected momentum would be at few percent more than the summary momentum of the incident ones. For the other potentials so small difference may be even negative. In general, that problem is very complicated and requires additional investigations, because the results depends in a complicated manner on initial conditions (initial velocity, initial phase and distance).

From the philosophical point of view any categorical prohibitions like impossibility of perpetuum mobile creation are absolutely unacceptable. If everybody will be convinced of that forever, then the laws of conservation and prohibitions for perpetuum mobile would remain unshakable for all civilizations while humanity lives. Of course, Conservation Laws funeral can continue very long. By the way, we are not going to do that, and may be our book only clears a little the place for further grave, and sumptuous funeral with proper honors will be done by future generations. On the other side, undoubtedly, these laws will never become a thing of the past and of course will be constantly used but at the beginning there will be small areas of science and engineering where these laws application will be evidently insufficient.

The truth should be accepted irrespective of the source it came from. That is why it would be useful to cite a quotation of "Natural Dialectics" of F. Engels:

> *"But when Solar System will finish its circle of life and suffer the fate of everything finite, when it will become a victim of the death, what will be later? Thus we realize that the heat radiated in world space should have the possibility in any way to be determined in future, to transform in other motion form where it will be able to be accumulated again and begin functioning. But in that case the main obstacle preventing the reverse transformation of dead suns into red-hot nebula will drop away".*

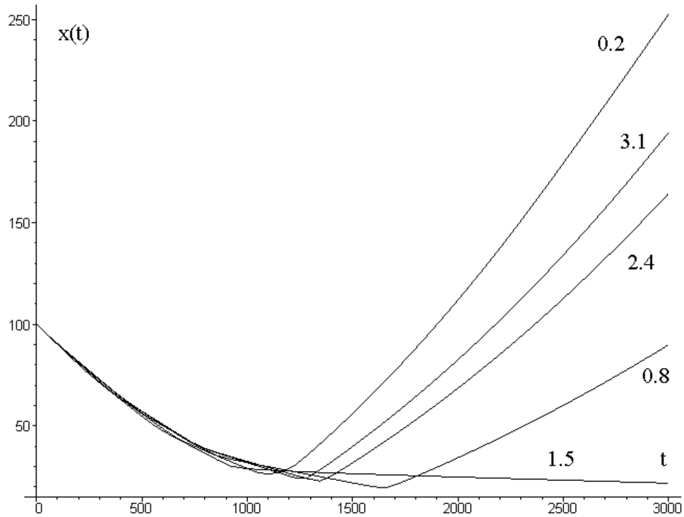


Fig. 3.2.2 *Dependence of distance between moving charges on time for solution of equation (3.1.4).*

The question whether the conservation laws exist in global form (we have already proved that it is not local) remains open. Nothing except human mentality inertia is leading to that. That inertia is based on Newton laws that have been already exchanged for the Quantum ones. Thinking inertia leads to the situations when in the cases of motion equations solving an excess energy appeared the question where it has come from arise.

Of course, if the particle (for example, photon) is falling down at half-transmitting mirror and is divided into two parts, then due to vacuum fluctuations superposition could be detected by photo multiplier tube full two photons. In this case the excess of the energy can be fixed, as if, obtained from vacuum: two photons instead of one. In other case, the photon divided at the mirror in two parts can be not detected at all and its energy is, as escaping into vacuum.

Once we have absorbed energy from vacuum, at the other time and in other act we have returned the same quantity. And so one might think, and probably such process takes place in reality. But if we examine solutions of the equation with oscillating charge, then the laws of energy and momentum conservation do not work in principle. Vacuum fluctuations have nothing to do with it. And the question where could energy appear from is based on the inertia of out thinking and as a matter of fact is an atavism, dictated by the Newton mechanics.

It is interesting that even in logical definition of the energy there is a bomb. If the energy is something that can neither arise nor disappear and is just always transforming from one form into another the single value that obeys these conditions is null. We are far from the thought that energy does not exist at all.

But the problem if its existence is being solved in various philosophical systems in different ways, but it seems the most correct approach is mathematical: an object exists if it is free from contradictions. But energy was not lucky, and thanks to that approach it should be null.

And many cosmologists would like to have theories, which assume that there are in Universe localities where the energy is coming into being and also other localities where the energy annihilates. For example, British astronomer Fred Hoyle has developed the theory of Universe where the continuous creation of matter takes place. He wrote:

> *"... Different atoms constituting the matter do not exist at some given moment of time and then after instant they exist already. I must admit this idea may look as strange... But all our ideas about creation are strange. According to previous theories the whole quantity of matter in Universe was coming into being just as whole and all process of creation looks as super-gigantic instant explosion. As for me, such idea seems much stranger, than idea of continuous creation..." F. Hoyle, La nature de l'Universe, 1952.*

The official astronomical science does not accept the ideas of F. Hoyle and of some other astronomers (H. Bondi, T. Gold, P. Jordan) about continuous creation of matter in Universe because the Conservation Laws are considered as infallible. But from the viewpoint of our UQT these ideas are not so strange.

3.3 Energy Generation in Potential Well and New Energy Sources

The highest mastery both in theory and practice is the ability to transfer a problem into postulate.

Jogann Wolfgang von Goethe

The energy carrier in mechanical systems is usually the moving mass. Its locomotion uses some form of energy. Contrary to that, in a wave process in any medium the energy is carried by the wave, and in this case the energy carrier does not deal with the carriage of mass, but the energy and the mass are connected by a proportionality constant. There are waves able to carry negative energy, but those arise within the inversion mediums and we are not going to examine so exotic case. As far energy and mass are different sides of the one quite hazy object, the energy generation and the mass generation are two names of one and the same process. As we will see later this takes place in UQT.

The ancient classical idea «perpetuum mobile» assume that energy is simply created but not obtained from outside (the impossibility of «perpetuum mobile» is in fact the first law of thermodynamics).

A lot of articles and even books examining the idea of energy extraction from vacuum appeared recently. We slightly touch in section 3.10 the problem of energy extraction in a random process and the interpretation (in our point of view, sometimes not entirely correct) of that problem.

One group of main ideologists of that new trend in science are Daniel C. Cole and Harold E. Puthoff, their first serious work titled «Extracting energy and heat from the vacuum» was published in Physical Review E, vol.48, #2, (1993). Here the authors are exploiting Quasi-space Casimir forces. The appearance of such forces in vacuum could be intuitively described in the following way. Suppose two big parallel plates placed in blusterous sea. Outside of those plates the waves would strike in rather random way and there would not be waves between the plates at all. The result of wave strikes from the outside of the plates would be attraction appeared between them (it is the Kasimir forces experimentally detected long ago). The authors of that interesting work were going to exploit that power. It is easy to see that here the energy is obtained from vacuum fluctuations.

In our approach everything is otherwise. Solving the equation with oscillating charge for the quantum oscillator we have detected 4 types of solutions. The most important for us are two of them: the "Crematorium" and the "Maternity home". According to one of them (the "Crematorium") the particle slowly descends to the well bottom and in the end transforms into a phantom (in accordance with strict UQT the particle has disappeared, has got spread all over the Universe, and makes its contribution to vacuum fluctuations everywhere). In accordance with the other solution – the "Maternity home" - the particle is able to appear from rather small fluctuation and produce quite big energy.

We should underline once again that both processes are not connected logically to each other. In other words, one can imagine mathematical systems where energy either vanishes (electrolytical baths, see paragraph 3.4) or unrestrictedly increases (probably, it is our Universe). And the energy conservation law is the greatest drag in any cosmological points of view. However, the theories considering the Universes, where the creation of matter takes place (see above sect. 3.2), appeared in scientific cosmology long ago independently of us. The question whether such model is realized in the nature at all and whether the energy generated by quasars a result of some huge well effect, - will be the most intriguing questions of future.

We should note once again that it is not clear yet whether the values of appearing and disappearing energy corresponding to our solutions are equal. But the vacuum (as enormous set of random oscillations) is considered in no way as the source of the energy generation within UQT. Of course UQT admit such exchange between vacuum and energy (section 1.5)

For example, in the case of a photon splitting on a translucent mirror sometimes both photon halves are not detected, they vanish (put out energy into vacuum) and disappear for the researcher at all, at sometimes two packets are detected, as it were obtained from one, and the excess of energy is taken from vacuum. But the motion equations themselves know nothing about vacuum and are able to generate energy by their nature (they are non-invariant in respect to coordinates translations) and the laws of conservation so habitual for us do not exist for them.

Remind once again that the last result from Newton equations, and Newton equations appear at doings ample quantity averaging, and there are no laws of conservation for single events at small energies.

In other words philosophically speaking we can say that some motion being started at once in future will create other motions (energy) and, as a result, a substance. And as far the most various and giddy speculations are possible here, right up to Universe creation we are going to stop here.

Thus, according to our approach the generated or vanishing energy can be manifested not only in changes of the particle velocity while a particle moving in any potential field, but also in appearing or disappearing of particles. The changes of the particle velocity in motion can be easily detected. In particular, the velocity increase can be used for the generation of both heat and electric current. May be there are power systems where the fact of charge oscillation and its effects are exploiting (see the following sections 3.4 -3.11). Perhaps these phenomena, which are in conflict with the most fundamental laws of the modern science, were discovered long ago. Perhaps they are and even are used. But exactly these phenomena are easy to operate at the first stage of such new energy technologies development.

To develop such energy generation technology it is necessary to suppress the solutions of "Crematorium" type. But all quantum processes are based on elementary acts and each individual process is not a subject to separate control.

But if one controls the probabilities of such processes, they, being multiplied by the great number of process participants, automatically become macroscopic variables of quantum kinetics and the process become possible. That can be easily done by choosing the process members having correlated initial phases.

3.4 Review of Some Anomalous Phenomena Connected with Violation of Traditional Fundamental Laws

You see things that are and asking "Why?" As for me I'm imaging things that have not been yet and say "Why not?"

George Bernard Shaw

In accordance with our theory, the conservation laws are not valid for the single micro-particles, they appear after averaging over particles' ensemble only. Thus, if one were able to collect together all processes generating energy and suppress those ones with vanishing energy it would be able to obtain a classical «perpetuum mobile» (it has been already considered in details in section 3.2).

All this is particularly apparent in the problem of the oscillations of the harmonic oscillator, where four types of solutions can be obtained. Three of them are of the most importance for us: the stationary one, the "Crematorium" and "Maternity home", traditional laws of conservation do not work in the two latter ones. Such behavior of the oscillator is able to explain most part of experimental data (we should remind that these solutions apparently take place not only within classical parabolic potential $U(x) = \frac{kx^2}{2}$, but within many other potentials too). But the UQT and the equation with oscillating charge differ in many aspects not only from the classical mechanics equations but from some equations of electrostatics and electrodynamics also.

There is a fundamental theorem about circulation for electric field. Let us examine it more detail. Assume there is the vector's field (of electrostatic or gravitational character):

$$\mathbf{E} = P(x, y, z)\mathbf{i} + Q(x, y, z)\mathbf{j} + R(x, y, z)\mathbf{k}$$

Circuital integral

$$\Gamma = \oint(Pdx + Qdy + Pdz) = \oint \mathbf{Edl} \qquad (3.4.1)$$

is called the circulation of vector field **E** round the closed contour (or path) l. Of course circulation depends not only on **E**, but on the direction of integration along l; the change of the tracing direction leads to the sign change. The form (3.4.1) is convenient for mathematicians, but for our purposes we will write (3.4.1) in slightly differed form. If we multiply both parts of the equation (3.4.1) by the electrical charge q then we will obtain in the right part the integral of the force qE along the path dl, i.e. work necessary to move the charge along the closed contour. It is well known that its value is equal to zero.

$$\oint q\mathbf{Edl} = \mathbf{0} \tag{3.4.2}$$

If that value were not be equal to zero, the source of energy could be created. For this purpose it is necessary within the electric field E to shift the charge from the point a, located in the area of high field strength, to the point b, where the field is weak, and then move it back to **a** along another path. The values of work of $a \to b$ and of $b \to a$ would be different and we would be able to derive work from the field without any changes of the system. When the charge is constant, no doubts it is true, that is why in the case of a macroscopic constant charge that theorem is some analogy with the energy conservation law. We have not met similar interpretation of the energy conservation law in other works. If the charge is microscopic, it changes, depends on time, coordinate and velocity, and effects produced at moving $a \to b$ and from $b \to a$ will be different. And then in principle it would be possible to extract work from the field without any additional changes in the system.

Furthermore now we have tunneling possibilities different from ones predicted by standard quantum mechanics, we have analyzed in sections 2.5. and 2.6. According to our approach the probability of tunneling depends on the phase of wave function. That will be used in further analysis.

Now we will describe and analyze some unusual experimental results, some unusual devices meant for laboratory or even industrial use. The authors of this book have nothing to do with these experiments and devices regarding many of them with skepticism. The problem is that the sphere of new sources of energy – is a headache of the all-human civilization. The dividends in that can be high as nowhere else. So, surely, there could be a lot of swindlers (the last are even among theorists) and simply honesty mistaken persons in that field. The official science in the whole world do not believe to such researchers, but the most suspicious fact is the extraordinary number of such projects, and it is not out of place to list here the Russian (may be, not only Russian) saying "There is no smoke without fire".

The fact is that an absolutely youthful sphere of power engineering has appearing nowadays. It is thriving on, a lot of new devices are appearing that differ substantial from the existing ordinary energy converter and generate additional energy, i.e. possess the efficiency more than 100%(!). The English term "overunity" has been specially invented for such devices.

In the USA such works are not officially supported by the state yet (unlike the problem of hot nuclear fusion), but a huge number of private companies and single businessmen are carrying out such researches. Special magazines involved in that problem have been established in the USA: Journal of «New Energy», «Infinite Energy», «Cold Fusion», «New Energy News», «Fusion Facts». In Russia the Journal "New Energy Technologies" (St. Petersburg, published in English and Russian) is established. Among the countries where the problems of new power engineering are studied quite seriously are Switzerland (where the Journal "NET-Journal" is published), Italy, Germany, France, Japan. Japanese researchers are in extremely earnest about these problems. It appeared that the most advanced country in the field of these problems research are not USA but Japan, the last is even financing many institutes within USA in the network of that problem. Japan total cost of research work is more than $200.000.000 per year. We may forecast that at Japanese mentality and state policy aiming the export not the minerals but the products of high technologies and intelligence, that country will be among leaders in the beginning of XXI century. In Russia such researches are also carrying out, but till now mainly on the base of personal enthusiasm.

Let enumerate some of interesting directions in new power engineering:

1. Patterson fuel element.
2. Super- magnet super-engines Tahahashi, Apsdent and Adams.
3. Swiss device Testatika.
4. Engines working on water.
5. Griggs hyper-sound pump, heat-generators of Potapov and Schaffer.
6. Cluster systems of Kenneth Shoulder and Hal Fox.
7. N – machines of Faraday, Bruce de Palma, Neumann, Searl, Tewari and others.
8. PAGD reactor of Canadian researches P&A Correa.
9. E-Cat Andrea Ross-Italy.

We should add the astonishing experimental results of A. Samgin and A. Baraboshkin (Russia, Institute of High-temperature Electro-Chemistry RAS, Ekaterinburg) [63, 64] and of T. Mizuno [65] (Japan). They have used, apparently independently one from each other, some special proton-conductive ceramics that is able to generate the thermal energy thousands time more than energy consumption if current runs through it. In some experiments of T. Mizuno that value exceeded 70000(!). In private talk with one of the authors T. Mizuno said that he was worried to get sick with radiation sickness due to exposure of radiation. However no α, β, γ radiation or nucleus fragments were detected and, consequently, nuclear processes (fusion) are not responsible for such energy liberation. Such proton-conductive (to be more correct – deuteron-conductive) ceramics was created with of a powder metallurgy method by agglomeration at high temperature. In other words all chemical processes had finished long ago. The origin of such a great quantity of excess energy is unexplainable in the framework of usual science, because it can not be explained either by nuclear or chemical reactions or by changes of phase. The authors of that experiment thought that reactions of nuclear fusion like D+D took place. At our request A. Samhyn exchanged deuterium for hydrogen in his experiments. If that great energy generation were had to do with nuclear D-D reactions all anomalous heat efficiency would disappear, but it remained valid. After so great energy emission the tablet went to powder.

These effects can be easily explained from the viewpoint of the harmonic oscillator theory. Caverns of hundreds Angstroem (units) appear in the tablet during agglomeration. While passing direct or alternative current, moving protons or deuterons (such ceramics contains few electrons) get into these caverns and there the processes described as “Maternity home” may start. The particle oscillates within the well taking the energy and in the long run that energy will be enough both for heating and for breaking the walls of the well (the tablet becomes powder). It seems that the same processes take place within palladium electrolytic cell containing heavy water and within nickel electrolytic cell with ordinary water.

It would be better if one experimentally tests the tunneling dependence on initial phase. But as it seems to us it would be more important for our critics as both cold nuclear fusion (CNF) and discovery of nuclear transmutations (from the modern science point of view the last is more nonsense than observations of CNF are) can not be apparently explained in any other way. Besides a lot of people and groups all over the world believe of phenomenon of nuclear transmutations can be used for processing and utilization of radioactive wastes. Moreover, the question of industrial generation of tritium with the CNF technology from a military view is studied in Los-Alamos with the support of army. Magazines and Internet are full of such news. We are not going to place here Internet address, because everything is constantly changing in that lively system.

Let us analyze some of the above-mentioned devices.

The first and the most "ancient" and strange news were numerous information about internal-combustion engines working on water. Here we give one example only: when we were students one of our lectures the late Prof. G. V. Doudko (1959) told us that in 1951 he had participated in testing of internal-combustion engine [81]. The device was a hybrid of a diesel and a common carburetor engine. That device was started using a glass of petrol. Then the ignition was disconnected. Instead of fuel, pre-heated compressed water was supplied into the drum with a usual diesel fuel. Pump in drum was supplied water with some additives. (The inventor was adding them in the tank by himself, and it is clear now these additives were the main secret). The engine was placed at the boat. The inventors boated during two days in the Azov Sea. Engine exhaust consisted only of water vapor. The fuel was water. Prof. G. V. Doudko was scooping it himself from the sea and filling the tank. The engine required a lot of water, many buckets a day, but there was no lack of the water…The question why if it is so amazing these engines are not used, can be asked only by someone who has never lived in Russia.

The possible theoretical explanation of above can be given by solutions of the harmonic oscillator problem [58, 82-86]. Viz., if a highly compressed quantity of water with appropriate additives (namely these additives are the main secret) is injected into the drum, then each water drop starts to expand and passes owing to inertia the equilibrium position. In the result caverns (empty volumes) in few tens of Angstrom each can appear inside. If a free proton gets into such cavern (or any other micro-particle) with an appropriate phase (we assume that such phase is owing, namely, to additives), then as a realization of "Maternity Home" solution some of the drops will blow up…Many times we have heard and read about Russian inventors created and successfully tested engines working on water with some secret additions.

Of course we can not totally avoid the probability of water catalytic decomposition with law energy inputs in the drum. All this is examined in details in sections 4.2.-4.4. Such energy sources would be absolutely pollution-free, and the only limitation would be the heat pollution of the environment.

The ideal solution for the motor transport would be use of some new types of electric energy generators also. UQT assume even the possibility of such systems, many times experimentally studied both by Nicola Tesla and Canadian physicians Correa, who have even patented the system, generating electric current by taking the energy, as they thought, from vacuum fluctuations [87, 88]. The readers have the possibility to acquaint themselves with our detailed theory of these processes in paragraph 3.5. Besides the ideal system for motorcar would be, of course, Testatika.

The thermal cell CETI (created by James Patterson in 1995 [66]), using electrolyze of specially manufactured nickel bolls in common water, has shocked scientists in USA. American newspaper «Fortean Times» No 85, 1995, wrote about it: "December the 4th, 1995 will go down to history!" At that day the group of independent experts from five American Universities tested the work of new energy source with stable output heat rating 1.3 kWatt. The electric energy input was 960 times less." All experts noted that generated heat had enigmatic origin and would be explained neither by chemical or nuclear reactions nor by phase transitions. By American ABC TV there were two telecasts at 7th and 8th of

February, 1996 in cycles «Nightline» and «Good Morning America» about Patterson creation of new source of energy, able to generate in hundred times more energy than it had consumed. And again it were accentuated that the origin of generated heat remains mysterious. It is interesting that American Company Motorola made attempts to buy the patent for cell CETI for US$ 20.000.000, but was rejected. We are sure that Motorola Company had spent a certain sum for the study of that problem before making so serious an offer. All processes within the Patterson cell do not concern nuclear reactions (although Patterson thinks otherwise), and at our opinion can be explained with the same processes used here above for the description of proton-conductive ceramics.

Experiments of Andera Rossi at his E-Cat have agitated the Europe. It's difficult to falsify any generation of energy at the level of 1 MWatt. We cannot make the final assessment of these processes because of the absence of the most important details, and we cannot find anything apart some articles in the internet. By fragmentary information the E-Cat looks like a ceramic tube with conventional Nickel powder filled under pressure with Hydrogen. The heat (thousand times more than in any chemical reaction being processed in the same volume) is generated during very long period if current runs through the tube, so 1 watt of electric energy input generates 4-5 watt of thermal energy (in fact the energy totally can be transferred into the heat). Experts who repeated that experiment in Sweden and Switzerland with no doubt insist that great excess heat is existing, but the principle of what is going on is absolutely unclear due to the absence of any radiation. The analysis of rest Nickel powder shows the presence of Cupper. For complete understanding of the principles of the running processes it would be better to see the microscopic photos of the powder before and after experiment. Nevertheless we can make some simple conclusions on the basis of UQT.

First: there is a nuclear reaction

$$Ni^{62} + p \to Cu^{63}$$

impossible in general quantum theory, but reasonable in UQT. By laws of general nuclear physics basing on mass numbers transformation this reaction is endothermic, i.e. no energy can be generated. According to UQT it is an absolutely new type of nuclear transmutation where proton of very low energy penetrates inside the nucleus. It is like a tunnel effect: one stable nucleus transforms into another stable nucleus with no energy generation, this phenomenon is described in details in section 3.1.

Second: It seems that the nature of heat relates to the processes obeyed by solutions of “Maternity Home”. Proton or any other free atom (it can be even a nickel) gets in cavern in a grain of Nickel powder (this processes requires certain size of caverns) and then heat is generated by realization of “Maternity Home” solution. The process is described in 3.3. There are a lot of such examples above. By the way nuclear transmutation has nothing with heat generation even in classical experiments because the volume of the nuclear reaction products is not enough for the observed thermal effects always. The time will dot the i's and cross the t's in these processes.

The phenomenon of sonoluminescence looks absolutely darkly too. According to it some liquids begin to glow when a weak ultrasound passes through them. That experimentally established phenomenon was discovered by Professor of Moscow University S. N. Rghevkin in 1933. It still has no satisfactory explanation. As the Nobel Prize laureate Prof. Julian Shwinger said, *“it did nothave the right for being but existed”* [90]. And again it can be explained from the above-mentioned viewpoint of UQT.

Moreover, there are heat generators (Yu. Potapov [60-62, 91], (*) - Moldova, James J. Griggs [68], Huffman T. [69], - USA and other). Inside of these generators the forced circulation of usual water takes place getting warmed during this process while the intensity of the water heating corresponds (if taking into account all energy expenses) to efficiency 150-200% and more. The cause of such heating is unexplained within the standard quantum theory and no question about any chemical or nuclear reactions arise.

It is possible to explain the principle of the functioning of such generators within UQT. The fact is that in the water flow inside of generators a lot of cavitations bubbles are created. That is made either by the water flow interrupt with a special rotor (J. Griggs, Huffman, Schaffer), or by swirl jet with a special elbow with further getting into the abrupt enlargement zone where cavitation bubbles are appearing (Yu. Potapov). It should be said that in general even now the cavitation is a great mystery for theoretical hydrodynamics and science at all. For example, forged large-tonnage screw propeller of huge nuclear-powered submarines may be destroyed in few hours only due to cavitation, with appropriate work conditions and geometry of surrounding forms. That takes place because of huge energy to be generated in cavitating bubbles. Viz., the behavior of particles inside of the bubbles may be describes by our solutions of the harmonic oscillator's problem. According to these solutions, any particle getting inside of the bubble will oscillate between inner walls of the bubble. The velocity of particle having certain values of the phase will increase after each reflection from the wall, and after numerous reflections the particle will gather energy big enough to destruct the bubble. In the long run the oscillations energy of such a particle gathered inside the bubbles is usually transformed into heat or

(*) Notice that more over thousands of Yu. Potapov generators are produced to-day and used for houses' heating.

bremsstrahlung which destructs bubble. That physical idea is able at once explain the sonoluminescence (in general, in the case of the sonoluminescence that process looks not so primitive) and the energy liberation in proton-conductive ceramics (the caverns instead of the bubbles play the same role), in the nickel during the process of electrolysis in common water (CETI cell), in water bubbles in heat-generators. The theory suggests that samples should crack due to the increase of pressure on the walls of potential well, that is already because ceramic samples as well as nickel balls within CETI cell get into powder in the end. Apparently because of that fact any metal containing in its lattice many hydrogen atoms becomes brittle and falls apart in a short time. That phenomenon is well known to engineers.

Due to the not enough quantity of the experiments carried out it can not be specified now what particles are generating into the potential well (micro-bubbles). Besides for even electron escape the depth of potential well should be about 0.5 MeV, in solids the depth of potential wells is about few eV, and here apparently kinetic energy overflow is realized only. That fact that such a process requires extremely deep potential wells, and such conditions do not exist in solids, changes nothing.

Of course in general terms both competitive processes “Maternity home” and “Crematorium” take place, and they are compensating each other saving energy. At energy liberation “Maternity home” solution should prevail. Both processes take place at the same time and compete with each other, but formally they are not joined in space or time. The problem complexity of energy generation is in knowingly optimization of parameters to suppress “Crematorium” solution and promote realization of “Maternity home” solution. Nowadays nothing can be said exactly about either optimal dimensions of cavitating bubbles in heat-generators or type of the object oscillating within them, because it requires special experiments that have not been carried out jet.

Of course in the way of the transformation of the heat obtained at heat-generator or ceramics into electric or mechanical power there is an implacable Robber in the form of Sadi Carnot principle. According to that principle it is possible to transfer electric or mechanical energy in the whole into the heat but reverse processes is followed with great leakage.

If there are experiments where energy liberation conflicting with the general laws of conservation have been detected, then the opposite experimental data should exist according to which energy vanishes, i.e. the "Crematorium" process prevails. And it turned out so. There are so conditions at the process of electrolysis within electrolytic tank, when temperature of the solution within tank by no evident reasons noticeably decreases. That phenomenon has been detected many times ago by engineers in industry and is called "baths freezing" [93, 94]. In his experiments [92] Chinese physician Swe- Kai-Chen (Taiwan) has steadily studied the same phenomena. The explanation is quite evident; a particle with the velocity higher than the most probable one within the given distribution gets into caverns of electrodes. After few oscillations it decelerates, its velocity becomes less than the most probable one and the particle leaves cavern with low velocity. Then the same process may occur with another energetic particle. If there are many such events, it results in cell freezing.

The problem of ferromagnet switching (Ising model) may be also reduced to magnetic dipole orientation by external magnetic field. And then it is basically a harmonic oscillator equation with a slightly different returning power ($F = \frac{\mu}{r^3}$) and any conclusion obtained in the section 2.8. remains valid. So switching process effects of energy liberation should also take place. It turned out so. For the general public everything began at the 17th of May, 1996, when Frode Olsen form scientific group "Free Energy" showed at Norwegian television (TV2) film surprising everybody about "dynamic sculpture", made by artist and sculptor Reidar Finsrud from Skaarer, Norway. The creator of that "dynamic sculpture" had no idea about physics he had build his sculpture over 12 years. Now it is a perfect time to recollect the A. Einstein idea about how the discoveries are made: *"everybody knows that this or that things are utterly impossible, but once a person appears who knows nothing about it. And he invents it"*.

That "dynamic sculpture" has an explanatory label «perpetuum mobile» attached to it. It is a thoroughly polished iron ball 2.7 inches in diameter and weighing about 2 pounds. The ball circles along two parallel skids 25 inches in diameter. On its way it passes three constant magnets. Near the magnets there are three additional mobile magnets placed at special mobile levers, each 5 inches long. While the ball is rolling by these mobile magnets, they incline slightly (due to the ball attraction) and after the ball has passed, they are lifted by hold-out springs (rock like a cross-beam). The ball completes a revolution in 3 seconds. They claim that the ball had been circling more than a year (!)

That magical device, which does not have any energy sources, is placed for universal observation viewing in picture-gallery (Norway). It stands on a special pedestal and covered with bell-glass. The authors only saw a perfect film about that device and were most surprised by fact that the ball had not stopped during the shooting of the movie (approximately 20 minutes). We are quite familiar with conjuring tricks but it is beyond our understanding how that trick could be performed even with the help of some secrets. It could be clearly seen that while moving the ball always transferred part of its energy to the three long swinging pendulums, but they could not be in any case used for the ball jog and friction compensation, the only fraudulent idea that could be realized here. All other details were clearly seen and did not contain anything suspicious.

Let us estimate generated energy. At initial velocity about 1 m/sec. the ball would stop after 30 seconds, if all magnets were taken away. That means that energy consumption within 30 seconds is approximately 0.5 Watt-second or 1/60 Watt. The total energy generated during the month equals 43200 Watt-second. But that enormous energy is much bigger than the energy of a good shell!

It is understandable (if this word is appropriate here at all) that when the ball approaches to the constant magnet and is magnetizing it accelerates. But when it leaves the equilibrium position and moves away, it becomes demagnetized. So the attraction power (now it starts to slow the ball down) is a little bit less than it was at the moments of ball acceleration. That small difference of forces guarantees some positive work of friction compensation. That had been predicted by one of the authors in journals Infinite Energy vol.1, No.2, p.38, (1995); Proceedings of the ICCF5, p.361, April 9-13, (1995), Monte-Carlo; Cold Fusion, No 11, p.10, (1995); Chinese Journal of Nuclear Physics (vol.19, №2, 1997). The quantum-mechanical processes that take place are especially complicated, but some questions are understandable.

Of course, all advanced thinking physics understood that at once. In France J. Naudin in a short time staged a similar but a much simpler experiment. The ball of magneto-soft metal rolls along exclusive U-guides inside a system of four magnets. There is a small fade step near the U-bottom. Apparently, it was made especially to make the duration of magnetization and demagnetization processes different, and that is quite essential. If there are no magnets, nothing interesting would happen and oscillations relax rapidly (just in few seconds). If there are magnets, then the oscillations continue up to 3 hours 27 minutes. It seems that in this case the experimenter has not managed to find a better material for the ball and better device parameters. Therefore an imperfect compensation of friction forces takes place. And during all experiments constant magnets have not become demagnetized, as the experiment has been repeated many times with the same results.

And now we would like to say few vague words about the processes of switching. At the process of the ball magnetization its atoms are oriented along the field lines (as an arrow of compass). When ball leaves the area of magnetic field, atom's magnetic moments are disoriented under the influence of thermal motion and ball becomes demagnetized. According to Unitary Quantum Theory the part of the oriented magnetic moments may be more ("Maternity home") than it is predicted by standard quantum mechanics, and so the ball's attraction power may be more too. As for the disorientation of these moments, they are approximately similar in both theories. The magnetic forces during the ball's getting close to and moving away from the magnet apparently differ both for this reason and because of the difference in times of switching and demagnetization.

Then (or independently?) Greg Watson, President of Microtronics Company from Adelaide (Australia) promised to produce similar toys in small series at price $150 per unit. It was announced in advertisements that money would be immediately returned if toys were not working. The company plans to arrange mass production of so toys, and when its number will prevail some critical value, then would be possible to speak about the most solemn funeral of the conservation laws.

The scientists of older generation can recollect that in 30-ties similar toy was shown to David Hilbert, and he said it was the most interesting thing he had ever seen. There is the question, why it has not been realized jet? We do not know a physic-mathematical answer for that question, and the analysis of social reasons is out of the area of our investigations. The Japanese have another mentality; there is a special state program to generated energy from constant magnets in Japan. And Tahahashi [95], probably, has created electric motor with the efficiency to 318%! The well known problem of “shortage” of energy in many biochemical reactions with the ferments (enzymes) participation looks even more mysterious. For example, in the deeply studied reaction of polysaccharides disintegration in presence of lysozyme the following take place: a molecule of polysaccharide appears in a special cavern in a big molecule of lyzozyme, sole time later its debris is thrown out (Fig. 3.4.1)

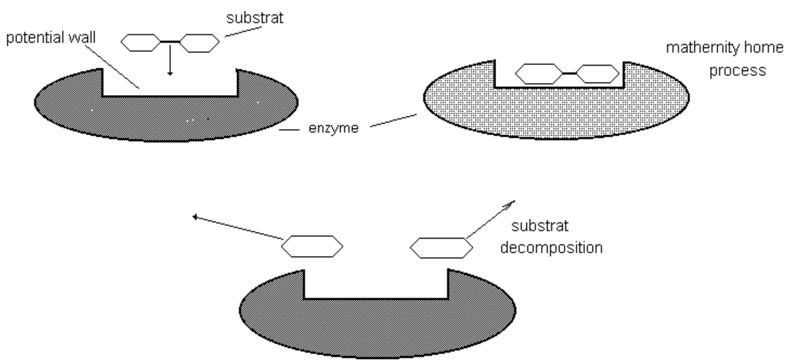


Fig. 3.4.1 *Disintegration of polysaccharides molecule in presence of lysozyme.*

The energy of broken bound in polysaccharides is about 3 eV, and the energy of thermal motion is 0.025 eV only. So it is absolutely incomprehensible where the lysozyme takes energy necessary to break polysaccharide from. There is no any satisfactory mechanism to explain this type of reaction (although they are a lot of the explanation). As physics say, “the problem was pigeonholed”.

The most astonishing is the fact that in all excess energy liberation can not be explained by chemical reactions or changes of phase. If sometimes nuclear reactions take place (in accordance with modern science that could not be at all) they are able to explain a hundredth or a thousandth part of the heat energy liberated. There is no doubt that all these facts belong to the new physical theory, because there are no any reasonable explanations for these facts in the network of the old theory at all. The problem of catalytic process is described more detailed further in the sections 4.1-4.4.

But the existence of a devise able to generate from nothing about 10 kilowatt of electric energy in direct current with voltage 300 V seems nearly incredible. One of the authors wrote about that in 3 different journals and here we give only a summary of it [96-98].

In summer 1999 one of the authors visited some scientific-research organizations with an invitation of Switzerland physicist (Adolph Schneider, the Director of the Institute of New Energy Sources in Egerkingen). It is interesting that small Switzerland have such an institute and big Russia have not. The purpose of the invitation was quite simple: just to explain the work of one device generating energy from nothing, i.e. “perpetuum mobile”. In Switzerland these devices are called Testatik Machine M/L Converter from religious group «Methernitha» (Address: Methernitha, CH-3517 Linden, Switzerland, phone: ++41 31 97 11 24).

Such machines are working now in Switzerland in the small town Linden near Bern. A part of that town belongs to a Religious Christian Community, enclosed and thoroughly guarded. Commune contain about 250 members, most of them are physicists, graduated from Geneva, Lausanne and Bern Universities. That is not research Laboratory only; they have their own TV center, film studio, small furniture production, workshops, garages, living houses and other services. As you have perhaps have already guessed that community do not consume any energy. That fact is the most exact in that story, as the community does not receive bills from the electric power station supplying electricity to the town. Meticulous reporters cleared up that fact. They just have in the cellar of one of their houses their own electric power station that generates energy … from nothing. The inventor of so inexhaustible free energy source of the direct current

Swiss physicist Paul Baumann (from other sources he is a watchmaker) created his first sample in a Swiss prison, where he has spent over 20 (!) years. Unfortunately we could not clarify how did he managed to get that not best place for creative work place, may be it was due to our bad knowledge of English.

Note, that it is not a unique case when great discoveries were made in prison. And Russia, of course goes ahead of all. For example, the Russian mathematician M. V. Ostrogradsky proved a theorem (now it is called Ostrogradsky-Gauss Theorem) in Saint-Petersburg debtor's prison, where he was canned for big loss in cards he was not able to pay out. It is curious that in this building on Fontanka Street is now the Petersburg University of Fine Mechanics and Optic. But more curious is the following circumstance: having proved that theorem he sent it in Paris to the French Academy. He received a replay from famous mathematicians O. L. Cauchy who highly evaluated these investigations and published the article in the Comtes Rendues of the French Academy. Frankly speaking, in his letter to M. V. Ostrogradsky he expressed his astonishment that such a gifted person worked in prison. Ostrogradsky answered that he was not working but was imprisoned for cards' debts. Cauchy was a rich man and paid Ostrogradsky's debt…

Let us briefly describe these fantastic devices: they are created in four types (sizes) with the power equal to 0.1, 0.3, 3.0 and 10.0 KWatt. The device looks like a standard electrostatic machine with Leyden jars, which is widely used in physical demonstrations. It has two revolving in opposite sides acrylic disks with 36 narrow aluminum sectors attached to them. First samples were made of gramophone records. The machine is started pushing the disks in opposite directions with a finger. Speed of rotation is 50-70 revolutions per minute. After being started disks are rotating spontaneously and can be easily stopped with a finger. The voltage of direct current output is about 300-350 V, the current is up to 30 A. The mechanical energy required for revolving (according to measuring of

Prof. Marinov is about 100 mWatt only) is hundreds times less than electric energy output. The biggest device with the output of 10 KWatt has plastic disks more than 2 meters in diameter (Fig. 3.4.2.), and the smallest – 20 sm. only. The device weight is quite small, because the machine with the 3 KWatt output weight about 20 kg.

Fig. 3.4.2 *Device with electrical power 10 KWt.*

The process of charges separation (that also requires energy!) almost does not brake the disks. Connection of an additional load in the form of 200-Watt lamp does not change the revolving rate too. Neither cooling nor heating of the air or machine's parts during long-term work arise, only light aroma of ozone is smelled. Such a system is noiseless, compact and environmentally appropriate, it can be installed everywhere.

The Community leaders justly suppose that mass distribution of such systems all over the world would result in a thermal explosion, because in the long run the energy generated by humanity is collected on the energetic dump (it is transformed into heat) and as a result leads to the environment overheating. They do not believe (and not groundlessly) in the humanity's ability to agree about the rational use of the discovery. They suppose it can be more dangerous, than nuclear, bacteriological or general weapons. Their main request to the Humanity is to live in balance with environment and to fully utilize the energy of wind, sun, water and so on. That is why everything in that Community is thoroughly guarded and unauthorized people have no access there And for these reasons they are not going to put main discovery at the disposal of the humanity.

And further we have a real detective story: an Austrian physicist from Institute of Fundamental Physics in Grats (specialist in electrodynamics) Prof. Stefan Marinov had visited the Commune twice (at July 1988 and February-March 1989). He was presented with such a device with the output of 100 Watt (300V, 0.3 A), and he studied it in his Laboratory. As we know now the inventor himself does not fully understand the principle of his machine operation. So he has contacted Marinov just out of the scientific curiosity.

In 1989 Prof. Marinov published his book "Thorny path to the truth – documentary confirmation of laws of conservation violation" with International Publishers East-West Co. That book contained a number of photos, measurements report, and device description. He established a scientific-research group "Free Energy" (Methernitha Group Stefan Marinov Free Energy) in the community. That book contains quite astonishing words:

"I can confirm without any doubts: that machine is unadulterated classical perpetuum mobile. After initial push being imported it continues revolving arbitrarily long without any assistance and generating electric power in the value of 100 watt… In that device engine and generator, separating the charges, are combined… However it is still vague how it could happen…"

As we know, nobody managed to create similar device anywhere else.

In 1995 one of the authors of the book read the paper “About mechanism of energy generation in unitary quantum theory” at International Conferences on Cold Nuclear Fusion in Monte-Carlo. In October of 1996 in Japan he read the report “Energy generation in Schroedinger equation solutions”. Then in April 1997 Professor Stefan Marinov called him up and they agreed about the author’s visit to the Graz Institute of Fundamental Physics. But on the July 15th, 1997 Prof. Stefan Marinov was thrown out of the university library window in Graz by unknown people. He died carrying away a lot of secrets. Any good detective would evolve further a theory about these unknown persons were acted on behalf of coal, oil, electric power or gas companies, and poor religious Commune had nothing to do with it. But the authors have a firm aversion to detective stories…

Modern times are taught, and we can explain why it is happened. It is widely known that the great Serbian Nikola Tesla developed in the USA similar source of energy. When Morgan, who financed his project, got known that Tesla was creating an inexhaustible energy source and was quite near to solution, he immediately stopped financing and prohibited further investigations. Morgan considered that such source of energy would make independent a lot of people and they would become hardly governed… and nevertheless N. Tesla died a natural death…

In gloomy Middle Ages such persons were simply faggoted, at socialism in Russia out of humanity considerations they were not published, those people were quasi not existing, now in the west they are thrown out of the library windows. Some progress with oscillating character is on hand, and really momentary death is better than medieval tradition of faggoting…Further the readers can draw parallel by themselves and think who is in advantages.

As for us, we are coming back to Egerkingen. First Swiss party agreed with Community about our visit together with one acquainted physicist from Bern University. Exactly at that time in Community there should be an anniversary meeting of some Bern University graduates. But at the last moment we were kept out Community, as for our acquainted physicist (now he is a lecturer of physics in Bern University) he spent there the whole day. For consolation we had to ascend a hill to have a look at Community from the car window. Really we could see at Community territory besides numerous buildings and laboratory with transparent «Methernitha» there were one small wind turbine and small water wheel. Most likely the total energy generated by those sources was not exceeded 2-5 kWatt.

Next day after his visit to the Community we were able to talk with our physicist at his home. We learned a lot of interesting things. He looked quite confused mentally, his hands trembled. In Russia we say in such a cases that, “he was, as it were, hit by dusty bag” [176].

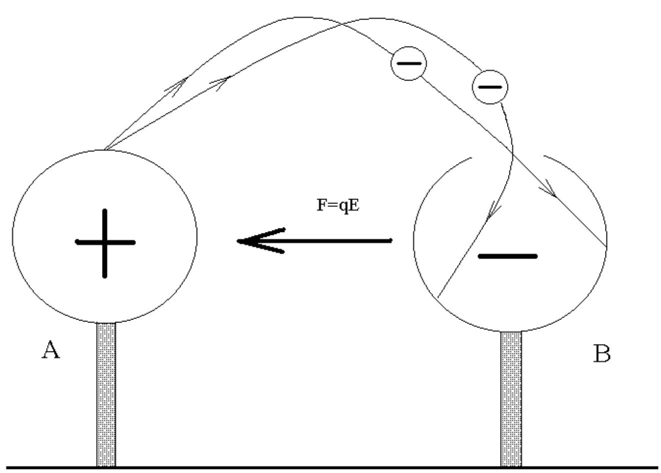


Fig. 3.4.3 *Work for transferring the charge depends on themode of transferring and on the path.*

We are just going to show that existence of so device is in harmony with UQT.

It is natural that machine works on the principle of charges separation. Assume there are two metal spherical surfaces with a hole isolated from Earth and from each other. If we transfer with the help of isolated stick the first charge from sphere A to the internal surface of sphere B through the hole, then the voltage will appear. And if we transfer the second and further charges, sphere A will attract transferred charge and sphere B will repel it. And for all these we will need energy for the charges transfer. (Fig. 3.4.3).

Recall that in accordance with the present circulation theorem all this is impossible. The energy used for the charge transferring would be equal to the liberated one. But in the UQT the circulation theorem for the single elementary charge (equation 3.4.2.) does not work. So we are able to choose such time and way that if the second charge is transferred along them, then the value of the field will be near zero, and therefore the electrostatic power will be near zero and of course the same will be true for the work of the charges' transferring and separation. For example, we choose not the way but wait the moment when charge reduces to zero and then rapidly displace it, and stop that process when the charge appears. One may choose appropriate way and velocity. There are a lot of variants. Probably Paul Baumann has realized exactly that way, but till now he is nearly unknown for official science. Today he may be consoled by the fact wheel inventor will never be known. The problem how to implement it technically is an engineering question.

And totally impossible looks the sensational story of curling and flying disk Searl (see Internet), that can be also explained but we are not going to do it just now.

One can not help wondering whether all that is not just a trick? First of all, if everybody always will believe in energy conservation law firmness, there would be no progress in that question, and moreover it is totally out of understanding how could the humanity come down from palm tree. Second, to excuse the rebellious point of view offered we can say that if the authors were told 30 years ago (they were professors already) that in the beginning of next millennium they would write such a book, they would have thought that not only the most fool joke, but something absolutely impossible. But as Voltaire said: *"The fool is, who does not change"*.

It will be a mistake to think that modern quantum theories do not contain paradoxical theoretical questions and examples. We have already written above (section 1.3) about some paradox connected with Dirac equations.

Let examine now some simple cases. In solutions of Schroedinger equation for harmonic oscillator there are such cases when the ψ-function of the particle equals zero. Nobody knows how a particle oscillating in parabolic well manages to pass through those points. The answer that a particle does not have a definite trajectory makes little clearer. A similar situation appears in hydrogen atom s-state, when, for example, in 2s –state electron clouds of the electron's ψ-function are divided by a closed spherical surface where the ψ-function equals zero. And how does the electron managed to get from one cloud to another?

R. Feynman was the only physicist who said about quantum theory *"the quantum world relates with that strange peculiarity of nature that is contradictory to common sense"*.

Today quantum electrodynamics gives the most exact among other sciences mathematical description of nature. For example, abnormal magnetic moment is evaluated with especially high accuracy, 12 fugues of which coincide with experimental data. There is no any other exact science that has been examined with so high accuracy. The same Feynman writes: *"Quantum electrodynamics gives totally absurd, from the common sense point of view, description of Nature. But it absolutely coincides to experimental data… Physicists have realized that it has no matter whether they like any theory or not. The other point is more important: whether the theory is able to predict results that coincide with the experiment. It does not matter whether a theory is good or not from philosophical point of view, whether or not is it easy for understand, whether or not it is flawless from the position of common sense… Physicists gave up, they are not searching for any physical sense in quantum science… we leave alone the question about why the Nature was arranged in such a way and not in other…"*

The most evident of absurd in quantum electrodynamics, from the common sense point of view, is, for example, the presence of two types of particles. One transfer momentum only, but does not carry energy, the others on the contrary transfer energy but do not carry momentum. As far that problem has not examined jet under that point of view in different modern serious monographs concerned to electrodynamics let examine that phenomenon in details and may be we will be able to reduce it to that awful paradoxically. Let examine that process of electron scattering at electrons (Meller dispersion) electron dispersion at positrons (Bhabha dispersion) [99]. Feynman diagrams for such processes $e^-e^- \to e^-e^-$ and $e^+e^- \to e^+e^-$ are shown at Fig. 3.4.4.

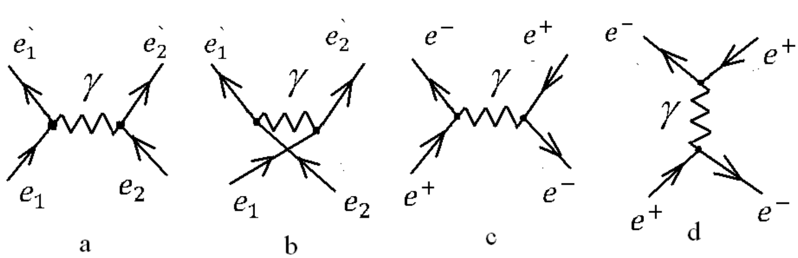


Fig. 3.4.4 *Diagrams for scattering processes* $e^-e^- \to e^-e^- u$ $e^+e^- \to e^+e^-$.

Both electrons in scattering $e^-e^- \to e^-e^-$ are indistinguishable and so both diagrams a and b should be considered simultaneously. As it is impossible to say what process a or b takes place in reality amplitudes but not density is to be summed up.

Both particles at dispersion $e^+e^- \to e^+e^-$ differ from each other by electrical charge, but again we can not say what process c or d occurs and again amplitudes of both process is to be summed up. Contribution of c process is called contribution of photon exchange; contribution of d process is called annihilation contribution. Let examine the last one in details. The contribution arises because quantum numbers of electron-positron pair are equal to quantum numbers of photons, viz:

$$A = q = S = L = L_{\mu} = 0.$$

It is clear that once virtual photon has appeared it “forgets” everything about generated process and may cause the whole line of the following reactions:

$$e^-e^+ \to e^-e^+, 2\gamma, \mu^+\mu^-, \pi^+\pi^-, \pi^+\pi^-\pi^0, K^+K^-, \bar{p}p, \bar{n}n \cdots$$

Only first three processes deal with the electromagnetic coupling, the first of them is presented at Fig. 3.4.4c.

For counter-current electron packets both angular dependence of effective cross-sections and their absolute values were measured. To reduce Rutherford dispersion at target nucleus a special method was used (positioning of counters under special angular and match circuits). The results of experiment and theoretical calculation match perfectly. But what is the price?!

For that purpose let us study in details diagrams c and d. Virtual photons at exchange diagram c and annihilation diagram d appeared to be totally different. Both photons are virtual and do not comply general correlation for the energy E=pc. Let examine both perfect processes within the center-of-mass system. For the exchange diagram c incoming and outgoing electrons obtain similar energy and opposite momentum. So energy and momentum of virtual photon are equivalent to:

$$E_\gamma = E_e - E_e^{'} = 0$$

$$\mathbf{p}_\gamma = \mathbf{p}_e - \mathbf{p}_e^{'} = 2\mathbf{p}_e$$

If we determine the virtual photon mass with the help of the relation

$$E = \sqrt{p^2c^2 + m^2c^4}\ ,$$

then we will get

$$m^2c^4 = -\left(2p_e c\right)^2 < 0$$

In other words that virtual photon transfers momentum only, and does not carry any energy. The square of its mass is a negative value and is called space-like. The origin of such a name comes from special theory of relativity. According to that theory it is a four-dimensional vector for which the square of its temporal component is less than the sum of its space components' squares. If any physical value appears to be a space-like vector, then an inertial reference system where time component vanishes always exists. If at any point of space spatial distance between two points is under consideration, in initial system to be moving relative to initial distance four-dimensional vector will be transferred in space-lie vector with time component.

For the annihilation diagram d we have inverse situation. Its energy is:

$$E_\gamma = E_{e^-} + E_{e^+} = 2E\ ,$$

and momentum will be:

$$\mathbf{p}_{\gamma} = \mathbf{p}_{e^-} + \mathbf{p}_{e^+} = 0 .$$

That virtual photon transfers energy only and does not carry any momentum. The square of its mass is

$$m^2c^4 = -(2E)^2 > 0$$

positive value, and the photon itself is called time-like. Any four-dimensional vector according to special theory of relativity the square of temporal component is more than the sum of its space components' squares is time like. The square of four-dimensional length of time like vector is negative figure:

$$\sum_{i=1}^{4} A_i^2 < 0$$

if $A_\alpha(\alpha = 1,2,3)$ are space components, $A_4 = i|A_4|$ is time component. There is so inertial reference system, where space components of given time like vector in $A_1^{'}, A_2^{'}, A_3^{'}$ are equal to zero and, consequently,

$$A_i^{'2} = \sum_{i=1}^{4} A_i^2 .$$

Such important for relativistic mechanics values of mass point as four-velocity u_i, four-momentum p_i are time like vectors:

$$u_i^2 = -1, \quad p_i^2 = -m^2c^2 .$$

The square of the length of vector connecting two world points (two events) to be taken with reversed sign is square of interval. So interval will be time like vector if square of interval is positive. Recollect, that if two events are connected with each other or may be connected by causal relationship, the vector connecting them will be time like.

Thus in electron-positron dispersion tae part two such wild, from the common sense point of view, particles. Of cause it looks awful and everybody tries to forget about that. That is why physical reasoning are nearly absence in books concerned quantum theory, they are substituted for bare mathematics able to make correct theoretical forecasts and matches experimental data. We are acquainted with the work of Hans Frauenfelder and Ernest M. Henley "Subatomic Physics", the only book [99] where the authors had courage to speak about this in quite direct expressions.

To our regret we are not ready exactly to simulate situation with the help of our equations because the exact form of the wave packet for electron is not known jet. Nowadays electron and positron are considered as point particles, but a packet like Coulomb potential is hardly physically possible due to divergence at zero. Nevertheless, we are going to understand that strange processes from the most general positions, or in any case to get rid of anguish. For that assume that near zero electron structure looks like Hamada-Johnstone potential, i.e. electron center is surrounded by potential barrier.

Assume the particle is flying the barrier in such a phase when the packet is small. At small amplitude equations become linear and packet passes the barrier maximum without any momentum transmittance. But now after passing the barrier maximum its velocity may be extremely small, it can nearly stop and thus contributes to amplitude (energy) of electron's wave packet. It is a process with energy transfer but without momentum.

Another situation may occur when the packet approaches the barrier in such a phase that becomes reflected without momentum changing, but the momentum is transferred to the scattering center. That is a process with momentum transfer but without energy. Similar processes have been illustrated above in sections 2.4 - 2.11 and 3.1 - 3.3. Of course all these are corollaries of absence of conservation laws in single processes with small energies.

3.5 Anomalous Phenomena in Gas-discharge and Possible Energy Sources (Pulsed Abnormal Glow Discharge-PAGD)

There is a hint, but tail is lie,

Perfect lesson for a guy.

A. S. Pushkin

Fantastic phenomena at certain gas discharge regimes (the anomalous gas discharge close to the arc regime) were discovered as far back as 1929 by Nicolas Tesla [100]. It was discovered that due to some unknown reason within a powerful pulse gas discharge in the course of one pulse a lot of extremely short current spikes occur (see Fig. 3.5.1).

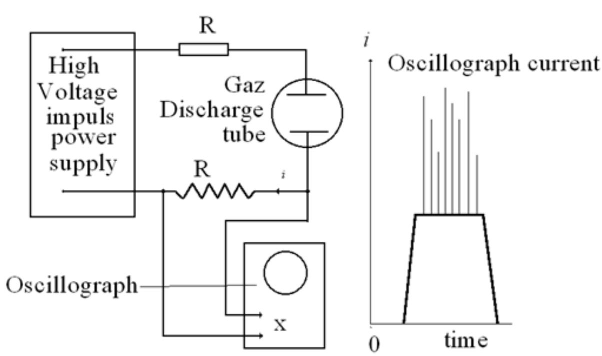


Fig. 3.5.1 *The scheme of the electric measurements.*

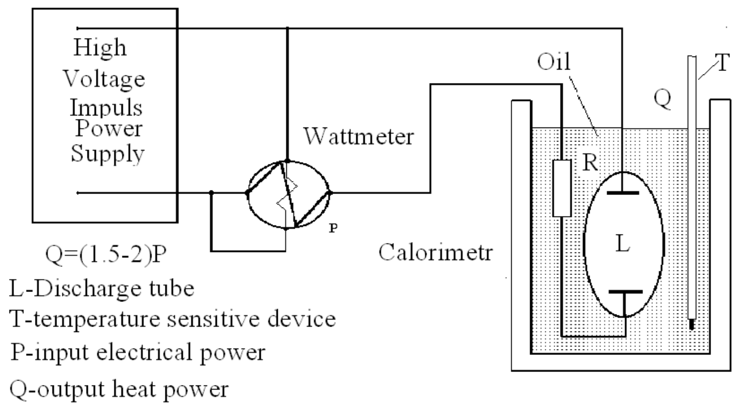


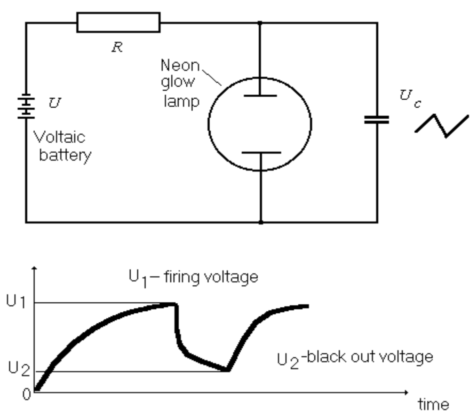
Fig. 3.5.2 *The scheme of the heat measurements.*

According to Tesla's estimation the energy resulting from these spikes exceeded the energy of the applied electric pulse. This fact did not attract much attention at that time, because it contradicted the existed physical ideas. Tandberg was the next [101] to discover this phenomenon but he had connected it to some mysterious processes taking place in the cathode. He had staged a number of experiments but did not manage to elucidate the nature of the phenomenon.

Later Prof. A. V. Chernetsky [103] (as well as Manfred Fon Ardenne, - Germany physicist (a privet communication)) performed some calorimetric measurements in a deuterium-lithium discharge (see Fig. 3.5.2). It was turned out that the heat generated in a jug with plasma appeared to be 1.5-2 times greater than the applied energy. Chernetsky had associated this excess heat with nuclear reactions allegedly taking place in the deuterium-lithium plasma, but neither neutrons, nor tritium was discovered, though these products were expected to be found in abundance.

Later on Dr. Wilhelm Reich in America [102] and P. &A. Correa in Canada had built a prototype of reactor, which generated excess pulse electric current. Except operating the tubes at a lower pressure, the Correas' claims seem to stem from a tube design based on Reich's work. However, it is necessary to see Reich's actual drawings in the article "The Geiger Muller Effect of the Orgone", 1947, published in the "Oranur Experiment," or to see the actual tubes in the Wilhelm Reich museum before coming to that conclusion. We do not remember any mention of Reich in the Correa's patents. That possibly can invalidate the patents, even though the operation in the (lower) PAGD specified pressure range may (or may not) be considered by an examiner a novel invention over Reich's work.

Unless Marett [privet communication] lies, Correas certainly knew about Reich's tube, because Marett claimed to work with the Paulo Correa on replicating it in the mid-1980's. If this is true, Correas cannot hide behind his ignorance as an excuse for failing to mention Reich in the references to prior state of the art. All this could make defense of the Correas' patent very difficult at least. It appears possible the invention could even end up being public domain for all practical purposes.



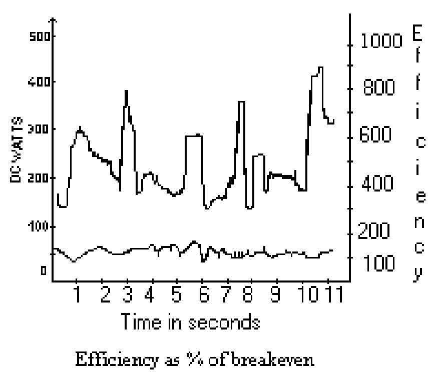


Fig. 3.5.3 *The Generator on neon lamp.* ***Fig. 3.5.4*** *Generation of the energy.*

This is not a meant to comment Reich either positively or negatively, but only Marett's allegations of the Correas' lack of candor. Marett stated: "Bravo to Correas for solving the motor force mystery, and shame on them for not giving

Reich credit to Reich whom the credit was due.” We just want to emphatically agree with Marett. However, the PAGD device should stand or fall on its own merit, not on Reich's or the Correas' or Marett's reputation.

Correa’s objective, as could be inferred from his patents [87], was to create an effective gas-discharge direct-alternated current energy amplifier to use in electric motorcars together with a common relaxation generator on the basis of a neon lamp (see Fig. 3.5.3). It was assumed that the electric motor operation had to be effected by changing the power voltage frequency, which from the energy viewpoint was more effective than the rheostat control (handling) of the direct current engine. In the course of the research it was discovered, according to Correa that the relation of the output electric power to the input amount exceeded 10 times (see Fig. 3.5.4).

The apparatus represents a common two-cathode gas-discharge vacuum device, which is wired according to the diagram (see Fig. 3.5.5). In its original form the Correa reactor has three electrodes, two of which are absolutely identical and works in a two-cycle regime (see Fig. 3.5.5). On the figure below a two electrode one-cycle system is considered. The original design is the following (see Fig. 3.5.6). The two-accumulator system seems a bit awkward. One of the accumulators maintains the anomalous gas discharge there and discharges, while at the same time the second one is charged, and then the accumulators exchange their places.

Why didn’t Correa use a common capacitor with a big capacitance? It seems one might obviate the use of any kind of electric power source for the work of the device (the power might only be needed to start the device). In this case all the arguments of any opponent would fall away. When we addressed Correa this question we did not receive any answer. Anyway let us try to show in terms of the UQT that excess electric energy is, indeed, possible in such a system.

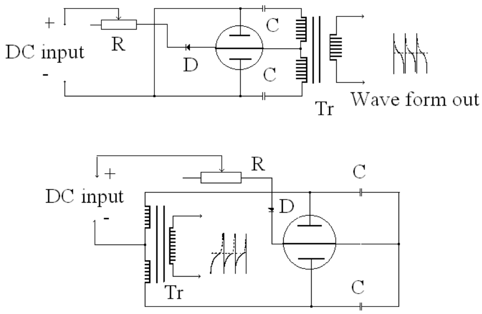


Fig. 3.5.5 *The Schemes of the installation with transformer.*

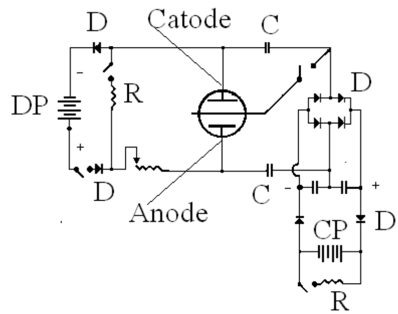


Fig. 3.5.6 *The Schemes of the installation without transformer.*

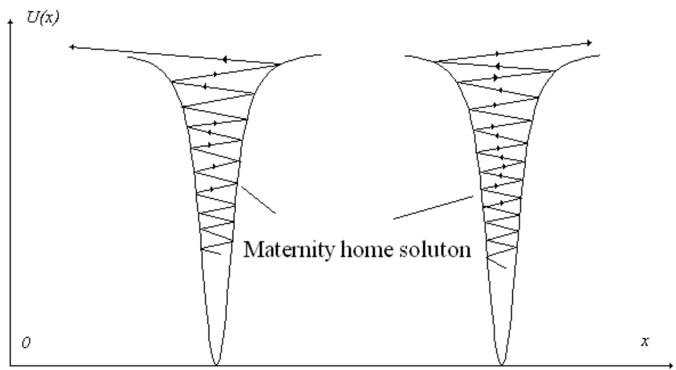


Fig. 3.5.7 *The Maternity home solution is realized in a symmetrically parabolic potential wells.*

From the physic-mathematical viewpoint it is clear that if the "Maternity" home solution is realized in a symmetrically parabolic potential well with identical walls [88], then there will be no excess electric current, as half of the electrons, having acquired energy, will flow to the left while the second half will be directed to the right (see Fig. 3.5.7) and these currents compensate each other. But if we take the well walls to be asymmetric, all the electrons subject to the

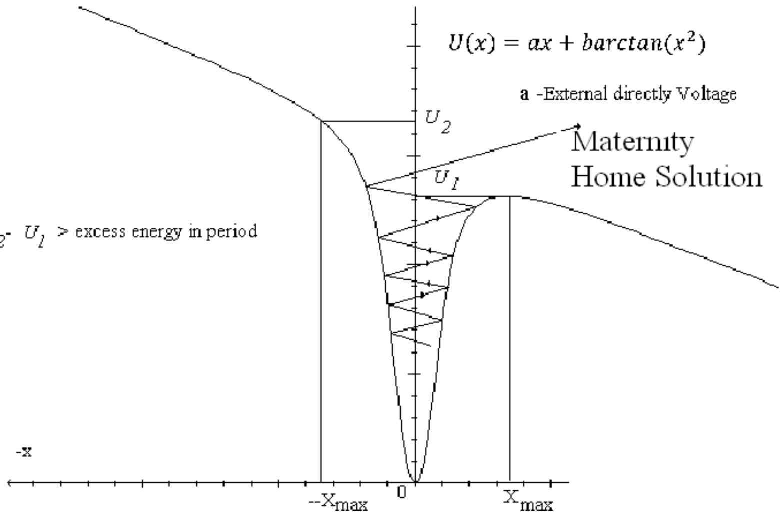


Fig. 3.5.8 *The Maternity home solution is realized in scewnes parabolic potential wells.*

"Maternity Home" solution will flow to the left and contribute to the quickly alternating excess electric current component. The evident inequality should be fulfilled (Fig. 3.5.8):

$$W << U_1 - U_2 , \tag{3.5.1}$$

where W is the energy obtained by the electrons in the "Maternity home" solution within one period of oscillations.

We shall show that in a gas discharge plasma the situation described in Fig. 3.5.9 is possible. Let us consider the uniform plasma layer with thickness l and transfer all the electrons to a distance x distance. We will arrive at a plane capacitor (see Fig. 3.5.9) with an electric field between the plates

$$E = \frac{\sigma}{4\pi\varepsilon\varepsilon_0}$$

where σ is the charge surface density

$$\sigma = en\_x$$

Then

$$E = \frac{en\_x}{4\pi\varepsilon\varepsilon_0}$$

This uniform electric field affects both electron and ion, but the latter will be at rest because of their big mass, so their motion can be neglected.

The force acting upon the area unit in a layer of l thickness is equal to the product of the layer's charge Q value by the field voltage

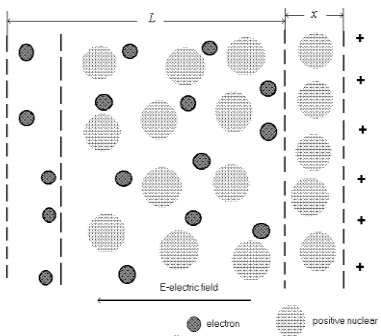


Fig. 3.5.9 *The plasma oscillations.*

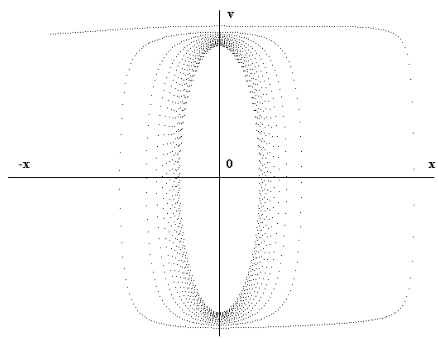


Fig. 3.5.10 *The phase portrait of the oscillations with growing of the energy.*

$$F = -QE = -en\_lE = -\frac{e^2 n\_^2 lx}{4\pi\varepsilon\varepsilon_0} = -kx$$

This force acts upon the M mass of all electrons available on the area unit

$$M\frac{d^2x}{dt^2} = -kx$$

where $M = n\_m\_l$

$$\omega = \sqrt{\frac{k}{M}}$$

As then

$$\omega_p = \frac{4\pi\varepsilon\varepsilon_0 n\_ e^2}{m\_}$$

The obtained frequency of plasma or I. Langmuir oscillations is usually within the limits $10^9 - 10^{13}$. Such plasma oscillations differ from the wave process, as they do not spread out in environment; in other words, some local disturbance remains local in character. The obtained differential equation for the plasma oscillations coincides with the conventional harmonic oscillator equation.

It is clear, that in collective movement of electrons each of them is also subject to this equation and due to this we can now use the main oscillating charge equation. It is evident from simple physical reasoning that if the current flows it means that the potential well has a wall. Although the well is symmetric by nature, it will become distorted in a strong electric field; its form will be similar to that shown in Fig. 3.5.8. Such a potential can be easily simulated by a simple function:

$$U(x) = ax + b\arctan(x^2)$$

Then the main equation that describes processes taking place inside the Correa reactor will take the following form:

$$m\frac{d^2x(t)}{dt^2} = \left(a + 2b\frac{x(t)}{1+x(t)^4}\right)\cos^2\left(\left(\frac{dx(t)}{dt}\right)^2\frac{mt}{2\hbar} - x(t)\frac{dx(t)}{dt}\frac{m}{\hbar} + \phi_0\right) \qquad (3.5.2)$$

We have carried out below (see sect. 3.13) the numerical integration of equation (3.13.3) being similar to equation (3.5.2) and describing a similar physical process. The results show that there is a certain region of initial values in which all the electrons, accelerated by the "Maternity" home solution will flow in one direction.

These very fast electrons are responsible for the anomalous excess heat on the anode (discovered by Chernetskij and Correa); it is the current spikes at the top of the pulses that contribute to the excess useful electric current component.

It is possible to make the following important statements concerning the Correa plasma reactor:

1. The cathode processes have nothing to do with excess heat, therefore of the [143]-type research is useless.

2. Inequality (1) is possible at large currents, which are easier to obtain in a pulse regime.

3. The plasma composition is not very essential, ionization potential serving as a single criterion of importance, but it is desirable to choose it to be as small as possible.

4. At large currents the cathode electrode dispersion is inevitable. It leads to the metal erosion and its settling down on the flask (retort) walls, which shortens the device life. Correa had used Aluminum for the electrodes and this was not a very successful decision. The use of liquid metals (for instance, Hg - mercury with a sufficiently small output work) for the electrodes seems to be more expedient. Having been condensed on the walls it would trickle down to the liquid electrodes. Such electrodes would have a very long service time. It is natural that further recommendations could be made after preliminary experiments.

In conclusion of this section it is impossible to say nothing about the problem of the negative resistance origin in gas discharge. If the heat is generated at current flow trough active positive resistance, the negative resistance is exactly an energy source. It is necessary for that to joint in parallel general oscillatory circuit to such a negative resistance. Continuous waves will spontaneously appear within the circuit.

At the earliest stages of radio electronics the first radio transmitting equipment was based on that principle. Most likely the area of negative resistance of voltage-current characteristic coincides with the area the processes of particles acceleration in asymmetrical potential well (like Fig. 3.5.8) are most effective ("Maternity Home" solution).

However no serious books (or works) dealing with the theory of gas discharge contain a clear physical explanation of the negative resistance appearance when the voltage is decreasing and the current increasing. Now it is evident that particles acceleration in potential wells like one in Fig. 3.5.8 is responsible for that process.

3.6 Possible Application of the Unitary Quantum Theory in Microelectronics

In the world literature it is written that tunnel diode has been constructed by Japanese researcher Esaki. However, at the end of forties in Soviet popular magazine "Radio" was published a series of articles about "crystadin" created by Russian ham Oleg Losev. He used a falling sector of voltage-current characteristic of point contact between steel wire and homemade crystal FeS. Such diode was made from mixture of iron filings and sulfur powder heated within test-tube. The obtained coked mass was then broken into pieces from which suitable crystal was chosen. That prototype of tunnel diode was used for oscillatory tuned-circuit

Q-factor excursion in general crystal set. Articles described the way to do it at home. One of the authors did himself being a schoolboy.

The unitary quantum theory predicts a number of new phenomena that occur when charged particles pass through a potential barrier. A new type of semiconductor devices can be created based on [104, 106]. The oscillating charged particle equation that was suggested in [172, 200, 201] to explain the cold fusion should be used to analyze these processes.

The above equation determines relationship between the particle passing through the potential barrier and the wave function phase. In other words, if the charge of a particle that approaches the barrier is small, then it passes the barrier quite easily. Due to this small-energy deutons can approach each other and interact but this effect takes place only within a narrow phase range.

In order to describe the particle's behavior while passing through a periodic sequence (chain) of potential barriers we shall use the simplest potential of the kind:

$$U(x) = Ex + A\sin^2(x)$$

Then the equation for the particle's motion within such a potential with a superposition of a weak uniform field (external operational field) will assume the following form:

$$\frac{d^2x(t)}{dt^2} = (E + A\sin(2x(t)))\cos^2\left(\frac{t}{2}\left(\frac{dx(t)}{dt}\right)^2 - x(t)\frac{dx(t)}{dt} + \phi_0\right),$$

where E is the small external operational voltage (power supply).

Assume that a certain number of charged particles with a uniform phase and Maxwell velocity distribution move through a periodic chain of potential barriers being subjected to action of external electric field. According to the UQT nearly all the particles which have passed through the barriers have approximately equal velocities and phases (a coherent flow). It is interesting that the slow particles are accelerated while the fast ones are slightly slowed down. Consequently, the particle's phase changes too. To check this point the following problem was set: upon a sequence of five barriers (Fig. 3.6.1) a flow of particles is directed, the particles possessing various velocities (uniform distribution with respect to velocities) and various initial phases uniform distributed in the $0...\pi$ region.

In practice this problem was solved with a mathematical program in two cycles. The first velocity-cycle contained a phase cycle (101 phase-values were used) in the $0...\pi$ range. The number of phase values should always be odd, as in even splitting the point $\frac{\pi}{2}$ was sure to emerge and the PC would hover for many hours until it reached zero due to the equation's singularity in this point. The velocity range was split into 500 intervals (stretches). Thus, the particle's motion equation was solved by the Runge-Kutt method of the fourth order 500*101=50500 times, the procedure taking no less than a month with ordinary PC.

In fact, the standard Monte-Carlo procedure was applied within the two cycles. If the particle changed its velocity sign (was reflected), its behavior was not considered anymore and it was excluded from the analysis. All the trajectories are calculated, the histograms of the particles number distribution in relation to their velocity are made, these results are given on a plot (see Fig. 3.6.2).

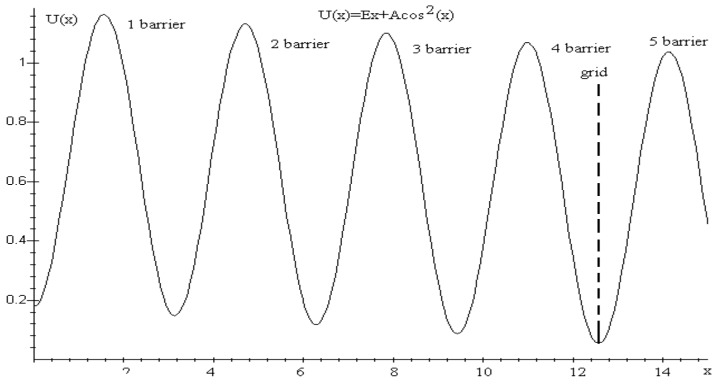


Fig. 3.6.1 *The Potential Barriers.*

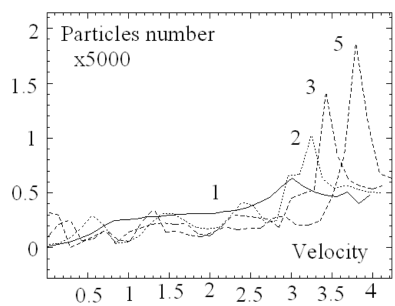


Fig. 3.6.2 *Dependency of the number of the past particles depending on velocities and numbers barrier.*

As seen from the plot (Fig. 3.6.2) a lot of particles possess identical velocities and phases having passed through 5 barriers. It is clear that such automatic phase and velocity phasing in a periodic potential sharply raises the probability for the deutons to approach each other, which in itself serves as an additional argument to CNF explanation [53]. Of course, in real lattice this effect is much weaker, because the solved problem is one-dimensional. In order to solve a three-dimensional lattice model (pattern) one needs a lot of time and a very powerful supercomputer.

But the experiments on the tunnel-effect dependence upon the wave function phase should be carried out by all means. Such a problem has never been considered in quantum mechanics because the wave function square module rather than the wave function itself has the physical meaning and hence the wave function phase has been excluded from the analysis. If the relationship between the particle passage through a potential barrier and the wave function phase will be proved experimentally it will serve as a crucial evidence of the UQT validity and will allow creating electronic devices based on new electron-control principle.

Let us regard the operational principle of such a new device, its schematic diagram being given in Fig. 3.6.3.

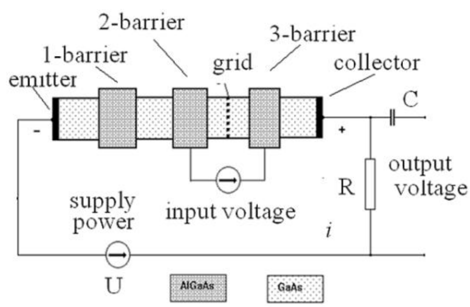


Fig. 3.6.3 *Scheme of the new transistor.*

This semiconductor includes several equidistant potential barriers produced by introducing impurities and a grid structure between the 2-nd and the 3-rd barriers. The processes that will take place within such a device can be easily predicted: all the electrons with equal phases but different energies will pass through the 1-st barrier. The electrons with de Broglie wave length, equal to distance between the two barriers divided by N (where N is an integer number), will also pass the 2-nd barrier. The energy deviation being rather small, a monoenergetic equal-phase (coherent) electron flow will be formed upon passing through the second barrier. Consequently, any change of a grid potential between the 2-nd and the 3-rd barriers will cause the electron phase change at approaching the 3-rd barrier and hence the amount of electrons having passed through the third barrier will decrease.

The above-predicted results were simulated on the same 5-barrier chain, the grid being placed between the 4-th and the 5-th barriers, which did not bring any essential changes of the situation. The resulting current behind each barrier had been summed up. In the current value calculation each particle's velocity and instant charge were taken into consideration.

In fact, for a 1-, 2-, 3-, and 5-barrier tunnel diode mathematical simulation was carried out. The dependence of each behind-barrier current upon the squared velocity of incident particles (this value being proportional to the device operational voltage) is shown on the plots in (Fig. 3.6.4).

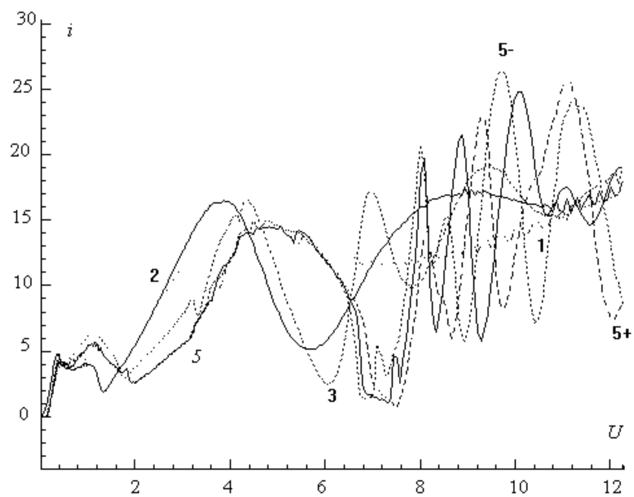


Fig. 3.6.4 *The Electric current after passing several barriers.*

It is clearly seen, that within the resulting 5-10 range volt-ampere properties there is a place with a negative resistance, and on the whole these characteristics give a sufficiently accurate description of the tunnel diodes (Fig. 3.6.4).

Further on, mathematical simulation of a new kind of device has been made, the concept of the latter is presented in Fig. 3.6.3 and its operational principle is described above. To achieve this velocity of each electron that passed through the 4-th barrier was changed by 5% as compared with its calculated value; the charge’s instant character had been taken into account. In other words, an attempt was made to imitate the grid, which either accelerated or slowed down by 5% the electrons that had passed the 4-th barrier; the current that had got through the 5-th barrier was also calculated.

The results are given on a summary plot (Fig. 3.6.4), where two more curves representing positive and negative grid voltage, correspondingly, are shown. The simulation’s outcome had surpassed our most far-reaching expectations; although it looks much more complicated than was expected proceeding from the above theoretical reasoning. The simulation analysis shows that there are some voltage areas, where the gain coefficient is very high; therefore, doubtless, devising of such instruments holds very much promise.

Some strange things are also observable: the current through the 2-nd, 3-rd and 5-th barriers may at certain voltage values be bigger than through the 1-st barrier. Any researcher can ask a legitimate question: how can it be possible within a series resistor circuit with one and the same current flowing? The answer to this strange paradox is rather simple: the phases of all electrons passing through the chosen point are such that their summed up charge varies only slightly, which leads to various current values at different points. Note, that just the same phenomenon is arranged by Nature within the so-called “Lecher wires (patterns)”.

It is experimentally established that within the Lecher wires (lines) there are some points in which the voltage is equal to zero. The lines can be short circuited in these points without any change in voltage on a payload at the line’s end. Similarly, there are points, where the currents run through the wire are equal to zero and the wire can be safely cut in these points without any damage done.

Besides, the plot (Fig. 3.6.4) reveals another curious phenomenon: one can see that all curves have common intersecting points at voltage values of 1.6 and 6.4.

This is a consequence of a trivial resonance effect, when de Broglie wave length changes by 2 times. In so doing, as the phase had altered by 2π, nothing will change in the probability for the electron to pass through the barriers via these points.

In electronics there are two principal ways to control the electron flow only:

1. Control by interception, when a common vacuum electronic triode or a lock (closing device) (a field or channel transistor) the amplified signal exercises control with the help of a grid (netting) over the number of the electrons passed, while the controlling element represents something like a bar (gate, valve) within the water flow.

2. This way of control involves the procedure in which electrons are slightly accelerated or slowed down with the help of the amplified signal, which leads the velocity being modulated. Then in the course of their movement in free space the faster electrons overtake the slow ones and the flow splitting or grouping into space charge clots occurs. Further on this density modulated bunch of signals interacts with the resonator or with the system with slow wave. Such a method of control is used in all the super-high-frequency devices - magnetrons, amplitrons, klystrons, TWT, canceratrons ets.

Note, that the proposed (suggested) way of controlling the electron flow is, in fact, essentially new and unknown to science because the tunnel effect dependence upon the wave function phase has not yet been established. It is clear that it is easier to control the electron wave function phase than to use other control procedures.

There is no need to wait for a long time till the velocity modulated signal bunch will group into clots in the free space. Therefore such a device could apparently allow obtaining very prompt work. Probably, it would be expedient to develop this new semiconductor device on the basis of either Ga-As or Al-x-Ga-x-As super lattice devices, proposed by Esaki L., Tsu R.[105], Japan. It could also be achieved on the basis of common tunnel diodes [107] or a resonance-tunnel dipole transistor [108, 109].

This experiment could be carried out in institutions possessing sub-micron semiconductor technology. It is also necessary to make a super pure semiconductor device with the electron free path length being greater than the device's dimensions. So, the electron flow control devices seem to be quite possible and new electronic devices using the phase control mechanism can be made. The consequences of these developments are to be very far-reaching.

3.7 Anti-Stokes Luminescence

What shall you say for this, the Physics? Friction among people leads to coolness in their relations.

"Shaggy thoughts". Stanislav Yezzy Lets.

It was discovered early in the last century that some luminescent solids (substances which glow after an exposure to radiation or seem to accumulate the light energy) manifest a strange feature: they give out light with a wavelength shorter than that of an incident (exciting) light flux. This effect was given the official name of anti-Stokes luminescence [110-112, 116]. In other words, it is the ability to transform, convert, or turn not only the exciting light into heat but also the inner (heat) energy of the substance into the light. It is, in fact, an ability to accumulate heat. For many decades there was a narrow academic argument going on whether in the course of over-irradiation the light could carry away some of the luminescent solid's energy. This resulted in an admission of the possibility of efficiency more 100% under a number of strict conditions.

The thermodynamic validation of this fact was achieved at a very high cost. The time component had to be introduced into equations - that was impossible (prohibited by the canons) in terms of the thermodynamics postulates. This fact acquired a practical value starting 1961 when S. Jatsiv [111], Japanese, proposed to use luminescence of a gadolinium compound for the optical cooling. Numerous measurements have shown in indirect way that the luminescent solid cools down, i.e. it emits more light energy than it has received [110, 112]. In 1966 there was report (A. T Aronov, B. M. Vool and others) on the electro-luminescence energy output up to 1.1, attention being paid to the fact that the sample's cooling was compensated by taking the heat from the environment. The established efficiency could achieve 1.6, the crystal being cooled up to 26.6 C, the irradiation amounting to 1 Watt/cm2.

Moreover, it is widely known that fuel elements installed on board the American "Apollo" and "Gemini" spacecraft also have an efficiency of more than 1(?!).

3.7.1 The Electric Conductivity of Water

Another mysterious phenomenon is associated with the electric conductivity of water: in numerous experiments of various researchers an anomalously high electric conductivity of very pure water (with the concentration of which corresponds to H_30 and OH equal to $10^{-7}-10^{-8}$ has been established. As the energy necessary for the molecules dissociation should amount to about 3 eV, it is easy to evaluate with the help of Gibbs statistic multiplier (factor) the resulting concentration of dissociated molecules:

$$n = A\exp\left(-\frac{\Delta E}{kT}\right) = A\exp\left(-\frac{3}{0.025}\right) = A*10^{-52},$$

where A is the coefficient of entropy having the order of several units. It is easy to yield to temptation and declare that such high dissociation is caused by energy generation processes that occurred in free spaces among the water clusters (pseudonuclei).

3.7.2 The “Levy Flight” in Brownian Movement

One more absolutely unordinary occurrence is the so-called “Levy flight” in Brownian movement. It was discovered by a team of French researchers [113] that in certain specific systems intended for study of Brownian movement some particles, being subject to random impacts of their neighbors, travel very far and it is absolutely unclear where they take the enormous energy needed to achieve this. Here we observe violation of one of the most important laws of mathematic statistics - Lyapunov’s Central Limit Theorem. That is why the authors of the experiment are faced with problems of theoretical interpretation. From the UQT viewpoint this is a natural result because here some energy generation process is going on. Curious but the process of similar origin is responsible for energy generation in Correa’s plasma reactor [87].

3.7.3 The Experimental Results of Professor Kasagi Group

It is possible to explain experimental results of Professor Kasagi group [114] on the basis of the conventional classic electrodynamics invoking the UQT idea about varying electric charge of a particle and its movement in space: when passing through a barrier field of intensity E

$$\mathbf{E} = -\mathrm{GRAD}\ \mathrm{U}(\mathbf{r})$$

the particle acquires acceleration

$$\boldsymbol{a} = -\frac{e\mathbf{E}}{m} = -\frac{e}{m} GRAD\, \mathrm{U}(\mathbf{r}),$$

the energy dW irradiated by the particle within the time dt is proportional to a square of acceleration a^2 and is equal to

$$dW = -\frac{2}{3}\frac{e^2}{c^3}\left(\frac{e}{m} GRAD\, \mathrm{U}(\mathbf{r})\right)^2.$$

It is seen that the irradiated energy (which is directly associated with the "bremsstrahlung" probability) is proportional to the fourth degree of charge - e^4 .

When the particle passes the barrier its charge decreases until the particle leaves it the charge grows. If the charge is very small, then the probability of radiation will be small too, but Professor J. Kasagi has another explanation, which, also, seems to be correct. The choice between these viewpoints is difficult. Moreover, another element of uncertainty is connected with unclear processes of strong interactions. Therefore it's not correct to stage similar experiments to prove the trigger point, although it can confirm UQT assumptions. In case we use some installations to determine the tunnel effect probability dependence upon the wave function phase, there will be no need in any alternative explanations (they will have a very general character).

We would like to recollect that within conventional quantum theory the probability of passage is not generally dependent upon the phase and to-day it will be difficult for us to explain any negative result. The negative result will mean that the UQT is not a true theory. Whereas a positive result will not prove the UQT validity, because it is impossible to prove any theory's validity, as there is always an opportunity that some of the results may turn out to be negative.

Therefore, the experiments on verification of tunnel effect probability dependence upon the phase should be considered a trigger point of all the research. Our principle interest at present is the resulting possibility to create new electronic devices. In fact, staging of such an experiment will be much cheaper than more sophisticated experiments on nuclear installations. It could be made on the basis of Motorola, Hitachi, Sony or NEC or some other firm interested in production of tunnel diodes and chips.

There is a strong impression that theoretical physics, although considered a respectable science, is not being paid much attention to a number of serious research institutions (such as NASA, Motorola, etc.) when dealing with fundamental problems and that seems to be quite correct.

These simple and clear results alongside with others (for instance, the Gibbs paradox) compel us to scrutinize over and over again the thermodynamics statistic foundation and the impact of the UQT on its postulates.

3.7.4 Tunnel Effects in Proximity to Zero Point Temperature (Single Electronics)

Recently in the United States a number of surprising experiments were carried out. First, they may be considered as the direct confirmation of the electric charge oscillations. Second, the standard quantum mechanics is this case altogether unacceptable, therefore the explanation offered by the authors [57], seems superficial and erratic. In fact, these experiments serve nowadays as the first direct evidence of the Unitary Quantum Theory validity and prove certain inadequacy of the Quantum Mechanics classic Copenhagen interpretation.

Let us consider these phenomena more detail. We shall start with a simple question: which is the smallest charge to occur on a “pinhead”? From the UQT viewpoint the answer is very simple: if there is only one electron on the "pinhead", then the smallest charge value may range from 0 to -2e (the charge averaging takes place in conditions of frequent oscillations and we observe the e value), i.e. for any value within the said range, but taken separately, the charge value at a certain time point will be dependent upon the phase, the correlation, naturally, being different in different systems of measurement.

In terms of rigorous quantum mechanics the answer is much simpler: the "pinhead" consists of electrons, protons and neutrons. Each individual proton or electron possesses either +e or -e charge, whereas the neutron has no charge. The total (summed up) "pinhead" charge will be equal to the number of electrons minus that of the protons. From this inevitably it follows that the smallest charge value should be +e or -e.

Yet, recent experimental results [115] show that the above is not true. They evidently point to the fact that the "pinhead" charge may be equal to a part of the electron's charge, for instance, to a half (0.5e) or one tenth part of it (0.1e). The said experiments involved extremely small structures (samples) of the order of 300 Angstroms, which represented a common tunneling transition. Such tunneling device consists of two conducting electrodes (made of aluminum) separated by a thin dielectric layer (aluminum oxide) with a 10 A thickness. If voltage is applied to such a tunneling device, the electrons will start tunneling through the dielectric basically in one direction. As a result of this, due to the electrons movement through the tunneling, a certain current flow will be observed.

Direct experiments with devices of this kind have yielded a surprising result: if a direct electric current flows through the transition (tunneling), a periodically varying voltage will be built up on the electrodes with a frequency being equal to the current value versus electron charge ratio. This phenomenon is called "set oscillations". It is clearly seen that the same effects take place in the course of analysis of the new electron device theory, as the current is different in different points, which means different charge values at different points and serves as a prerequisite of the potentials' periodical difference.

The electric current flows through the conductor due to the fact that some electrons are free and may move freely within the lattice made of atomic nuclei. Irrespective of the electrons movement the conductor of any given volume (size), in fact, has no charge, as the negative charge of the moving electrons is always compensated by the positive charge of the atomic nuclei within any given conductor volume. Consequently, it is not the total (summed up) charge within any given volume, which serves as important quantitative characteristics, but the value of the charge carried (transported) through the conductor.

The most surprising in the experiment is the fact that the transported charge can have any value, even fractions of the electron charge. Further on, the authors of the work [115] give a superficial, or to be more exact, not quite correct explanation of the observed phenomenon. The authors' physical concept of the occurring process is following. The transported charge value has very little to do with the summary count of the protons or electrons number. This charge is proportional to the summed movement of all the electrons in relation to the atomic lattice. As the electrons inside a conductor can be shifted for an infinitely short or long distance this sum can vary gradually and consequently the same can be said about the carried charge value.

If necessary, the charge carried through the conductor may be changed incessantly (continuously) within the range from zero to +e or -e. If the common conductor structure is interrupted by a tunnel transition, then the electric current flow within such a system will be both of uninterrupted or discrete character. When the carried charge is moving within the conductor continuously it will be accumulated on the electrode surface at the tunneling insulation layer, the opposite electrode having charge equal by value, but opposite in sign. This surface Q charge may be represented as a gradual insignificant electrons shift near the surface in relation to their position in a state of equilibrium.

The authors of [115] observed that phenomenon at tunnel transitions being very small and the surrounding temperature being extremely low (in liquid helium conditions). Low temperatures are necessary to reduce heat oscillations (fluctuations), which bring chaos into the movement of electrons. In this case if the Q charge at tunneling is bigger than e/2, then the electron is capable of passing through the barrier in definite direction reducing the value of Q by e.

The possibility of tunneling is explained by the fact that this process lowers the system's electrostatic energy. Similarly, if Q is less than -e/2 the electron may start tunneling in the opposite direction, increasing the charge Q by e, then the system's energy is again reduced as a result of this. Yet, if the Q charge is less than +e/2 and bigger than -e/2, then tunneling in any direction will increase (!) the energy of system (it is absolutely unnatural from the physical viewpoint – our remark). Consequently, if the initial charge value is within the given range, tunneling will not take place. Such tunneling suppression is called the Coulomb's blockade.

The authors of [115] suppose following. Let a single electron to approach the barrier (if the electrons are numerous then their further assessment will look even worse for the authors of [115]-our remark) having the charge e (or –e). The passing through the barrier is possible if the electron's charge will change in proximity of the barrier's border-line by value not less than $e/2$. Meanwhile, such charge's changing may proceed provided by the moving electron displacement to the distance of electron's radius order. Such displacements are easily controlled by the fixation of the moments when the Coulomb's blockade begins and ceases.

In other words, the experiments show the possibility to determine indirectly the electron's co-ordinate with accuracy equal to half its diameter!!! This is obviously true only within the classic mechanics, but utterly impossible in terms of standard quantum mechanics because of the following reason: it is a well known fact that the exact ordinate and momentum values of an electron cannot be measured simultaneously, although each value taken separately can be measured to any degree of accuracy. The exactness of the electron Δx co-ordinate determination is related to the Δp momentum measurement accuracy through the Heisenberg correlation:

$$\Delta x \Delta p \geq \hbar$$

If the co-ordinate's accuracy measurement is equal to $\Delta x = 10^{-15}$ cm, then it is possible only at energies of the GeV order, but the electron energy confined within the lattice at helium temperatures is billions of times less and the only possible explanation to-day is the charge oscillations of the moving electron.

But the other circumstance is the main. The fact is that electrical current flow is stopped during Coulomb's blockade and electrons become motionless and their impulses become exactly known (are equal zero). The coordinate of given electron becomes quite indeterminate in this case and we don't know even what electron is observed (!). Just the idea of charge oscillations supposed by our theory allows to give the only correct to-day explanation of observed phenomena.

And this means that the UQT is valid in this case whereas the standard quantum theory fails.

It should be noted that quantum mechanics in general is not concerned with single events (in which only one particle participates) and had never claimed to do so. Final elucidation of this circumstance took place under the impact of A. Einstein and E. Schroedinger works.

On the other hand, it is important to remark that the oscillating charge equation always remains a single particle equation, which is absolutely uncharacteristic of standard quantum mechanics. This fact should be viewed both as fundamental and extremely important.

3.8 "Nuclear Democracy" and Anomalous Slow Processes

Occasionally I'm able to do without something necessary, but never without luxuries

A. P. Chekhov

Intermediate or composite nucleus – in some nuclear reaction at compound nucleus – is an intermediate, relatively long-lived composite system consisting of nucleus and a trapped flying particle. Its decay to radioactive products somewhat depends on the mechanism of its composition.

That model was introduced by N. Bohr as far back as 1936. According to it a nuclear reaction is proceeded in two stages. At first fast stage the flying particle is penetrating into the nucleus and gets captured. Due to the strong interaction the excitation energy is rapidly distributed among all the nucleons of the nucleus. It seems that the particle becomes entangled in the core of the target so the average extraction energy appears to be less than cohesive energy (approximately 8 MeV). During a long time it is unable to leave the nucleus until all nucleons located near the nucleus band have again collected the energy exceeding the cohesive energy. But what shall we do with the Carnot theorem?

The other possible way of composite system decay is the emanation of γ-quantum. It is well known that it is quite a slow process too. Life interval of such composite system is extremely long; sometimes it is million times longer than the estimated time of the particle's flight through the nucleus-target. After the expiration of so a long time τ (the system seems "to forget" the way of its creation) the second stage of nuclear reaction begins. It is the intermediate nucleus decay, following either in the flying of a similar particle either another nucleon or a γ-quantum (in general by other processes too).

The probability of the intermediate nucleus decay is

$$\omega = \frac{1}{\tau} = \frac{\Gamma}{\hbar}$$

where Γ is the width. The nucleus may split by different channels. So the probability of the decay can be presented as a sum of partial probabilities along different channels, each of them characterizes one separate way of decay:

$$\omega = \omega_\gamma + \omega_n + \omega_p + \omega_\alpha + \ldots = \frac{\Gamma_\gamma}{\hbar} + \frac{\Gamma_n}{\hbar} + \frac{\Gamma_p}{\hbar} + \frac{\Gamma_\alpha}{\hbar} + \ldots$$

The relative probability for the composite nucleus to decay through definite channel is equal to

$$\eta_i = \frac{\omega_i}{\omega} = \frac{\Gamma_i}{\Gamma}.$$

Of course, the existence of an intermediate or composite nucleus is possible, but one can be confused by the circumstance that the energy of the flying particles may be a portion of eV and the energy of the flying out (born) particles is sometimes the same. It is well known that the first levels of the exited nucleus usually lie above the general one approximately at 400 KeV. Here utterly strange levels with the energy of bits of eV suddenly appear. Besides they are extremely narrow. But even more queer is that the extremely small energy of the flying out particle (according to existing quantum theory) always first of all “spreads” over all nucleons and then, in a complete contradiction with the Carnot theorem, again gathers together in one particle. Later that particle is able to flight out. It is incomprehensible how it has managed to overcome the forces of nuclear attraction between nucleons (the energy of such strong interaction may be near 8 MeV). These processes can be detected for both protons and neutrons.

All these circumstances have resulted in the appearance of sarcastic remarks in some theorists about “nuclear democracy”: after a particle with small energy has flown into the core of the target (nucleus) “the latter is worrying for a long time because of the discussions in nuclear parliament about what nucleon and when should leave the nucleus and if there is not enough means (energy), they are assigned anyway”. And all these debates need time. Here in Russia we say that any joke contains a bit of truth. We are not going to criticize that perfect bureaucratic analogy, but its existence points for us.

N. Bohr had even invented special drop nucleus model working in few cases only (for example it could not explain the existence of magic nucleus at all). In general we can say that till now there is no good model of the nucleus because strong interactions are as complicated as possible and till now there is no in the slightest degree suitable universal mathematical expression for strong interactions potential.

It seems to us that all troubles with the abnormal long time of particle (proton) flight through the nucleus-target are generated by “snail effect” (section 3.1). The same effect is responsible for all other abnormal slow processes. The delayed neutrons able to leave the nucleus after few minutes can be also “explained” from this point. It is only due to that phenomenon we are able to affect nuclear reactions at thermal neutrons in reactors.

Note the behavior of neutrons and protons are different. Evidently the proton flying towards the nucleus spends a lot of time for overcoming Coulomb repulsion (snail effect). But when it leaves the nucleus it does it quickly thanks to helpful Coulomb interaction. For a thermal neutron the Coulomb interaction nearly does not exist (the interaction due to the magnetic momentum is sufficiently small in comparison with the Coulomb interaction for protons). In quite short time the neutron reaches the nucleus, but when it (or other neutron) is leaving the nucleus the snail effect appears again while overcoming the forces of nucleus attraction.

Of course for that it should be assumed that oscillating mechanism of charge is universal, i.e. suitable for not only electromagnetic coupling but for strong interaction too. From the viewpoint of the UQT all reasons are voting for it because vanishing in some points wave packet in the UQT, and so in these points all interactions disappear.

In accordance with general nuclear physics delayed neutrons (approximately they constitute 1% of total numbers) may appear only when the nucleus is exited with the energy higher than the cohesive energy of one neutron in the nucleus. As usual the mechanism of delayed neutrons emission is related with the β - decay of such nucleus, but it must be over-laden with neutrons. Of course that process also takes place and makes its contribution to delayed neutrons.

3.9 Photoluminescence of High Porosity Silicon

Most great truths were blasphemies at the beginning.

Bernard Shaw

The experiments described below were as if specially performed for the check of the Unitary Quantum Theory and its basic prediction - energy generation. In 1956 A. Uhlir [117] was the first to obtain porous silicon by means of special electrolytic etching in hydrofluoric acid. This substance was a monocrystal of very pure silicon with an enormous quantity of microscopic pores, which was formed in the result of etching. The porous density was so great that the porosity coefficient (the relation of the removed material to the initial quantity) reached 50-85%. Such silicon was characterized by numerous interfaces and possessed tremendous internal surface area of up-to 600 m2 per 1 cm3. The electronic microscopy revealed a great number of caverns measuring 10-100 Angstroms, connected with each other by minuscule passages. In fact, the said material had a coral-like structure.

But a real sensation in microelectronics was in 1990 when L. Canham and his team of researchers [118] accidentally discovered that when electric current was applied to the porous silicon a sufficiently strong red-orange photoluminescence at room temperature appeared. Practically at the same time similar phenomenon was discovered in France [119]. It was a challenge to theoreticians and experts working in the field of semiconductor physics. Yet, there is still no satisfactory explanation of the observed processes. Only few believe that the effect is based on the electrons recombination and holes [120], besides this explanation stands in direct contradiction to some experimental facts. In terms of the Unitary Quantum Theory porous silicon differs very little from the water cavitations bubbles in Yu. Potapov [60-62] and J. Griggs [68-69] heat installations.

When a weak electric current passes through porous silicon, a free proton gets into a cavity and starts generating energy at certain initial conditions. This process is described by the “Maternity Home” solution. The «bremsstrahlung» irradiation of the energy-saturated proton causes a red-orange photoluminescence. The potential well destruction by energy-saturated protons would entail destabilization of this effect. This fact was observed in different experiments. Moreover, if one fills the pores (caverns) with molecules of light organic compounds (ethanol, methanol, acetic acid) that cause a shift of the photoluminescence stripe from the red into a yellow-green area [122].

According to the UQT this effect can be expected when the mass of the particles oscillating within the well is increasing. There is another more surprising experimental fact [120-122]: heating the newly prepared porous silicon to temperatures exceeding 250 degrees Centigrade results in total disappearance of the luminescence.

Careful analysis showed that at such temperatures the hydrogen left silicon just after the pores forming in acid electrolyte disappears from the sample. At present there is an impression that these experiments serve as direct confirmation of the UQT, but the authors dream the other independent researchers could share this conclusion.

3.10 The Possible First and Second Thermodynamics Law Restriction

«…superposition of alive and dead cats states»

E. Schroedinger

3.10.1 The First Thermodynamics Law

The most mysterious, of course, are phenomena associated with energy generation processes - excess energy in cavitations bubbles and caverns, CNF, catalytic reactions. The said phenomena were discussed in more details in our earlier publications, therefore we are not going to focus on them in this book, but we shall try to analyze their impact on physical science. It is to be underlined that thermodynamics is an absolutely consistent science and there is no use to look for contradictions within it.

Our present discussion will be concerned with main postulates of thermodynamics and the restrictions in use of the First and Second Thermodynamics Laws which arise if UQT is valid. Note that the official science recognizes absolute truth of the First and Second Thermodynamics Laws in all the fields of life [123-125].

To overcome the contradiction it is more expedient to consider the First Thermodynamics Law as a convenient postulate extremely useful in describing a wide range of phenomena, than to apply it indiscriminately (without proper careful analysis) to all cases, being fully aware that rigorous mechanics doesn’t work here. This problem was dealt with in details in Sapogin’s report prepared for the International Conference “Nuclear Power Engineering in the Third Millennium” (Obninsk, Russia, October, 1996).

Further to abovementioned (section 3.2) the law of energy and momentum may be derived within Unitary Quantum Theory after averaging over all initial phases of numerous particles, but these laws are not valid for a single particle. Since Thermodynamics is in general a statistical science, its First Law is quit not bad postulate and will serve the Science for a long time. Nevertheless, some fields of Science and Techniques have appeared where this law is not inviolable.

3.10.2 The Second Law of Thermodynamics

If the First Law of Thermodynamics is now unquestionable (let us remind you that starting from 1755 the French Academy of Sciences had established by fiat the Law's universal application and up to now there has been no evidence that this fiat being wrong from the viewpoint of the classical physics), then the situation is different in respect to the Second Law of Thermodynamics. Here we can't help citing some pillars of thermodynamics and prominent physicists.

First, we wish to express our own viewpoint: through the mossy grating of the Second Law of Thermodynamics our future looks indeed dark and horrible: thermal death of the Universe and energy crisis. It should be noted that the process of the Universe thermal decay has been suspended and can hardly be envisaged within the nearest billions of years! As regards the energy crisis on the Earth this problem is sure to be solved within 5 or 6 years. Most probably there are systems in which the Second Law of Thermodynamics has a limited application. Fortunately, other researchers share our viewpoint.

Thus, I. Prigogine, the Nobel Prize Laureate and author of non-equilibrium thermodynamics, says: "... now, one hundred and fifty years later, after the Second Thermodynamics Law was formulated, it still represents a program rather then a well-defined theory" [140]. So far even the field of its validity or application hasn't been delineated. The two greatest Russian minds, K. Ciolkowski and prof. V. Vernadsky, always doubted the Second Law's absolute truth. K. Ciolkowski even wrote an extensive research work named — The Second Law of Thermodynamics in which he showed the latter's limitations [126].

But it was probably J. Maxwell who saw for the first time the necessity or, to be more exact, inevitability of certain restriction for the Second Thermodynamics Law. He wrote [127, 128]: "... our conclusions proceed from experiments with bodies, consisting of uncountable number of molecules, they may turn out to be wrong when applied to more subtle cases and experiments, which could probably be performed if one learnt to differentiate and control molecule".

J. Maxwell was the first who introduced statistic methods in gas laws and he had to work hard on a problem what entity should be considered as a sand-hill (heap)? Two, five ... a thousand grains of sand? In other words, starting from which number of molecules the statistic laws become really valid? The statistical analysis of molecular systems consisting of a huge number of molecules allows to obtain certain mean (statistical) values of various parameters describing the behavior of given systems on the whole. Their knowledge is usually sufficient in majority of practical cases. But average values differ from the exact for a single molecule or for a special group of molecules. It is assumed in conventional thermodynamics that when molecules collide its energy and momentum are strictly conserved within the elementary act (taken only for two particles [132, 133]). In UQT the same is not true for two particles, but remains valid for the particles' assembly when summed up at all their starting phases. However, it is still unclear what consequences does this discrepancy entail.

But practical benefits, a possibility to achieve quick results, have overshadowed development of a more direct, simple and, in fact, more potent dynamic procedure. And it was not accidental that Maxwell did not ascribe to his statistic method any other meaning than that of a temporary solution for the situation. It was likewise natural that he, seeing how different and sometimes even quite opposite are the results of both methods, had devised a special kind of "entity" known under the name of "Maxwell's demon". Over the past centuries the demon had made a useful contribution to thermodynamics. In particular, this demon did not allow the faith into the Second Thermodynamics Law to become unlimited, as was the case with the First Law. Maxwell wrote [127]:

> *"... imagine a creature with a sense of perception so acute that it can trace any molecule trajectory; such a creature, with capabilities essentially as finite as ours, could perform things impossible for us at present. In fact, we*

have seen that molecules, contained in a jar filled with air at uniform temperature, move with their velocities being essentially different, although the mean velocity of any randomly selected big quantity of them is almost exactly uniform (even). Now, assume the jar being separated into two parts, A and B, by a partition, in which there is a small hole, and that the creature, capable of seeing individual molecules, opens and closes this hole so as to let the fastest molecules pass from A into B and the slow ones from B into A. In so doing this creature, without any particular work spent, will manage to raise the temperature in B and to drop the temperature in A in contradiction to the Second Thermodynamics Law".

Maxwell's demon is still bothering inventors alongside with orthodox-thinking professors. True, not everybody thinks so. Thus, R. Pohl [129] ironically says:

"... existence of irreversible processes is an established experimental fact. Its authenticity has been reliably proved due to scientific effort of numerous Maxwell demon inventors' failures. Because of statistic character of molecular fluctuations of all the possible material valves this demon will always remain unable to work. It is - a sleepy door-keeper"

Publishers of J. J. Thomson's reminiscences explained [130]: The paradox of Maxwell demon for a long time did not have any theoretical solution. And only after the approval by the science of the information a c concept, it became clear that it was an illusion, resulting from the neglect of energy spent for access to the information about the molecules velocity. Indeed, in order to evaluate velocity the demon should, at least, be able to see the molecule, for which purpose he has to illuminate it, for example, with the help of some source of light, which in its turn will require some energy for functioning. Therefore, it is assumed that the Second principle of thermodynamics is not violated. The examples of such superficial judgment are numerous. To justify own-self we wish to remind that

Hopkins (Maxwell's teacher) used to say that Maxwell was physically incapable to wrongly thinking about science. Indeed, the paradox will remain in case the energy spent for information acquisition on velocity is less than the energy yield resulting from the demon's work within the system.

J. J. Thomson [130] actually stressed this fact when he wrote: *"The demon performs his job in purely intellectual way: one can neglect the muscular effort made"* (sorry, back translation). As regards the valves, the molecular nature of which does not allow them to fulfill their mission (task), according to Maxwell, there was no intention to regard these particular devices. The case in point is: if there were a way to sort out particles as individual entities, characterized by specific velocities, the Second Law would not be valid.

Though, everybody agrees that the law does not apply to behavior of separate particles or to a limited number of them (here, again, the sand heap problem appears). And what if there were a lot of systems consisting of small number of particles? But conventional science currently refrains from making any logical conclusions out of all this reasoning and state that if in a system there appears a demon (no matter of what origin) the said system immediately falls out of reach of The Second Thermodynamics Law. Therefore, even potential existence of Maxwell's demon should be viewed as clear evidence to the Second Law's restrictions actual availability and the whole situation should no longer be regarded as a paradox.

Curiously, in USA (according to confidential information) an extensive research program has been going on for several years (Motorola, Intel Company and other) to develop micro-processors (chips) of the Maxwell demon type. It is immediately evident from Feynman's lectures. Thus, Feynman, one of the most prominent physicists of current science, in a chapter called "Ratchet and Pawl" [131] (v.1) gives a faulty analysis of a heat engine (machine) consisting of a wheel with paddles, ratchet and pawl. When thinking along conventional lines the wheel with paddles will rotate in one direction under the impact of random blows caused by molecules. The random blows directed oppositely will not force the wheel to rotate and perform useful work, because the ratchet and pawl will prevent it. Feynman further states that the pawl subjected to impacts (blows) of other random molecules would be somewhat raised erroneously, causing failure in the machine's operation and the wheel would slightly pivot in opposite directions in a random way, and the whole system would thus fail.

But if the system with ratchet and pawl is placed in a vacuum (this is not a matter of principal importance but a purely technical problem), then there will be no molecular impact upon the pawl and Feynman will find himself in a very awkward position! In all probability we can obtain work out of random movement contrary to Feynman [132, 133] and thermodynamics [134-138]. Thus for some time in Russia they produced mechanical wristwatches with a self-starter (the self-starting resulting from occasional arm/hand movement and effected by the above ratchet and pawl with an additional small mass placed on their axis). In our youth we even intended to make a present to Professor Richard P. Feynman of such kind of a wrist-watch (in which energy required for operation is generated from random fluctuations), but, unfortunately, we did not have time to do it.

According to R. Clausius [134], the Second Thermodynamics Law states that heat cannot be transferred all by itself, free of charge (i.e. without any energy expended), from the cold body to a hot one as, obviously, one has to pay for it (just like in a refrigerator system). Indeed, heat cannot "by itself" be transferred from cold body to a hot one, even if one has to pay for it. And humanity continues to pay for it thoughtlessly directing all the engineering effort only towards reducing this pay. But the Second Thermodynamics Law does not name the payer. Today it is much more important to decide at first who is to pay rather than how much to pay? Moreover, let anyone pay! Why should we bother about it?

In works of many scientists (particularly, by Ludwig Boltzmann [139] and Leo Szilard) it was established that the Second Thermodynamics Law was based on statistic laws. Application of the latter to thermodynamics is founded, according to Charles Kittel [138], on an a priori fundamental assumption that a closed system with equal probability may occur in any permissible quantum state. It is hardly possible to prove this assumption in terms of the UQT, because this theory does not contain closed systems. But this problem requires further serious consideration.

Sly and clever Ju Sin Chan (China) knew nothing about Clausius, Carnot and the Second Thermodynamics Law and may be because of that he had devised his bowing bird ("Chinese bird"). This brilliant toy is sometimes sold on Russian markets. It is capable of tirelessly and perpetually transforming the heat energy of environment into useful work. When it porous beak touches water in a small glass and becomes wet then, due to evaporation of water, the head temperature lowers, the ether inside condenses and flows down, the center of gravity changes and the system collapses. After the evaporation of water from the bird's head, its body and head temperature becomes the same, the ether inside the head evaporates only partially, the system replaces the center of gravity and overturning again occurs.

The main prerequisite for the work of the toy is the requirement that the time needed for the bird's oscillations complete attenuation be longer than that needed for the water full evaporation from the bird's porous beak, which can occur within a wide enough temperature range. Note, that the water contained in the small glass is in a state of thermodynamic equilibrium with the environment (!).

As seen from the above, both the First and the Second Thermodynamics Laws have certain restrictions to their use and it is the UQT that is to help to establish and delineate the said restrictive boundaries. Above we had considered some experimental effects, which apparently run contrary to the First and Second Thermodynamics Laws.

3.11 Gas Outflow Through Very Narrow Slot

"As I have more than once underlined experiment means nothing without being interpreted by theory".

Max Born.

Research of compressed gas outflow through a nozzle or a slot into a medium filled with the same gas, or into vacuum, has been going on for a very long time. Usually, all researches were made in the near-sonic or supersonic zones of gas speed and for such nozzle or slot dimensions, when the outflow was of a manifest turbulent character. Not long ago multiple experiments [141] of laminar gas outflow through very narrow micron slots proved that the kinetic energy of the stream flowing out of such a slot exceeds the incoming gas energy by two and more times. The authors of such experimental research generally believe that a laminar stream carrying excessive mechanical energy in the experiment takes it from the environmental energy, to be more precise, from the atmospheric air.

It is supposed that such a laminar stream represents a direct transformer of thermal energy of the atmospheric air into mechanic energy, and quite a few researchers stick to this position. Moreover, there is only one air temperature level for such transformation and that irrespective of the operation of the transformer. It is well known that in thermodynamics, for heat to produce certain work it should move from the heater to the cooler, and it can made some work on the way (fully similar to a water flow). The proposed explanation of the results of such experiments totally contradicts the second law of thermodynamics (the Sadi

Carnot theorem). By the way, it was questioned by many great scientists (e.g. K. E. Tsyolkovsky). The idea that in the presence of the gravitation field gradient heat can pass from a cold body to a hot one along the gradient is a moving force behind many such research works and technical proposals. Let us note that the solution of the Ludwig Boltzmann kinetic equation for the heat conductivity of electron gas in a semiconductor with superposition of an external permanent electric field [142] does not predict it and leaves no hope for such effects. However, the results of multiple experiments made by Dr. Yu. I. Volod'ko [141] and others, prove the contrary. So, instead of pretending that these effects do not exist, one must offer a new explanation for them.

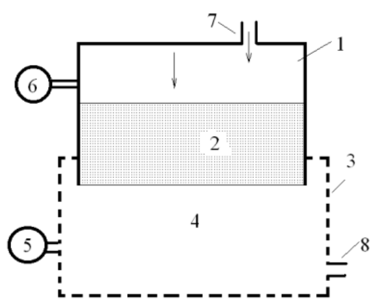


Fig. 3.11.1 *First measurement scheme.*

The phenomenon of an increased energy of the flowing out gas stream was first discovered experimentally in quite a different system, and was totally unexpected. Air filtration through powdered magnesia isolation used in a heat-resistant cable was studied. Fig. 3.11.1 shows the scheme of this experiment.

Compressed air is fed to receiver 1 through reducer and tube 7, and it passes through filtering layer 2 into volume 3, which can be quickly connected to or disconnected from the atmospheric volume with the help of tube 8. Surface of the filtering layer 4. Average excess pressure value is 0.41 kilogram-force per square centimeter only.

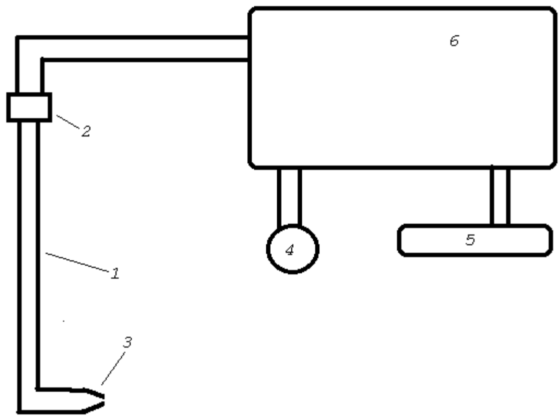


Fig. 3.11.2 *Scheme of second experiment.*

There was a possibility to sharply change (reduce or increase) for 1-2 seconds the pressure in receiver 1 and volume 3 with the help of a special device connected to tube 8 (not shown on the scheme). During the rest of the time volume 3 was connected to the atmosphere. Manometers 5 and 6 allowed creation of the pressure dependence on the time in these vessels after the filtering layer and before it from time in case of sharp pressure changed in volumes 1 and 3. Their readings in case of big volumes were changed quite slowly. 10 measurements of this kind were made, each having its own thickness of the filtering layer and its own pressure in the receiver. Knowing the air consumption and pressure values, it was possible to calculate the gas speed in the filtering pores of magnesia isolation using the standard methods. A very big value of excess pressure on surface 4 and a high value of outflow speed were discovered. This allowed calculating the “thrust” of the system, and it turned out to be about 4000 kilogram-force per square m (!!!), but the value itself was not measured.

The determination of thrust in the nozzle section was made in other direct experiments. The relevant scheme is shown in Fig. 3.11.2. Flexible tube 1 is suspended in such a way that one end is hanging vertically and can deviate as a pendulum with revolving fixing in point 2. The end of the tube is equipped with a cap with nozzle 3 and a load, and the air flow from the nozzle is directed horizontally. The second end of tube 1 is connected to receiver 6 equipped with manometer 4, where pump 5 can feed compressed air. The air consumption through the nozzle was measured by the volumetric method with the help of a thin rubber bag, which was connected to the nozzle for a fixed period of time. Thrust (deflecting force) was defined by the deviation angle of the cap with the nozzle. It is known that jet engine thrust equals:

$$F = G(u - V) + (P - p)S \tag{3.11.1}$$

where G is the mass gas consumption, u is the gas outflow speed, V is the aircraft speed, P is the absolute pressure on nozzle section, p is the atmospheric pressure, S is the nozzle cross-section, F is the nozzle traction. In this equation u and V are regarded as measured in relation to the Earth, and value u-V is thus the gas speed relative to the nozzle. The first term in this equation is the “reactive force”, which includes mass gas consumption. The second term does not include gas consumption, but consumption is necessary for pressure distribution and, consequently, for difference P-p. The idea under consideration can be more profitable and economic, when the first term is smaller and the second one bigger. This will create conditions for small gas consumption and a big thrust simultaneously.

45 nozzles were tested, each of them (Fig. 3.11.3) representing a flat slot with clearances 2a from 8 to133 μm.

The length of the route the air passes in clearance L is between 0.2-62 mm. For all nozzles the slot clearance is much less (by 75-1600 times) than slot width B, measured across the air movement direction, and the length of the route L of the air in the slot is 2-1200 times bigger than its clearance. The calculated O. Reynolds criterion was below 1000 for all measurements, and the gas movement speed in the slot was about 100m/s, which testifies to the laminar character of the flow.

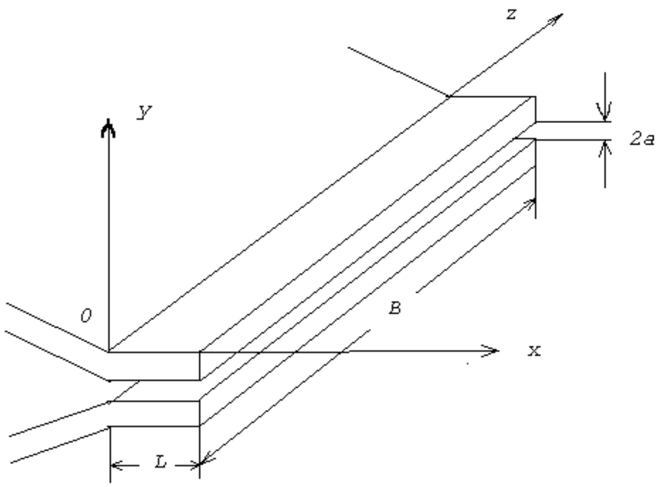


Fig. 3.11.3 *Slot appearance and coordinate system.*

If the nozzle thrust is divided by its cross-section of the narrow internal channel, the resulting value will have pressure dimensions. It can be called "effective pressure". It is surprising, but measurements show the excess of the pressure in the receiver (the input) by 2-4 times, which is equivalent to a molecular speed increase, since pressure is composed of the blows of different molecules, and the higher the molecular speed the greater the pressure.

The gas speed increase effect after the exit from a narrow slot leads to simultaneous increase of both terms in equation (3.11.1). The measurements show that the role of the small value of the slot width is not to reduce consumption, but mainly to make the flow laminar. In this case one can observe that the gas speed at the end of the slot is bigger than at the beginning. Numerous experiments show that the kinetic energy of the flowing out gas exceeds by twice and more the energy spent for air compression. In other words, the gas molecular speed at the nozzle (slot) output exceeds the input molecular speed at the beginning of the slot by 2-4 times. This incomprehensible effect contraries the modern gas dynamics and leads to a considerable growth of excess pressure. As the width of clearance 2a increases, the effects gradually disappear.

All these experiments were repeated in February 1988 in the Lavochkin NPO by a group of researchers: A. M. Baklunov, I. E. Karetkin, E. G. Antonov, Yu. V. Lyutykh, S. M. Trusov, and N. I. Stepanishcheva. They received nearly the same results [141]. These experimental data shows that if many very narrow slots are made on a closed bearing plane and air is pumped into the volume with the help of a compressor, then it would be possible to create a completely new type of aircraft based on a new flight principle and reminding a helicopter by its flight characteristics. About 70-80% of the thrust in such a device will be obtained due to consumption of excess static pressure at the nozzle section, and the remaining 20-30% will be due to the reactive action.

Dr. Yu. I. Volod'ko [141] and others believe that the resultant additional energy is taken from the environment (!), where it exists not as mechanic energy, but as dispersed heat energy. The authors of the book totally disagree with it and give another, and more natural, as it seems to us, explanation to these wonderful experiments by Yu. I. Volod'ko.

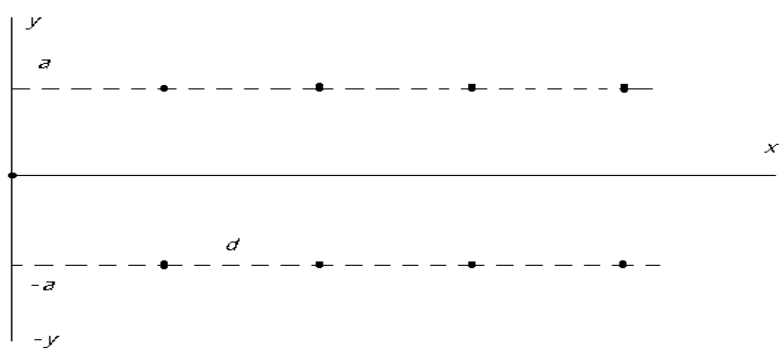


Fig. 3.11.4 *Coordinate system in slot.*

Further to abovementioned the absence of translation invariance of movement equations with an oscillating charge imply lack of energy and impulse conservation laws for them. In this case a particle in a narrow slot will periodically bumps into the walls while moving and in a result of many bumps can accumulates extra energy. With certain geometry of the slot, the processes of particle energy reduction after many bumps can be suppressed. It slightly resembles the “Maternity home” solution for the processes happening in a harmonic oscillator.

Let us consider the two-dimensional problem of particle movement in a potential created by a double chain of point sources (the atoms of the slot walls), with period π and distance between the chains 2a (the width of the slot clearance). The choice of this potential is connected with calculation problems.

$$U(x,y)=Q^2\left[\frac{\cos^2(\pi x)}{\left(y^2-a^2\right)^6}+\frac{\cos^2(\pi x)}{\left(y^2+a^2\right)^6}\right]^2 \qquad (3.11.2)$$

The potential with a=5 looks as follows:

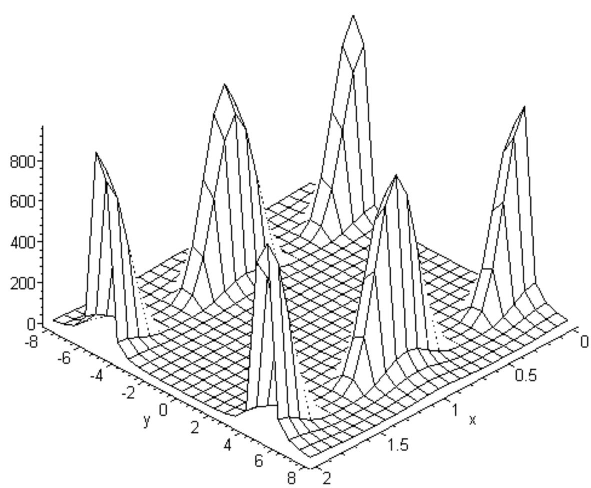


Fig. 3.11.5 *Potential in slot clearance. Particles are moving along the x axis.*

If the gas molecular speeds is very small, the interaction potentials will be either of the J. Van-der-Waals (Mie-Lennard-Jones) type:

$$U(r)=\frac{A}{r^{12}}-\frac{B}{r^{6}},$$

where A and B are certain constants different for different molecules; or of the Buckingham type, where the repellent term is an exponent. Since the interaction potentials of the gas molecules with the slot walls are very complicated and depend both on the slot atom and gas molecule parameters, the value of the dipole moment and their orientation, the task seems to be almost hopeless, and it strict solution is hardly feasible in the near future. Fortunately, as the modeling shows, the effect under consideration has a weak dependence on the concrete repulsion potential type. For example, in the cases of repulsion potentials (the exponential, the coulomb, dipole $U(r)=\frac{A}{r^{2}}$) the general quality picture of the processes changes but little. In future we will ignore the part of the potential connected with gravitation, and will consider the repulsion potential as approximately the same:

$$U(r)\sim\frac{A}{r^{12}}$$

But if we will try to write the potential of a chain of several dozen atoms, the final equations will be very complicated for numerical modeling, and the best PCs will be altogether helpless. For this reason we use numerical calculations of slightly modified simple type potential (3.11.2).

Such a potential will create repulsion forces along the x and y axes:

$$F_x=-16\pi Q^2\sin(\pi x)\cos^3(\pi x)\frac{\left(y^{12}+15y^8a^4+15y^4a^8+a^{12}\right)^2}{\left(y^4-a^4\right)^{12}}$$

$$F_y = -96Q^2 \cos^4(\pi x) y^3 \frac{\left(y^{27} + 36y^{23}a^4 + 365y^{19}a^8 + 848y^{15}a^{12} + 651y^{11}a^{16} + 140y^7a^{20} + 7y^3a^{24}\right)}{\left(y^4 - a^4\right)^{13}}$$

Movement equations for a particle with a unit mass will appear:

$$\frac{d^2x}{dt^2} + F_x \cos^2\left(x\frac{dx}{dt} + y\frac{dy}{dt} + \varphi_0\right) = 0$$

$$\frac{d^2y}{dt^2} + F_y \cos^2\left(x\frac{dx}{dt} + y\frac{dy}{dt} + \varphi_0\right) = 0$$

This system has been solved numerically by Runge-Kutt-Merson method with automatic pitch selection. Since these movement equations are approximate, type of potential is approximate too, the main thing in further modeling will be to establish the effect of particle acceleration in a narrow slot after numerous bumps against the slot walls, and the only requirement to be met will be:

$$\lambda \approx 2a$$

In other words, de Broglie wavelength of particles moving in the slot clearance must be of the same order with the slot width. This is what happens in the experiment. The movement equations are solved for the following starting conditions:

a=2, $\varphi_0 = 1$, Q=100, $x_0 = -1, y_0 = 1, V_0x = 1, V_0y = 0.23$.

The resultant movement trajectory of the particle in the slot is shown in Fig. 3.11.6, where characteristic oscillations of the particle can be seen along the y axis, when the particle bumps against the walls, and the forward movement itself happens along the x axis with certain acceleration. Let us note that the graph is much compressed along the abscissa axis, which is made to fit in more oscillations. In reality such ordered oscillations cannot take place for a long time, and the length of the trajectory should be of the order of the length of the free path of molecules in gas. Hence the limitation of slot clearance width 2a, which should be much less than the free path length in gas. For these reasons (not only for quantum ones) the effect will depend on the clearance width. When clearances are small, this dependence will have a complicated periodic character, but when value 2a increases, the effects shall totally disappear, which is observed in the experiment.

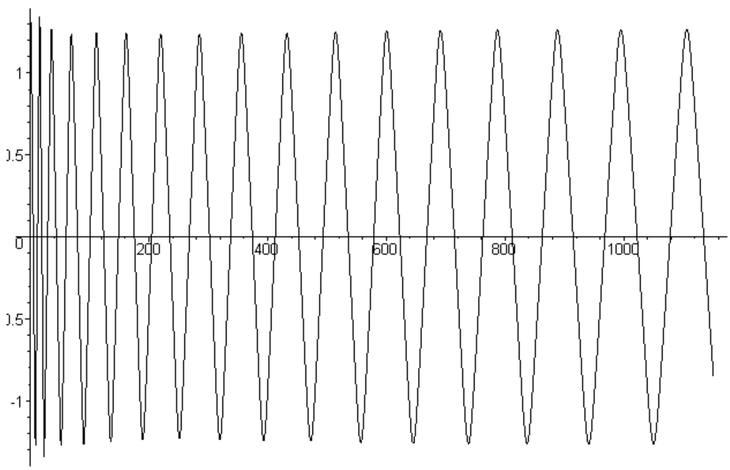


Fig. 3.11.6 *Trajectory of particle movement in slot.*

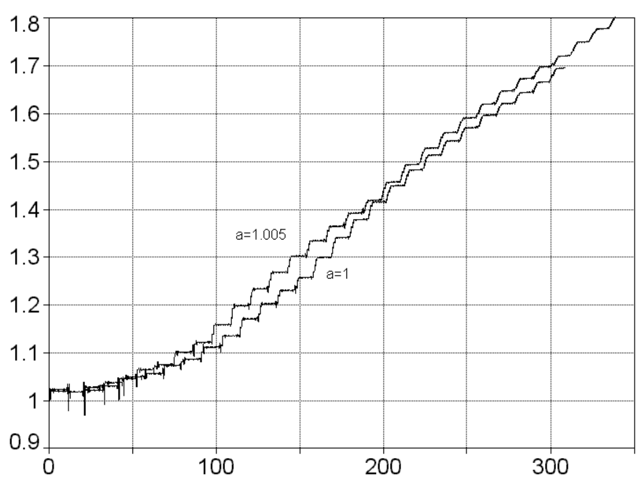


Fig. 3.11.7 *Growth of particle speed Vx depending on route L along axis x.*

It should not be assumed that the speed growth along the x axis happens due to speed reduction along the y axis. It is seen from Fig. 3.11.7. that the particle energy is up nearly 4 times, and the speed along the y axis remains practically unchanged, which is well illustrated by Fig. 3.11.8.

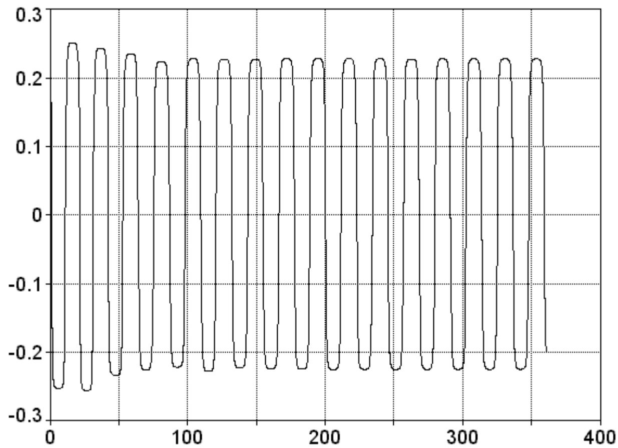


Fig. 3.11.8 *Speed dependence Vy(L).*

In real systems energy growth can hardly be more than double, since multiple encounters with gas molecules stop the increase of Vx following the growth of L, because measuring the particle speeds leads to its falling out of the energy accumulation process. Of course, under other starting conditions, the particle, as a result of bumps against the slot, may reduce its energy, and this alternative process might worsen the effect. To find it out, mathematical modeling should be made for a flow of many particles with random speeds and initial phases, and in a more real potential. But such research requires a good supercomputer, which the authors do not have.

3.12 Generation of Excess Energy During Charged Cluster Acceleration *(This Section Was Written Together with Prof. Hal Fox - USA)*

Caesar: Let me have men about me that are fat;

Sleek-headed men and such as sleep o'nights:

Young Cassius has a lean and hungry look;

He thinks too much: such men are dangerous.

William Shakespeare, "Julius Caesar"

For the last 20 years, both in Russia [47] and abroad [48-51], research has been underway of the generation and properties of electron clusters, which appear on pointed cathodes with large currents of autoelectronic emission. The first research in this sphere was started by Kenneth Shoulders [48-51]; later independent research was made in Belorussia by Dr. Ilyanok and in 1966 in Russia by Dr. G. A. Mesyats [47]. These researchers discovered two extremely interesting facts:

1. Electron current is generated by sufficiently stable electron clusters consisting of $10^9 - 10^{11}$electrons with a size of the order of 20 microns. Sometimes such a cluster can seize up to a million heavy positive ions.

2. These clusters acquire during acceleration (nobody knows how?!) an energy, which exceeds by 30 and more times the value possible when the charge passes the used potential difference.

These phenomena (especially the second one) are absolutely incomprehensible from the point of view of the ordinary physics, and we will discuss these two problems below.

Clusters widely spread in nature are ordinary polytropic balls, which are prevented from dispersion by gravitation and other (Van der Vaals) forces, among which stars (including neutron) and spherical star clusters can be rated. However, gravitation forces for electron clusters are too small to hold such a cluster from repulsion and dispersion under the effect of the coulomb forces. To hold the cluster charges together, it should be assumed that electrons in the cluster are moving in some complicated way and all together generate a self-consistent field, which has a potential hole retaining the electrons inside it. This idea goes back to famous Russian physicists Ya. Frenkel and A. Vlasov and then to Dr. Vladimir Sapogin, who devoted a whole monograph [21] to this issue. Unfortunately, he did not examine the questions concerning the stability of such a formation meeting with great mathematical difficulties. On the other hand, Kenneth Shoulders realized that the problem of cluster existence should be somehow explained, and he offered a certain qualitatively similar mechanism. According to Kenneth Shoulders [48-51, 156, 157], an electronic cluster is a toroid (of the vortex type), which is held from dispersion by its own magnetic field. This is a kind of speculative analog of the well-known pinch effect, when a plasma current filament is pressed out by its own magnetic field and thus is kept from expansion. Unfortunately, Kenneth Shoulders did not make any quantitative evaluations, and the authors have neither courage nor time to solve such an excessively difficult mathematical problem.

According to Kenneth Shoulders' measurements, such a cluster has rather small longitudinal (perpendicular to movement) dimensions, which fact is important for our further analysis. We can summarize the first item as follows: numerous experiments undoubtedly confirm the existence of such clusters, and they speculatively can be imagined, which soothes the mind somewhat.

But generation of excess energy of such clusters in experiments cannot be explained in the framework of the existing standard science based wholly on energy and impulse conservation laws, and no tricks in the framework of standard science would produce such an explanation. We will try to give some explanation to the emergence of such excess energy.

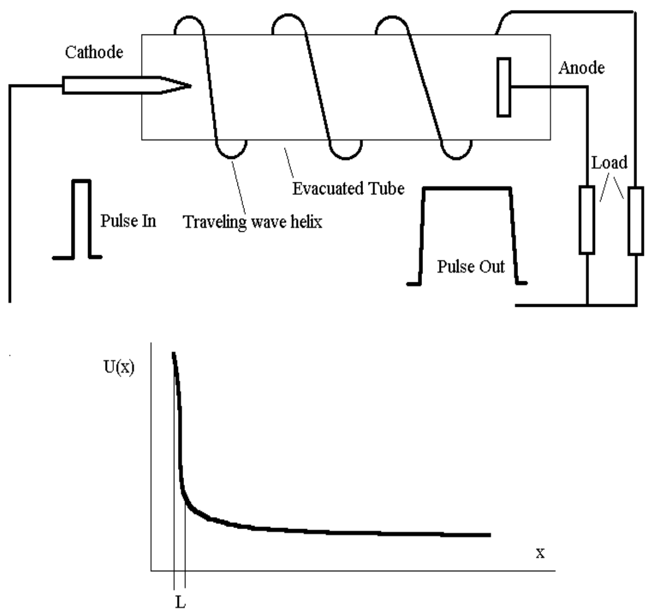


Fig. 3.12.1 *Principal scheme of experiments with clusters.*

The typical scheme of Kenneth Shoulders' experiments is shown in Fig. 3.12.1. Distribution of the electric field potential U(x) along the Evacuated Tube can be conditionally shown in the diagram placed below the scheme. The biggest electric field gradient exists near the spike, and length L of such a strong gradient does not exceed 1-2 Angstrom units. Far from the point, the field can even be periodic, but the amplitude of such changes will be extremely small compared to the field change near the spike. Calculations show that the field far from the spike will have a weak effect on the ongoing processes.

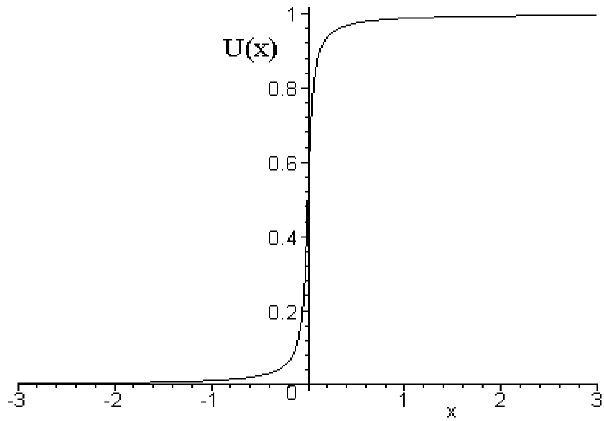


Fig. 3.12.2 *Normalized potential used for mathematic modeling.*

In the case of thermoelectronic emission, the electrons flying out of the cathode have approximately evenly distributed initial phases, because such a current is conditioned by electrons having kinetic energy over the barrier height (output work) and thus overcoming the barrier. Contrary to this, all the current of the autoelectronic emission is due to the electrons having overcome the potential barrier on the metal surface with the help of the tunnel effect, and, in accordance with the UQT, all the electrons that have passed have approximately the same phase. The existence of the same initial phase of all the electrons possibly affects somehow the cluster formation process, but so far it is no more than just an intriguing and very vague idea. Experiments show the cluster having very small longitude dimensions (is flat).

Potential can be approximated within bounds of mathematical modeling of experimental scheme shown on Fig. 3.12.1 by the simplest normalized function

$$U(x) = \frac{1}{\pi}\arctan(ax) + \frac{1}{2}$$

the graph of which is given in Fig. 3.12.2.

Since all electrons in the cluster have equal initial phases, the movement equation for each electron in an external field with potential U(x) has the following identical form:

$$m\frac{d^2x(t)}{dt^2}+\frac{2U_0}{\pi\left(1+a^2x(t)^2\right)}\cos^2\left(\frac{mt}{2\hbar}\left(\frac{dx(t)}{dt}\right)^2-\frac{mx(t)}{\hbar}\frac{dx(t)}{dt}+\varphi_0\right)=0$$

where x(t), m, $\hbar$ are the coordinate of the electron as a time function, the electron mass, the Planck's constant correspondingly, U_0 is the parameter describing potential near the spike, and φ_0 is above mentioned initial phase. Unfortunately, analytical solutions of such types of equations are highly unlikely to be found, because in our view, the golden times when differential equations were precisely integrated are already over.

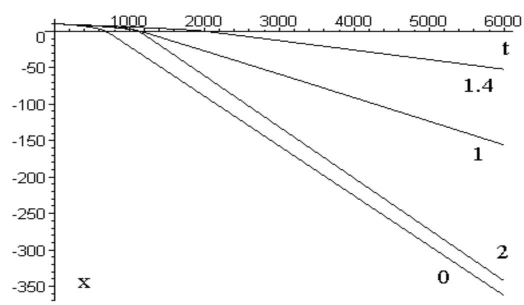


Fig. 3.12.3 *Cluster coordinate as a time function for different initial phase values.*

Numerical solution of this was executed under the following conditions: a=25, $U_0=\frac{\pi}{2}$, m= $\hbar=1$, $x_0=10, V_0=-1/250$ for several values of the initial phase $\varphi_0=0$, 1, 1.4, 2.

The results are given in Fig. 3.12.3, where the graph shows the electron (cluster) coordinates as the time function.

It is seen from this graph that the maximum cluster speed under certain values of the initial phase after acceleration can differ by 6 -10 times from the minimum speed under other initial phase values. This means that in our modeling the cluster energy can be many times higher than follows from the ordinary science. Apparently, just that phenomenon is observed experimentally. But there is one important detail: in order for this effect to be observed in mathematic modeling, the following key condition should be met: the length of the de Broglie wave of the electron before acceleration λ should be much greater than the size of the area with the maximum gradient L

$$\lambda >> L .$$

In all the experiments with autoelectronic emission this condition is always fulfilled. For example, the length of the de Broglie wave of the electron equals about 50 Angstrom units in the standard Pippard metal under the conditions of these experiments, and the value L has the order of only several Angstrom units. In case of the opposite ratio $\lambda << L$, this intriguing effect almost totally disappears if different solutions are analyzed. In our calculations $\lambda \approx 250L$.

Unfortunately, exact mathematic modeling of the experimental situation is extremely difficult because of the total uncertainty of the concrete expression of the potential value near the spike, since it depends to a great extent both on the point geometry and on the location on it of different alien atoms and even dislocations in the crystal grid.

Our task was to show that such experiments are not completely erroneous as the ordinary science so far has the right to think they are, but can have a clear physical interpretation. The above approach proves that the cluster itself carries no special excess energy (beside the one received from the field).

Many people think that it takes the energy in some incomprehensible way from the vacuum fluctuations, but in our approach this is not the case. It is simply that the energy accumulated by the cluster in the permanent electric field depends on its initial phase.

It should be noted that excess energy accumulation was experimentally discovered by Kenneth Shoulders [48, 49], because for the cluster it is easy to measure, although the same is observed for individual electrons, but for them this fact is hard to notice, because it is necessary to analyze the distribution of probabilities of individual events.

We will not touch upon the commercial possibilities of such cluster technology, because it is not our task either. But the existence itself of such an effect can be to a certain extent regarded as confirmation of the correctness of the UQT.

3.13 Spontaneous Polarization of Some Glasses and Inexhaustible Energy Source of Direct Current

The queer situation has arisen in the contemporary scientific world: some editorial staff do not allow the publication in scientific Journals the papers concerning the nuclear low-energetic transmutation or the devices with efficiency more, than 100%, because they contradict conventional paradigm, and others do not publish the theoretical works concerning the same questions because the corresponding experimental data are in scientific press absent.

The Newspaper "Duel", № 14, 1999.

At the beginning of the last century Mary Sklodowska-Curie discovered a spontaneous temperature increase of the radioactive samples in comparison with the environment. Scientific Community met that fact with the greatest district, as it seemed breaking the Supreme Energy Conservation Law. But for that moment the latter survived. However, some recently discovered and absolutely unexpected facts hardly let it withstand this time.

Imagine semi-conductor (transistor) approximated in the width of its inhibited zone to the dielectric (non-conductor) [160]. Within that inhabited zone some traps could arise oriented while of the material producing by the strong external electric field. The energy (potential) of such traps can be spherically unsymmetrical and looks (1-Dimentional case) like one shown for example at Fig. 3.13.1.

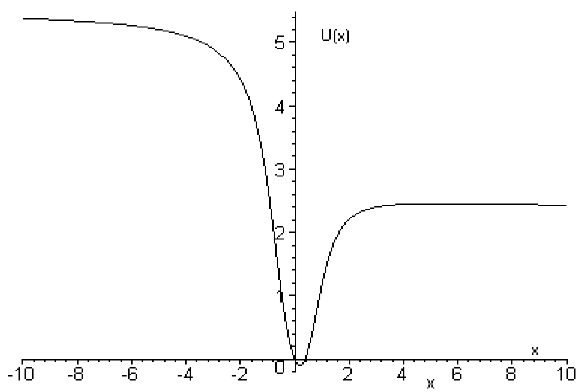


Fig. 3.13.1 *The energy (potential) of some traps can be spherically scewnes.*

The electrons' behavior in that potential well trap will bear a strong resemblance to the process inside the Correa reactor described above in section 3.5. When electrons fall in such traps there the solution called "Maternity Home" can be realized. Electrons according to that solution acquire power after series of oscillations inside the trap and they leave the trap moving in one direction (to the right), in essence spontaneously, creating so direct current without any additional outside efforts. The idea of using such effect to create the energy sources normally arises from the Unitary Quantum Theory. The authors comprehended it far ago but worried even to speak about because of its suddenness and improbability. But today there are considerable proofs of the existence of that effect studied and utilized by Prof. Valery M. Sobolev and his group with the use of especially prepared glasses. To our regret we do not know strict scientific publications or reports of that group, but the entire fact of the creation of the inexhaustible energy source by that group is widely discussed in mass media, see also Journal "New Energy Technologies" #5(8), page 70, 2002 published by Faraday Laboratories Ltd.

Let us treat these ideas in details.

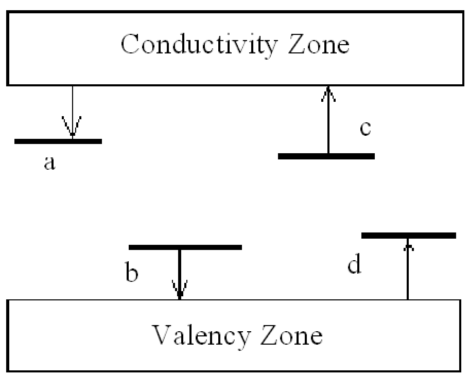


Fig. 3.13.2a *The ordinary crystal lattice has with discrete levels of energy and forbidden zones.*

As usual crystal lattice contains the formations, which break its periodicity. Here electrons' localization (capture) can occur from the conductivity zone or holes out of valency zone. Exactly these formations serve as wells (traps). They can differ by their origin: for example, alien (admixed) atoms in the lattice points or interstitial space, vacant lattice points (Schottky defects), atoms accented from equilibrium positions (J. Frenkel defects), dislocations, micro-crystals' bounds. According to zone theory of solid state such crystal lattice irregularity are entailed with discrete levels in forbidden zones of the electronic state power spectrum (Fig. 3.13.2a). In the quantum states corresponding to these discrete levels electrons are localized in the traps. Electron localization arises at its transition from the conductivity zone to the discrete level a Fig. 3.13.2a. Electrons transition from the discrete level b to the valency zone may be considered as hole's capture by the trap (adhesion). The reverse transfer c and d – are the effects of delocalization of the electron and holes (liberation, throwing out).

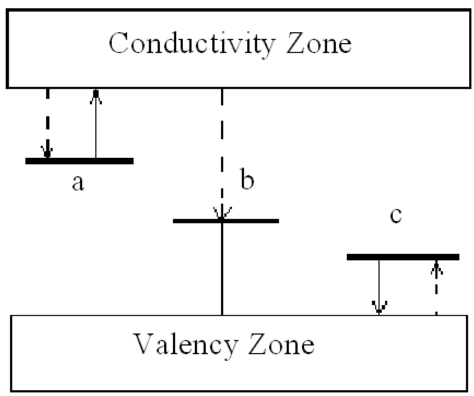


Fig. 3.13.2b *The trap may be the center of the holes adhesion*

The simplest model of the trap is hydrogen-like atom. If the crystal dielectric coefficient is high enough (for such glass it is $\varepsilon \approx 10$), the influence of the crystal lattice electric field can be described by means of crystal polarization. In this case the binding energy of the electron inside the trap equals to $E \approx \frac{m^* e^4}{2\hbar^2 \varepsilon^2} \approx 0.1 - 0.05$ eV, the Bohr orbital radius of the localized electron in primary state is - $r = \frac{\hbar^2 \varepsilon^2}{m^* e^2} \approx 5$ A. Thus geometrical section of such trap equals about $25 \cdot 10^{-16} cm^2$, as for the examining capture cross-sections their dimensions are limited within $10^{-12} - 10^{-22} cm^2$. Electron has after the capture by the trap two possibilities either to be thrown into the conductivity zone again or to pass to the valency zone. If the possibility of electrons thermal throwing into the conductivity zone prevails, the trap is an adhesive center. In the case of predomination of the electron transmission into the valency zone, i.e. in the case of the hole capture right after the capture of the electron, the trap serves as a center of abundant electrons and holes recombination. Similarly the trap may be the center of the holes adhesion, as it is shown at Fig. 3.13.2b. In that case the hole captured from the valency zone returns to that zone again.

The character and the properties of the trap are determined by the power and conditions of its level or levels, if the trap is polyvalent, as well as by the effective electron or trap capture cross-sections or by the electrons and holes densities in the zones. The latter depends on the Fermi level or quasi-levels of the material. The trap may serves as donor or acceptor, center of adhesion or recombination, luminescence activator or extinguisher. Unfortunately in solid-state physics the questions dealing with these phenomena – are the mostly complicated and do not have any conventional technical terms. The energy increasing of all electrons or of their majority inside the traps and their flying out mainly in one direction requires the strong deformation of the spherically symmetrical field of the trap, as well as their definite orientation with respect to some selected direction.

Such a result may be achieved if one use as a material a special glass exposed at the stage of fusion to strong electric field. The exposition is to be stopped after total cooling only. The non-stochiometric character of the glass (quite general situation for all glasses) results unsymmetrical character of the traps due to the different natures of the neighbor charges (atoms) surrounding the trap.

The glass as a material combines in either one or other proportion vitreous and crystal phases. It can be obtained in the process of metals' oxides and natural materials agglomeration. And in the cases of the glasses partial crystallization there are rather promising materials like glass-ceramic and glasses studied by

Prof. Valery M. Sobolev group can arise. For example, the well-known astro-glassceramic has within quite wide range of temperatures vanishingly small linear expansion factor. That means that the atoms belonging to the astro-glass-ceramics structure are positioning inside potential wells with strictly parabolic shape. It is quite astonishing fact.

We have no idea about Sobolev's glasses' technologies. From the reporters and eyewitnesses attended at the materials production and measurements of their parameters, we know that mostly the result looked like transparent pieces like blue quartz (might be because of the cobalt or ferrous oxide admixture). But on the assumption of the above mentioned the said glass in the process of melting should be obligatory positioned inside the strong electric field and has to be cut off after total chilling only.

It should be done for the nonequilibrium state freezing. Only then the material will contain the electron traps with strongly asymmetrical field each is oriented by electric field (like dielectrics' dipoles while its polarization). The entire material by its nature will be similar to the well-known electrets. If positioning that material between condenser's segments (in the experiments of Prof. Sobolev the tension arose has the value up to 1500 V within 100 cubic cm of glass) it could be discharged giving useful load. The condenser will be discharged by delivering its power, but after some time (about 3-4 hours) it charge will be restored to the initial value and the process can be reproduced again and again, in principal - unlimitedly.

The operational principle of that glass is the following: electrons in the traps (adhesive centers) start oscillating due to heat fluctuations and if the initial phase is appropriate for the "Maternity Home" solution, then this electrons having conducted some energy will fly out of the traps moving mainly in one direction.

The negative charge at one side of the sample increases until the electric field arose begins to break the electrons flying out of the trap and totally stops the process. After the condenser discharging that surplus negative charge disappears and the process can be repeated once again: after 3-4 hours electrons will be accumulated at one side of the sample and so on and so on. The ordered spontaneous motion of the electrons creates magnetic field that was also fixed during the experiments. In fact if take quite a big sheet of such a glass with the sprayed capacitor plates there will be always direct voltage on them creating the direct current within the unlimited period of time.

We should underline that according to our point of view the energy does not appear from the outside (gravitational, electric or magnetic fields, heat energy of the fluctuations) but is generated inside the traps from nothing. These are the laws of motions for the single quantum micro-particle.

The theorists of the Sobolev's group do not have any clear explanations of the exposed facts and intend to create in future "some theoretical model of the ordered structure on the basis of the magneto electric theory – generation arising inside the dielectric crystal of the magnetization induced by the electric field.

The theoretical model may be created basing on the Landau thermodynamic theory of 2nd type for the phase transitions generalized in case of the dielectric matrix of the melt magnetization by the electric field of the charge, that is an internal parameter of the melt and belongs to the structural element of the melt" (such are the words official information on Internet). However we should note that contemporary theoretical science is based entirely on conservation laws and every logically correct corresponding analyses does not allow to obtain the results exceeding the limits of these laws. The new physical theory, the new picture of the world is required only for explanation of Sobolev's results. We propose Unitary Quantum Theory [1-9, 53-58, 81-90, 200, 201].

Let us note that standard view point terms cannot explain the work of any inexhaustible energy source also by using the ideas of energy transformation adopted from the surroundings because of meeting principal obstacle once again (theorems of Carnot and circulation).

We are considering below some theoretical illustration of electrons' behavior in such traps that due to the data lack does not relate any concrete glass model.

Examine for the illustration the motion of the electric charge inside the potential well, determined by the potential:

$$U(x) = -\arctan(x) + 2.5\arctan(x^2), \tag{3.13.1}$$

corresponding to the diagram at the Fig. 3.13.1. The motion equation of such a particle looks in accordance with our theory like (non-autonomous variant):

$$\ddot{x} = (\frac{1}{1+x^2} - \frac{5x}{1+x^4})\cos^2(\frac{1}{2}t\dot{x}^2 - |x\dot{x}| + \theta), \tag{3.13.2}$$

where the particle's mass and charge as well as the Planck's constant for simplicity are considered equal to the unity. The very essential role here has so called initial phase θ, as the solution character $x(t)$ mostly depends on its value.

Examine the graph $x(t)$ as the function of time t, obtained by numerical integration (we hardly can expect the construction analytical solution) of that equation for initial data $x(0) = 0, \dot{x}(0) = 0.1$ (Fig. 3.13.3) and initial phase $\theta = 0.6$.

We can see that the particle leaves the potential well (trap) after approximately $t = 70$ units of time and after a series of the monotone increasing oscillations. We can see from the corresponding graph $\dot{x}(t)$ that the particle velocity gains after sufficiently complicated oscillations before flying out the trap the value exceeding initial velocity $v_0 = 0.1$ nearly 5.5 times. The charge oscillations remain in full measure that is seen from the analysis of the value $|\cos(\frac{1}{2}t\dot{x}^2 - |x\dot{x}| + \theta)|$ as t function. That behavior of the particle is typical for the other values of the phase θ, except some interval around the value $\theta = \pi/2$ (that value is critical in some sense).

If considered the particle motion in the case of the potential

$$U(x) = -0.2\arctan(x) + 2.5\arctan(x^2), \quad (3.13.3)$$

(the left arm of the potential for $x \to -\infty$ is higher than its right arm for $x \to \infty$ merely at 0, 6, that is essentially less in comparison with the arms potential (1)) the pattern of the motion is more complicated. Viz. $x(t)$ at the initial velocity $v_0 = 0.1$ and phase θ within the intervals from 0 to 1.2 and from 2.0 to 3.0 continuously oscillates, at the phase θ=1.4 electron flies out the trape after the time $t = 250$ with the velocity $v \approx 2.5v_0$, at the phase $\theta = 1.41$ we get the reverse flying out, at the phase θ= 1.42 – the result is the flying out with the velocity $v \approx v_0$, at $\vartheta = 1.46$ - flying out with the velocity $v \to 0$ without initial oscillation and so on. But in the case the initial velocity is $v_0 = 0.5$, then for the most part of the phases θ lying out of the critical range around $\pi/2$ the particle flying out of the well with the velocity exceeding 1.2 – 1.3 times its initial velocity v_0 with velocity nearly equal to v_0, at the phases $\theta = 0.2, \theta = 2.6$ we get the reverse flying out and so on and so forth.

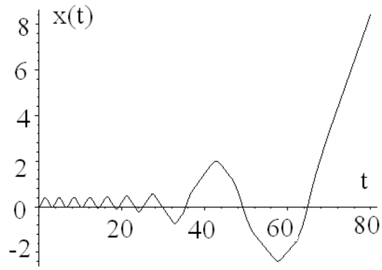


Fig. 3.13.3 *Growth of the energy in potential wall.*

In the cases of the initial velocities being between 0.1 and 0.5 we can see intermediate patterns. Thus we can assert that the computations confirm the general tendency of the particles to fly out the potential well in one direction mainly (to the right) with increased velocity for the potential types (3.13.1), (3.13.3) and initial velocities lying in the proper intervals.

We would like to pay also attention to the other effect observed by the group of Prof. V. M. Sobolev, namely, the luminescence (self-luminosity) of obtained glasses during unlimited period of time. Such phenomenon (not requiring the external energy source for its existence) may appear in sufficiently deep potential holes possessing on its upper part the metastable level.

The considered above process of electron's oscillation in such potential hole (Fig. 3.13.3) may lead to the increasing of electron's energy and to the transition of electron on metastable level, which is determined by alloying admixture. If such transition is permitted then the dipole radiation (glow) will be realized. This phenomenon, which is new in principle and is not to be explained from the viewpoint of modern science, may be used on a large scale.

Meanwhile we are not going to comment the other numerous and highly interesting phenomena, examined with the use of these glasses.

4

Possible Uniform Approach to the Theory of Catalytic Processes

4.1 Short Review of Chemical Catalysis

It is an awful thing to write text-books On the Chemical Catalysis because everything is going topsy-turvy every year.

J. J. Berzelius.

Let's consider for the sake of simplicity only two types of chemical reactions: decomposition and synthesis, when a complex molecule decomposes under certain conditions into two or more component atoms or molecules, or two atoms or molecules combine with each other and create a new chemical compound. To create a new molecule two different particles should joint each other, but the most complicated role here belongs to interaction potential, which is today unknown even for the simplest chemical reactions. According to Arrhenius' theory (today accepted by everybody), only those collisions are chemically effective, when the participating molecules have an excess of the energy over the average value. The difference between the minimal energy of a molecule, necessary for the reaction and reaction resultant from the bump, is called activation energy E_a . It depends on the temperature of the system. When the number of active molecules N_a is only a small share of the total number of molecules N, their number can be expressed through the Boltzmann-Gibbs activation energy as follows:

$$N_a = N \exp\left(-\frac{E_a}{RT} \right) \tag{4.1.1}$$

It is known that a temperature increase usually considerably speed up the reaction rate. Van't Hoff discovered that the reaction rate increases by 2-4 times, when the temperature raises by 10 degrees, and if the temperature raises by 100 degrees, the reaction speed grows approximately by 1000 times. If the temperature raises by 10 degrees, and it is assumed that the activation energy remains constant (which is possible under small temperature intervals), the temperature effect on the number of active molecules can be estimated. Let us assume that the activation energy for a certain reaction under $300^0 K$ is 24000 cal. In this case:

$$\frac{N_a}{N} = \exp\left(-\frac{24000}{2 \cdot 300}\right) \approx 4.1 \cdot 10^{-18}$$

and such a reaction with 4 active molecules at 10^{18} will certainly be very slow. Under $T = 310^0 K$ the same exponent will equal $16 \cdot 10^{-18}$, i.e. the number of active molecules will quadruple. There will be 16 of them per each 10^{18} molecule. The average molecular energy reserve will increase only by 3-4%.

It should not be assumed that everything is so nice and the reaction speed increase is due only to the higher number of collisions between molecules and to the increased number of active molecules. For example, the increase in the number of gas molecule collisions under the growing temperature T will be proportionate to $\sqrt{T}$. But the change of speed in a homogeneous reaction

$$2HJ = H_2 + J_2$$

cannot always be accounted for only by the Van’t Hoff rule. If we calculate the number of molecular collisions HJ using the molecular-kinetic theory equations in 1 cubic cm per second at the pressure of 1 atm., it will be of the order of 10^{28}, and the speed of this reaction with a 100% efficiency of each bump must be gigantic, and everything should be over in 10^{-10} seconds, which never happens in reality.

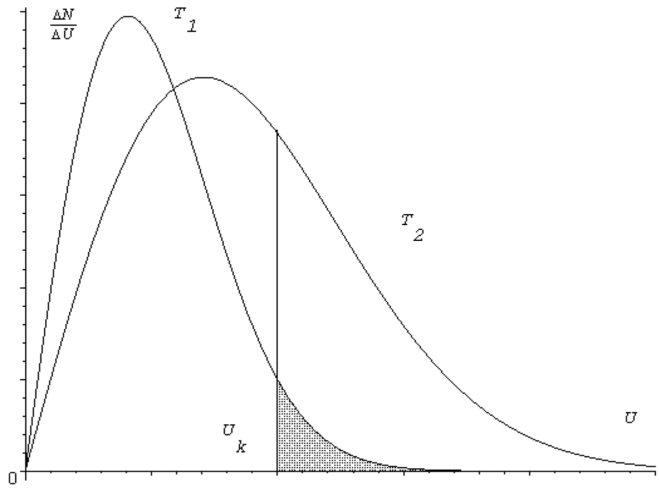


Fig. 4.1.1 *Distribution of molecules by kinetic energy ($T_1 < T_2$).*

This happens, because not every bump ends with interaction. Thus, a molecular bump for biomolecular reactions is a necessary condition, but not a sufficient one.

By Arrhenius, the constant k of the reaction speed can be expressed by the following equation:

$$k = A\exp\left(-\frac{E_a}{RT}\right)$$

where A is the pre-exponential multiplier, constant for this case. In accordance with Maxwell-Boltzmann ideas, Fig. 4.1.1 contains a sketch of two curves of gas molecule distribution by kinetic energies under two different temperatures $T_1 < T_2$. Along the axis of ordinates the ratio between the number of gas molecules ΔN, the energy of which is between U and $U + \Delta U$, to the energy value interval ΔU, is shown, and along the abscissa axis the energy U. Only such molecules are capable to enter into the reaction, whose kinetic energy is not less than a certain value U_k, meeting the activation energy. The number of hot molecules able to enter into reaction under T_1 is graphically shown by the crosshatched region. It is evident that this number is greatly increased if $T_2 > T_1$, which happens in accordance with equation (4.1.1), and the average kinetic energy grows much slower, because it is simply proportionate to the absolute temperature. The source of molecular activation may lie not only in heat, but also in radiant or electric energy, the energy of radioactive particles, and… a catalyst. For a reversible reaction, the heat effect equals the difference between the activation energies of the direct and reverse reactions.

Not all chemical processes happen spontaneously. There are reactions that go only in one direction with full consumption of the initial substances (explosive processes). Such reactions, as a rule, cannot spontaneously go in the reverse direction.

The situation is much more interesting with reversible reactions. If we mix, for example, hydrogen and iodine warmed up to $800^0 K$, they will react with forming of hydroiodine. If HJ is not removed from the reaction space, the iodine and hydrogen will never be totally consumed. Under these conditions, the state of dynamic chemical equilibrium will be achieved, which could otherwise be achieved by warming HJ to $800^0 K$, because we are dealing with a reversible reaction (only under these conditions).

Real equilibrium is characterized by the fact that it can be approached from two sides. In a state of equilibrium the concentrations of all the substances in the system remain unchanged under these conditions, since the speed of the direct and reverse reactions is the same.

Real equilibrium in case of a thermodynamically reversible process is shifted under very slight changes in the external conditions, strictly following these changes. It is believed that any transfer to a less stable state is always connected with some work expense from outside. The farther the system is from the balanced state, the more capable it is principally of entering into reactions. But this capability does not always reveal itself under the said conditions. For example, a mixture of H_2 and O_2 is very reactive, but at room temperature their concentrations in mixture do not change. There are a lot of such examples. These systems are in a state of an unstable false equilibrium, and changes are not observed in them simply because the process speeds are infinitely small. There are lots and lots of such false equilibrium systems, and we can even say that we are living in a world of false equilibriums. However, if the process is accelerated by heating or by a catalyst, the false equilibrium will be broken and a reaction will take place. In other words, false equilibrium is almost always caused by kinetic problems (difficulty) during a reaction.

According to the Sadi Carnot theorem, the efficiency equals

$$\eta = \frac{A}{Q} = \frac{T_2 - T_1}{T_2}$$

where T_2 and T_1 are the temperatures of the heater and the cooler. Be it quickly or slowly (equilibrium thermodynamics does not deal with this at all), every chemical reaction goes in such a way as to tend to a state of real equilibrium. If the reaction takes place in a system under constant pressure and temperature, the change of enthalpy ΔH (heat content) can be presented as a sum of two terms: the change of the Gibbs free energy ΔG and the change of the bound energy ΔL:

$$\Delta H = \Delta G + \Delta L .$$

The Gibbs free energy G is sometimes called the isobaric-isothermal potential and it is not the free energy under constant volume and temperature, which in theoretical thermodynamics is usually denoted by the letter F. The bound energy ΔL is expressed by the product of absolute temperature T multiplied by the change of the state function (change of entropy) ΔS . In this case:

$$\Delta G = \Delta H - T\Delta S \tag{4.1.2}$$

Fig. 4.1.2 shows the dependence of the free energy on the relative content of HJ in the mixture ($H_2 + J_2$). If, for instance, in the system

$$H_2 + J_2 \leftrightarrow 2HJ$$

being in a state of equilibrium free energy has the value designated by the ordinate at point C (Fig. 4.1.2), any deviation of the composition of the mixture of initial and end substances from the equilibrium to the right or to the left from point C requires certain work, so the free energy must increase both with an increase in the partial pressure of HJ and with an increase of partial pressures (concentrations) of H_2 and J_2 . It follows that under the chemical equilibrium a gas system of H_2 , J_2 and HJ has the minimum value Gmin. On the way from the mixture of H_2 and J_2 (point A) to the equilibrium mixture composition, loss of free energy must be observed - $\Delta G < 0$. The same $\Delta G < 0$ on the way of the mixture composition change from B to C. With equilibrium mixture composition at point C

$$\Delta G = 0$$

the condition of chemical equilibrium is $\Delta G = 0$, and the criterion of reactivity is the requirement $\Delta G < 0$ under constant pressure and temperature. In other words, the reaction is possible, if G decreases, and once it begins, it will go on spontaneously. The moving force of the whole process is the value of ΔG . Loss of this free energy in a reaction going on under a constant pressure and temperature does not depend on the route of the process and equals the maximum reaction work, i.e. $-\Delta G = A$.

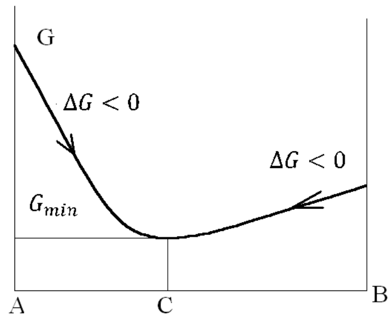


Fig. 4.1.2 *The influence ΔG on running processes.*

Of course, if for a certain process $\Delta G > 0$, then, from the point of view of the existing science, there is no point in trying to hold it under the said conditions. Let us note that earlier the criterion of chemical affinity was considered to be the value of the positive heat effect Q. Under low temperatures this is almost true, because the product $T\Delta S$ in equation (4.1.2) becomes very small and ΔG nearly coincides with ΔH. Much later it was discovered that there were many reactions with heat absorption, which usually go on under very high temperatures. If $T\Delta S > 0$, the second term of equation (4.1.2) can be more than ΔH, and then ΔG will have a negative value, which makes such reactions possible. Here is an example. Reaction

$$CH_4 + CO_2 = 2CO + 2H_2 \qquad (4.1.3)$$

Which under normal conditions goes on from right to left, can, nevertheless, go on from left to right. For it $\Delta H_{1000} = 62$ kcal, $\Delta G_{1000} = -26.1$ kcal, i.e. below zero. The Unitary Quantum Theory gives us hope that for reactions of the left-right type the effect of high temperature may be replaced by a relevant catalyst.

Equilibrium chemical thermodynamics only establishes a principal possibility of a reaction and solves the problem of achieving the equilibrium, but it does not answer the question of how quickly this equilibrium can be achieved, because the time is absolutely absent from this theory. In no case it can be assumed that the lower the negative value of ΔG , the quicker the process, because kinetic problems may appear on the way.

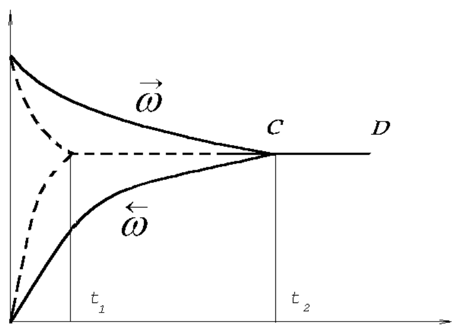


Fig. 4.1.3 *Establishment of chemical equilibrium. Along axis x-time, along axis y - reaction speed. Firm line – without catalyst, dotted line – with catalyst. CD – chemical equilibrium line;* $t_1 << t_2$.

The questions of chemical reaction speed, the effect of different factors on speed, and the reaction mechanism are the subjects of chemical kinetics. Using different methods: changes of temperature, pressure, concentration, introduction of catalysts, light irradiation, it studies the speeds of achieving equilibrium. If the definition of the "energy capacity" of ΔH and the "work capacity" of ΔG in the process requires only the knowledge of enthalpy and the free energy of the formation of the initial and the end substances under given conditions, the process speed depends not only on what substances there are in the right and left parts of the equation; it also always depends on intermediary products and, mainly, on catalytic processes.

Chemical reaction speed $\vec{\omega}$ in straight direction:

$$lL + mM + ... = qQ + rR + ...$$

where l molecules of substance L react with m molecules of substance M, etc., is expressed by the following equation:

$$\vec{\omega} = \vec{k} C_L^l C_M^m \cdots \tag{4.1.4}$$

where C_L, C_M are the concentrations of the substances L and M, i.e. the number of molecules in a volume unit or a proportionate value, and $\vec{k}$ is the reaction speed constant. The reaction speed in the reverse direction is totally similar:

$$\overleftarrow{\omega} = \overleftarrow{k} C_Q^q C_R^r$$

At the equilibrium $\vec{\omega} = \overleftarrow{\omega}$, and, consequently,

$$\frac{C_Q^q C_R^r \cdots}{C_L^l C_M^m \cdots} = \frac{\overleftarrow{k}}{\vec{k}} = K$$

This is the equation of the active mass law for chemical equilibrium in ideal systems, and K is the equilibrium constant.

The active mass law is intuitively clear: for a reaction to happen the molecules of the initial substances should bump, i.e. the molecules should as a result of chaotic heat movement approach each other to a distance of the atomic dimension order. The probability of finding in a certain small volume at a given moment of time l molecules of substance L, m molecules of substance M, etc. will be proportionate to the probability of compound event $C_L^l C_M^m$. Hence, the number of bumps within a unit of time in a unit of volume is proportionate to this value, which leads to equation (4.1.4).

This law can have a different interpretation: the reaction speed is proportionate to the derivative of the concentration of the reacting substances in time.

It is clear that the observed speed of a reversible reaction will be as follows:

$$\omega = \overset{\rightarrow}{\omega} - \overset{\leftarrow}{\omega}$$

But the seeming simplicity of chemical kinetics is broken by catalytic processes. The speed of catalytic reactions is changed by other substances (catalysts) introduced into the system, the composition and quantity of such catalysts remaining unchanged by the end of the reaction. However, catalysts take part in the process. In biochemical processes a huge role belongs to organic catalysts – ferments (enzymes). In case of homogeneous catalysis, the catalyst is in the same phase with the reacting substances. In case of heterogeneous catalysis, reactions go on the surface of the catalyst, which forms an independent phase.

Today it is believed that all catalytic reactions from the thermodynamic point of view are spontaneous processes, i.e. they are accompanied by reduction of free energy, and the catalysts do not shift the state of chemical equilibrium, but accelerate its achievement. One and the same catalyst accelerates, as a rule, both the direct and the reverse reactions. All catalysts have a selective effect, accelerating not any reaction at all, but one that is thermodynamically possible. Dehydration of ethyl alcohol on different catalysts is a vivid example:

Under 350 degrees C on Al_2O_3 reaction is

$$C_2H_5OH \rightarrow CH_2 = CH_2 + H_2O$$

Under 350 degrees C on Cu reaction is

$$C_2H_5OH \rightarrow CH_3CHO + H_2$$

On other catalysts and under different temperatures butadiene $CH_2CHCHCH_2$, butyl alcohol C_4H_9OH, diethyl ether $(C_2H_5)_2O$, and other substances are received from ethyl alcohol. It is clear that the type of ethyl-alcohol dehydration is defined exclusively by the catalytic substance.

Acceleration of reaction in homogeneous catalysis is a more or less understandable process and is explained by formation of intermediary compounds (sometimes of a whole chain of them). If a reaction A+B=AB requires a greater activation energy E_a and goes on slowly, introduction of catalyst C allows for holding the process in two stages through an intermediary compound, which process will require smaller activation energies and go on at a much quicker pace, e.g.

C+A=AC and AC+B=AB+C

The catalyst C remains unchanged in quantity. D. Mendeleyev thought, however, that even in homogeneous catalysis another mechanism may exist: the catalyst may sometimes simply reduce the value of E_a in the reacting molecules.

But if the processes in homogeneous catalysis seem fairly clear, in heterogeneous catalysis, which is much more selective than homogeneous and is very widely used, all is in the dark, and the number of heterogeneous catalysis theories is probably only slightly less than the number of heterogeneous catalytic processes themselves. This statement is in no way original. It is enough to read an article by G. Bond [144] with a characteristic title: «Catalysis: Art or Science?». Of course, it is only the opinion of a singe researcher, but… here below are the words [145] of the well-known German specialist in chemical catalysis A. Mittasch:

«When a question was raised of the practical use of the ammonia direct synthesis process discovered by F. Gaber, K. Bosch, to whom the matter was entrusted, set a task before his team – to replace expensive and rare substances like platinum, osmium and uranium, with more affordable ones, or to improve the known but rarely used catalysts in such a way that they could be used in the industry…We paid principal attention to mixtures of iron with other metals, but in laboratory experiments we, besides iron, mixed every element A from the periodic table with any element B as such, or in the form of compounds with different ratios and by different methods (!!!-authors) [145] ».

A. Mittasch and all his multiple employees from the Baden plants of IG Farbenindustrie solved the problem: the required catalyst was found. They also received patents for hundreds of other catalysts discovered while solving this problem.

Modern chemists can say that the method of primitive and nearly meaningless sorting out remains the main one in the search of the necessary catalyst. Thus, the results of practical work have advanced greatly, but no general catalysis theory has been created for a very long period of the existence of catalytic processes and reactions.

The chemists first faced the catalysis phenomena in 1800's, and today they have a right to expect an understanding of the essence of them. However it did not happen and very serious reasons appeared for being discontent with those theories and hypotheses, which reflected only separate, and not always principal, aspects of the phenomenon. The theories satisfied only their authors, but were not understandable and acceptable for others, and, most importantly, were totally useless as a help to experts in the selection of this or that catalyst.

Let us shortly list the main research results received in heterogeneous catalysis experiments.

1. All solid bodies with all kinds of chemical compositions possess a certain surface activity and can be conducive to initiating and accelerating chemical reactions. But the surface activity of some bodies is so small that these bodies are practically unfit for catalyzing reactions that need even minimum activation energy. The surface activity of some other bodies is sufficient, and they can be widely used as catalysts for a big number of reactions. Such was the conclusion made, for example, by D. Mendeleyev [146], although there are many other researchers who came to the same conclusion independently.

2. Since the catalytic activity, in particular, the orienting actions of catalysts, mainly depends on the chemical composition, the latter is the key factor defining the catalytic qualities of solid bodies. This conclusion was made by D. Mendeleyev, I. Langmuir, A. Mittasch, G. Konovalov and many others.

3. Together with the chemical composition, the physical state of a body is another factor defining the catalytic qualities of solid bodies, first of all, the excess saturation of the body's surface due to an excess of free energy. Such are the conclusions of D. Mendeleyev, G. Konovalov and P. Roginsky, and others.

4. Out of more concrete physical reasons defining the qualities of solid catalysts, porosity and crystallographic state were identified. Nearly all researches came to this conclusion.

5. The catalytic surface of solid bodies represents, as a rule, a largely heterogeneous surface, i.e. the sum of sections differing in their adsorption

and catalytic qualities. The best results are produced by catalytic surfaces of the "spongy" type. It is interesting to note that it was observed by M. Faraday, who devoted much of his time to catalytic processes.

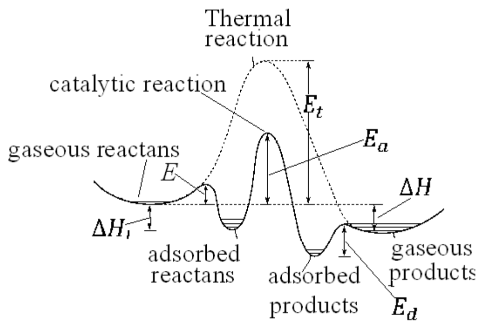


Figure 4.1.4 *Energy profiles for catalytic and thermal (noncatalytic) reactions in the gaseous phase.* E_a *is activation energy for catalytic reaction;* E_t *is activation energy for thermal reaction;* E *is activation energy of absorption of gaseous reactans;* E_d *is activation energy of desorption of gaseous products;* ΔH_1 *is heat of chemisorption of reactans;* ΔH *is heat of overall reaction. (Encyclopedia Britannica).*

Moreover, D. Mendeleyev defines the essence of catalysis through such a form of chemical interaction between catalysts and reagents as provides for continuous chemical interaction and excludes stoichiometric relationships.

Despite the electronic-microscopic research, it is still unclear what serve as active centers of heterogeneous catalysis on a "spongy" surface. The questions of whether they are peaks or wells have long been debated. Are they angles, ribs, or planes? No experimental answers have been found so far.

The accelerating action of a catalyst can be formally explained by the S. Arrhenius equation, if we assume that the molecule activation energy E_a in catalytic reactions is normally less than in non-catalytic ones. It is proved to be true. For example, in case of non-catalytic decomposition of ammonia NH_3, the value E_a is about 80 kcal/mole, and in case of catalytic decomposition E_a ~40 kcal/mole, i.e. twice less! Due to reduction of E_a, acceleration of catalytic reactions is achieved as compared with non-catalytic reactions.

At first this conclusion was made by S. Arrhenius himself, but he did not suggest any concrete ideas concerning the mechanism of reducing E_a. D. Mendeleyev went further and compared the effect of a catalyst with heat energy! Understanding that there was no source for heat energy, he, nevertheless, reduced the value of E_a with the help of molecule deformation. Today it is absolutely clear that such deformation still needs energy, and it would be naïve to think that D. Mendeleyev did not understand it.

Of course, it could only be a local energy directed specifically to reducing the value of a certain connection, and not heat energy distributed uniformly over the interaction volume, but even such energy in today's science has nowhere to appear from. This is illustrated by Fig. 4.1.14. From this figure it is clear that the reacting particles and particles appearing after the reaction are sort of divided by a potential barrier with the height E_t. An analogy with the tunnel effect suggests itself, but it is very superficial, because the usual quantum tunnel effects do not exist here, and these phenomena are similar only in results.

A natural question arises. If the reaction goes on from left to right, can there be a catalyst that would conduct the reaction from right to left without consumption of energy ΔH? Both states are divided by a high barrier, and there are lots of reactions, which do not go from left to right without a catalyst at all. The unitary quantum theory gives hope for realization of such phenomena, although within the existing science it is impossible without consumption of energy ΔH.

Next we will give a short statement of the main ideas of Mendeleyev [146] concerning chemical catalysis.

Chemical interaction of two reagents always takes place when they touch each other, i.e. in contact. The reason of chemical modification E_a of two different substances lies in the emergence of conditions changing the movement peculiar to masses of solitary homogeneous bodies. In a heterogeneous system, at the meeting place of two bodies, in the touching point… real perturbations and deviations of movement will take place, of a different type as compared with a free surface. The difference of movement on the surface is defined by the influence of particles and atoms of one type with the surface ones, and in case of a meeting between two bodies, changes on their surfaces will be defined by the influence of their own and alien atoms and particles.

In a homogeneous system, when "a chemical phenomenon takes place in a homogeneous gas mixture, or in a solution of two bodies, it cannot be regarded as alien to the change taking place on the contact surface, because a particle surrounded by other particles, different from it, must more or less change its state as compared to the one it has when surrounded by similar particles".

Thus, according to D. Mendeleyev [146], a contact of two different substances A and B facilitates modification of their valence state and may lead to redistribution of their "component elements", i.e. the composition and structure, or otherwise, may cause chemical interaction between them. In this sense, a contact is similar to the effect of temperature; "internal movement changes brought about by a contact with an alien body can quantitatively and qualitatively correspond to such internal movement changes as may happen due to the said physical conditions, e.g. from temperature changes. This brings catalytic or contact phenomena closer to dissociation ones, although does not allow for intermixing thereof".

It is clear from the above-cited statements that D. Mendeleyev was very brief on the concrete matters of the catalysis mechanism. In his ideas of "perturbations" and "deviations in movement" happening in contact some chemists (A. Balandin, multiple theories [147]) saw signs of an explanation of the catalysis mechanism through molecule deformation, others – through the chemical orientation of reactions. Since every complex molecule has a certain chemical state, any "perturbation" or "deviation in movement" (oscillations) of its atoms can be regarded as a modification of its form and as a more significant modification of its structure, up to a free radical formation.

Of course, there is much room for interpretation. D. Mendeleyev only put the question of the catalysis mechanism and slightly raised the curtain, but he did not solve the problem, and was not even going to do it. He finished his main article on catalysis [146] with only a hint of "finding a method for research, which must… lead to clarification not only of the position of contact reactions in connection with other types of chemical transformations, but of the very mechanism of chemical modifications".

We have already noted that for molecule deformation in the existing science there is a need for energy, and the main stumbling block lies in the unclear character of the mechanism of reducing the value E_a , because without the Unitary Quantum Theory it is incomprehensible where such energy can come at all. It is this very circumstance that is the main reason of catalysis being so far an art, and not a science!

4.2 Biochemical Reactions whit Participation of Enzymes and Their Interpretation Within Modern Science

Even the brilliant brains were not able

To elucidate the darkness surrounding,

They have just told us few fairy tale

And went to sleep with us.

Omar Khayyam.

Persian mathematician and poet.

Ferments or enzymes are catalysts for the reactions taking place in living matter, but at some aspects their functioning principally differs from homogeneous and heterogeneous catalysis. Ferments are highly active organic or metal-organic catalysts. Their activity is mostly the activity of total catalytic systems. The most important characteristics of ferments are: highly strong dependence of their reactivity on pH of the medium and relatively narrow temporal area they react. Besides they are characterized by the aggravation effect and extremely complicated “architectonics” of molecules.

The aggravation effect entailed the increase of catalyst reactivity with attaching particles of bigger molecular masses. It is considered that it probably may be caused by arising of “energy trap” helping in keeping the excess of energy, necessary for further passing over the activation barrier. The aggravation effect may also arise as a result of ferment and carrier interaction, i.e. with the basic mass of protein.

The dimensions of ferment molecule may be both noticeably bigger and smaller than those of the substrate molecule. As a rule, if some connections within the substrate are broken (decomposition) due to special caverns or hollows in the ferment molecules where the substrate molecules get into.

For the time being most part of ferments have been educed in the form of pure crystal substances. It appeared that some of that crystal ferments are pure protein; such are the pepsin, one of proteolytic ferments that catalyses hydrolysis of peptide connection (— CO — NH —) in proteins, and the urease is catalyzing the hydrolysis of urea. Other ferments contain apart of protein prosthetic group important for their catalytic activity; very often prosthetic group is a flavin, like in different ferments able to catalyze oxidation-reduction reactions, or a hematin in the catalysis of peroxidases catalyzing some reactions with hydrogen peroxide. Some other ferments are active in presence of a cofactor besides the substrate. Like ferment, a cofactor takes part in reaction to be catalyzed by the ferment, but it is not destroyed and may have quite simple chemical structure like a non-organic ion, in that case it is called activator. In other case it may be a complicated organic molecule, known as coenzyme.

Apparently, cofactors react like prosthetic groups (or some of such groups) that can be easily separated from ferment. Even the difference between cofactors and prosthetic groups within the limits of ferment is very important from the point of view of biology; it may be quite strained if we speak about mechanism of catalysis. It is considered that ferment by itself or in presence of cofactor creates active zones or active centers where catalysis takes place. Probably each molecule of activated ferment contains only a few active centers (in fact, usually it is only one center) and each active center is polyfunctional. It means that some of its zones (parts) are able to hold substrate in such a position at what its other parts initiate changes of chemical bindings thus activating it for catalysis. The exact knowledge of ferment molecule configuration, including protein conformation in folds or at molecules coiling as well as chemical structure near active center may become rather important. For example, ferment activity may be upset at heating or chemical reagents acting (acids, alkalines or concentrated salt solutions) able to transform protein conformation by means of denaturation. Besides that, the activity may be reduced in the result of inhibitors influence. The latter work generally in the process of interaction with active centers and are used to determine the number of separate active centers in single ferment molecule and for data about its chemical structure.

For the time being the idea of active center as one with algoristic steric features gives the most logical explanation of one of the most important characteristics of ferment as catalysts, viz. their high specificity. Ferments are specified for certain types of reactions, for example, for hydrolyze of some bindings, or certain groups transfer, they may be even specified in definite substrates among huge quantity of others with the same bindings.

One of characteristic features of enzymatic catalysis is its extraordinary selectivity lying in the ability of each ferment to turn one definite reaction. Very often that situation is explained by the words “key-lock” (that idea was born in 1899 by German researcher Emil Fischer) it is shown in detail on Fig. 4.2.1. For the explanation of that phenomenon, a hypothesis of tension and deformations is used, based on the principle of structure distortion of parent material under the influence of catalyst active center and their approaching to the structure corresponding with reaction product. At this activation barrier is going down. However, all these obscure ideas and fine pictures are able to explain energy drop with the words: molecules loosening, deformation, conformational transformation of molecules in the form suitable for specific compounds formation and so on, but they do not say even a word where does energy come from, we mean energy necessary for breaking of any “specific” molecular bond. The existing science stipulates that all these transformations require energy but it is nowhere to be taken from because laws of conservation tie the researchers' hands.

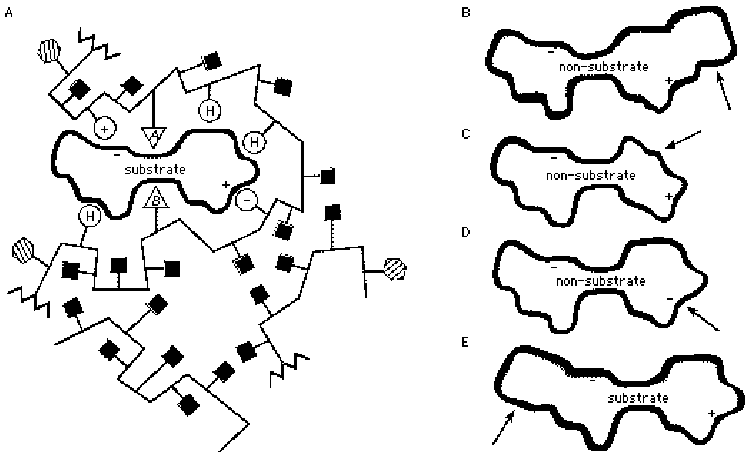


Fig. 4.2.1 *System key-lock and its action.*

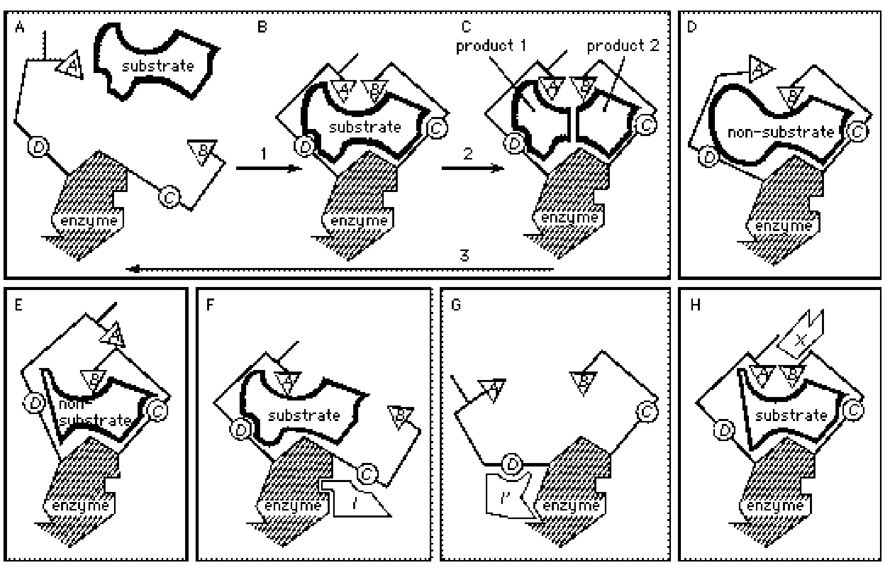


Fig. 4.2.2 *System key-lock and allosteric processes.*

To redeem the position and explain the energy deficiency a special term "energetic trap" was offered. That trap stores the energy and is able to return it in an isolated interaction. But after becoming empty it should store energy again. But where does it take energy? Thermal fluctuations may become such source but till now S. Carnot theorem prevents it officially (Second law of thermodynamics). Within the limits of general science that question does not have answer yet.

But generally the single structure of active center is unable to provide the optimal correspondence both for substrates and reaction products. By its structure the active center is mostly close to reaction transient state.

Even if not in all but in most cases ferments catalyze reactions of one of the pair of optical enantiomorphous isomers only. Thus any detailed enzymatic reaction mechanisms should be able to give explanation for both chemical and stereochemical specificity. The troubles dealt with it are usually similar to those we have to run into at interpretation of the mechanism of Ziegler catalyst to be acting in the reaction of obtaining stereoregular polymers.

M. Dixon and E. Webb in their monograph [149] made review of these ferments' characteristics, according to them *"ferment is a protein with catalytic properties resulting from its ability to specific activation"*.

The number of known ferments is great. In 1959 M. Dixon and E. Webb had counted more than 650 different ferments and evidently their number will increase with further study of various reactions proceeding within organisms of animals, plants, moulds, bacteria and viruses. For the time being their number reaches few thousands. In absence of more detailed information about individual ferments structure and mechanism of their activity all ferments have been divided into groups by types of reaction they were catalyzing. Ferments have a rather complicated name system; let us dwell on its details shortly. Some of ferments have conventional names, for example, pepsin, trypsin and renin; the others are called after the substrate in the reaction to be catalyzed, e.g. the urease or the fumarase; there are more complicated names describing in detail the catalyzed reaction, for example, tranceglucosilase of maltose (catalysis of glucose group transfer from maltose to receptor molecule).

Hydrolyzeable ferments form one big group that can be subdivided in accordance with the type of bond to be hydrolyzed. For example, peptidases catalyze the reaction of peptide bond hydrolyze — CO —NH —, glucosidases – glucoside bond within glucosides or polysaccharides, esterases – the ester bond in carboxylic, phosphoric and sulphuric esters and so on. The other big group contains ferments – groups' carriers - able to catalyze the transportation from substrate towards acceptor of definite chemical group like the hydrogen atom, phosphate, glucosile or acyl groups. Reactions with the hydrogen atom transfer as usual concern with the generation of energy in living matter. Ferments are called "oxidase" if such transfer proceeds towards the molecular oxygen or from it, and "dehydrase" if such transfer occurs towards other molecules or from them. Besides these two big groups there are a lot of smaller groups, for example, either for the ferments able to catalyze nonoxidizing decarboxylation, or adjoining to double bond and opposite decomposition, or changes of spatial configuration.

Although kinetic researches of definite type with numerous known ferments have been implemented an extremely small amount of them is known in details. Among them are [149] peptidases: pepsin, trysine, chymotrypsin and carboxypeptidase; esterases: cholineesterase and adenosinetryphosphotase; urease; fumarase; lacticodehydrase; peroxidase and catalase.

These researches have shown that ferments are extremely active catalysts in comparison with any other ones used for homogeneous non-chain reactions. Comparative research of enzymic processes has been carried out by different ways with the use of two useful criteria – the number of ferment's turnover and reaction constant. In most works, the natural value of the ferment's turnover number is not used at all, as for the activity of enzyme with one and more active centers per one molecule, it is expressed through the molecular activity, i.e. the number of substrate molecules to be transformed within one minute under the influence of one active center. At any reasonable comparison it appears that ferments are much more active catalysts than, for example, hydrogen or hydroxyl ions as hydrolysis catalysts or metals' ions in oxidation-reduction catalysis. For example, urease is about 1014 times (!) more active than hydrogen ions (in convention of reacted molecules number at one ion) in urea hydrolyze, and catalyses is approximately 10^6 time more active than bivalent iron ion in decomposition of hydrogen peroxide.

This extremely high output reminds about photochemical chain reactions and therefore some researchers have assumed that enzymatic reactions are proceeding in accordance with the chain mechanism. From that point of view the high reaction rate can be explained by chains initiated by ferments, as well as the high speed of polymerization reactions that can be obtained in presence of oxidation-reduction or ion catalysts. Inhibitors may react by reducing chain centers, thus shortening chain's length. For example, F. Gaber and E. Wilshtetter [150] assumed that the catalyses was able to initiate the chain decomposition of hydrogen peroxide. The reaction initiation:

$$H_2O_2 + \text{Catalase} \longrightarrow HO_2 + \text{Desoxycatalase.}$$

leads in chain growth:

$$HO_2 + H_2O_2 \rightarrow H_2O + O_2 + OH$$

$$OH + H_2O_2 \rightarrow HO_2 + H_2O$$

Quite similar mechanisms were discovered for dehydrase and oxidase, mutase, glyoxalase and peroxidase catalysis. I. Woters [151] worked out chain mechanisms for some ferments catalyzing oxidizing processes. But it is rather difficult to explain the specificity of ferments and coferments on the basis of chain mechanisms. The activity of catalysts or chain initiators mostly depends on reaction, corresponding to a long chain, i.e. to the large value of relation between the rate of chain increase and the rate of the breaking of the chain. If that takes place then nearly any substance able to decay with production of free radicals that can initiate chains at temperate rate will result in fast speed of chain reaction. The latter is equal to the product of the rate of initiation by the chain length. It is difficult to adjust that "non-specific" behavior of free-radical chain reactions catalysts with the strictly specific behavior of ferments.

Furthermore, till now no satisfactory proof of free radical presence in enzymatic reactions has been obtained; in fact it was demonstrated that free radicals (to be obtained in the result of radiation treatment) reduce the ferment's activity. These facts convey that rather evident multi-stage mechanisms of homogeneous catalysis are hardly usable. Moreover some data [152] testifying against the presence of free radicals or free protons in some reactions of proton transfer because that transfer is made without exchange with dissolvent. Apparently, it is unlikely that ferments react in the form of chain initiation with free radicals or with free ion-radicals as chain carriers. On the other hand some of the abovementioned troubles will disappear if we assume that ferments participate at the stage of chain growth; that stage may be extremely specific. In reality all catalytic reactions going by intermediate complexes can be considered as chain reactions. The catalyst disappears at one stage of reaction with the substrate to appear later, as the chain carrier appears again at the stage of the chain growth.

In reality it seems that both substrate and ferment are transformed. Ferment-substrate reaction may be conditioned by hydrogen bonding, electrostatic coupling, and complex forming with charge transfer. The influence of hydrogen bonding on the process of enzymatic reaction is typical for aqua solutions. If a pair acid-alkaline combined by hydrogen connection exist in the ferment active center, then due to the possibility of an easy proton transfer from one energetic minimum to another that system is able to be highly catalytically active. At the same time the so-called coupled catalysis takes place.

Most part of quantum-chemical models of ferments' activity is based on optimal correspondence of geometrical and energetic parameters of substrate and ferment to be obtained in the appearing intermediate complex.

Besides high rates and specific direction enzymatic reactions have other property principally different from other catalytic reactions. In the overwhelming majority of the cases there is not a purely biological catalyst but a self-controllable catalytic system or a cooperative catalysts system.

As for any natural system with numerous input and output data for enzymatic system internal regulation is typical along with return bond (connection) and the statistical nature of action. And here the significant role of secondary, tertiary and quaternary structures of enzymatic and substrate proteins must be taken into account. Within the process of their transformation the importance of entropy and nega-entropy (the negative entropy of Leon Brillouin) factors, those probably are able to change the process kinetics in principle. Here we are going to mention three aspect of that cooperative origin of enzymatic activity only.

The first deals with the phenomenon of enzymatic activity regulation or allosteric phenomenon, perfectly illustrated by Fig. 4.2.1. and 4.2.2.

The second concerns the ability of enzymatic reaction to process in series or simultaneously in many active centers of one or few ferments. In the case of series reactions cooperative nature of enzymatic system becomes appeared in the process of charged particles transfer and in electron density move along molecule chains.

The third poorly studied factor is the appearance of negative entropy, apparently able even to upset the balance of chemical process in one or opposite directions as it is evident from equation (4.1.2).

The influence of cooperative phenomena is finely shown at Fig. 4.1.3.

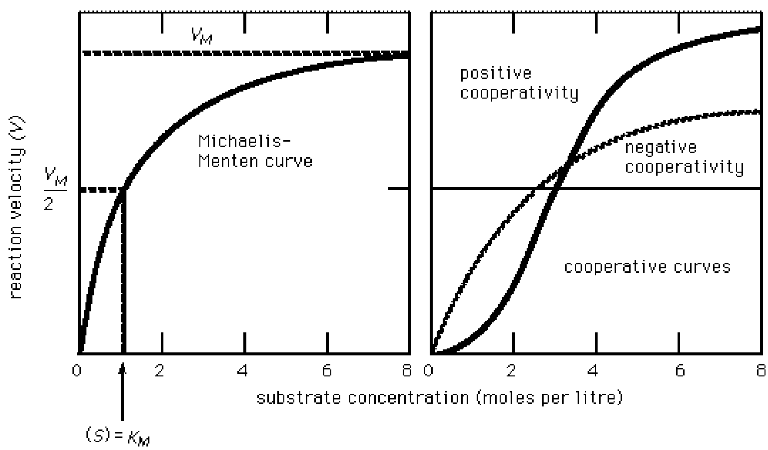


Fig. 4.2.3 *Curves representing enzyme action.*

Some peculiarities of reactions catalyzed by ferments are similar to those discovered for heterogeneous reactions, for example the type of kinetic equation and inhibitors' activity [150, 151]. V. Beylis suggested [152] mechanism of enzymatic catalysis based on substrate adsorption at ferment surface with further reaction of adsorbed bonding. For the time being there are a lot of similar proofs [150, 151] of the fact that there is a specific chemical reaction between the substrate and the ferment (but not a pure physical adsorption) the same as occurs in the process of heterogeneous catalysis between the substrate and the catalyst surface.

When we will get more information about the structure of active centers of ferment molecule, then the real necessity to examine "surface geometry" of ferment molecule will appear (Fig. 4.2.1. and 4.2.2.). At present it is often quite enough to examine the composition of the substrate S and the enzyme E as a single whole.

In most cases the mechanism of enzymatic reactions is a strong modification of a quite simple transient formations or complexes, shortly touched upon in section 4.1.

As we will see later, there is a related coupling between the heterogeneous catalysis and the mechanism of enzymes action, because in both cases the mechanisms of activation energy drop are similar.

So let us return to the question of heterogeneous catalysts. The most significant heterogeneous catalysts for industrial and laboratory processes are metals, oxides, sulphides or combinations of those substances. Molecular crystals are rarely suitable for catalysis' purposes. Among metals, the transition metals and platinoid metals are usually used. As it will be shown later they react similarly in all reactions enumerated. Thus, for example, for oxidation catalysts one can often see oxidation and its reduction to metal back or pair of oxides creation easily turning from one into another.

There are no doubts that the hydrogen is chemisorbed by hydrogenation agents with further dissociation. More active metals have free l-orbits able to couple Hydrogen atoms. In Fisher-Tropsh synthesis the ability of Carbon oxide for chemisorption (without dissociation) is very important because similar agents are used in Ammonia synthesis to split nitrogen molecules into atoms. Oxides can be divided into two separate groups.

Oxide-insulators are used for cracking, isomerization and dehumidification reactions, its activity can be concerned with acidity of their surfaces and ability to carbonize (to form carbonium ions) from carbohydrates. Oxides-transistors are suitable for the hydrogenation, exchange, oxidation and some decomposition reactions. Apparently, they are adsorbing reagents in the form of ions because quite interesting relations between catalytic reactivity and surface conductivity of these transistorized oxides have been discovered. The surface itself does not react and plays an utterly mysterious role.

An ideal catalyst for industrial production of any chemical substance must be extremely reactive, firm and stable as well as reproducible. To our regret we have to notice that highly reactive surfaces as a rule do not have a long life-time and the expenses for renewal or re-activation of spent catalyst were so high, that usually that resulted in use of a less active but more stable agent.

The capacity of specified catalyst quantity can be increased by extension of activity of the surface area unit and catalyst surface area. Due to the difficulties of surface structure determination we know less about factors controlling the activity of the surface area unit than about the influence of various preparation procedures on the specific surface area value. It has been fixed that the specific activity is highly preparation procedure-sensitive. The only way to guarantee the repeatability and the satisfactory work is a tried formula.

Generally it is considered that in accordance with the standard preparation technique a catalyst with activity proportional to its surface area is to be produced from certain raw materials. But this proportionality may be exact only when the surface is strictly homogeneous or is characterized by homogeneous activity in all range and when it is equally available for reagents.

The necessity to save world resources of oil and at the same time more and more growing use as feedstock resulted in series catalysis reactions applied in oil-refining industry. From decade to decade the tendencies in that sector changed radically. The first oil refinery was nesessary, especially Sulfur stripping, then automotive and aviation fuel of higher quality became required, that resulted in researches of possibility of low-boiling fractions use obtained from crude oil stripping and refining. Later monomer production like styrene and butadiene for caoutchouc and other polymers production took on special significance. Either it is considered as a rule that most part of these reactions includes an intermediate stage of carbonyl ions forming, their further isomerization, adjunction and exchange reactions, the details of these mechanisms are not studied well enough. Thanks to intensified researches the best conditions for catalyst work have been empirically determined. And quite satisfactory rules for products distribution prediction became known. But much more work is necessary to elucidate the kinetics and mechanisms of different catalysis reactions.

The main reactions are nowadays classified as: a) cracking, where carbohydrates with lower boiling temperatures are produces from “heavier” oil fractions, b) catalytic reforming including hydrogenation – dehydrogenation, isomerization reactions, rings’ opening and closing; c) hydro fining, i.e. catalytic hydrogenation of unsaturated compounds and decomposition containing Sulfur and Nitrogen with forming and removal of Hydrogen sulphide and Ammonia; and d) scaling and polymerization reactions that usually are cracking counter reactions.

The economy of developed counties is in particular based on the catalytic cracking of mineral oil. The idea of cracking is in the destruction of long hydrocarbon molecules with mainly long chain $C_{12} - C_{16}$ into smaller molecules $C_4 - C_8$. Thus mainly paraffin, olefinic and aromatic hydrocarbons are destructed. At that so-called “breakdown” of oil take place and light and heavy motor fuels are produced. Enzyme application in similar processes as oil treatment may lead to fundamental changes in future. It is quite enough to mention enzymatic processes of paraffin treatment in the result of which we get both diesel fuel and artificial protein as fodder addition. That is why we would like to study the processes of cracking shortly later. We could do it even before in section 4.1.

First cracking performed in 1920-1930 was non-catalytic thermal reactions. In these reactions big paraffin molecules or side chains of substituted aromatics were splitted to smaller molecules of hydrocarbons and olefins. It is considered that as intermediate compounds of these reactions uncharged free radicals are obtained. The main final products obtained from paraffin and olefin and side chains of aromatic compound were hydrocarbons from C_1 to C_3. But in the shortest time it was determined that fuel of better quality can be produced by catalytic decomposition. Thus the non-catalytic thermal cracking was mainly replaced by the charcoal or platinum catalytic cracking or by different acid catalyses as, for example, at acid-treated clays or mixtures of silica gel and aluminum oxide or at "double effect catalyst" composed of Platinum, Nickel or molybdenum over Aluminum Oxide.

It is considered that acid catalysts react like Fridel – Krafts catalysts transforming olefins into ions of carbonium, participating in various transformations, resulting in series of products absolutely different from those to be obtained in thermal cracking, with a better output of hydrocarbons C_3 and C_4, brunched olefins, iso-paraffin and aromatic hydrocarbon, that are in particular used in the compounds of petrol or in the case of source material for other chemical products' synthesis.

Apparently these reactions over metal catalysts belong by their character to free-radical ones, but nevertheless their products are more useful than the products of the thermal cracking, because here isomerization in branched chains, $C_5 - C_6$ naphthene dehydrogenation into aromatic hydrocarbons and paraffin cyclization are proceeding to a greater extent. These reactions are often classified separately from cracking as reactions of “reformation” or “reforming”.

Without catalytic decomposition (cracking) it would be impossible to produce that quantity of petrol and no natural sources would be enough, because in the process of general simple distillation only a small part of petroleum is transformed into petrol and the other 95 % would remain in the form of bitumen. It is quite difficult to split strong molecular bonds thanks to thermal motion only without any catalyst. Catalytic cracking saves the situation at level of oil stock conversion of 75-80% and usually proceeds at 470-550 ℃. It includes not only endoergic reactions (splitting of C-C bond), but also a series of secondary exothermic reactions: dealkylation and alkylation, isomerization and hydrogen redistribution, dramatization, dehydrocyclization, polymerization.

In other words the whole series of complicated catalytic processes takes place. As raw materials for catalytic cracking atmospheric and vacuum distillates of primary oil refining within temporal interval 250-500 ℃ are used, in addition to heavy distillates of secondary oil refining processes – coking, deasphalting, oil paraffin production.

As catalysts natural and synthetic aluminosilicates, porous platinum and zeolites are used. Great number of internal channels and cavities of porous platinum, zeolites and aluminosilicates guarantee the active diffusion exchange between vapors of raw material and products. For effective cracking, the pore size should be about 1-10 NM.

We are not going to review theories of catalytic processes with enzymes; they are too many of them. We should note only that both heterogeneous catalysis and reaction with ferment show effective process of molecular bond splitting. Energy strength of these bonds exceeds by dozens of times the energy of thermal motion. However exactly this fundamental phenomenon is explained by different theories in different ways, though, as we will be able to see later, a suitable simple mechanism exists for these processes [185, 197].

4.3 General Approach to Catalysis Phenomena Connected with Energy Generation

The man with a new idea is a crank, until the new idea succeeds.

Mark Twain

As a rule atoms but not molecules participate in primitive reactions. In the case of gas mixtures, for example, the latter should be in atomic state. If examined for example the reaction between the nitrogen and either the oxygen or the hydrogen, these gases do not react in general conditions, and moreover the nitrogen, due to its chemically passive behavior, resembles rare gases, because it either does not react at all, or reacts at extremely high temperatures. The Nitrogen reacts with the Oxygen and forms the Nitric oxide only at the temperature of $4000^0 C$ and with the Hydrogen it forms Ammonia and not only at terms of high temperature and pressures but in the obligatory presence of a catalyst. That happens due to the extremely high energy of the Nitrogen dissociation, about ~170.22 kcal /mole that is essentially more than energy of the thermal motion at usual temperatures. At $3000^0 K$ and normal pressure Nitrogen is dissociated at 0.001 portion, in the same conditions Hydrogen and even Oxygen are dissociated more than at one tenth. However so huge temperatures are not used in the large-scale production of Ammonia and Nitric Acid, but a special catalyst is required (as a rule it is a heterogeneous one).

It is known that both plants and animals assimilate Nitrogen, of course first having transferred it into the atomic state. The mechanism of atomic Nitrogen assimilation by animals is connected with the activity of the nitrogenase ferment. The attempts to reproduce that reaction in artificial conditions without ferment or catalyst failed.

During the last years it was shown for the first time that the molecular Nitrogen is able to form complexes with some transition metals, and then conditions were found for the reduction of Nitrogen molecule combined within the complex to hydrazine. Such binuclear complexes correspond to the idea of model catalytic system with two active centers that work simultaneously.

The conventional today point of view [153] is that this process consists of the following ones: for the Nitrogen molecules activation it is necessary to spend some energy for the first π -bond, at the further stage of Nitrogen regeneration it requires essentially less energy. It was possible to overcome the high activation barrier at the first stage due to the electron redistribution within the complex. At this stage, electrons populate the antibonding π -orbits of Nitrogen molecules and reduction of electron density at bracing σ and π -orbits takes place. Electron re-distribution on the Nitrogen molecule’s orbits happens due to the participation in that act of some d-electrons of transition metals that promote the N-N connection slackening.

To realize the described electron transmission within the complex transition metal – Nitrogen molecule a correspondence between definite geometrical and energetic factors is required.

In fact, the scheme presented is a quantum-chemical picture of cooperative action model, typical for ferments. We should note that influence of ligands' and protonic solvents on the Nitrogen molecule activation and further reduction has not been shown in that scheme. Meanwhile such an influence on the catalysis exists, that has been confirmed by experiments, and that fact brings the model even closer to enzymatic reactions. Quantum-chemical models of the process of activation and molecular Nitrogen reduction in living organisms with the participation of iron protein ferrdoxin – supplier of electrons for the purpose of N-N bond splitting have been developed.

But the above mentioned explanation of the Nitrogen splitting into the atomic state (recall that it requires an enormous energy and it remains unknown where to take it from) is not free of criticism above because any bond's loosening should be paid off by a tremendous quantity of energy.

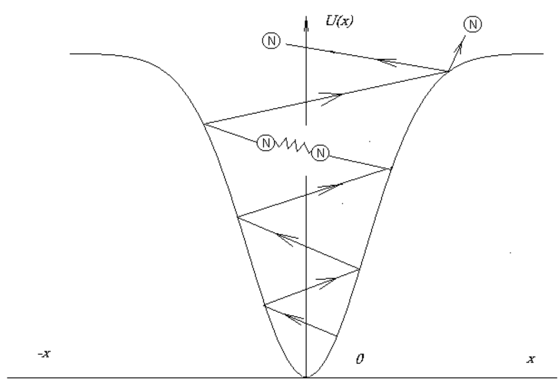


Fig. 4.3.1 *Oscillation of Nitrogen molecule in potential well of catalyst.*

That process seems more natural in accordance with the UQT [185, 197, 200, 201]. For this we should return to section 3.3. The bottom of nearly any potential well may be fully approximated by a parabola. Then the use of results obtained in

3.3. is possible. Let a Nitrogen molecule to get into a cavern or some cavity on the catalyst surface during the adsorption. Then the natural oscillation of that molecule starts. During the oscillation, its energy starts growing and becomes more than the energy of the Nitrogen dissociation, in the result two Nitrogen atoms will fly out of the cavity and they will have enough time to react without any energy problem (with an Oxygen atom, for example). That is sketched on Fig. 4.3.1.

After that the cavern is ready for next “free of charge” repetitions. Of course a satisfactory initial phase of Nitrogen molecule getting inside is required to realize exactly the “Maternity home” solution, because at other phases the molecule flying in starts to deliver to the vacuum its kinetic energy thus realizing the “Crematorium” solution. Probability of that or other solution strongly depends on the catalyst geometry and material by potential equation and on the value of the most probable material molecule velocity and structure. The cavern itself can be compared with the catalyst active center. If such well were changing its form for whatever reason or an alien object were sticking in then the divergent oscillations would stop, that equivalents to the “poisoning” of active center.

The material of well’ walls should fulfill the only task – to reflect in a proper way the object getting into it. That is the general requirement for all ferments and catalysts. And of course the type of the wall potential plays a very significant role, but the most important are its dimensions and form, that from the most general considerations should be about nanometers (an upper estimate). Exactly that explains the widest universality of some catalysts like the platinum black, clays, and aluminosilicates. As it is known these catalysts work perfectly in different reactions.

In the case of enzymes the form of cavities have dimensions and potential specific for each type of ferment (molecule architectonics, key-lock system) and sometimes the molecules of definite form only may take places and oscillate.

That apparently explains the high specificity of enzymes reactivity.

The idea of molecule decomposition mentioned above looks quite simple. But ferments and heterogeneous catalysts are able to synthesize in spite of repulsive forces that associating atoms have to overcome. We shall assume the existence of simultaneous orthogonal oscillations of atoms-respondents within one general well or in few next one to another wells. Then the energy of these oscillations at "Maternity Home" solution implementation will be spent for overcoming of repulsive forces hampering reaction.

We should specially note that the energy during that process is liberated locally within the area of some concrete molecular or atomic bond and meanwhile the energy destroys that bond but does not disperse over the surrounding medium, so the process hardly can be detected by temperature increase. In that simple variant of heterogeneous catalysis the constant of chemical equilibrium will not shift.

In the framework of proposed mechanism the positive influence of effect of aggravation becomes clearer: the catalyst activity is considerably increasing due to the assembling of big molecular masses that is probably necessary because the solution "Maternity home" is more likely for big masses. Coenzymes may play a similar role. In addition, the influence of pH at enzymic processes is explained, because a Hydrogen free atom or bare proton can easily "connect" to nearly any chemical object and so it may radically change the character of oscillations within the well. Temperature also strongly influences these processes because enzyme form is strongly connected with it (as a rule an enzyme is a protein).

To shift equilibrium constant (equation 4.1.2.) of a chemical reaction requires changes of the system entropy, that cannot be excluded for enzymatic processes, because ferments can deliver negative entropy, as we have mentioned already in section 4.2. Today it is considered impossible, but who is able to foresee the future?

We cannot exclude the idea of energy generation within a potential well is just waiting for the creation of general theory of catalysis. Here we should recall brilliant words of a famous Russian specialist on physical chemistry Professor A. N. Kharin (Taganrog, 1954) who always said at his lectures [148]:

> *"The problem of chemical catalysis is the most incomprehensible in the modern physical chemistry and it won't be solved until physicists discover some new mechanism able to explain the liberation of the energy that lowers the reaction barrier."*

Our UQT allows, as we hope, to make the first shy steps in right direction [1-9, 55, 72, 81-86, 200, 201].

4.4 Possible Perspectives

Se non e vero, e bene trovato.

It is known that the human society nowadays faces the problem of a new steady energy source, as far as the reserves of burned (in the literal sense of a word) natural fuel – oil, gas, coal and so on rapidly run out.

Over the last decade it became evident that further intensive development of modern power engineering and transport leads the humanity into a large-scale ecological crisis. Rash decrease of fossil fuel resources against the background of the natural annual growth of power consumption forces industrially developed countries to expand their net of nuclear energy installation. That in more and more increases the risk of their exploitation.

The problem of nuclear wastes utilization becomes more actual. Taking that alarming tendency into account a lot of scientists and experts definitely express their opinion in favor of speeding up the search for new alternative energy sources and new energy carriers' application in power engineering and transport. In particular they fix their eyes on Hydrogen, as its sources in the World Ocean waters are inexhaustible.

Additional irrefutable advantages of that fuel are the relative environmental safety of its use, eligibility for heat-engines without any noticeable changes of their construction, high-calorie capacity, possibility of permanent storing, transportability by existing transport network, nontoxic character and etc. However an essential problem, that has not been overcome till nowadays, is the diseconomy of its industrial production.

More than 600 companies, concerns, university laboratories and social scientific and technical societies in Western Europe, USA, Australia, Canada and Japan toil at reduction of prices of the process of Hydrogen generation (see magazine "Motor transport", № 4, 1992, and page 38). Successful solution of that important problem will revolutionary change World economy and will be able to sanitize the environment by reducing carbon-dioxide wastes.

There is a whole range of well-known water decomposition techniques: chemical, thermo-chemical, electrolysis and others, but all of them have the same imperfection, the using of expensive high-grade energy in engineering process of hydrogen generation. More over this high-grade energy liberation requires the scarce fossil fuel (coal, natural gas, oil products) or power energy produced at electric power stations. It suffices to say that the conventional industrial electrolysis requires for one cubic meter of Hydrogen generation of 18-21, 6 mega-watt-seconds, and taking into consideration the generation of electric power itself general power consumption exceeds 50 mega-watt-seconds, that makes the Hydrogen extremely expensive (about US $2 per cubic meter).

At the same time our Earth is literally bathing in the heat energy flow, received from the Sun. And the task comes "to insert" that inexhaustible source of free-of-charge low-potential heat into the industrial procedure of Hydrogen generation. Hydrogen exceeds natural gas by its calorific value in 2.6 times, oil in 3.3 times. It addition, the cleanness of the process of Hydrogen burning, transportability, possibility of direct transformation of the chemical energy into the electric one should be added. Moreover, the sources of Hydrogen are practically inexhaustible. But we will have to develop inexpensive, technologically applicable, large-scale method of Hydrogen generation requiring low energy consumption. Due to that reason the electrolysis cannot be used for this purpose.

From that point of view the bio-photolysis of water with the use of non-organic catalysts or enzymes and solar energy attracts out attention. Of the most interest was the hydrogenise application. The process of water bio-photolysis consists of two stages. At the first stage the flow of solar energy acts upon the mediator-carrier. As carriers compounds with strong electron-seeking characteristics, for example, viologenic dye (γ,γ'-dipyridine derivative) or nicotineamideadeninedinucleotide (NAD+) are used. Mediator with a high oxidative-reduction potential being excited by radiation takes electrons away from the water molecule and passes into the reset state. Molecular Oxygen is liberated; it does not oxidize the mediator in the reset stage.

At the second stage there is the electron transfer with the help of bacterial ferment of hydrogenise from the mediator in the reset form to protons with combining of molecular Hydrogen. Till now the efficiency of the process of water bio-photolysis under this scheme is too low, and the system itself is not stable enough, but researches in that field are successfully continuing. That classical direction appeared not far ago and promised to be interesting being quite close to equilibrium with environment.

However sometimes ago there was a report on practically spontaneous water decomposition by Oxygen and Hydrogen under the influence of catalyst. That partially confirms the accuracy of ideas described above. For example there was a private communication about a Japanese Kamuro Dozi, who used for this purpose catalyst of cupric oxide. The other two groups (one in Philippines and the other - in USA) are already testing a vehicle powered by mixture of Oxygen and Hydrogen to be generated by catalytic decomposition (with low energy consumption) of common water. The authors have even attached a plate with the inscription: “They said it couldn’t be done!” to the reactor where water decomposition takes place. The vehicle itself is provided with a label: “Powered by ordinary water”. There is a widely known opinion of most chemists: “If any reaction does not precede that means that an appropriate catalyst has not been developed yet”.

Of course if it were created a source of electric power similar to working in Switzerland device of Paul Baumann of “perpetuum mobile” type, there would not be necessity in using of water electrolysis or even it catalytic decomposition for the purposes of motor transport because that would decide all existing principal energy questions. But never the less solar energy should be used as utter as possible because that approach will not move general heat equilibrium of the Earth.

There is no necessity to add anything about further perspectives for professional researcher and advanced thinking reader.

4.4.1 Modern Trend in Quantum Picture of the World

(I) Introduction

It seems that the majority of researches have absolutely forgotten the fact that one of the master spirits of contemporary world, A. Einstein, till the end of his life had not adopted the standard quantum mechanics at all. Better to cite his well-known words: *"Great initial success of the quantum theory could not make me believe in a dice game being the basis of it. I do not believe this principal conception being an appropriate foundation for physics as a whole… Physicists think me an old fool, but I am convinced that the future development of physics will go in another direction than heretofore I reject the main idea of modern statistical quantum theory… I'm quite sure that the existing statistical character of modern quantum theory should be ascribed to the fact that that theory operates with incomplete descriptions of physical systems only."* A. Einstein (back translation).

At the first stage of quantum mechanics evolution in the frame of classical physics theory the mechanism of corpuscular-wave dualism was not discovered at all, as it was done later in the UQT [1-9, 165-172, 186]. It is worth a surprise that the super abstract quantum ideology ad hoc designed by Niels Bohr was suitable in general for the description of quantum reality. An explorer contradicted anything by strictly using new frequently paradoxical quantum rules, and any paradox could be removed by the simple prohibition of its analysis. Although many researches tried to solve these problems they were not successful. The outspoken interpretation of quantum theory had become out of any criticism. More over the determination of simulators describing one of the sides of quantum reality had been announced as the main target of quantum science, while the picture in figures and a-going had become simply an optional target.

Nevertheless one general philosophic problem had to be remaining: the dual principles of the fundamental physics. There were particles as some points being the source of a field that could not be reduced to the field itself; the researchers did not do their utmost, though. Introduction of this micro-particle resulted in a wide range of different divergences - anybody knows now that electric power of a point charge equals infinity. A lot of ideas has appeared, absolutely brilliant ideas from mathematical point of view, suitable for these appearing infinities abolishing. We can use as a cover the words of P. A. Dirac: *"most physicists are completely satisfied with the existing situation. They consider relativistic quantum field theory and electrodynamics to be quite perfect theories and it is not necessary to be anxious about the situation. I should say that I do not like that at all, because according to such perfect theory we have to neglect, without any reason, infinities that appear in the equations. It is just mathematical nonsense. Usually in mathematics the value can be rejected only in the case it were too small, but not because it is infinitely big and someone would like to get rid of it"*. Direction in Physics, New York, 1978 (back translation).

The substantial success of the quantum mechanics (particularly in the stationary cases) was based on the simple correlation of de Broglie wave length and geometric properties of potential. Formally the particle was considered as a point; in other case it was difficult to add probability amplitude character to the wave function. But the point-character of a charge as well as the principle of Complementarity did not allow going ahead in the elementary particles structure and thus the further development of the quantum theory of the field in the frames of the assumed paradigm had resulted in total fiasco of the field quantum theory itself.

There is another concept in physics; it comes from W. Clifford, A. Einstein, E. Schrodinger and Louis de Broglie in which the particle is considered as a bunch (wave packet) of a certain unified field. The position of associated concept would be expressed the most clearly by the following words of A. Einstein: *"We could* *therefore regard matter as being constituted by the regions of space in which the field is extremely strong. A thrown stone is, from this point of view, a changing field in which the states of the greatest field intensity travel through space with the velocity of the stone. There is no place in this new kind of physics both for the field and the matter, for the Field is the only reality... and the laws of motion would automatically follow from the laws of field".* (back translation). By (M. Jemmer, [179]) definition of the particle as a wave packet is the item for some unitary theory.

The first articles concerning this matter were published in [1-9]. The entire term "unitary" belongs to who has classified quantum wave's theories, and it is correlated with the theories that represent particle as a wave packet. In Unitary Quantum Theory a particle is described as a wave packet that in its movement is periodically spreading along the Metagalaxy and is gathering again. For such moving wave packet both the relativistic and the classical mechanics follow from these unitary quantum equations, probably the Maxwell equations and the gravitation follow from exact UQT equations [200], but this has not been proved yet being the problem of the future. Nevertheless the UQT scalar equation (a telegraph type) in general makes it possible to obtain not only Schrodinger but also Maxwell equations [165, 166, 200, 201].

The field of investigations of the Unified Unitary Quantum Theory (UUQT) is the most profound level of substance: the level of elementary particles and quantum effects.

As well known all particles have besides corpuscular properties wave properties too (particles can interfere with each other or with themselves), and their behavior is described by means of the wave function. In the case of a particle moving in the free space, the wave function is described as de Broglie plane wave which wavelength is inverse to the momentum of the particle. If the particle is slowing down or accelerating by applied fields then its wavelength is increasing or decreasing, respectively. The wave itself has no physical interpretation, but the squared value of its amplitude is proportional to the probability to find the particle in a defined place. That is why these waves are also called “waves of probability” or “waves of knowledge”, etc.

There is another problem: the particle has no exact value for coordinate and for momentum at the same time, although either value could be measured arbitrarily closely (uncertainty relation). That is why the definition of trajectory of a quantum particle has no sense.

As opposed to the laws of the classical physics with its determinism where one can predict results of the motion of separate particles, in the quantum theory one can only predict the probability of the behavior of separate particles. Even the nature does not know the way a particle goes by in the case of diffraction by two slits. But not this is the most depressing. The Quantum Physics has wave-corpuscle dualism as well as field dualism and matter dualism. All particles act as sources of field, but it appears that they are only points which have no relation to these fields, and one can’t tell anything in concrete about them.

Let us continue to confuse the reader. We shall consider an extremely simple experiment with single particles in the terms of the modern quantum theory. It will allow us to understand what is going on and will be useful for us in the future.

Let single photons fall on a semitransparent mirror directed at the angle of 45 degrees to their stream. Semitransparent means that a half of the falling light is reflected and another one passes by. Photon counters are installed on the paths of reflected and passed rays (Fig. 4.4.1).

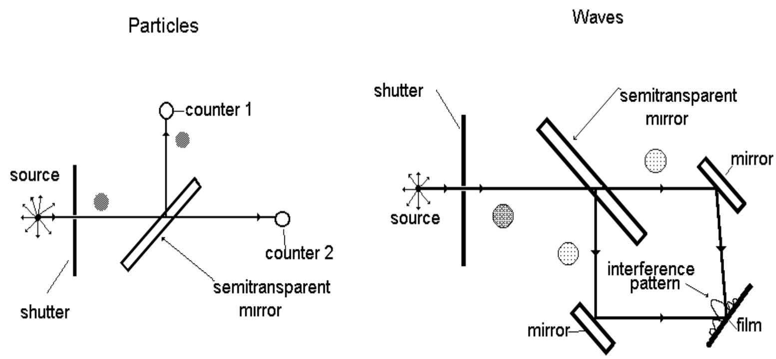


Fig. 4.4.1 *Experiments with individual photons on semitransparent mirror.*

In the terms of the wave theory everything is simple: an incident wave will be reflected and will be passed partially.

But particles as they are indivisible have to be reflected or be passed by. If a counter of reflected beam s particles registers an event it is evidently to suppose that the second counter will register nothing. It is easy to see that if one will re-unite passed and reflected beams and sends them to the screen then... it's all about the way how we are going to argue.

From the wave theory there will be an interference pattern, but from the corpuscular theory it will not occur. In fact, an interference pattern is observed in experiments even for single photons, and our suppositions are wrong to say the least. In order to spare the doubts about how is it possible, it is better to forbid one to think about it. And the principle of Complementarity in modern physics does it in any case. It allows to ask only the questions for which it's possible to give an answer by experimentally only. When one tries to find a particle it means that one rejects to observe the interference pattern and vice versa. As though we could know from experiment either a particle has passed by or has been reflected, we would realize the real particle behavior. But it's impossible to do by the means of macro-instruments.

The principle of Complementary makes the quantum physics descriptively inaccessible. *"There are many experiments, that we just cannot explain without considering the wave function as a wave that influences on the whole region and not as particles appearing may be here, may be there, as it is possible in the terms of the clearly probabilistic point of view"* (E. Schrodinger). In other words a wave acts in the whole area simultaneously, not "may be here, may be there", otherwise there wouldn't be any diffraction or interference.

Eventually we have to admit that the prohibitions of the principle of Complementarity respond to the weakness philosophy, and the role of this principle is obviously analogous to the role of a calorie, a phlogiston and other obsolete concepts.

(II) Unified Field Theory Approach

Let us ask the questions that are forbidden by the principle of Complementarity. What is the wave of an electron? What is the behavior of an electron indeed, when nobody looks at it? (it's natural behavior?) How does it manage to go through a potential barrier when its energy is less than the barrier height (tunneling effect)? How does it, as it is indivisible, go simultaneously by two slits which are divided by a great distance in comparison with its own size? What kind of structure has an atom of hydrogen constructed at the lowest energy state (s-state)? How can the probabilistic consideration of a wave function to result from the mathematical formalism of the theory? Why is the actual Quantum Mechanics reversible? This is a primary law, and the irreversibility has to follow from it for dispose the paradoxes in the statistical mechanics. Last but not least: what structure has the electron itself described in the terms of probability?

This is a huge complex of mysteries. All (or almost all) physicists resigned and even prefer not to speak about it. But there is also someone who does speak. Paul

Langevin even called the formalism of Quantum Mechanics with its principle of Complementarity the “intellectual debauch”.

E. Schrodinger wrote that he “was happy for three months” when he had got the idea to consider the particle as the packet (bunch) of de Broglie waves until the English mathematician Darwin proved that the packet would spread and vanish. But the trouble of all of these attempts (E. Schrodinger, Louis de Broglie, etc) was the fact they always tried to construct it by means of de Broglie waves with such dispersion that any wave packet has to spread. The including of nonlinearity (Louis de Broglie) just extremely complicated the problem but didn’t solve it.

(III) Unified Unitary Quantum Theory Interpretation

The critical feature of the Unified Unitary Quantum Theory (UUQT) is the fact that it describes the particle as a bunch (packet) of certain unified field, but not as a questionable structure of the de Broglie waves of probability.

For spying upon the particles which we consider as very small bunches of the real field, let us consider a Hypothetic Observer (HO) which is able to measure the parameters of these bunches with the hypothetic microprobe. Dimensions of microprobe are much less than the dimensions of the particles. The result of these measurements will be certain structure function that describes bunch of the real field. Obviously, this hypothetic HO and microprobe couldn’t exist, but our thought experiments will be as simple as possible.

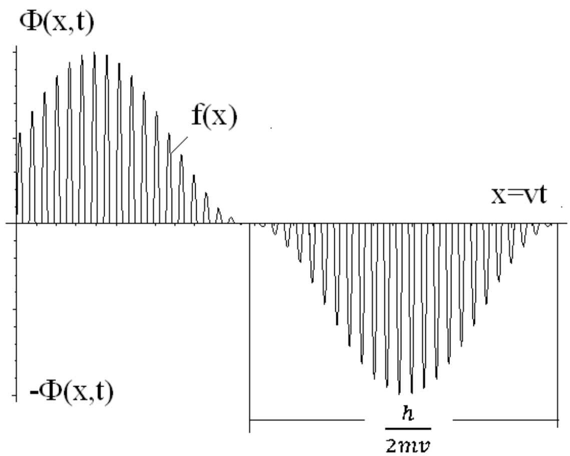


Fig. 4.4.2. *Behavior of wave packet in linear dispersion medium (i.e., rather like a series of stroboscopic photographs).*

If we choose the dispersion of these partial waves equal to linear, we could have an extremely curious process, which mathematical formulation hasn't been used ever before. If we have dispersion, then harmonic components of partial waves propagated with different velocities will result in spreading of the wave packet over all space or over all Metagalaxy. Mathematical investigations show that the spreading goes on without any changes of the form of the wave packet; but at the end, there is a moment when a wave packet vanishes at all. Where does its energy disappear to? It remains in the form of harmonic components that set up a certain background in any point in the space. As these waves are not damped and continue to propagate with velocity of their own, then after a while the wave packet begins to revive in another point, but its sign will be changed at that. During the motion, the packet will appear and disappear periodically (Fig. 2).

The envelope of this process is locus of points, locus of points of its maximum, it is a sinusoidal quantity and it rests in all reference frames; in other words, its phase velocity is equal zero in any reference frame, i.e. it's relativistically invariant (only by means of it the results of the relativistic dynamics are absolutely correct). If we change a reference frame, we will receive a different value of wavelength of the envelope, but it will be motionless as well. As the computing shows the wavelength of the envelope is exactly equal to de Broglie wavelength, and the dependence of this wavelength on packet velocity is the same! As you see, all the Unified Unitary Quantum Theory is occupied with the resolute exploiting of this basic idea. It should be stressed that this periodical appearing and disappearing of particles doesn't refer to the Quantum Mechanics, as an immovable packet doesn't oscillate. The requirement of the relativistic invariance, that would be the main requirement for any theory, specifies the idea further. It states the following: when Lord has excited in space continuum wave packet with his finger and then he has taken it away, then the packet will go on oscillating as a membrane or a string after impact. The frequency ω_S of these free oscillations is very high: it is proportional to the rest energy of the particle and it is equal to the frequency of the so called Schrodinger's trembling ("zitter-bewegung").

$$\omega_S = \frac{mc^2}{\hbar\gamma}, \quad \gamma = \sqrt{1 - v^2/c^2}$$

Within the motion there arise de Broglie vibrations with frequency $\omega_B = mv^2 / \hbar\gamma$ due to dispersion. At small energies $\omega_s >> \omega_B$ and in the presence of quick own oscillations has no influence on experiment. So, all quantum phenomena result from de Broglie oscillations.

The value of frequency ω_B tends to ω_s with growth of energy and resonance phenomenon appears that results in oscillating amplitude increase and in mass growth. Thus the well-known graph of particle mass dependence on the velocity (Fig. 4.4.3) approaching to light s velocity constitutes actually a half of usual resonance curve for forced oscillation of harmonic oscillator if energy dissipation is absent. In the case when $v \to c$, frequency $\omega_B \to \omega_S$ (frequency resonance), $\gamma \to 0$ and the beats appear with difference frequency

$$\omega_d = \omega_s - \omega_B \approx mc^2\gamma / \hbar$$

and particle will obtain absolutely new low-frequency envelop with wave length

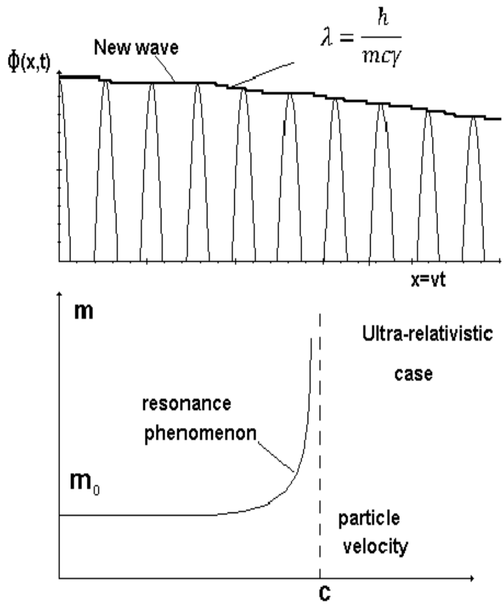
$$\wedge = \frac{h}{mc\gamma}$$

This is a new wave. This can be checked experimentally in CERN. In ultra-relativistic limit case the value of $\wedge$ becomes much greater as typical dimension of quantum system it (new wave) interacts with. Now the length of new wave grows with energy contrary to de Broglie wave length slowly decreasing, and particle requires the form of quasi-stationary wave packet moving in accordance with classical laws. That explains the success of hydrodynamics fluid theory concerning with numerous particle birth when the packet having extremely big amplitude is able to split into series of packets with smaller amplitudes.

But such splitting processes characterize not only high-energy particles. Something like this takes place at small energies also, but overwhelming majority of arising wave packets are under the barrier and so will not be detected. It would be perfect to examine by experiments at future accelerators the appearance of such new wave with the length growing together with energy [165, 166, 200, 201].

If our HO places at the way of motion of the wave packet a number of his microprobes, then due to the dispersion spreading and rebuilding he can observe the envelope of this process, and it will not be at variance to the general Quantum Mechanics, as this envelope corresponds to the wave function. This figure, i.e. a sinusoidal envelope with a regular shape, can be seen by the HO in the only case:

if the only single particle would exist in the world.



Within the ultra-relativistic Limit the wave length λ be Comes much greater than the characteristic dimension of the quantum system with it interacts. Therefore, the particle represented as a quasi-stationary wave packet moving in accordance with the classical laws.

Fig. 4.4.3 *Appear of the New Wave in the ultra-relativistic limit.*

But the real world consists of an enormous number of particles moving each other with different velocities. The partial waves (harmonic components) of those particles which have vanished at this moment can be summarized and emerge real fluctuations of the field or in other words the vacuum fluctuations that will act in a random manner. These fluctuations could destroy all idyllic character of measurements of our HO (Hypothetic Observer) for single particle in Universe because the sinusoidal envelope will be distorted by vacuum fluctuations and it will be difficult to separate it clearly.

Any wave packet that is described in the terms of the becoming structural function could be decomposed by means of Fourier transforming into plane sinusoidal (partial) waves. These waves are infinitely numerous, and their amplitude is infinitesimal. If we summarize them it will emerge zero everywhere except of the area occupied by the structure function. Thus the structure function could be represented either as a function of time (time representation) or as a function of an amplitude of harmonic components related to frequency (spectral representation). It is absolutely equivalent to mathematical representations.

Now there is no necessity in the principle Complementary that was a very convenient view ad hoc. It is easy and clear how the synthesis of corpuscular and wave properties is realized. Corpuscular properties occur due to the localization of a wave packet in a small spatial region. The wave properties of the de Broglie waves can be explained in the following way: when the wave packet approaches to the diffraction system (for example Young's experiment with two slits) then we have an ordinary diffraction of partial waves by splites, and the diffraction pattern of partial waves appears at the screen. HO could observe it with his microprobes.

As these packets are not overlapped then everything is linear and the superposition of the partial waves creates a total diffraction pattern modulated by the de Broglie wave, although the plain de Broglie wave doesn't exist at all. It should be stressed that de Broglie wave is a packets locus of points of maximum in his motion, and it is a superposition of partial waves, that is why it appears in any diffraction and interference experiment.

(IV) Quantum Measurements

Let us try to consider real instruments, which are always macroscopic. Atomic nuclei and electron shells are situated very near to each other and form a very numerous, but discrete series. A transition from the one such a state to another is a quantum jump. That is why the absorption and emitting of energy between the atomic systems is carried out by means of the quanta. However, it doesn't mean that in the motion process the quantum or the particle propagates as something constant and indivisible. The energy of the particle can be divided or changed by vacuum fluctuations. The wave packet of a photon, for example, can, in the issue of the overlapping of vacuum fluctuation, turn into meson at short time, and photon can disguise oneself as a proton or as a neutron. It s assumed in the ordinary quantum field theory that a proton has an atmosphere mesons; it follows from the interpretation of the results of its collisions with another particles. There is no mesons atmosphere indeed. A proton appears and disappears during its motion constantly at the de Broglie wavelength, and its mass changes periodically from the double value of a proton's mass to zero, taken on the intermediate values of mesons masses.

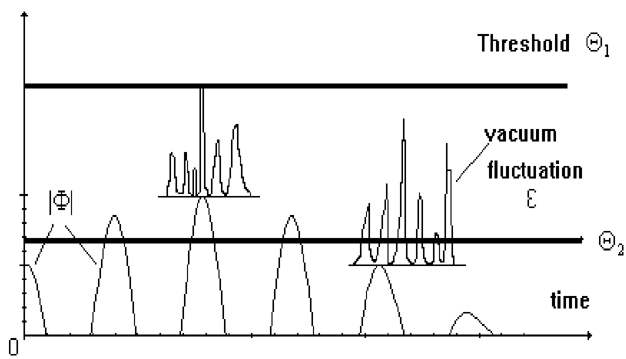


Fig. 4.4.4 *Quantum measurements.*

Eventually, all of the quantum measurements are based on energy absorption and present inconvertible processes [4, 5, 165, 166, 200, 201]. For every instrument founded a particle will operate, a quantum of energy is needed at least, thus it is a threshold energy of instrument defining it's responsively. By the way, we would like to notice that our HO (Hypothetic Observer) uses the instruments with zero threshold energy that is why it can register even vacuum fluctuations.

Let us consider the process of interaction of a particle with a macro-instrument [5, 6]. As soon as the particle is a wave packet, its energy is proportional to the intensity of the packet, but it can be changed because of periodic spreading's and appearances. Besides the packet itself can be divided during the interactions. The macro-instrument to register a particle has to wait for a moment when the total energy of the particle and of the fluctuation of the atom would be more or equal to threshold energy. It is clear that the probability of the operation of the apparatus will be proportional to the amplitude of the wave packet, or more exactly, to the value of intensity of the envelope of the wave function.

If the wave packet with a too low intensity in comparison with threshold energy of the macro-instrument approaches to the macro-instrument, the great fluctuation of vacuum is required, but the probability of such an event is too small, and it means that the probability to detect the particle is small too (Fig. 4.4.4). The theory of the quantum measurements is developed in the Unified Unitary Quantum Theory (UUQT), and the statistical interpretation follows now from the theory, but not just postulated, as it was before in the conventional quantum theory. This point of view requires automatically that the value of the dispersion of vacuum fluctuations is finite that, in another turn, requires the finiteness of the Universe.

(V) Unitary Quantum Illustrations

The uncertainty relation arises because energy and momentum are not constants, but they periodically change because of the dispersion owing to disappearance and appearance of the particle [2-4]. Besides because of statistical laws of measurements with macroinstruments, there is no any way to measure anything accurately owing to the unpredictable fluctuations of the vacuum. HO (Hypothetic Observer) could predict the coordinate, the momentum or the energy of the packet, if he would be the only one in the Universe, i.e. in the case of absence of the vacuum fluctuations.

The presence of unpredictable vacuum fluctuations makes all of the laws of the micro-world principally statistical for any observer. An accurate prediction of expected events requires an accurate knowledge of the vacuum fluctuation in any moment of time, what is impossible, because it is necessary to have the information on the structure and the behavior of any packet (particle) in the universe and to control their motion. The mechanical determinism of Laplace went absolutely lost in the modern physics as well as in the future one. Maxwell was right when he told; “the true logic of the universe is calculation of the probabilities” (back translation). The envelope of partial waves, occurring due to linear transformations at the wave packet and being in the ruins of splitting of the packet corresponds to Huygens principle. It explains how the relating of a moving particle with a monochromatic de Broglie wave is formally possible, propagating in the direction of the motion, and with all wave properties. There are partial waves that we consider as participants of diffraction and interference, but due to the principle of superposition we get the same result as if it a de Broglie wave would participate at the process.

The new linear equations of the UUQT allow the time inversion with simultaneous replacing of the wave function with a conjugated one, with the formal reversibility. Actually this reversibility takes place just in the case if the Universe consisted of the only one particle, as in the real world the recovering of the previous vacuum fluctuation is also needed for the total reversibility of the process. But there is a simultaneous reversibility of all processes in the Universe required for it that is impossible. It doesn’t mean that quantum processes are inconvertible, just the reversibility has a statistical character, but now direction of the current of time defines entropy only.

The envelope, introduced before, is accurately monochromatic, but it does not exist as a traveling plane wave with such properties in the reality. Though it is related to the energy of the particle, the following definitions, such as “waves of the probability”, “waves of the knowledge”, could be related with it too. In contrast to the general quantum theory, now a very important phase is coming. It is the most easy to show it as the tunneling effect.

We would like to mention these established quantum phenomena to the reader. If we have a sufficiently narrow barrier with the height that is larger than the energy of an incident particle, according to the classical mechanics it will never go through the barrier. In the general quantum theory, the incident wave reflects and passes by partially, and we have a finite quantity of the probability that the particle will be behind the barrier. In these cases the general Quantum Mechanics states that the particle makes a tunnel in the barrier for itself, hiding the method of creation of this tunnel.

Let us listen to what HO says of this process? If a particle is approaching closely to a potential barrier in the phase of an absolute collapse, then it easily goes through the barrier, not interacting with it because of linear of all of equations for the small amplitude of the field. It just appears behind the barrier, without interacting with it, if its width is much less than de Broglie wavelength. And there is no necessity for it to make a tunnel. However, if it approaches in the phase with the maximal value of the packet, then the particle would be reflected because of the nonlinear interaction of the waves with the field of the barrier.

Now let us return to the experiment with the semitransparent mirror, discussed above. In terms of the described point of view, the wave packet (particle) will be divided at the mirror and enter in every beam, that depends on the packet phase near the mirror and on the structure of the mirror in this place. We have, in general, two not equal wave packets fragments with less values of the amplitude that can interfere. The changing of the parts of the fragments does not follow by because all processes are linear, i.e. they are not dependants on amplitude. Besides the probability of detecting of the fragments is reduced, because an appreciable fluctuation of the vacuum is necessary for arising of threshold of detection of the counter. Consequently, in the results of the measurements the particles have to be lost or be observed as single particles in both of the beams simultaneously. The creation of two particles from a single is not a confusing fact, because the energy of the fragments will be reconstructed to the necessary level by means of the vacuum fluctuation. Note, the statement of Standard Quantum Mechanics that the particle may be presented simultaneously in many points of quantum world sounds strange from the common sense and remained for decades without any understanding of principal things. Within bounds of UQT scientific explanations are correct in principle.

At present time we have an ambiguous situation when high-tech experiments with fantastic results have been carried out, for example the classical experiments of Brown and Twiss and the variations of them (Fig. 1). It was found out that frequently both of the counters detect particles simultaneously, that is confirmed by the proposed mechanism. Furthermore, most of such experiments (including experiments with entangled photons) confirm directly this interpretation. The results of experiments with entangled particles are quite simple and understandable within bounds of UQT, and the idea to seek some over light mystic relations between particles is fully meaningless.

In consequence, an increasing number of photon pairs are always observed in the beam of light. However, it was found out that it is possible to carry out experiments whose effect remains also in the situation when there is no any way for any induced radiation. If we collide particles of any kind, and if in the colliding point one or two particles are vanished, then they have to go against another without any interaction. Indeed, in the proton-proton interactions 6% of the particles don't interact, but go through the others. An analogous effect takes place in the atom of hydrogen in the state of minimum of energy. It is well known that this s-state is not rotational, and Bohr-Sommerfeld's atom model describes the spectrum strictly in the relativistic case. If we apply this model to the s-state of the electron, we will obtain that the paths of the electron pass through the nuclear, and they were early excepted as absolutely absurd. Today it is clear that an electron just oscillates along a straight, going through the proton. All this allowed one of the authors to consider the problem of deuteron-deuteron interaction in other aspect and to predict the cold fusion [7, 11].

Quantum object is getting classical one with a simultaneous increasing of its mass, i.e. in the case of superposition of a large number of wave packets. The case when all packets creating a body are consolidated and spreading simultaneously is impossible in physics, as they have different velocities and masses. That is why such a combination seems as a stable and permanent object, moving according to the classical mechanics laws, though every packet is described in terms of the Quantum Mechanics. It looks like all particles in the Universe owe their existence to each other, and the Universe itself is just a mathematical illusion, a trick.

In justice to the adherents of the Complementary we have to say the following. They do not retract it, though they have to wriggle, they have to tell that particles always go to the mirror as correlated pairs, and one of them goes through, but the second is reflected. Of course we need to consider the induced radiation effect, when the one atom’s radiation is increasing the probability of emitting from another excited atom of the same source, but it does not always happen. Let us return to the principle of Complementary. It is clear, that if we would not be interested in the nature of the particle and consider it just as an indivisible point then the principle of Complementary is correct. It is a very curious principle and it is amazing how N. Bohr could invent it.

In recent years a numerous of experiments was carried out, which found out superluminal speeds. Not debating if the special theory of relativity is right or not, let us show that in the Unified Unitary Quantum Theory (UUQT) any velocity is possible and the velocity of light is not maximum possible.

Let us consider Euclidean plain space, in which the photon propagates along the X-axis. According to the UUQT it is a wave packet and it can be presented as an infinite sum of harmonic components, that exist on the X-axis, figuratively speaking, and are placed at a distance of a million light years ahead and backwards. Now if we place on the X-axis arbitrarily far some special device, creating an anomalistic high dispersion, then the photon can occur at the exit of the device, because the harmonic components shift each other. The most interesting in this process is that nothing has moved between incident and reconstructed photons at this velocity! With other words, the conventional definition of the velocity is getting obsolete [165, 166].

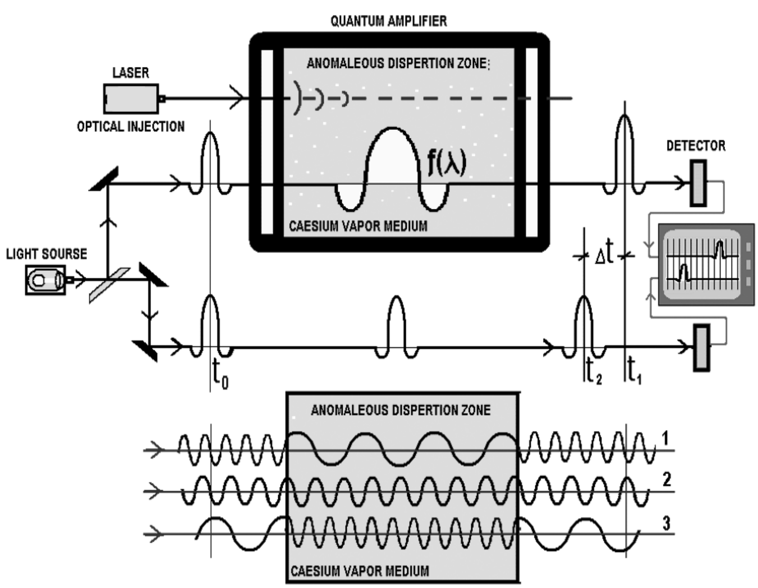


Fig. 4.4.5 *Experiments of L. Wang - superluminal light propagation.*

Such experiments were carried out by several teams (in Berkeley, Vienna, Cologne, Florence, etc.) and they emerged the superluminal speeds. The most interesting were Lijun Wang's investigations [27] in which the velocity 310 times higher than the speed of the light (Fig. 4.4.5) was found. Wang gives the same interpretation as ours, but only for an impulse of light. In this case it was a wrong interpretation, because in the experiment the envelope of the light pulse was not distorted absolutely, but it had to be obligatory, and Wang noticed that it was amazed. He supposed that the special theory of relativity was absolutely destroyed. But it is not quite true.

Our idea that particles are wave packets is an absolutely original idea for the world wide science. The waves at the Fig. 4.4.5 have to be realized as separated partial waves of the spectral decomposition of the wave packets of the separated photons, but not as a spectral decomposition of the light pulse. Then the form of the momentum envelope will not be distorted.

The aspects of the Unitary Quantum Theory are confirmed by results of their practical applications to traditional tasks of physics. The UUQT allows for the first time in the international science, not either to compute the electron charge and the fine structure constant (1/137) with the great precision (0.3%) [6, 7, 165, 166] but even to compute masses of many elementary particles [162, 164, 200, 201] (with the accuracy of 0.1-0.003%)! It s amazing that in the calculated spectrum of masses there is a particle mass about 131.7 GeV (L=2, m=2) that can be called Higgs boson [202].

The Modern Standard Model and quantum theories of field couldn't even raise these problems mathematically. It should be stressed than when we will find the spectrum of masses and charge of electron, time won't be a part of the ultimate equations and it will stay Newtonian. In the Unified Unitary Quantum Theory all interactions and particle production (packet split) are considered as an effect of diffraction of the packets by each other because of the nonlinearity. An analytical solution of these tasks will require new mathematical methods, and it is not even clear how to start with it at presence.

(VI) Approximated Equation with the Oscillating Charge

There are strong hard rules in the modern theoretical physics. Any new theory has to include classical results. This is strictly satisfied because the Hamilton-Jacobi relativistic equation and Dirac equation follow from the UUQT, i.e. all modern basics of the fundamental quantum science. In the linear equations of the UUQT the mass is replaced by the rest energy divided to square speed of light, and then the system of 32 nonlinear integro-differential equations appears as a consequence. They were firstly found out by L. Sapogin and V. Boichenko [8] in 1984, and only in 1988 they solved the dimensionless scalar version of this equation that allowed to get the fine structure constant 1/137 and electron charge with accuracy 0.3% [6, 7, 165, 166].

In this approximation of the UUQT, the wave packet is realized as a spatial divided electric charge that oscillates, its equation depends on time, coordinate and velocity and it could work in the rough model of the particle as oscillated charge, so we can exploit the Newton equations. It is becoming easy to see the tunneling effect: while the moving particle is approaching to the potential barrier, in the phase when the charge is extremely small, it is easy for it to go through the barrier, and when the quantity of the charge is large, the repulsion force is increasing, and the particle will be reflected. The numerical solution of these equations [172, 183, 200, 201], for the most common quantum tasks emerges approximately the same results as the calculation of the general Quantum Mechanics (QM). By the way, by means of the UUQT it is possible to get this equation from the Schrodinger’s one with very low energies [172, 183, 200, 201]. But there are though some interesting differences. The equations of motion of the oscillated charge were not treated in physics before and they have an important difference from the classical laws of motion - the invariance of the motion in the relation to invariance translations. It means the absence of the great classical momentum and energy conservation laws. They appear in the UUQT and then in the classical mechanics only with an averaging for all particles.

Now we obtain Uncertainty relations [200, 201]. As far as the particle (wave packet) is periodically appearing and vanishing at de Broglie wave length (more precisely, the packet disappears twice, and the probability of its detecting is sufficiently big in maximum region only) the position of such a packet may be detected with error

$$\Delta x \geq \frac{\lambda}{2} \text{ and then } \Delta x \cdot P \geq \frac{h}{2}$$

As at measuring of momentum module is inevitable the error P= 2P, then we have following inequality: $\Delta x \cdot \Delta P \geq h$. The statements of standard quantum mechanics that particles do not have a trajectory become more understandable. Of course, there is a lot of truth in these words. First, it is possible to say so about intermittent (dotted) motion of the particle with oscillating charge. Second, any packet (particle) is able during its motion to split into few parts. Each of these parts being summed with vacuum fluctuation may product, in principle, some new particles. Or visa versa the broken particle may vanish at all and contribute to general fluctuating chaos of the vacuum. But in any case it is better to have more clear idea of particle concrete motion than operate with generally accepted nowadays-obscure sentence about lack of trajectory.

The consideration of the problems concerning oscillations of particles with an oscillating charge in a parabolic well (harmonic oscillator) besides the common results of QM for stationary states results in two different solutions that are shown on Fig. 4.4.6. New amazing solutions appeared, one of them was called

"Maternity Home" and another was called "Crematorium". In the first case the energy of the particle can increase indefinitely, furthermore if we proceed from a very low initial quantity in the equation, it results in the increasing of the energy of the particle in the production of the matter, indeed. The second solution could due to collapse (disappear) of the matter-particle. These solutions are logically independent directly, and their appearance depends on initial phase. With other words, one solution describes the matter (energy) production, and another one its collapse; and it may be said that the Unified Unitary Quantum Theory (UUQT) allows to describe the creation of the matter and the Universe, but not as a result of the Big Bang. The Universe wouldn't be given to us in the static form, it arose in some way and it continues to develop, and we could see that one of the basic features is the filling of space by matter.

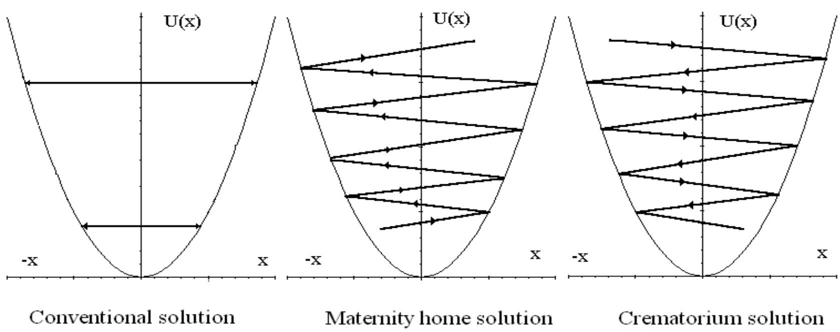


Fig. 4.4.6 *Possible solutions for the harmonic oscillator.*

(VII) New Sources of Energy

As well known, in all experiments the local law of energy conservation (LEC) and the law of conservation of momentum in individual quantum process are correct only for high-energy states. For low energies we can't claim that, because of the uncertainty relation and the stochastic nature of QM's predictions. That is why the idea of the global, but not of local LEC exists invisibly in the QM and it is not a new one.

For the physics it only means that for the stationary solution with fixed discrete energy levels (the general QM) of the velocity of the particle reflected by a wall is equal to incident one. The UUQT allows to consider another ways too. Thus if the velocity of the particle for every reflection is decreasing, then it corresponds the "Crematorium" solution, but if it is increasing, then it corresponds the "Maternity home". What scenario will turn to the reality depends on the initial phase of the wave function and on the energy of the particle. Besides the UUQT is fundamentally inapplicable for closed systems, because such systems are idealizations, which are very useful, but not according to the base of consideration used in the UUQT.

Anyway, the whole modern science, including the Quantum Mechanics (QM), is still based on the great LEC. However, there is a difficult situation in the Quantum Mechanics. It deals with the fact that the LEC follows only from the Newton mechanics. QM generalizes the facts of the classical mechanics including all of its laws, but its results have a sufficiently statistical nature, they are correct only for large amounts of particles. But how do we have to consider single particles, with their individual processes? It appears that for the single particles LEC does not follow from QM (!), thus individual events are absolutely incidental and do not follow this law. To evade this question it was announced that Quantum Mechanics does not describe individual events (!?)

Let us discuss a thought experiment. To make our reasons more simple let operate a certain quantum ball-particle. If the ball is approaching to the wall, then its velocity after reflection will always be equal to the incident velocity (here we neglect a quantity of the friction force and consider that the ball and the wall are perfectly elastic). In the case of the quantum ball the velocity after the reflection would possess the whole arrange of the values, in different experiments under equal conditions. There would be some balls that would be reflected with velocities that are higher and some that are lower than the initial velocity, and some of them with velocities equal to the incident one, and every case would be considered statistically in the terms of the Quantum Mechanics.

Let us answer the following question: what would happen if we placed another wall opposite the first, and tried to increase the velocity of the ball after every reflection? Then we would get increasing of energy of the ball without action of any external force. The energetic of the systems in the XXI century will treat the question of constructing of initial conditions for a numerous quantity of particles to realize only the "Maternity Home" solution so that the "Crematorium" solution would be damped as far as possible. But it depends on the selection of initial phases and the geometry of the system.

Thus, if we use the ideas of the Unified Unitary Quantum Theory appropriately then a general prohibition for creating of a quantum perpetuum mobile does not exist. Formally there is no such a prohibition even in the general Quantum Mechanics, because there are no conservation laws for a single process under the low energy conditions, but it treats with probabilities instead of this. In other words, the Quantum Mechanics (QM) also offers opportunities for getting energy by collecting of random process someway. It seems that UUQT affords today such an opportunity and suggests the ways how to regulate the values of probabilities.

Together with theoretical investigations plentiful of numerical solutions of equations with oscillating charge were performed, momentum of particles falling with different velocities were summarized and the result was compared to momentum of reflected particles. It was found out that for different repulsive potentials, the total momentum of reflected particles was equal to momentum of the falling particles with a high accuracy, but for a single scattering particle the value of momentum could be either less or more than the momentum of the falling particle. This problem is very complicated and it requires subsequent researches as all this depends on initial conditions (velocity, phase, distance) complexly as well.

The prospects following from the UUQT are not even the most significant. Any flat bans as the impossibility of perpetuum mobile creation and any other confirmation of the immovability of conservation laws are unacceptable in philosophy. No, these laws will never be neglected; but there will be such areas in science and technology, very limited in the beginning, so that these laws will be not enough.

The problem of existing of the global conservation laws (we have proved that they are not local laws) is left in abeyance. Nothing but the idleness and atavism of the human thinking lead to it. But this idleness of thinking - concerning the physics - manifests itself in the intuitive atavism for the Newton laws.

Yes, the conservation laws are incontestable in the classical mechanics and in terms of this theory a continuously operating machine is theoretically impossible. It should be stressed that the conservation laws were transferred to the Quantum Mechanics as an object of worship of the classical mechanics. But the Quantum Mechanics is more fundamental, Newton laws follow from it as a particular case. And if in the terms of the Unitary Quantum Mechanics a possibility to get energy from nothing is theoretically possible, thus a quantum perpetuum mobile can be constructed.

It is made possible by means of the equation with oscillating charge. It describes single particles; the difference in their behavior depends on the initial phase of the wave function, but there are no conservation laws for an individual particle at all, they appear only after an ensemble averaging. The equation with an oscillating charge is absolutely new type of motion equation [200, 201, 172, 183]. For such equation energy and impulse conversation laws do not exist. It appears after the ensemble averaging. By the way Schrodinger mechanics also does not propose energy conversation laws for small energies (it can offer only a probability of this or that event happening) but it cannot advise how to combine processes and energy liberation while UQT can. A theorem on the circulation does not work in the equation with oscillating charge that allows using different way to move charge from the point A to the point B, but different ways operations will be diverse and this difference should be used.

The authors are trying to design new power plant working at these principles. We think that such a plant will be able to produce energy with extremely small spending of energy. If such power program was fulfilled on our Planet then it would be no doubt result in overheating of the environment. But UQT suggests the solution again: we can construct refrigerating plants which realize the “Crematorium” solution and promote the cooling. Extra heat will disappear. Numerous experiments with the cold nuclear fusion (including the latest of Andrea Rossi - Italy) have shown that nuclear reactions do exist but the nuclear reactions products by themselves are not enough for the explanation of huge amount of heat being produced. It is the responsibility of the UQT solutions “Maternity Home” [200, 201, 172, 183]. So it looks like catalysis mechanism [200, 201, 185, 197]. Besides all the equation with oscillating charge is quite good in describing the wave properties of the particle. We predict that experiments on the diffraction reflection of electrons from the lattice (classical experiments of Davisson Germer) can be simulated by supercomputer, but authors do not have such possibility.

Interestingly enough, there are devices called Testatik Machine M/L Converter from religious group Methernitha. They belong to a religious Christian commune, situated in Linden near Bern. They were created by Swiss physicist Paul Baumann living in the commune. These fantastic devices run as direct current generators, are made as a four dimensions (sizes) type with power value of 0.1, 0.3, 3 and 10 kW. In outward appearance this device resembles an electrostatic machine with Leyden jars, so familiar from school physics laboratory. There are two acrylic discs with 36 narrow sectors of thin aluminium stuck to it. The discs rotate in different directions and their mechanical energy is hundreds times lower that produced energy it accounts for about 100 mW in measurements. The largest device with the power value of 10 kW has disc diameters more than 2 m, and the smallest has 20 cm; the device with the power value of 3 kW has 20 kg in weight. There is no cooling or heating of the air during the long operation of the device, it just smells of ozone there. It was found out that the inventor doesn't clearly understand the principle of operation of the device.

Professor S. Marinov (Austria), whom the commune had given as a present the device with the power value of 100 W wrote in his book called "Difficult way to the truth - documents on the violation of conservation laws", issued in 1989 by International Publishers East-West: *"I can confirm without any doubt that this device is a classical perpetuum mobile. Without any initial impact, it could rotate an unlimited long period of time and generate electrical energy equal to 100 W... In that device, the motor and generator are connected... However, it is not clear how it is possible".*

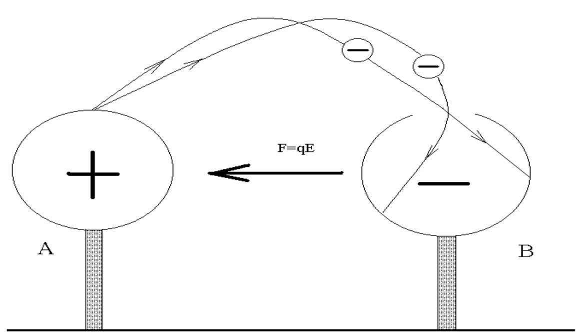


Fig. 4.4.7 *Work for transferring the charge depends on the mode of transferring and on the path.*

The authors of the Unified Unitary Quantum Theory know approximately how this device is constructed, but in this article we are going to do only what is absolutely clear: we are going to show that the operation of this device completely corresponds with the UUQT. Evidently, it operates due to the charge separation concept.

Let us consider two metallic spherical surfaces with a hole isolated from the Earth and from each other. If we carry a first electron from sphere A to the inner surface of sphere B through the hole by means of an isolated stick, then there appears a potential difference. Further, if we carry the second one and the subsequent electrons, sphere A will attract the carried charge, and B -will repeal it. It is clear that to move the charge we will have to spend energy. (Fig. 4.4.7).

In the Technical University MADI (Moscow) professor V. I. Uchastkin gives lectures on the Unified Unitary Quantum Theory (UUQT) and new energy sources. In his explanations, he uses the figurative analogy: Let us consider a sack of potatoes which mass is m. If we carried it to the fourth floor (the height is h), then we spend the quantity of work opposite to the gravitational field which is equal to mgh. And if we threw it down we would get kinetic energy $mv^2/_2$, and these quantities would be equal to each other. But we could also carry not the whole sack, but every potato one by one. The work of one quantum of a potato s transfer depends on time, velocity and coordinate, and it must be carried in such way that the spent work would be minimal. If you carry the whole sack in this way, you can get the quantity $mv^2/_2 > mgh.$ So, there are no changes in the system, but the energy has appeared.

(VIII) Conservation Laws and Unitary Quantum Theory

Inventors and swindlers of every stripe and range many years tried to construct or even to design perpetuum mobile, i.e. imaginary mechanism able to work without outside energy supply. Peter the First (Russian Emperor Peter Great) had even established Russian Academy of Science for such researches (see. V. L. Keerpechev, “Talks about mechanics”, Gostechisdat, 1951, page 289), but today persons from modern Russian Academy of Science do not like to recollect that circumstance. At the other side French Immortals have decided in 1775 to consider no projects of perpetuum mobile, and it seems they have not been mistaken jet. However one mistake is known: Daniel Bernoulli was awarded a prize by French Academy for mathematical proof that a boat with engine and screw propeller would never have faster speed than sailing ship!

Magnificent successes of classical thermodynamics have strengthened Humanity confidence in Divine Infallibility of Conservation Laws. Today it is considered nearly indecent to call in question these laws.

First of all let us clarify the origin of conservation laws in classical mechanics [165, 166, 200, 201]. Nearly each textbook contains a statement that Energy Conservation Law (ECL) results from homogeneity of time, Momentum Conservation Law results from homogeneity of space, and Angular Momentum Conservation Law – from isotropy of space. And so many people are impressed that Laws themselves result from space-time properties that nowadays they are no doubt relativistic conception. But for example angular momentum is not a relativistic conception already. Therefore such restricted approach is not totally correct; Newton's second law of motion or relativistic dynamics equation and concept of system closeness should be attracted. More over the requested space-time properties themselves are usually wrongly being interpreted. For example, it is assumed that time homogeneity means simple equivalence among all moments of time and homogeneity and isotropy of space means equivalence of all its points and absence of preferential direction in space (all directions are equal) correspondingly.

But these statements are sensu stricto wrong. For example, within many mechanical systems the Earth center direction and horizontal direction differ in principle (for example, pendulum clock located in horizontal plane will not work at all). We can say the same about the body being at the top of the hill, it is able to roll dawn independently, but according to classical mechanics it never climbs by itself. And for a person, being young or old, these moments of time are not equal at all. Hereinafter we would like to explain in what way all that should be understand.

Time homogeneity implies that, if at any two moments of time in two similar closed systems somebody runs two similar experiments, their results would not differ.

Space homogeneity and isotropy means that if closed system is moved from one part of the space to another or oriented in other way, nothing would be changed.

Derivation of energy and momentum conservation laws from Newton equation is quite simple in idea. Viz., let us write down the main equation of dynamics in form of

$$\mathbf{F} = \frac{d\mathbf{P}}{dt}$$

For closed system **F**=0 (there are no external forces) and the equation possess the integral

$$\mathbf{P} = Const$$

expressing the momentum conservation law.

Now let's write the main equation of dynamics in the form:

$$\mathbf{F} = m\mathbf{a} = m\frac{d\mathbf{v}}{dt}$$

and scalar-wise multiply it by v

$$\mathbf{F}\cdot\mathbf{v} = m\frac{d\mathbf{v}}{dt}\mathbf{v} = \sum_{i=1}^{3} m\frac{dv_i}{dt}\mathbf{v}_i = \sum_{i=1}^{3} m\frac{d}{dt}\left(\frac{\mathbf{v}_i^2}{2}\right) = \frac{d}{dt}\left(\frac{m\mathbf{v}^2}{2}\right) ,$$

where v is a modulus of velocity vector v. For the closed system F=0 it exists the integral

$$\frac{m\mathbf{v}^2}{2} = Const$$

expressing one of the forms of energy conservation law.

Using the definition of the angular momentum for the particle, i.e.

$$\mathbf{L} = [\mathbf{r}\times\mathbf{P}]$$

and differentiating it both parts by t, we obtain

$$\frac{d\mathbf{L}}{dt} = \left[\frac{d\mathbf{r}}{dt}\times\mathbf{P}\right] + \left[\mathbf{r}\times\frac{d\mathbf{P}}{dt}\right]$$

As the momentum vector is parallel to velocity vector, the first bracket is equal to zero. And basing on the equation and on definition of central force, as one not creating a momentum, we get

$$\left[\mathbf{r} \times \frac{d\mathbf{P}}{dt} \right] = 0$$

and

L=Const.

In the case of central force within unclosed system angular momentum remains constant in value and direction.

The energy and momentum conservation laws can be easily obtained within relativistic dynamics from relativistic relation between energy and momentum

$$E^2 = P^2c^2 + m^2c^4$$

The term m^2c^4 is an invariant, i.e. it is similar within all reference frames. In other words it is a kind of constant. This relation can be written in rather different form

$$E^2 - P^2c^2 = Const$$

To satisfy that relation one should admit that

$$E = Const \quad \text{and} \quad P = Const$$

And that is nothing else than energy and momentum conservation laws.

But strictly speaking in relativistic mechanics there is a law of conservation of four-momentum vector P^{μ}, but we are not going to stop at these details.

In accordance with the classical mechanics, the energy conservation law signifies that energy of closed system remains constant, hence, if at the moment t=0 the energy of such system is denoted by E_0, and at the moment t is denoted by E_t, then

$$E_0 = E_t.$$

In accordance with standard quantum theory, the energy conservation law is laid down in the same way. Within that theory we have the same integrals of motion as in classical mechanics. Some value L is an integral of motion if

$$\frac{d\hat{\boldsymbol{L}}}{dt} = \frac{\partial \hat{\boldsymbol{L}}}{\partial t} + \left[\hat{H}, \hat{\boldsymbol{L}}\right] = 0 \qquad (4.7.1)$$

As $\left[\hat{H}, \hat{\boldsymbol{L}}\right]$ is determined by commutator of operator $\hat{\boldsymbol{L}}$ and of Hamilton's operator $\hat{H}$, so any quantity L, being not evidently dependent on time will be an integral of motion if its operator commutes with $\hat{\boldsymbol{H}}$. When quantity L is not evidently dependent of time, then the first terms in (4.7.1) vanishes. As remainder we have

$$\frac{d\hat{\boldsymbol{L}}}{dt} = \left[\hat{H}, \hat{\boldsymbol{L}}\right],$$

and, as we know, the quantum Poisson bracket vanishes for the integrals of motion being not evidently dependent on time. Thus,

$$\frac{d}{dt}(\boldsymbol{L}) = 0 .$$

In any good work dealing with quantum theory it is shown that probability w to observe at any moment t any value of such motion integral $\boldsymbol{L}$, does not depend on time at all. We will denote below such integrals of motion $\boldsymbol{L}_n$. As far operators $\hat{\boldsymbol{L}}$ and $\hat{\boldsymbol{H}}$ commuted they had common eigen-functions that were functions of stationary states. We should note that the last were obtained from solution of Schroedinger equation without time (not containing t) which is derived from full Schroedinger equation if

$$\Psi(\mathbf{r},t) = \Psi_0(\mathbf{r}) exp\left(i\frac{E}{t}\right),$$

i.e. if this equation has the periodic solutions. The solutions of Schroedinger equation not containing t satisfy conservation laws, which are, in fact, dictated by condition of total time-independence. The expansions of such solutions in eigen-functions' have the form

$$\hat{L}\Psi_n = L_n\Psi_n,$$

$$\hat{H}\Psi_n = E_n\Psi_n,$$

where

$$\Psi(x,t) = \sum_n c_n\Psi_n(x) exp\left(-i\frac{E_n}{\hbar}t\right) = \sum_n c_n(t)\Psi_n(x),$$

$$c_n(t) = c_n exp\left(-i\frac{E_n}{\hbar}t\right) = c_n(0) exp\left(-i\frac{E_n}{\hbar}t\right).$$

As $c_n(t)$ is eigen-functions' expansion of the operator L_n, the probability does not depend on time, i.e.

$$w(L_n,t) = |c_n(t)|^2 = |c_n(0)|^2 = Const$$

We should note once more that it is the probability to observe some given value that is time-independent, while the value itself is occasional in each individual case. As far the energy is an integral of motion and probability w(E, t) to find out at the moment t energy value to be equal to E is time-independent, then:

$$\frac{dw(E,t))}{dt} = 0$$

Quantum energy conservation law in the above mentioned form assuming the possibility not to take into account energy determination at the current moment of time and its uncontrolled changes due to influence of the process of measurement itself. That situation does not raise any doubts within classical mechanics. But according to quantum theory (as we have written already in [13-15]), the energy can be measured without disturbance of its value only up to

$$\Delta E \geq \frac{\hbar}{\tau},$$

where τ - is the duration of measuring process. Formally, there are no troubles for energy conservation law, as the energy is the integral of motion and we have arbitrary large time interval to accomplish long measuring. For example, let measure within time τ, then leave the system alone for the time T, and then measure the energy once again. The energy conservation law in standard quantum mechanics states that the result of the second measuring will coincide to $\Delta E \approx \frac{\hbar}{\tau}$ with the results of the first measurement. But even according to standard quantum theory all this is not totally logical, because really existing vacuum fluctuations may meddle and they are able to change the result. Here we have evident violation of conservation law due to vacuum fluctuations, although the integrals of motion exist (contrary to UQT). The standard quantum theory carefully avoids the question of conservation laws for single events at small energies.

Usually that question either does not being discussed at all, or there some words that quantum theory does not describe single events at all. But these words are wrong, because the standard quantum theory describes, in fact, single events, but is able to foreseen only the probability of that or other result can be added. It is evident that at that case there are no conservation laws for single events at all. These laws appear only after averaging over a large ensemble of events. As the matter of fact it can be easily shown that classical mechanics is obtained from quantum one after summation over a large number of particles. And for a quite large mass the length of de Broglie wave becomes many times less than body dimensions, and then we cannot talk about any quantum-wave characteristics any more.

It is well known that local laws of energy and momentum conservation for the individual quantum processes are valid within all experiments at high energies only. We cannot say so in the cases of law energies at least due to uncertainty relation and stochastic nature of all predictions in quantum theory. The idea of global but not local energy conservation law is invisibly presenting in quantum mechanics and in any case is not new. From the physical viewpoint it just means that in stationary solutions with fixed discrete energies (standard quantum mechanics) the velocity of a particle reflected from the wall is equal to the velocity of an incident particle. If the particle energy decreases at each reflection, then that case corresponds to solution type “Crematorium” and if increases – to “Maternity Home” solution. The scenarios under which events will be developed depend on the initial phase of the wave function and particle energy.

In the strict Unitary Quantum Theory and in the theory of quantum measuring (chapter 1.6) un-removable vacuum fluctuations have a great role. It is quite clear that these fluctuations are totally unforeseen and non-invariant with respect to space and time translations. In other words, within UQT there are no habitual space-time properties. Now space-time is heterogeneous and non-isotropic. For example, if the experiment is replaced in any other point of the space or repeated at other time, then in the point where the particle's parameters were examining and particle was interacting with macro-device, another value of vacuum fluctuations would appear (differing from the previous one) that would give another result. Of course that is true for small energies and individual events (particles) only.

The Unitary Quantum Theory is much more destructive with regards to the notion of Closed System. For single events at small energies that notion is inapplicable at all because at any moment of time and in any place where the particle is located (for example, within potential hole) vacuum fluctuation may be abruptly changed. It may occur thanks to various causes; either due to the nature of vacuum fluctuations, or due to the tunneling effect of other random particle.

Sometimes it is stated that energy conservation laws follow from E. Noether theorem, although those results have been contained in the works of D. Gilbert and F. Klein. For any physical system, the motion equations of which can be obtained from variation principle, every one-parameter continuous transformation, that is keeping the variation functional invariant, corresponds only one differential law of conservation and then there exists explicitly conserved quantity. However, it can be easily seen that vacuum fluctuations being imposed on varying functional (Lagrangian) does not remain constant (in any case it seems so today) under parametrical transformations. That consideration does not work too without ensemble averaging either.

In other words, all requirements that lead to classical laws of conservation are absent now. It is hard to expect that the entire laws of conservation will remain valid in that situation for the single particles at small energies. But nowadays it seems that classical laws of energy, momentum and angular momentum conservation for the single quantum objects do not work at small energies due to the periodic appearance and disappearance of particles. All direct experimental checks of the conservation laws were carried out in the cases of great energies but in the cases of small energies for single particles probability results can be obtained only. In that case it is indecently even to recollect the idea of conservation law.

And now a bit of Philosophy for reader. Local Energy Conservation Law (LECL) for individual processes results from the Newton equations for closed systems. It is naive to think that its local formulation will remain constant forever. And it would be a gross error to transfer ECL without alterations from Newton mechanics to quantum processes inside microcosm. Definitely speaking references to the first law of thermodynamics are baseless because it is a postulate. For example, in his letter to one inventor the famous Russian mathematician N. N. Lousin wrote: “first law of thermodynamics was a product of unsuccessful attempts of the humanity to create perpetuum mobile and frankly speaking did not follow from anything”. Today we can say with more belief that no resourceful machines within the network of Newton mechanics are able to realize perpetuum mobile, and the decree of French Academy, accepted in 1755 to consider no projects of perpetuum mobile is still valid. We should add that is apparently true for all projects based on Newton mechanics only.

It is characteristic of the understanding the position ECL in modern physics that this low is bringing down, especially in theory, to the rank of second-order conclusion from the equations of motion. Some physicists reduce ECL to the statement of the first law of thermodynamics, others as for example D. I. Blochintsev [79] consider that “it is quite possible with further development of new theory ECL form will be transformed". As F. Engels wrote in his "Natural dialectics": *"...no one of physicists does not, in particular, consider ECL as everlasting and absolute law of the nature, as a law of spontaneous transformation of substance motion forms and quantitative permanency of that motion at its transformations."* Many of them are thinking in another manner as, for example, M. P. Bronshtein. He wrote in his work "Substance structure" ECL is one of the basic laws of Newton mechanics. And nevertheless Newton had not attributed to that law rather general character that law had in reality. The reason of that Newton mistaken point of view at ECL was quite interesting... Now it is understandable that in the light of the above mentioned such point of view was not wrong at all. And we should remind that Newton had foreseen in his "theory of bout" many things even quantum mechanics.

At the other side, the founders of quantum mechanics perfectly understood that the conservation law for the single quantum processes at small energies did not exist at all. So, the first thought that understanding of ECL on a par with the second law of thermodynamics, as statistical law, being correct on average and not applicable to the individual processes with small energies, appeared as despair and went back to Erwin Schroedinger first and then to N. Bohr, Kramers, Sleter and G. Gamov. In 1923 Bohr, Kramers and Sleter in despair tried to construct the theory according to which in the process of dispersion energy and momentum conservation laws were satisfied statistically on the average during long time intervals but were inapplicable to the elementary acts. Leo Landau even called that as "Bohr perfect idea".

According to that theory, the process of dispersion should be continuous, but Compton electrons are emitted in a random way. The authors assumed both processes of wave dispersion and Compton electrons dispersion were not connected with each other (?). The main idea was to lay a bridge between quantum theory of the atom and classical emission theory. There were introduced specially so called “virtual” oscillators which generate in accordance with classical theory waves (non quantum one) enable to induce the transition from the state with lower energy to the state with higher energy. These waves did not carry the energy, but power necessary for atom transition from lower to the higher state was generated within the atom itself. Along with that the inverse process of the atom transition from excited state to the lower one could take place, but the energy was not taken away by waves but should disappear inside the atom. In other words, the increase of one atom energy was not connected with energy decrease in another one. Authors considered that these processes compensated each other on average only and that compensation was the better the more events are participated. Energy conservation law has statistical character according to that interpretation, and there is no law of conservation for single events, but they appear in processes involving large number of particles, i.e. at transition to Newton mechanics. But then it should be acknowledged that in the case of Compton effect the changes of motion direction of the light quantum and its energy to be appeared in the result of collision were happening apart from the changes of electron’s state. The unfoundedness of such an approach was lately experimentally proved by Bote and Geiger. To say the truth, the authors abandoned that point of view later; moreover at that time this idea did not follow from quantum theory equations. And to get out of the tight spot it was declared that quantum mechanics did not describe single events at all. Thus the most striking paradox was removed by a simple prohibition just to think about it! But genius idea that laws of conservation are not valid for individual processes and appear in quantum mechanics after statistical averaging does not become less genius even if those for whom it “has come to mind” rejected it. May be, this idea was a little premature and should have a somewhat different shape. Contrary to that Unitary Quantum Theory describes single particles. And the alteration of their behavior is determined not only by initial values of its position and velocity but also by initial phase of the wave function (of the wave packet). Then for the single particle local conservation laws do not exist at all. And that is quite another question how to measure the initial phase or any other parameters of a single particle.

Let us examine the following virtual experiment. For more simplicity let use in our reasoning some quantum ball-particle. If classical ball is running to the wall (for simplicity assume it as perpendicular), the velocity of the reflected ball would be equal to its initial velocity (we neglect friction and consider the ball and the walls as totally resilient). In the case of quantum ball the velocity of the reflected ball in various experiments with similar initial circumstances will have the whole spectrum of values: there will be balls reflected with the velocity higher than initial, equal to it and lower then initial. And all these will be described by means of quantum mechanics within uncertainty relation.

Let us ask what would be if we placed a second wall parallel to the first one in such a way the ball at each reflection increased its velocity? Then we would get the growth of the ball energy without any efforts from our side. The aim of future constructors of such systems of XXI century would be the necessity to create such initial conditions for the great number of particles forming the object, that is realized the sole solution “Maternity Home” and is suppressed as far as possible the other solution.

It is evident from the above-mentioned that at competent exploitation of the Unitary Quantum Theory ideas the principle prohibition for perpetuum mobile does not exist. Formally as it was shown above that prohibition does not exist even in standard quantum mechanics (there is no laws of conversation for single processes with small energies), and to get energy the particles should be selected in some way (grouping together all random processes with excess energy). But the standard quantum mechanics refuses to describe single events and is not able to advise the way for grouping. As it seems today, the Unitary Quantum Theory gives us such an opportunity.

However, by efforts of scientific groups, interested in their own stability because of simple instinct of self-preservation the great idea of free energy generation was distorted to such a degree everybody who started to talk about it was taken for mad.

The modern experimental physics has examined the correctness of conservation laws for huge energies in single cases and for large macro-object when ensemble averaging is used, but the area of small energies is terra incognita.

(IX) Prospects

Let us remember the problem of the maintenance of long-term flights to the outer space with electricity. The Prof. Uchastkin's describes precisely a theoretical approach for solving this problem. Of course, there is a great deal to do though, to understand what phenomenon will play the role of those quantum potatoes and how to construct an instrument that would be able to support a minimal energy to bring them to the fourth floor. How can a spaceship be supplied with energy during many months of flight? Near the Earth, photovoltaic cells can be used but the more the distance from the Sun is increasing, the more needless they will; and the use of a nuclear energy source will problematical for different reasons.

Today we can neither improve this situation considerably nor do we have even any theoretical conditions which could let us approach it. On the base of such a situation there are common ideas of the construction of matter and its properties. Now then, a new conception of physics is being proposed. Like many others as well. If we stay by the space technology, it is over constructing of engines based on new principles of energy production, maintaining of real-time telecommunication on the distances in outer space, free of limits which are proper to the diffusion of electromagnetic waves. It follows from the foregoing that UUQT opens up a perspective of a solution for the communication problem on extremely wide distances in outer space, excluding the limits of information exchange between Earth and spaceship. The theory also predicts the approaches of creation of the new energy sources and of the new types of engines that would be almost ideal for creating of spaceships of the future.

Conventional jet propulsions transform the conducted energy in the kinetic energy of the beam of a working body flowing from the engine, and the reaction force of this beam the pulling force accelerate the spaceship. Therefore space flights to extremely wide distances will require huge stocks of working body. A classical progression curve reflects the velocity increasing of a thrown-off mass of the working body. Though there is a possibility for creating of a very weak constant pulling but (!) without throwing off of mass.

Let us use the method of analogy again. Regard a classical trick problem in physics for universities admission tests: there is a boat in motionless water and a man with a sandbag in this boat. Can he move the boat by performing any manipulations with the sandbag, for an endless time?

Correct answer: throw the sandbag from the front part of the boat to its back, then carry it back slowly, throw it again and so on. As the viscous friction force by Stocks is proportional to the velocity, the boat will perform swinging motions, over which some linear movement will be applied. Based on this idea, marsch buggies were constructed in Germany - there is heavy mass moving in there, in one direction quickly and back slowly. Many decades ago, the same effect (Dean’s engine) was wide-ragingly discussed in the USSR in popular science magazines and on TV.

There is a similar phenomenon in the classical electrodynamics as well as in the quantum electrodynamics and it s related to the Lorentz radiative friction force. The appearance of Lorentz force becomes evident by considering the interaction of the charge and the field caused by it. For a motionless charge the force of such an interaction or self-action is equal to zero, otherwise the free charge would experience a self-acceleration. The charge begins to move, but the electromagnetic field, as its spread velocity is finite, can’t reschedule immediately. The accelerated charge practically flies onto its own field; with other words, this effect can be described as appearance of energy flow which is directed upstream to the flow and slowing it down. It generates electromagnetic viscosity which value is related to the acceleration.

How can this phenomenon be used? If there is a charge cloud in flat capacitor, it is possible to make it swing between sheets with different values of acceleration forwards and backwards by applying a sawing motion to the sheets. Because of different forces of radiation friction in the alternate and opposite direction, pulling force appears along the lines of electric field. The radiation of such accelerated charges is always perpendicular to their movement and can be screened, but the most important thing on it is the fact that it doesn’t change its impulse in relation to the direction of the capacitor s field. It may be paradoxical, but it seems that we get a pulling force by spending energy for this process without throwing-off of any mass in the direction, which is opposite to the motion’s one. The authors even published in the US-magazine Journal of New Energy vol.5, #1, 2000 an article, containing an exact analytical solution of this problem: the pulling of some micrograms appears in a flat capacitor, containing a cloud of 10^{19} electrons in which the distance between the sheets is many meters long, by applying of sawing potential of millions of volts. Of course, it is an insignificant result in relation to such a huge (hypothetical) instrument employment, and the using of electron cloud in a flat capacitor has practically no prospects. But if stabile charged particles exist which mass is at least one billion of electron mass, then this idea becomes very interesting from the technical point of view. Do such stabile charged leptons exist at all and how is it possible to generate them in a sufficiently large number? Today nobody can give an answer...

To generate pulling it is still possible to throw off the mass/matter, created potential hole, accelerating in it in the same moment. Generally, UUQT allows such solutions that are evident from the “Maternity home” solution.

Let us consider the results. UUQT will in future let us solve several basic problems of the worldwide energy supply and all problems in outer space: immediate information changing, the problem of energy supply and constructing of new engine types. It is absolutely precipitant to make technical plans for those solutions, but the foregoing should be considered not as a wanton imagination, but as a possible future program of fundamental researches to transpose our civilization to new physical principles.

The UQT ideas are presented in instinctively absolutely clear picture of quantum events in terms of figures and movements. And philosophical principal of Complementarity can be now retired with well-deserved honors. In spite of mathematical complexity, the UQT delivers the physics from ordinary Quantum Mechanics paradoxes and consequently frank words of Richard Feynman: *“I can easily say that nobody understands quantum mechanics”* will become the property of history.

Moreover, it became possible:

1. to obtain after solving some QUT equations an electron charge with the

high precision;

2. to obtain after solving the scalar telegraph equation the mass spectrum of numerous elementary particles with appropriate precision the mass spectrums of numerous elementary particles[14-16, 18]. The same spectrum was followed from the solutions of the Schroedinger equation and Klein–Gordon integro-differential equations. The risk of computed mass spectrum being random is less than 10^{-60}. Of course such results cannot be obtained without sacrifice. What would be offered in sacrifice if Ordinary Quantum Mechanics is replaced by the Unitary Unified Quantum Field Theory (UUQFT):

- There are no in UUQFT strict principles of superposition. It is violated if wave packets are colliding.
- There are no strict close systems in UUQF and the Conservation Laws work for big energies only. Note that the Conservation Laws forbid beginnings of the Universe.
- The classical relativistic relation between energy and impulses is valid in UUQFT only after averaging of observed phenomena and Relativistic Invariance itself is not “the sacred cow”.
- The Space in UUQFT is not homogenous and not isotropic.
- The particles and their interaction are not local.
- The existing Standard Model Quantum Theory of Elementary Particles requires much alteration.
- The velocity concept as quotient from division of the traversed path to sometime interval is not quite appropriate in UQT.

If a wave packet (particle) is spreading along the Metagalaxy and then appearing somewhere else, what should we do with the rate, if nothing moves between the points of disappearance and arrival, does it mean that particle has just simply disappeared and then appeared in a new place? There was observed resembling crushing defeat of physics 50 years ago as "weak interaction" burst, so to say, into physics. As soon UQT is nonlinear, it automatically combines all four interactions that can pass from one into another distance. Below we analyze the most important fields of science from UUQFT general physics positions.

(X) Lorentz Transformations

It's quite complicated [200, 201, 182, 196, 198]. The special relativity is in fact of Lorentz transformations (1904) derived by V. Vogt (1887) in the century before last. These transformations followed from the properties of Maxwell equations which were also proposed in the nineteenth century (1873). One of these equations connecting electrostatic field divergence and electric charge (Gauss' law of flux), in fact is just another mathematical notation of Coulomb's law for point charges.

But today anybody knows that Coulomb's law is valid for fixed point charges only. It doesn't work for the frequently moving charges. Besides anybody knows that lasers beams are scattered in vacuum one over another, which is absolutely impossible in Maxwell equations. That means that Maxwell equations are approximate - and for the moving point charges experimental results essentially differs from the estimated ones in the case charges areas are overlapping.

Few people think about the shocking nonsense of presenting in any course of physics of point charge electric field in the form of a certain sun with field lines symmetrically coming from the point. But electric field is a vector, and what for is it directed? The total sum of such vectors is null, isn't it?

There are no attempts to talk about, but such idealization is not correct. We should note that Sir Isaak Newton did not use term of a point charge at all, but it s ridiculous to think that such simple idea had not come to him! As for Einstein, he considered “electron is a stranger in electrodynamics”. Maxwell equations are not ultimate truth and so we should forget, disavow the common statement about relativist invariance requirement being obligatory permission for any future theory.

To reassure severe critics we should note that UQT is relativistic invariant, it allows to obtain correct correlation between an energy and impulse, mass increases with a rate, as for relativistic invariance just follow of the fact that the envelope of moving packet is quiet in any (including non-inertial) reference systems. To be honest we should note that subwaves the particles consist of are relativistic abnormal, at the same time envelope of our wave packet being immovable in all coordinate-systems corresponds to of Lorentz transformations.

The success of Maxwell equations in description of the prior-quantum view of world was very impressing. Its correlation of the classical mechanics in forms of requirement to correspond Lorentz transformations was perfectly confirmed by the experiments that all these had resulted in unreasoned statement of Maxwell equations being an ultimate truth.

Other reasons for this were later very carefully investigated by a disciple of one of the authors (L. S.), Professor Yu. L. Ratis. (S. Korolev Samara State Aero-Space University), who has formulated the modern spinor quantum electrodynamics from the UQT point of view:

1. Maxwell equations contain constant c, which is interpreted as phase velocity of a plane electromagnetic wave in the vacuum.

2. Michelson and Morley have never measured the dependence of the velocity of a plane electromagnetic wave in the vacuum on the reference system velocity as soon plane waves were mathematical abstraction and it was impossible to analyze their properties in the laboratory experiment in principle.

3. Electromagnetic waves cannot exist in vacuum by definition. A spatial domain where an electromagnetic wave is spreading is no longer a vacuum. Once electromagnetic field arises in some spatial region at the same moment, such domain acquires new characteristic, because it became a material media. And such media possesses special material attributes including power and impulse.

4. Since electromagnetic wave while coming through the abstract vacuum (the mathematical vacuum) transforms it in a material media (physical vacuum) it will interact with this media.

5. The result of the electromagnetic wave and physical vacuum interaction are compact wave packets, called photons.

6. The group velocity of the wave packet (photon) spreading in the media with the normal dispersion is always less its phase velocity.

All abovementioned allows making unambiguous conclusion: the main difficulties of the modern relativistic quantum theory of the field arose from deeply fallacious presuppositions in its base. The reason for this tragic global error was a tripe substitution of ideas - velocity of electromagnetic wave packets ’c’ being obtained in numerous experiments physics was adopted as constant ’c’ appearing in Maxwell equations and Lorentz transformations. Such blind admiration of Maxwell and Einstein geniuses (authors in no case do not doubt in the genius of these persons) had led XX century physics up a blind alley. The way out was in the necessity of revision of the entire fundamental postulates underlying the modern physics. Exactly that was done by UUQFT [165, 166, 200, 201].

Some time ago CERN has conducted repeated experiments of the neutrino velocity measurement that appeared to be higher than velocity of the light. For UUQFT they were like a balm into the wounds. The administration of CERN renounced after sometimes these results considering them as the consequence of experimental errors. As far as the authors know, not all participants of this experiment have agreed to such renouncing. Besides, many astronomers detect superluminal velocities during observations of stars and galaxies [169, 189]. In fact the movements in excess of the light velocity were discovered earlier by numerous groups of researches. Nearly everybody disbelieved it [169, 189]. The importance of these experiments for UUQFT is settled in the article [166] where at the page 69 it is written that this should be considered as direct experimental proof of UUQFT principle.

Other ideas also exist [190, 191]. For example, at «New Relativistic Paradoxes and Open Questions», Florentin Smarandache shows several paradoxes, inconsistencies, contradictions, and anomalies in the Theory of Relativity. According to the author, not all physical laws are the same in all inertial reference frames, and he gives several counter-examples. He also supports superluminal speeds, and he considers that the speed of light in vacuum is variable depending on the moving reference frame.

The author explains that the red shift and blue shift are not entirely due to the Doppler Effect, but also to the medium composition (i.e. its physical elements, fields, density, heterogeneity, properties, etc.) Professor Smarandache considers that the space is not curved and the light near massive cosmic bodies bends not because of the gravity only as the General Theory of Relativity asserts

(Gravitational Lensing), but because of the Medium Lensing.

In order to make the distinction between “clock” and “time”, he suggests a first experiment with a different clock type for the GPS clocks, for proving that the resulted dilation and contraction factors are different from those obtained with the cesium atomic clock; and a second experiment with different medium compositions for proving that different degrees of red /blue shifts would result. To our regret, the authors today have no decisive position to these complicate questions.

Note, this question is terribly complicate and probably is to be leaved to next generations. From one side, the time in UQT exists, so to say, in our head only. From other side, the Lorenz Transformations describe correctly some experimental facts, for example, the mass growing with velocity. Otherwise, all atomic accelerators would be out of order. Thereafter, it is a big mistake to consider all Special Relativity Theory as erroneous. The attitude to the Special Relativity Theory is today highly vague and may be compared in full with the discussion among painters about significance of the Malevitch picture “The black square”.

Curiosity from the another side the Special Relativity Theory declares that the spreading velocity of the information and of the signals cannot exceed the light velocity. At the same time today it is well known that the gravity interaction spreads with the velocity exceeding many times the light velocity. Laplace has obtained corresponding estimates long ago. But this problem is not discussed in any way in Special Relativity.

There is a statement in Special Theory of Relativity that affects the mankind like a sleep-inducing mantra-paradox: suppose there are two observers with rules and watches sitting in two objects and moving straight-line and with constant speed in direction to each other. Then from the 1st observer point of view the watch of the 2nd observer is slow because he is moving. But the 2nd observer can (?) stipulate that he is at rest and the 1st observer' watch is slow. To find out which watch is slow indeed the observers should meet, but that will infringe the terms of inertia – constant and steady motion. The experiment shows the returning watch is slow and this time lag relates to the changes of the gravity potential. But if we return the rules their lengths will not be changed, and that is quite strange because both effects are closely associated.

We would like to show this mantra is absolutely false. Imagine the 1st observer is sitting of the rain drop falling with the constant speed in the terrestrial gravitational field, while the 2nd observer is on the Earth. By this doubtful statement of Special Theory of Relativity the 1st observer can say that his drop is at rest and that the 2nd observer together with the Earth is flying towards him. If observers are not absolute idiots the first observer should ask the second about the source of such a great amount of kinetic energy. This statement can have a little sense only if the masses of the 1st and 2nd objects are equal. The main problem is misunderstanding that any motion is absolute, this idea is thoroughly discusses by the authors in the recent works [205, 206].

(XI) Standard Model

As soon relativistic invariance underlies every of the numerous quantum theories of the field, it leaves a devilish imprint at everything. Nevertheless relativistic ratio between energy and impulse although being absolutely correct in fact are not obligatory follows from relativistic invariance only and can result from another mathematical reasons that will be discovered in future. Nowadays Standard Model (SM) contains the most elegant mathematical miracles of researches which hands were tied with relativistic strait-jacket and it not so bad describes these experimental data. Amazing that it was possible to think it out at all.

Nowadays to confirm SM one should find a Higgs boson and for this purpose the governments of some countries assigned essential sums for the construction of Large Hadrons Collider (LHC). For entire SM the interaction with Higgs field is extremely important, as soon without such a field other particles just will not have mass at all, and that till lead into the theory destruction.

To start with we should note that the Higgs field is material and can be identified with media (aether) as it was in former centuries. But SM authors as well as modern physics have carefully forgotten about it. We would not like to raise here once again the old discussion about it. It s a quite complicated problem and let us leaves it to the next generation.

But another problem of SM has never mentioned before: in the interaction with Higgs field any particle obtains mass. As for Higgs boson itself, it is totally falling out of this universal for every particle mechanism of mass generation! And that is not a mere trifle, such mismatching being fundamental fraught with certain consequences for SM.

After Higgs boson discovery nothing valuable for the world will happen except an immense banquet. Of course boson will justify the waste of tens billions of Euros But even now some opinions in CERN are expressed that probably boson non-disclosure will reveal a series of new breath-taking prospects and where were these voices before construction, we wonder? But that’s not the point! If this elusive particle were the only weakness of SM!

To our regret today this theory cannot compute correctly the masses of elementary particles including the mass of Higgs boson. More badly, that SM contains from 20 to 60 adjusting arbitrary! parameters (there are different versions of SM). SM does not have theoretically proved algorithm for spectrum mass computation and no ideas how to do it!

All these bear strong resemblance to the situation with Ptolemaic models of Solar system before appearance of Kepler's laws and Newton s mechanics. These earth-centered models of the planets movement in Solar system had required at first introduction of so called epicycles specially selected for the coordination of theoretical forecasts and observations. Its description of planets positions was quite good; but later to increase the forecasts accuracy it had required another bunch of additional epicycles. Good mathematicians know that epicycles are in fact analogues of Fourier coefficients in moment decomposition in accordance with Kepler's laws; so by adding epicycles the accuracy of the Ptolemaic model can be increased too. However that does not mean that the Ptolemaic model is adequately describing the reality. Quite the contrary.

The Unitary Quantum Theory allowed computing the mass spectrum of elementary particles without any adjusting parameters. By the way computed spectrum [162, 164, 200, 201] has particle with mass 131.51711 GeV (L=2, m=2). Once desired it can be called Higgs boson, it lies within declared by the CERN+Tevatron mass interval 125-140 GeV expected to contain Higgs boson. CERN promises to obtain more precise mass value by December 2012.

Note the following remarkable fact: the standard theory allowed to detect spectra by using always the quantum equations with outer potential and as corollaries to geometric relations between de Broglie wave's length and characteristic dimension of potential function. The quantum equation of our theory does not contain the outer potential and describe a particle in empty free space; the mass quantization arises owing to the delicate balance of dispersion and non-linearity which provides the stability of some wave packets number. It is the first case when spectra are detected by using the quantum equations without outer potential.

(XII) Nuclear Physics

Nuclear physics as a part of quantum theory is very luckless. Thus the potential of the strong interactions is so complicated that no one even very bulky and intricate mathematical expression is able to describe with more or less veracity the experiments of two nucleons interaction. This interaction depends in very complicated manner from all parameters of the nucleons movement and their orientation towards vectors of velocity, acceleration, spin, magnetic movement, etc. Scarcely one can find a parameter which practice interaction does not depend on. From UQT point of view the strong interactions appear in the result of nucleons represented by the wave packets overlapping. Today the way of mathematical notation of the overlapping wave packets interaction is absolutely vague as soon nonlinear interaction in any space-time point of the waves is different due to different amplitudes.

It's a really complicated problem as soon there is only one nonlinear mathematical problem existing for each space-time point and even with the intuitive clearance of situation we do not expects its soon solution. The complete understanding of the nuclear structure hardly can be expected in the soonest time without exact expression for the potential of the strong interaction.

In general it should be noted that quantum world looks more clear and simple in UQT than in the general quantum mechanics, but we cannot repeat it while speaking about the mathematics used. The appearance of the exact analytical solution of the scalar problem of elementary particles mass spectrum can be considered as Fate gift (or God's help) for UQT. By the way the standard Schrodinger quantum mechanics has the same gift -- the exact analytical solution of the Hydrogen atoms equation.

The nuclear process at small energies should be reviewed. Today the strict nuclear physics does not assume nuclear reactions at small energies and that contradict experimental data. Here we should also note our skepticism towards the idea of nuclear fusion in Tokamaks, we consider this way as hopeless. To justify these experiments we have to mention that the solution was obtained in the lack of other ideas and under the great pressure of the future power problems. But the use of the reactions of classical cold fusion for the power output is also difficult due to the complexity of colliding nuclei phasing. This phenomenon is well described by the equation with oscillating charge, while the cold nuclear fusion had been predicted in UQT 6 years before its real discovery [72].

(XIII) Solid-state Physics

The band theory of solid is based at the point on the solution of the problem of an electron movement in the field of two or more charges. But this problem does not have analytical solution yet, in practice a speculative quality solution is used only. The results are that electrons in the solid have quite specific allowed power bands. This field of the science is very successful and hardly will be revised. Any solution of the equations with the oscillating charge for the electron moving in the field of few nuclei also result in appearance of allowed and forbidden bands [200, 201].

Somewhat apart is classical tunneling effect. In UQT the probability of tunneling effect appearance depends on the phase of the wave function (in contrast to the ordinary quantum theory, where at the squaring of the wave function module its dependence on the wave phase totally disappears). It could be interesting to prove such dependence by the experiments. It can be easily done if creating a new transistor on the basis of absolutely new principle of the electron current control [172, 184, 200, 201].

We are not going to analyze the modern theory of superconductivity, but we are sure that the equation with oscillating charge will deepen on both understanding of superconductivity as well as mysterious properties of quantum liquids.

(XIV) Astrophysics and Cosmology

The authors regret not being in sympathized with the ideas of the Universe origin from one singular point. The most amazing in this theory is a detailed computation of events occurred in the fractions of the first second just after the Big Bang. Today when the fundamental physics is making only first shy steps towards the real understanding of the quantum processes we still do not have clear model of the particles, or understanding of a spin appearance, of a charge and magnetic moments. At the same time, in Internet there are sensational results obtained in well-known Lawrence Livermore National Laboratory USA were newly announced. In this Laboratory the space model of our Universe was constructed after many years of astronomical observations and their analysis with Supercomputers. It was turned out that our Universe has the flat structure and all Galaxies have dimensions near a half of million light-years being six milliard light-years apart and all Galaxies lie on the same plane (!). Obviously, such picture of our Universe has no relation with the Big Bang model.

According to UQT the processes of the multiple particle production at collision is a common result of the waves packets of big amplitudes diffraction in periodic structures one another, as for the multiple outgoing in different directions particles they correspond to the general diffraction maximums. But we do not assume the responsibility of the mechanism of the multiple particles production for the Universe appearance. To our opinion the complete understanding of the quantum world will arise only after solving of 32 nonlinear integro-differential equations of UQT [196, 198, 200, 201]. To their regret the authors are not able to solve these equations.

And many cosmologists would like to use theories assuming existence of

Universe localities where the energy is coming into being and also other localities where the energy annihilates. For example, British astronomer Fred Hoyle has developed the theory of Universe where it takes the place the continuous creation of matter. He wrote: *"Different atoms constituting the matter do not exist at some given moment of time and then after instant they exist already. I must admit this idea may look as strange. But all our ideas about creation are strange. According to previous theories the whole quantity of matter in Universe was coming into being just as whole and all process of creation looks as super-gigantic instant explosion. As for me, such idea seems much stranger, than idea of continuous creation"*. (F. Hoyle, La nature de l Universe, 1952.)

The official astronomical science does not accept the ideas of F. Hoyle and of some other astronomers (H. Bondi, T. Gold, and P. Jordan) about continuous creation of matter in Universe because the Conservation Laws are considered as infallible. But from the viewpoint of our UQT these ideas are quite not strange.

Our real world continuum consists of enormous quantity of particles moving with different velocities. Partial waves of the postulated vanishing particles create real vacuum fluctuations that change in a very random way. Certain particles randomly appear in such a system, owing to the harmonic component energy of other vanished particles. The number of such dependant particles changes, though; they suddenly appear and vanish forever, as the probability of their reappearance is negligibly small, and so we do expect that all particles are indebted to each other for their existence. Yet, if some particles are disappearing within an object, other particles are arising at the same moment in that object due to the contribution of those vanishing particles harmonic components and vice versa.

The simultaneous presence of all particles within one discrete macroscopic object is unreal. Some constituent particles vanish within the object while others appear. In general, a mass object is extant overall, but is not instantaneously substantive and merely a false image. It is clear that the number of particles according to such theory is inconstant and all their ongoing processes are random, and their probability analysis will remain always on the agenda of future research.

In accordance with UQT there are other solutions for the quantum harmonic oscillator besides stationary, where the given tiny incipient fluctuation is growing, gaining power and finally becoming a particle. It is so called “Maternity Home” solution. There are also other solutions where substance (power) is disappearing. Such solutions have been called “Crematorium”. May be Metagalaxy is simply entangled in searching the balance, isn’t it?

All this allows expecting that space continuum in the centers of Galaxies produces different particles, electrons, protons, neutrons, which are the sources of light atoms. Later thanks to the gravitation light atoms are transformed into gas nebulas where under gravity compression the stars are lighting. It s quite possible that the current theory of Stars evolution is correct in general while describing (via Supernova) the production of other atoms apart Hydrogen and Carbon the planets consist of. We do not think nuclear process at small energies (which are possible in UQT, but impossible in standard quantum theory) will essentially modify evolutionary view of the Galaxies development.

It is interesting that the state with the minimum quantum values L=0, m=0 belongs to the very heavy neutral scalar particle (WIMP) with our name Dzhan and mass about 69.6 TeV, which in principle should purely interact with the others [162, 164, 200, 201]. With the growth of the quantum numbers the mass of the particle is diminishing. So there should be a lot of Dzhan-particles due to the small quantum numbers. And probably their existence is responsible for the dark matter in general, in accordance with some evaluations Metagalaxy consist of up to 80-90% of the dark matter.

(XV) Gravitational Theory

It seems Gravitational theory should follow from 32 nonlinear integro-differential equations of UQT and the authors are expecting that it can be done in future [6, 200, 201]. Nevertheless we will make now some conservative assertions. The current data regarding the Universe expansion can be interpreted as the change of the gravitational potential sign (gravity is replacing by repulsion) at great distances for the great masses. Probably the difference between absolute the values of electric charge of a proton and an electron, say in 15-20 signs, is responsible for his phenomena, but for us this idea is extremely unsympathetic.

Gravitational interaction remains an extraordinary mysterious appearance in UQT as actually it has a very high speed of interactions distribution and approximately is in times weaker than electro-magnetic interactions. The origin of such an enormously big number remains the greatest riddle.

On the other hand if any particle is a package of partial waves of some uniform field, probably is possible a following curious phenomenon which has been observed and described by the authors more than once earlier [186, 187]. If to put a ditch with the substance having abnormal dispersion on a way of the wave package moving in flat Euclidean space, the package after ditches can appear even if it is situated at distance of many light years from a package as formally mathematically harmonious components exist on all infinite rectilinear coordinate of package movement as ahead of it, and behind. Thus the package can disappear in that place where it was, and to appear at huge distances ahead of a package, or behind. Thus the package did not move at all between points of disappearance and new appearance, and the normal idea of speed in the unitary quantum theory loses its initial meaning.

Similar teleportation was observed of ten times. Probably, it is actually a long-range action, (else à longue distance) observed in gravitation. A curious though appears that the waves building a package, could be connected with gravitation and all particles consists of a gravitational field. Then this field can be a stage or a scene where all other processes with final speeds of interaction transfer are played. It will allow connecting the quantum theory and the gravitation theory which while aren't connected yet today in the future. But it is a task for the future generations.

At the same time according to the processed information (Hlistunov at all [188]) from Russian Command-and-Measuring Complex for the monitoring and control of the space objects at the entire moment of collision geodesic satellites Tope-Poseidon and GEO IK began swaying at their orbits. Normally the orbit of a geodesic satellite lies inside the tube with about 1 km diameter and the orbit can be control with the high accuracy not more than one meter precision for the position data and centimeters per second for velocity.

During the collision the sensors registered 5-8 times increase of the trajectory tube diameter. In the same article Hlistunov [188] on the basis of correlation analysis of the position data measurements and information obtained from earthquake-detection station showed that the waves of gravitational potential variation were the trigger for earthquakes. To the authors regret they do not have the similar information from NASA. With other hand official science in Russia did not know about it [204].

(XVI) Chemical Catalysis

The process of chemical catalysis and the catalysts are the great mystery of the modern science. The number of chemical catalysis theories equals the number of chemical catalytic processes. A specialist in chemical catalysis used to think that this or that reaction is not going because of the needed catalyst has not been found.

Even Michael Faraday studied these problems. He seemed to say about platinum as being the universal catalyst. Only this (while platinum practically does not react with anything) immediately suggests an idea that chemical processes are not enabled at all and we should look for the physical universal mechanism of reactions.

The UQT has such a process. The details are listed in the articles [172, 183, 185, 197, 200, 201]. The universal mechanism of heterogeneous catalysis, for example in Ammonia Synthesis, consists of the following: Nitrogen molecule falls into a cavity (hole a few tens of Angstroms unit size), then at some initial moment the molecule starts oscillating with an energy augmentation implementing solution of “Maternity Home” like in a normal potential well - Fig. 4.4.6. If the augmented energy excesses the binding energy of molecule Nitrogen then atomic Nitrogen at the exit from the cavity will be caught by protons (Hydrogen), form Ammonia and then quit the game and free cavity for the new deeds.

We cannot exclude that idea of energy generation within a potential well and are just waiting for the creation of general theory of catalysis. Here we should recall brilliant words of a famous Russian specialist on physical chemistry Professor A. N. Kharin (Russia, Taganrog, 1954) [148, 200, 201] who always said at his lectures:

“The problem of chemical catalysis is the most incomprehensible in the modern physical chemistry and it won’t be solved until physicists discover some new mechanism able to explain the liberation of the energy that lowers the reaction barrier.”

Our UQT allows, as we hope, to make the first shy steps in right direction.

We are sure that in such a way water can be decomposed for Oxygen and

Hydrogen. At normal conditions the mixture of Oxygen and Hydrogen is stable. In other words two stable substances (water and gas mixture) are simply divided by a high energy barrier, that can be overcome (tunneling effect analogue) by using the exact catalyst and the UQT ideas. For today a lot of experiments of water decompositions are known, the energy evolved in the process of hydrogen combustion is ten times higher than necessary for decomposition. It makes possible to construct a water-engine for autos.

(XVII) Conclusion

In essence, our theory discovered new world properties and new theoretical possibility of the radical transformation of the civilization.

Let us to remind of the prophetical words of the famous US science-fiction author Arthur Clarke: Something that is theoretically possible will be achieved practically independent of technical difficulties. It's enough to desire it. (back translation)- Profiles of the Future, 1963.

In conclusion we would like to quote extremely acute words of Louis de Broglie: *"Those who say that new interpretation is not necessary I would like to note that new interpretation may have more deep roots and such theory in the long run will be able to explain wave-particle dualism, but that explanation will not be received either from abstract formalism, modern nowadays, or from vague notion of supplementary. But I think that the highest aim of the science is always to understand. The history of the science shows if any time somebody succeeded in deeper understanding of physical phenomena class, new phenomena and applications appeared. Hope that many researchers will study that enthralling question casting aside preconceived opinions and not overestimating the importance of mathematical formalism, whatever beautiful and essential it was, because that may result in loss of deep physical sense of phenomena"* (Louis de

Broglie, Compt. Rend, 258, 6345, 1964 back translation).

We would like to add the amazing phrase of A. de Saint-Exupéry: “The truth is not something that could be proved, but something that makes all things easy and clear” (back translation).

Supplement.

4.4.2 Seven Matrices 32x32

Matrix λ^{0}

$$
\begin{bmatrix}
u1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & u2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & u3 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\
0 & u1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & u2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & u3 & 0 & 0 & 0 & 1 & 0 & 0 \\
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0 & 0 & 0 & u1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & u2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & u3 & 0 & 0 & 0 & -1 \\
0 & 0 & 0 & 0 & u1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & u2 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & -u3 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & u1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & u2 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & -u3 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & u1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & u2 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & -u3 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & u1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & u2 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & -u3 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & u1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & u3 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & -u2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & u1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & u3 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & -u2 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & u1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & u3 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & -u2 & 0 & 0 & 0 & 0 & 0 \\
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0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & u1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & -u3 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -u2 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & u1 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & -u3 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -u2 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & u1 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & -u3 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -u2 \\
u2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & u3 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & -u1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
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0 & 0 & 0 & u2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & u3 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & -u1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & u2 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & -u3 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -u1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & u2 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & -u3 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -u1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & u2 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & -u3 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -u1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & u2 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & -u3 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -u1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
u3 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & -u2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -u1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & u3 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & -u2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -u1 & 0 & 0 & 0 & 0 & 0 & 0 \\
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0 & 0 & 0 & u3 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & -u2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -u1 & 0 & 0 & 0 & 0 \\
1 & 0 & 0 & 0 & -u3 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -u2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -u1 & 0 & 0 & 0 \\
0 & 1 & 0 & 0 & 0 & -u3 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -u2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -u1 & 0 & 0 \\
0 & 0 & -1 & 0 & 0 & 0 & -u3 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -u2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -u1 & 0 \\
0 & 0 & 0 & -1 & 0 & 0 & 0 & -u3 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -u2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -u1
\end{bmatrix}
$$

Matrix λ^1

u0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, u2 − u3 I

0, u0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, u2 + u3 I, -1

0, 0, u0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -1, −u2 + u3 I, 0, 0

0, 0, 0, u0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, −u2 − u3 I, 1, 0, 0

0, 0, 0, 0, u0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, u2 − u3 I, 0, 0, 0, 0

0, 0, 0, 0, 0, u0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, u2 + u3 I, -1, 0, 0, 0, 0

0, 0, 0, 0, 0, 0, u0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -1, −u2 + u3 I, 0, 0, 0, 0, 0, 0

0, 0, 0, 0, 0, 0, 0, u0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, −u2 − u3 I, 1, 0, 0, 0, 0, 0, 0

0, 0, 0, 0, 0, 0, 0, 0, u0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, u2 − u3 I, 0, 0, 0, 0, 0, 0, 0, 0

0, 0, 0, 0, 0, 0, 0, 0, 0, u0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, u2 + u3 I, -1, 0, 0, 0, 0, 0, 0, 0, 0

0, 0, 0, 0, 0, 0, 0, 0, 0, 0, u0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -1, −u2 + u3 I, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0

0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, u0, 0, 0, 0, 0, 0, 0, 0, 0, −u2 − u3 I, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0

0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, u0, 0, 0, 0, 0, 0, 1, u2 − u3 I, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0

0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, u0, 0, 0, 0, 0, u2 + u3 I, -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0

0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, u0, 0, -1, −u2 + u3 I, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0

0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, u0, −u2 − u3 I, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0

0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, u2 − u3 I, −u0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0

0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, u2 + u3 I, -1, 0, −u0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0

0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -1, −u2 + u3 I, 0, 0, 0, 0, −u0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0

0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, −u2 − u3 I, 1, 0, 0, 0, 0, 0, −u0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0

0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, u2 − u3 I, 0, 0, 0, 0, 0, 0, 0, 0, −u0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0

0, 0, 0, 0, 0, 0, 0, 0, 0, 0, u2 + u3 I, -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, −u0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0

0, 0, 0, 0, 0, 0, 0, 0, -1, −u2 + u3 I, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, −u0, 0, 0, 0, 0, 0, 0, 0, 0, 0

0, 0, 0, 0, 0, 0, 0, 0, −u2 − u3 I, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, −u0, 0, 0, 0, 0, 0, 0, 0, 0

0, 0, 0, 0, 0, 0, 1, u2 − u3 I, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, −u0, 0, 0, 0, 0, 0, 0, 0

0, 0, 0, 0, 0, 0, u2 + u3 I, -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, −u0, 0, 0, 0, 0, 0, 0

0, 0, 0, 0, -1, −u2 + u3 I, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, −u0, 0, 0, 0, 0, 0

0, 0, 0, 0, −u2 − u3 I, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, −u0, 0, 0, 0, 0

0, 0, 1, u2 − u3 I, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, −u0, 0, 0, 0

0, 0, u2 + u3 I, -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, −u0, 0, 0

-1, −u2 + u3 I, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, −u0, 0

−u2 − u3 I, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, −u0

Matrix λ^2

$$
\begin{bmatrix}
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & u0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & -u3 & 0 & 0 & u1 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & u0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & -u3 & u1 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & u0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & -u1 & -u3 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & u0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & -u1 & 0 & 0 & -u3 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & u0 & 0 & 0 & 0 & u3 & 0 & 0 & u1 & -1 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & u0 & 0 & 0 & 0 & u3 & u1 & 0 & 0 & -1 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & u0 & 0 & 0 & -u1 & u3 & 0 & 0 & 0 & -1 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & u0 & -u1 & 0 & 0 & u3 & 0 & 0 & 0 & -1 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & -u3 & 0 & 0 & u1 & -u0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & -u3 & u1 & 0 & 0 & -u0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & -u1 & -u3 & 0 & 0 & 0 & -u0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & -u1 & 0 & 0 & -u3 & 0 & 0 & 0 & -u0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & u3 & 0 & 0 & u1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -u0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & u3 & u1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -u0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -u1 & u3 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -u0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -u1 & 0 & 0 & u3 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -u0 \\
u0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & -u3 & 0 & 0 & u1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & u0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & -u3 & u1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & u0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & -u1 & -u3 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & u0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & -u1 & 0 & 0 & -u3 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & u0 & 0 & 0 & 0 & u3 & 0 & 0 & u1 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & u0 & 0 & 0 & 0 & u3 & u1 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & u0 & 0 & 0 & -u1 & u3 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & u0 & -u1 & 0 & 0 & u3 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
1 & 0 & 0 & 0 & -u3 & 0 & 0 & u1 & -u0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 1 & 0 & 0 & 0 & -u3 & u1 & 0 & 0 & -u0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 1 & 0 & 0 & -u1 & -u3 & 0 & 0 & 0 & -u0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 1 & -u1 & 0 & 0 & -u3 & 0 & 0 & 0 & -u0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
u3 & 0 & 0 & u1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -u0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & u3 & u1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -u0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & -u1 & u3 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -u0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
-u1 & 0 & 0 & u3 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -u0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0
\end{bmatrix}
$$

Matrix λ^3

$$\begin{bmatrix}
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,-1,0,0,0,0,0,0,0,u0,0,0,0,-u2,0,0,-I u1 \\
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,-1,0,0,0,0,0,0,0,u0,0,0,0,-u2,u1 I,0 \\
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,-1,0,0,0,0,0,0,0,u0,0,0,u1 I,-u2,0 \\
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,-1,0,0,0,0,0,0,0,u0,-I u1,0,0,-u2 \\
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,-1,0,0,0,u2,0,0,-I u1,-u0,0,0,0 \\
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,-1,0,0,0,u2,u1 I,0,0,-u0,0,0 \\
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,-1,0,0,u1 I,u2,0,0,0,-u0,0 \\
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,-1,-I u1,0,0,u2,0,0,0,-u0 \\
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,u0,0,0,0,-u2,0,0,-I u1,-1,0,0,0,0,0,0,0 \\
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,u0,0,0,0,-u2,u1 I,0,0,-1,0,0,0,0,0,0 \\
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,u0,0,0,u1 I,-u2,0,0,0,-1,0,0,0,0,0 \\
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,u0,-I u1,0,0,-u2,0,0,0,-1,0,0,0,0 \\
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,u2,0,0,-I u1,-u0,0,0,0,0,0,0,0,-1,0,0,0 \\
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,u2,u1 I,0,0,-u0,0,0,0,0,0,0,0,-1,0,0 \\
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,u1 I,u2,0,0,0,-u0,0,0,0,0,0,0,0,-1,0 \\
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,-I u1,0,0,u2,0,0,0,-u0,0,0,0,0,0,0,0,-1 \\
1,0,0,0,0,0,0,0,u0,0,0,0,-u2,0,0,-I u1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0 \\
0,1,0,0,0,0,0,0,0,u0,0,0,0,-u2,u1 I,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0 \\
0,0,1,0,0,0,0,0,0,0,u0,0,0,u1 I,-u2,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0 \\
0,0,0,1,0,0,0,0,0,0,0,u0,-I u1,0,0,-u2,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0 \\
0,0,0,0,1,0,0,0,u2,0,0,-I u1,-u0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0 \\
0,0,0,0,0,1,0,0,0,u2,u1 I,0,0,-u0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0 \\
0,0,0,0,0,0,1,0,0,u1 I,u2,0,0,0,-u0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0 \\
0,0,0,0,0,0,0,1,-I u1,0,0,u2,0,0,0,-u0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0 \\
u0,0,0,0,-u2,0,0,-I u1,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0 \\
0,u0,0,0,0,-u2,u1 I,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0 \\
0,0,u0,0,0,u1 I,-u2,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0 \\
0,0,0,u0,-I u1,0,0,-u2,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0 \\
u2,0,0,-I u1,-u0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0 \\
0,u2,u1 I,0,0,-u0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0 \\
0,u1 I,u2,0,0,0,-u0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0 \\
-I u1,0,0,u2,0,0,0,-u0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
\end{bmatrix}$$

Matrix Λ

$$
\begin{bmatrix}
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & I & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & I & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -I & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -I & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -I & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -I & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & I & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & I & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & -I & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & -I & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
I & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & I & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & I & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & I & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & -I & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & -I & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -I & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -I & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & I & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & I & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & I & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & I \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -I & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -I & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & I & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & I & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -I & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -I & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -I & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -I & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & I & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & I & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0
\end{bmatrix}
$$

Matrix Λ_1

$$
\begin{bmatrix}
0&0&0&0&0&0&0&0&0&0&-1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&-1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
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0&0&0&0&0&0&0&0&0&0&0&0&-1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&-1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&-1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
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0&0&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&-1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
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0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&-1&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&1&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&-1\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&1&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&-1&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&-1&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&-1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&-1&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&-1&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&0&0&0
\end{bmatrix}
$$

Matrix Λ_2

$$\begin{bmatrix}
I&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 \\
0&-I&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 \\
0&0&-I&0&0&0&0&0 & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 \\
0&0&0&I&0&0&0&0 & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 \\
0&0&0&0&-I&0&0&0 & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 \\
0&0&0&0&0&I&0&0 & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 \\
0&0&0&0&0&0&I&0 & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 \\
0&0&0&0&0&0&0&-I & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 \\
0&0&0&0&0&0&0&0 & I&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 \\
0&0&0&0&0&0&0&0 & 0&-I&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 \\
0&0&0&0&0&0&0&0 & 0&0&-I&0&0&0&0&0 & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 \\
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0&0&0&0&0&0&0&0 & 0&0&0&0&-I&0&0&0 & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 \\
0&0&0&0&0&0&0&0 & 0&0&0&0&0&I&0&0 & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 \\
0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&I&0 & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 \\
0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&-I & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 \\
0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 & I&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 \\
0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 & 0&-I&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 \\
0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 & 0&0&-I&0&0&0&0&0 & 0&0&0&0&0&0&0&0 \\
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0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&I&0&0 & 0&0&0&0&0&0&0&0 \\
0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&I&0 & 0&0&0&0&0&0&0&0 \\
0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&-I & 0&0&0&0&0&0&0&0 \\
0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 & I&0&0&0&0&0&0&0 \\
0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 & 0&-I&0&0&0&0&0&0 \\
0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 & 0&0&-I&0&0&0&0&0 \\
0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 & 0&0&0&I&0&0&0&0 \\
0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 & 0&0&0&0&-I&0&0&0 \\
0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&I&0&0 \\
0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&I&0 \\
0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&0 & 0&0&0&0&0&0&0&-I
\end{bmatrix}$$

Conclusion

Excluding a nuclear war and any unforeseen collapse of the civilization then world requirements in energy would be probably considerably higher than those determined by a general extrapolation. We base our prediction on three observations: a lot of people all over the world suffer from starvation; a lot of people all over the world suffer from poverty; a lot of people all over the world suffer from environment pollution.

Seaborg G. T., Corliss W. R. Man and Atom: Building a New World Through Nuclear Technology, Dutton and Co., Inc., New York, 1971

The age of mineral resources energy will probably end in the nearest future. And it is evident that humanity will thoughtlessly burn in its cars a half of extracted oil and gas. That grim conclusion is based on the main incontestable fact: the quantity of the mineral resources on Earth is limited and the resources are irreplaceable. If we estimate it in $Q = 10^{21}$ watt-second, then the world resource of oil and gas equals 10Q each, while there is approximately 20 times more coal, about 200Q. In 1960 the world energy consumption was equal 0.1Q per year; in 1975 it was about 0.4Q per year. It is assumed now that every 10 years the energy consumption is doubled. It is easy to calculate when the energetic Apocalypse will begin. Hopes for both hot and cold nuclear fusion nowadays are quite frail. That is shown at some relative graph, its concrete shape of course may be disputed but in general it seems to be absolutely correct.

The block curve is the energy to be obtained from minerals. The broken curve is the possible forecast, if the main idea of that works appears to be true. The deceleration of energy consumption growth is due to the world restriction on energy generation caused by the heat pollution of the environment and by CO_2 emission. That will put a serious ecological obstacle in the development of the civilization. The question is that in the process of energy liberation only one third of the heat energy obtained burning the mineral fuel is transformed into the power energy. The other two thirds have to be wasted in the form of heat in the environment. And in the long run about 99% of the total generated energy is again transformed into heat. Eventually we have a vast garbage heap of energy.

If the ideas described here were true then we would have a lot of free space at the heat energy garbage heap. More important, it would be possible to prevent the further emission of CO_2, Damocles' sword for civilization. Today UN is seriously putting the questions of limitation of heat and carbonic environment pollution. On the other hand in accordance with the forecasts of the American Administration, the USA is close to a tremendous fuel and energy crisis. They are starting the attempts trying to avoid it. There is no doubt that the expected crisis will be global. Simply the USA State Administration has better foreseen the problem than it happens in other countries. Because of this there is no doubt that any promising scientific direction in the field of new power engineering will be examined and so the authors are confident for their ideas.

As our theory does not contain energy and momentum conservation laws for single micro-processes it makes an absolutely new approach to the development of new energy sources.

The generally accepted quantum theory is not fully adequate with respect to numerous new experimental data, to the series of observable physical processes and phenomena (cold nuclear fusion, nuclear transmutations in plants and biological objects etc.), and becomes today, in our opinion, an obstacle on the way of new energetic. Besides, this theory does not describe, in principle, individual quantum events, but our approach allows to describe such events and shows the way of using redundant energy for the commonwealth. We wish to express our conviction that the time of the theoretical recognition and the practical use of over unity devices will soon come. The peoples of our planet will regret that so much oil, coal and gas was burned causing terrible ecological losses.

It is possible on the other hand that the appearance of new field basis may become decisive for the science in all problems of strong interactions and mass spectrum that turned out to be inaccessible during the whole century. And the question is not that the modern theoretical physics is not able to solve some non-linear equations. For the time being the standard approach just does not allow to formulate the problem of computation of the mass spectrum of an elementary particle.

It is hard to assume the attitude of experts in quantum science to our guerrilla acts on the home front of it. It may be the dramatic situation forecasted by R. Feynman in his work “Character of Physical Laws”: The astronomers of Maya Civilization were able to calculate the moments of sun and lunar eclipse with a great accuracy. They had special mnemonic rules and mathematical tables made up for these purposes. And they successfully used these tables.

Assume, R. Feynman says, that a modern third year student of celestial mechanics comes to these astronomers and says: *“Look, maybe everything is nothing of this kind, maybe the Moon, the Earth and other planets are big stone balls revolving around the Sun, maybe they periodically overshadow it and that is the reason for eclipses?”* And the Maya astronomers answer: “Are you able with your theory foreseen exactly the moments of eclipse beginning? No? Go away!”

The UQT is extremely simple and understandable science in its concept. The fact that equations appearing are non-linear is not an obstacle in quantum problems solution. The World is appeared to be mathematically complicated and non-linear. And the Golden Age of linear differential equations with general analytical solution probably has gone away irretrievably. Maybe some of our ideas are paradoxical and heretical, but only the time is able to answer the question whether the Nature proceeds in the way we have assumed.

Probably the authors have omitted some important results, appealed not to discoverers of that or other direction and even have forgotten to allude to somebody. We make our apologies.

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