# The quest for new physics. An experimentalist approach. Vol.2

(The second book on the topic, with emphasis on certain ideas.)

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## Introduction.

In the first book (Dmitriy Tipikin “The quest for new physics. An experimentalist approach” // LAP Lambert Academic Publishing, 2021, https://vixra.org/pdf/2011.0172v1.pdf ) the present situation in the fundamental physics was characterized as a condition of the deep crisis and some new ideas were proposed. In this book more philosophy will be added with some rational reasoning why the picture of the Universe is different compare to the modern vision. While in the first book the ideas were expressed mainly as mathematical formulas, here some key ideas will be explained in more details.

Chapter 1.

The experimentalist approach. Strong and weak features of the modern physics picture of the Universe.

The experimentalist approach to the analysis means that any postulate in physics works only in the limits it was proved experimentally and should be under doubt beyond this area. Why is it important? The largest problem with modern physics is continuation (similar to analytical continuation in mathematics) of some of the postulates that were never really proved onto the larger scale and transition of them into the kind of religious dogmas. Indeed, from experimentalist point of view the relativity principle was checked in famous Michelson-Morley experiment with certain accuracy. And this accuracy (improving slowly with time, as repeated experiments are performed) puts the limits on the applicability of this principle. It was eventually converted into something absolute, and that greatly simplified the task of theoretician to build a theory and that theory makes predictions, which were confirmed, that proves the first step (expanding the postulate beyond the area it was checked) and makes the theory very great. So far so good, but any postulate has certain limitations ("physics is not mathematics" [1]) and eventually physicist forgot to check, whether limitations should be discussed and the postulate now equivalent to religious dogma. But the nature does not conform and the new theory unfortunately now based on wrong assumptions and wrong from the very beginning, leads to the wrong conclusions and so the crisis in physics arrived.

How to find the moment when the postulate is ready to be discussed? The only way is to see the correctness of the predictions for the experiment – are they correct? Here comes the problem many theoreticians do not comprehend – the accuracy of the experiment, the human bias and the money for the grant. Being experimentalist myself I will try to reflect on those issues.

A.Accuracy. No experiment is perfect and error may be hidden deep inside. Theoreticians are checking calculations errors in a simple way – two co-authors make mathematics independently and the results must coincide – both the final formula and in the each step. If not – check every number till error is found. Experimentalists may of course make the independent experiment (and for important discoveries like in particle physics it is done despite huge costs for second collider) but this is not done always. So if error is made, it may be published, the result accepted as "pristine" and being used by theoreticians as a basis of new theory without realizing that this was an erroneous experiment (for example, this is the case of non-existing quantum entanglement of photons, wrongly interpreted Alain Aspect experiment [2]). It must be mentioned that quantum superposition (Ruby oscillations) is a valid experimental, well established fact.

B.Human bias. If the experiment results slightly deviate from the predictions of the well established theory the deviation is put "under the rug" and the experiment is reported as completely confirming theory. Eventually more and more experiments are casting doubts on the same theory, but deviations are now routinely put "under the rug" because it is not possible that "cheap" experiment may contradict to great and established theory. An interesting example would be big bang theory. While 100 years ago the explanation of the red shift as the Doppler shift seemed the only possibility (scattering of light, simple refraction of light etc were obviously out of accuracy of measurements of the effect) developments of new areas like quantum vacuum (participation of virtual particles) and standard model (one of the key experiments lead to quarks and standard model also demonstrated that photon by no means may be considered as piece of electromagnetic wave, it is without doubts something else [3]) created many other possibilities to explain the tired light on new physical principles but those were

never tackled (the big bang now is a religious dogma). With newest observations made by James Webb space telescope it seems that Big Bang is almost obsoleted by now.

C.Grant money. This problem is known not only in physics, and it is clear that money depends upon the positive reviews of grant proposals and the reviews are done at the end the authors of the most cited theories so the more known theory the higher the number of supporters. Only very few agencies deliberately disseminating grants among the outsiders (I know only the example of financing of the EmDrive by DARPA).

Those are known obstacles, however, the problem of crisis in physics is still present and needs some efforts to make the experimental discoveries (I am talking so much about necessity of experiments because after all this book is an experimentalist approach). Those experiments and discoveries would work as the "clues" for the direction of the search and eventually for the new physics (which of course, means both experiment and theory). Undoubtedly there are many unexplained phenomena in physics like dark matter, red shift of far galaxies but those are so difficult to tackle because it is not clear where to search, where to start explanation. From historical perspective situation resembles to some degree the explanation of the famous phenomenon of superconductivity. It was observed, had a lot of applications, but why it exists at all was not clear. Before BCS theory the speculations were mainly around electronic structure of the materials. Only after a discovery was made (completely forgotten by now) of the isotope effect (small effect, but observable and confirmed on many materials, dependence of the transition temperature on isotope composition of the superconductor) the clue was found. Isotopes have exactly the same electronic shells and electronic properties, but slightly different nuclear masses. The only influence they have in solids is in the lattice oscillations, the sound properties. That instantly hint onto the importance of phonons, and Cooper generated the key hypothesis about the pairing of electrons and origin of superconductivity. [Many theoreticians today are highly praising the experimentalist works on the simplest possible high temperature superconducting ceramics because the first ones were quite complex in structure, composition, properties and the key to the origin of the higher transition temperatures is hidden thoroughly. Unfortunately even now even the simplest possible high temperature superconducting ceramics still hiding the origin of extra-high transition temperature somewhere inside the snafu of interrelated properties.]

Such absence of key experiments is present in fundamental physics (cosmology) as well. Despite the problems in physics are present, the directions of search are still absent: to gravity, to dark matter, even to photons with respect to long travel, to space-time itself beyond Einstein. The directions where to search for such "clues" was already tackled in the first book [4] and will be continued here, too with emphasis on some most promising (from author of the book) ideas, with additional discussion from the point of view of historical perspective.

**Weak and strong postulates.**

As it was already mentioned above, from experimentalist point of view any theory has limitations. Even energy conservation law and other ideas of symmetry (momentum conservation, angular momentum conservation, space-time properties). Is it possible to through all those ideas away? And check every possible law of physics starting from most basic and primitive? Some theoreticians are doing exactly that (the idea of Stephen Wolfram [5] or superstring theory) and they so far made no testable predictions. History of science hints to a different approach: new theory would be very close to the previous one and experimentally observed and theoretically predicted deviations in results must be

extremely small. After all, Einstein theory predictions deviate from Newton theory predictions only slightly in obtained observations (precession of the Mercury orbit is very small, light deflection by Sun is tiny and despite GPS navigators need some general relativity corrections, the accuracy improvement is not enormous, not in kilometers, at best in few meters). The same with quantum mechanics: Bohr successfully built working good model of hydrogen atom using classical Newton physics with only one new idea: quantization of angular momentum. The corrections of the new physics (beyond general relativity and quantum mechanics) are expected to be much smaller compare to Einstein corrections or Schrodinger corrections or quantum electrodynamic corrections. Everything what is claimed today if it is greater than change from Newton to Einstein or from Newton to Schrodinger must be undoubtedly wrong. Indeed, one of the origins of the crisis in modern physics is that enormously small deviations need enormously high accuracy and enormously expensive equipment. Everything what is done at a low price and claiming new physics is wrong – at that level of accuracy it should be explained through existing theories. (Despite the author is not fun of classical high energy physics, like accelerators, to some extent the physicists demanding new extra expensive supercollider are right – you can not expect to find new physics on something cheap). The problem is in relative price jump – may be in another direction of search the price for new physics would be "only huge" not "absolutely enormous". But it is obligatory very high. A good example is James Webb space telescope – at a price of 10 billions it is finally challenging Big Bang and opening the road to new physics. The price is not "absolutely enormous", the new supercollider would be much more expensive, but it is OK from historical approach because 10 billions is not cheap.

Other hints to the directions where the new physics is easy to find would be the preliminary check of the existing paradigms and key assumptions. The strong assumption is to stay and weak assumption is to go the alternatives to be researched thoroughly. Among the most discussed and frequently mentioned doctrines I would mention dark matter, Big Bang, quantum entanglement.

**A.Energy conservation law**. This is **strong idea** (believe, concept). Never broken in any experiment and it should stay in the new physics search.

**B.Big Bang** – **very weak** dogma. Why is it so? I actually made wrong predictions already. Even before James Webb space telescope was designed the proponents of Big Bang predicted that due to cosmological enlargement the far galaxies should be spread across half a sky, the surface brightness should be negligible and they would never be observed. So make the Hubble space telescope "short-sighted" we never see the far galaxies anyway. After this prediction failed, Eric Lerner wrote the book ("Big Bang never happened", 1992) because honestly, once the theory prediction is falsified, the theory itself is falsified. The Big Bang was "saved" (patched) with the idea of dark matter playing important role in primary galaxies, that is why they might be so small (assuming cosmological enlargement due to the Universe expansion they enlarged just enough to be looking like normal galaxies but in reality are small in size, what is possible because of the dark matter). Recently James Webb space telescope showed far galaxies even smaller (because now the inevitable cosmological enlargement works much stronger) and again without any enlargement due to very strong cosmological enlargement close to the start of Universe (if the cosmological enlargement would real, the visible angular size of the galaxy would first stop decreasing, than start to be larger and larger despite the red shift is higher and higher and finally the primary galaxies should spread across the half of the sky and become invisible again due to negligible surface brightness). A second patch is necessary like primordial black holes. Another possible patch is the idea that Universe is actually older so the observed already galaxies have enough time to

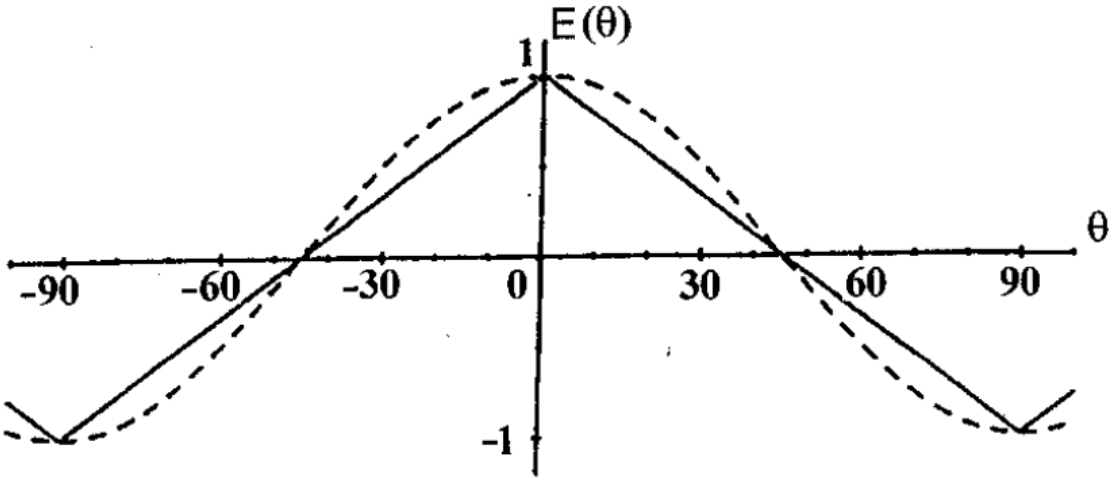
develop and cosmological enlargement is not so severe [6]. And the theory with base in Big Bang failed prediction again. Situation is more and more like epicycles before Copernicus. The simplifying idea is that red shift of light is merely some undiscovered yet phenomenon, nothing to do with Doppler shift is more and more appealing. In this case the red shift is some measure of the distance (linear in first approximation) the observed old galaxies are approximately of the same real size as nearby galaxies (and the angular size is inversely proportional to the distance – approximately to the red shift – confirmed by the observations made by Hubble and James Webb space telescopes), the Universe is quasi-stationary and quasi-eternal. Of course it has some beginning and will have some end, but definitely not on 14 billions years time scale, much-much larger and much-much older. Not "mathematically" infinite and eternal, but reasonably, for all present day observations infinite and eternal.

**C.Dark matter**. This concept is very non-trivial one. While from the point of view of particles interaction it is inevitable that particle exists that interacts only through gravitation (dark matter in the usual meaning) the idea that it is that particle which is responsible for the accelerated rotation of galaxies or galaxy clusters is most probably wrong. The search of such particles by use of very expensive underground chambers is at least partially justifiable (that search is very expensive – OK for new physics – and sooner or later they may find something unusual: exactly like with the new super-large future supercolliders). But this is not the shortest path to new physics: there is more and more data that the accelerated rotation in galaxies somehow correlated with the density of classical baryonic matter (in ultra-diffuse galaxies the rotation curves is Newtonian one). So the whole concept while valid and strong *in general* , **weak** with respect to gravitation and unusual rotation of stars in galaxies. At discussion of gravity and rotations of stars the obvious correlation exists already: the more noticeable particle or object (barionic matter composed of protons and neutrons) the more contribution to the gravity it makes. Electrons are less interacting with matter and spread everywhere in the Universe, but known to have small effect on rotation through gravity. Neutrinos are very difficult to detect (they are kind between normal and dark matter) but they are known to have negligible influence on gravity and rotation curves. On the opposite, something very big and noticeable should be responsible for the such too fast rotation, on the opposite side from baryonic matter. Or it is not matter at all, some field.

**D.Principle of causality**. Understood as the absence of choices in development of any system in time, this principle is the cornerstone of classical mechanics and classical wave physics (before quantum mechanics). It was challenged by quantum mechanics and greatly debated now. For the search of new physics it is considered to be **weak**, because the new physics would be undoubtedly about even smaller objects and values that present day quantum mechanics and the causality principle will be buried completely. Interestingly, Landau-Zener probability formula may bring the probabilistic approach (absence of principle of causality, multiple choice) even directly to macroscopic world [7], so even quantum Darwinism principle can not save causality even for macroscopic world. In the microscopic world the principle of causality is mainly already abandoned.

**E.Non-locality**. That is **very weak** idea. Not only Einstein, also Feynman are well known to reject anything what means non-locality. I personally completely deny idea of "entanglement" of Alain Aspect [8,9]. From my perspective in his experiments of 1981, 1982 he only proved the completely independent, born with different energies and at a different time down-converted photons in excited calcium has the similar polarization with some accuracy and nothing more. By rotating the polarizers he merely re-discovered (with small accuracy) Malus law for polarized light (known from Newton time).

Even the energies of so called “undistinguishable” photons are different (551.3 nm and 422.7 nm [8]). The second photon is generated not from virtual state, but from real excited state of Ca atom 4s4p1 P1, which has a finite life time and absolutely clearly will generate the second photon completely independent from the first one. It has a small lifetime, possibly 1-10 ns – typical for fluorescence, but that is enough for the atom to rotate a little due to rotational diffusion and make the difference in polarization vectors between two photons actually clearly visible. From fundamental physics point of view, the second photon if generated from that excited state after say 1 hour after first photon would create the same pair of photons which Alain Aspect considered to be “entangled”. All those processes are well investigated in photochemistry and the experiment done in the same way as in [8] may indeed generate important for chemists information. The delay between two photons may be measured if the distance between the source and one of the photomultipliers is changing a little (for 1 ns the expected shift is 30 cm assuming photons are moving in an air): when the correlations reach maximum as a function of the shift in distance that would be the estimate of the lifetime of the second excited state (30 cm for 1 ns, 3 cm for 100 ps etc). The accurate measurement of the polarization shift may allow to evaluate the rotational diffusion of the calcium atom and the difference in angle between the dipole transitions for first and second excited state (those dipoles are actually almost parallel from the consideration of both excited states). Another way to measure lifetime of each state is line broadening of each photon – and they most probably will not coincide. So the information about the source of those “entangled” photons hints that they are obligatory completely independent, may be separated in time by long interval (say use phosphorescence instead of fluorescence and it may be seconds and minutes) and just pure accidently have approximately the same polarization. Another error is in mathematical treatment of the experimental data obtained. Alain Aspect main mathematical error is that he considers the classical correlation function being tooth like function (see the picture below and in [9]):




And compares it with “quantum” correlation function which is Cos(Θ) for electric field or $Cos^2(Θ)$ for intensities (that would be exactly Malus Law [10]). But correlation function between vectors (two dimensional entities) can not be a linear function of angle, it must be function of Sin(f), Cos(f) or any combinations of trigonometric functions [2]. It means that classical and “quantum” correlation functions are exactly the same, the Bell’s theorem is not violated in any point and no proof of non-locality is present. The classical and quantum correlation functions coincide with the accuracy of Alain Aspect experiment. There is a good question – why quantum mechanics have the same answer as classical one?

The answer is in the history of the Schrodinger's version of quantum mechanics – this is wave mechanics (sometimes even called wave quantum mechanics) and all the properties of waves (including polarization) are deeply embedded into the quantum mechanics, into the mathematical apparatus of quantum mechanics. That property (polarization) lies deeper in quantum mechanics than the distance between the quantum mechanics and classical wave mechanics and may be attributed to "mathematical wave mechanics". In order to disprove locality principle it would be better to use Heisenberg version of quantum mechanics, making experiments exactly like described by Einstein in his EPR-article. Substituting pair pulse-distance described in EPR article to something including polarization leads to error in interpretation of the results. **Non-locality is a weak**, pure theoretical so far idea that has no experimental evidence. On the contrary, principle of locality is very strong (violations never observed), as strong as energy conservation law.

**F.Speed of light is the maximum speed**. The main idea of the special theory of relativity is a **strong postulate.** It will undoubtedly survived in the new physics with some important notices. The postulate was formulated by Einstein before any idea of quantum vacuum appeared. It is undoubtedly correct in the absence of any material bodies or fields (say very far from nearest galaxies in the empty space). Essentially it is absolutely correct in absolutely empty Universe with only one photon present. But since the real Universe has some matter inside (baryonic and non-baryonic like light), the maximum speed of light is not speed of light but Lorentz speed c (the same c from Lorentz formula). Extremely small deviations from of the speed of light in vacuum from c are inevitable and detection of those deviations would be the new physics indeed (one of the ideas for the search as specified in my book [4] is: light has some enormously small rest mass and photons with different wavelengths from far astronomical object will arrive with some delays). Recently recorded time delay between gravitational wave and light pulse is only the beginning of such measurements. This is not unexpected phenomenon, for example, Kerr effect for the light in vacuum (very strong electric fields are necessary for very small effect to take place) was already predicted [11] and based on the idea of quantum vacuum. The deviations of the speed of light from Lorentz speed (and from gravity wave speed, which may be also slightly different from Lorentz speed) is very small, measurements are very difficult and very expensive – good indication that once correctly discovered that would be a new physics phenomenon.

**G.Quantum vacuum**. The idea of quantum vacuum is a strong one and it is already working well in describing many phenomena. It is the idea of quantum vacuum that allowed to calculate speed of light and magnetic permeability from first principles (the existing particles mainly electron-positron pairs are virtual pairs in quantum vacuum but influence the real fields). Recent discovery of a discrepancy for g-factor of a muon (for the electron g-factor is calculated from quantum vacuum ideas with very high accuracy) may have either trivial explanation (not mentioning the experimental error) like one more undiscovered yet particles hiding in quantum vacuum and influencing the g-factor or it may be a part of new physics – for example, the concept of gravity and how it plays in microscopic level to be checked, because muons are much heavier compare to electrons and start to feel gravitational influence from virtual particles. In any case, research involving the properties quantum vacuum is a very promising area in a sense of the short road to new physics.

**H.Gravitational constant G is a constant. Space-time is not additionally distorted at the distances well exceeding Schwarzschild radius.**

General relativity taken for all distances and parameters is not correct – it obviously failed in the case of extra-strong gravity (inside black holes). But it is usually assumed that on the opposite side of extra weak gravity it coincides with Newton laws and absolutely correct up to infinite distances. The gravitational constant G is not influenced by gravity already present and space-time metrics itself is not perturbed except as being described by general relativity (at far distances distortion of space time looks like gravity according to Newton law, no additional distortion beyond GR is present). The competing concept is MOND or some recent ideas about weak dependence of G on gravity for the case of ultrasmall gravity. This weak dependence of G from gravity originates from the influence of perturbed by gravity quantum vacuum [4,12]. Another competing idea is that G=Constant but space time itself at the larger distances is distorted more than GR or Newton laws allow. That deviation is only revealed for the distances much larger than Schwarzschild radius, so to discover it the experiments at very large distances are necessary (wide binary stars are good candidates [4,13]). That would correspond to the small correction term introduced into General Relativity and frequently executed by theoreticians and discussed by them as a way to the new physics. Indeed, it seems inevitable that GR one day will be modified, the correction term is tiny (exactly like expected for new physics) but not yet found as a correct mathematical expression. But one more idea (widely accepted right now) is that GR is absolutely correct but all the problems with rotation of galaxies is due to the undiscovered yet dark matter (see **C.Dark matter** above). Despite from my perspective this is low probability event, it may be possible (nature is very bizarre after all) so the concept of G=Const and space-time not distorted additionally in the case of small gravity should be considered as **medium strength concept.** It means that it may be thrown away (for example if the "dark matter" is actually either quantum vacuum perturbation or additional space time-distortion) or it may survive if dark matter is a "classical" matter after all (particles, undiscovered yet dark holes, some WIMPs, or light particles not easily detectable etc).

Overall, the areas of the modern physics which are "weak"- mainly doing with weak compare to electro-weak and strong interactions (doing with gravity and all phenomena around gravity). Those are under-investigated areas. The areas which are "strong" are correlated with high energy physics (standard model). Similar division was already expressed in Vol.1 [4]: the feeble gravitational interaction needs much more money and more accuracy to be researched compare to "strong" in the sense per particle interactions. The "strong" interactions are less frequent but so easy to detect because the energy involved per particle is so much higher compare to the "chemical bond" energy that change of this energy creates "visible by naked eye effect" – sometimes literally.

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Chapter 2. New properties of photon – possible new physics.

Despite photon is very common in research, it may be still not thoroughly investigated. Despite the success of quantum electrodynamics the interaction of photon with the environment may be not fully recognized. Photon is famous for being first object for quantization and start of the quantum theory. From the application of Maxwell equations to quantum mechanics photon is mainly considered to be a piece of electromagnetic wave only. For example, transition of magnetic moment in magnetic resonance or optical excitation in optics are in excellent agreement with use of perturbation theory for oscillating magnetic or electric field of the photon. In first case oscillating magnetic field is forcing transition of magnetic moment (spin) placed in constant high magnetic field to upper level, in the second case the oscillating electric field is causing the electric dipole to excite to a new level. So the most common in chemistry and low to medium energy physics action of photon is through the associated with photon electromagnetic wave (photon may be successfully visualized as piece of EM wave).

But photon is much richer than piece of electromagnetic wave. Specialists in high energy physics know it already: vector meson dominance [1]. Energetic photons were scattering almost equally on either proton or neutron despite the first one has a charge and neutron only a weak magnetic moment. If photon would be merely a piece of electromagnetic wave, that would be impossible. So it turned out that energetic photons being "dressed" in a cloud of quantum vacuum particles, which includes vector meson, what (meson) is finally participating in scattering on either proton or neutron. Eventually this experiment lead to the idea of quarks, quantum chromodynamics and standard model. So people in high energy physics know well that photon is much richer than a simple wave. Why a similar interactions are not possible for low energy photons? For example for the gravity and influence of it on photon? In a sense why we can not hypothesize some new type of interaction of small energy photon, completely different from electromagnetic, which would lead to slow loss of energy of photon on a very long time scale and be responsible for the red shift in cosmology?

That would be the resurrection of the tired light hypothesis but based on new physical principles. This idea will exploit another, not electromagnetic side of photon which scientists from high energy physics are well aware of.

1.Tired light – what interaction may possibly lead to the desired result? The hypothesis of extremely weak but numerous interactions.

The idea that photons are slowly losing energy has a lot of problems. An old tired light hypothesis was based on scattering. The problem here is as follows: after traveling for around 80 millions of years the green light photon is red shifted to the value approximately corresponding to 0.005 of the initial energy. If it would be scattering and photon would lost 0.5% of the energy in one interaction, than, according to formula E=pc the change of pulse in the case of scattering perpendicular to the direction of travel would be also $0.005p_o$ ($p_o$ is the initial pulse). That means that deviation from the original direction of travel is huge: angle $\alpha=0.005*p_o/p_o=0.005$ rad ($0.25^o$). This angle is so big that we would never see far stars or galaxies – they would be completely blurred, the light would be completely scattered.

But the hypothetical expected interaction ("new physics") must be extremely small (otherwise it would be noticed long ago, that is a logical historical idea, new physics is both extremely small and

very expensive to discover). If hypothetical interaction is so small that the final change in energy of 0.5% (for the ~80 millions years old photon) is reached after enormous number of small scatterings, the result would be completely different. If the same energy loss is reached after say N=10exp(37) very small scatterings [2] the situation is completely different. There is only one chosen direction – direction of the light pulse and if there is no chosen somehow perpendicular direction (all scatterings are bending light on one side – seems improbable for so long travel) all those scatterings may be considered randomly distributed in all directions. In this case the largest possible fluctuation (from the laws of statistics) would be sqrt(N) and the maximum deviation of the pulse from initial direction would be $\alpha \sim 1/\sqrt{N} \sim 3*10^{-19}$ rad. Despite the scattering is still present it is so small that it can not be visible even with the help of future space telescopes (James Webb has only resolution of 0.1 arc-sec [3] or 0.07 arc-sec at 2 micrometer wavelength, what is around $3*10^{-7}$ rad and coincides with classical formula for the resolution of the mirror $\alpha=\lambda/D=2*10^{-6}m/6.5m$, where $\lambda$=2 micrometer -wavelength and D is the diameter of the mirror). It means that for extremely weak scattering (but repeated enormous number of times) the deviation of the light due to scattering is negligible and well far from being observed. Again, this would also satisfy the new physics criterion of the scale of interaction (very small, not yet observed because too high accuracy is necessary).

2.Possible microscopic origin of tired light properties. Quantization of the gravitational dipole.

Since the photon definitely has some properties beyond being a simple piece of the electromagnetic wave ("dressed particle" [1]) even in a vacuum, it would be great to speculate what type of interaction is possible for the slow but steady energy loss. If photon is imaged like something in addition to be wave (like particle), it may for some short time of existence in a matter-wave duality be a real particle with real mass. Gravitational interaction seems to be a good candidate for slow energy loss by a propagating photon (it is small and it is already known, no need to invent the fifth force). Another way is to hypothesize a completely new interaction, not yet discovered, small (because red shift is very small) and having influence on photons. I am choosing the simplest explanation (undiscovered yet influence of gravity). After all, gravitational interaction with non-baryonic matter (photons) is not tackled properly, the only real experiment is deviation of light by the Sun (one of the confirmation of the General Relativity). There is a proposed long ago experiment of direct observation of gravitational interaction of ultra-slow light [4-6] (predicted to be $n^2$ times stronger compare to photons in vacuum, where n is the effective refraction coefficient of the media) was never realized despite importance of the issue (if verified, it may mean a serious violation of weak equivalence principle for non-baryonic matter, because for the light with frequency $\nu$ the effective inertial mass is still $h\nu/c^2$, like in a vacuum, but the effective gravitational mass is expected to be $n^2$ times larger). It means that gravitational properties of light were never properly investigated and that seems to be the shortest path to new physics.

One of the simplest ideas is that light has a mass, despite obviously a very small but real inertial mass [6,7]. There are many hypothesis on this topic and the most frequently cited rejection is that this is not possible from Maxwell equations. Here comes the logical contradiction: according to Maxwell theory light is merely a piece of the electromagnetic wave. But as it was mentioned above it is already clear at least for the people in high energy physics that photon is something else, too [1]. Therefore for the most general treatment Maxwells equations are not enough (they must be modified in an unknown yet way, the added expressions are expected to be very small). The direct check for the rest of mass using present equations can not describe the absence of mass correctly because they are not complete

(instead of Maxwell equations Proca equations are analysed). The shortest way to show it is to hypothesize the introduction of the mass to the Maxwell's equations in a different way, not as Proca equations. When Yukawa potential is introduced into the Maxwell's equations it enters all 4 equations including one responsible for Gauss law on electrostatics. The Gauss law for electrostatics is very easy to check with high accuracy and this experiment eliminates the mass of photons with high accuracy (but only in this particular model). If instead somebody separates Maxwell's equations into two pairs: static ones (Gauss law for electrostatics and Gauss law on magnetostatics) and dynamic ones (last two, the wave equation is derived from last two) and proposes that the hypothetical new theory introduces the mass only into the dynamic pair of the equations, the situations becomes very different. There are many experiments confirming that speed of light in interstellar space slightly depends upon the wavelength (and many experiments are ongoing right now), so in this sense the mass of photon seems to be possible well larger than the null test of Coulomb inverse square law (the most constrained probe of the photon rest mass for today, but it assumes that rest mass is present in all 4 Maxwell's equations).

In addition to the mass (inertial and gravitational) photons may have another properties: gravitational moments (dipole, quadrupole, octupole etc). Similar to electrostatics the next in strength after mass would be gravitational dipole. Here comes one problem: while for baryonic matter presence of such gravitational dipole is not really forbidden: the particle may have mass and dipole moment (smaller than certain value) without presence of negative mass (merely distribution of the classical mass have a dipole moment, like M and mr, where m<<M), for the photons this is not possible without hypothesis of negative mass (especially if the first approximation the total mass should be zero). What forbids negative mass?

The most famous formula of Einstein $E=mc^2$ was derived actually for positive masses only. More general is Dirac's famous formula:

$$E^2=p^2+m^2c^4 \qquad (1)$$

From this formula for p=0 the correct formula for inertial mass should be like this:

$$|E|=|m|*c^2 \quad \text{or } E^2=m^2c^4 \qquad (2)$$

For positive energies the negative mass is OK: |m| will be >0 anyway. The energy conservation law (most important in physics) is intact. Even negative energies to some extent is not a problem (that idea I think should be put aside for the "newest physics" to tackle in far future). In the sense of consecutive perturbations, first it would be new physics with some negative masses allowed and later (few centuries ahead) the "newest physics" where negative energies are discussed. Once the idea of negative mass does not seems as contradicting to the most fundamental laws, the hypothesis of gravitational dipole (inertial mass dipole plus weak principle of equivalence) may be discussed.

How gravitational dipoles may be inferred from quantum mechanics? For this it would be necessary to go to the very foundations of quantum mechanics, below (deeper) than non-relativistic Schrodinger equation.

From Bohr rule, used to construct the hydrogen atom model (the very beginning of the quantum mechanics) it follows:

$$M*r*v=N*h \qquad (3)$$

here m is the mass, r – some distance, v -velocity of the particle, h – Plank's constant, N – integer positive number >=1 (1,2,3,4…..).

Let's consider some simple transformations of this formula:

A. $r=h/mv=h/p$ – de Broglie formula (4)

Here $p=mv$ – non-relativistic formula for pulse. That is in addition to the trivial expression connected to hydrogen atom, if r is considered as wavelength associated with the particle, the fundamental de Broglie formula may be inferred from (3).

B. $rv=h/m$ (5)

At first glance this formula can not lead to any non-trivial conclusions. The value rv looks like a dipole of velocity of particle. If no change in the direction of such a dipole is possible, it means that particle elongates like spaghetti on any travel (one part of the particle has larger velocity than another). That does not correspond to any known phenomena and seems completely impossible. If this dipole is allowed to change direction – still quite a bizarre motion: part of the particle moves ahead, second part lags behind, than catches up (when dipole changed direction) than moves forward, than lags behind again. Looks like strange oscillatory motion of a particle, not really possible. Yet it may be considered as approximate description of Zitterbewegung motion, predicted for relativistic electron by Schrodinger from Dirac equation and discovered many years ago. According to the solution of the Dirac's equation, the associated with Zitterbewegung angular velocity is $\omega=2mc^2/\hbar$. The approximate spread (uncertainty) of the particle is of course Compton length (mass is relativistic mass): $\lambda=\hbar/mc$. The velocity and angular velocity may be linked together too: $v=\omega*\lambda$. Then

$$r*v\sim\lambda*(\omega*\lambda)=(\hbar/mc)*\ 2mc^2/\hbar*\ \hbar/mc\sim 2\hbar/m\sim h/m \quad (6)$$

Since the evaluations are made only to check the physical sense of the expression, the difference between $2\hbar/m$ and $h/m$ is not crucial (after all, the initial formula (3) may be also modified to something like $mrv=h/2 + Nh$). From experimentalist point of view (and the book has it in name) the device to make the discovery of value would never be build to make measurement precisely in one point, usually a big range to vary the measured value is possible). Thus the formula B: $rv=h/m$ (5) also has non-trivial meaning (Zitterbewegung-like behavior).

C. $mv=Nh/r;\quad p*r=Nh$ (7)

This equation is similar to uncertainty principle of Heisenberg: $\Delta p*\Delta x>=\hbar/2$. More generally in quantum mechanics any pair of conjugated coordinates (like p and x) would satisfy two equations:

$<p>*<x>=Nh+h/2$ and $\Delta p*\Delta x>=\hbar/2$ (8)

Therefore, formula C also has sense in addition to the trivial dependence inside the hydrogen atom.

It is necessary to emphasize that finding of such non-trivial meaning is not straightforward and needs some imagination to find the correct interpretation.

Finally the most important from author's point of view equation would be:

$mr=Nh/v$ (or $=h/v +Nh/v$ or $h/2v+Nh/v$) (9)

Since all other equations (A-C) lead to non-trivial conclusions, there is high probability that this equation will lead to some non-trivial result too. Now mass is considered not as parameter but as a variable.

Author hypothesis is the equation mr=Nh/v is the equation of the quantization of mass dipole (and gravitational dipole provided the weak equivalence principle holds) [6]. Indeed the most straightforward interpretation of mr is the dipole of mass – and gravitational dipole. This idea satisfies the condition of new physics – this value is extremely small (indeed for ultra-relativistic particles including photon v=c and dipole is h/c). It is so enormously small because the very small constant h is divided by the very large constant c. No doubts why this quantization was never observed by accident – it is hardly possible to apprehend and in many practical applications this small value may be safely neglected.

The origin of this quantization may be inferred from the uncertainty of time. Let's consider the ultra-relativistic particle like electron. It moves with velocity very close to c and the uncertainty of the velocity is small (ultra-relativistic case). In this case application of the uncertainty principle for time would be:

$$\Delta E*\Delta t>=\hbar/2 \qquad (10)$$

But $\Delta E=\Delta(mc^2)=\Delta m*c^2+m\Delta(c^2)\sim \Delta m*c^2$ because uncertainty of the velocity is small.

As far as Δt is concerned, it may be related to uncertainty in coordinate using the velocity of the particle: Δx=c*Δt. Than:

$$\Delta m*c2*\Delta x/c>=\hbar/2 \qquad (11)$$

$$\Delta m*\Delta x>=\hbar/2c \qquad (12)$$

For the pair of conjugated variables m and x equation (12) should have the corresponding pair (similar to pair of equations (8)):

$$<m><x>=Nh/c \text{ (or may be } h/2c+ Nh/c) \qquad (13)$$

Which would again lead to the equation of the quantization of the gravitational dipole like (9):

$$mx=Nh/c$$

Of course the considerations above should be considered as only a hint onto the existence of such phenomenon with value of quantum of h/c. Author never found mentioning of this ratio of two important fundamental constants like h and c in a literature (like mentioning of parameter α=1/137) and from dimensions of the value this ratio corresponds to kg*meter, which is **gravitational dipole**.

Now this equation may be generalized from one limiting case onto the photon: photon hypothetically has a gravitational dipole:

$$mr=h/c \qquad (14)$$

or may be =h/2c or may be h/2c+Nh/c)

and for another limiting case onto the non-relativistic particle moving with velocity v [6]:

$$mr=h/v \qquad (15)$$

The last equation may be obtained from De Broglie formula, too:

$$\lambda_D=h/mv \rightarrow m*\lambda_D=h/v \quad (16)$$

and since De Broglie wavelength is a measure of "spread" of the particle in space, uncertainty of the position of the particle in space would be:

$$mr=m\lambda_D=h/v=m*h/mv=m*\lambda_D \quad (17)$$

Gravitational dipole of the non-relativistic particle is merely mass of the non-relativistic particle time De Broglie wavelength. The particle doe not have a particular position in space and it's position kind of "spreaded", "smashed" in an area with the size of $\lambda_D$. And this distribution doe not obliged to be spherically symmetrical – thus external gravitational field feels center of mass **and dipole**, which is obligatory non-zero and quantized.

Another possibility to infer a hint onto such quantization is the well known effect of Zitterbewegung, which was postulated for every particle: predicted for relativistic electron, observed experimentally in Bose-Einstein condensate and generalized onto photons. Even for classical (Schrodinger) interpretation of Zitterbewegung for electrons (no negative mass or negative energies, instead excitation of the virtual electron-positron pairs as electron moves) the moss distribution of the electron is not symmetrical and may be described as center of mass plus some mass dipole. Because of the uniformity of Zitterbewegung (this is not chaotic motion), that dipole can not be averaged out (at least for some directions and frequencies) and therefore must have some certain value (quantized and that value is expanded in some multiples of h/c or h/v for non-relativistic particles).

The experimental setups suitable for the discovery of such gravitational dipole are described in [6,9] for the easiest case – ultra-cold electron or neutron. Ultra-cold Bose-Einstein condensate may be of some help here, too.

The most important part of the hypothesis is formula (14) for light and other light-weight ultra-relativistic particles like neutrino. In this case the presence of the negative mass should be postulated (at least presence of the negative mass as virtual particle in quantum vacuum) so in this case the photon or neutrino or any other undiscovered yet particle (axion?) must have some small but not vanishing to zero gravitational dipole moment. If such dipole is present, it may be responsible for some already known and unexplained yet phenomena (weak and revealing itself only on cosmological scales). The idea is to explain the existing phenomena like dark matter and red shift (interpreted as tired light) by the influence of not a mass, but a second, less important from gravity point of view property - gravitational dipole [9,10]. This explanation fits several existing observations:

-Dipole dark matter easily explains empirical formulas created by MOND, and MOND confirmed by observations on many galaxies [11,12]

-Dipole term in gravity is very small (because the gravity itself is small due to small compare to other forces value of G) which is OK from point of view of New Physics (obligatory very small perturbation to already observed phenomena).

-Influence of the dipole term in gravity for the classical barionic matter (planets) is extremely small compare with the gravity influence of mass, so in places where simple baryonic matter predominates (Solar system) that influence is very small and may be neglected [10] ( in Solar system this term may be

discovered only at a specially designed experiment, like the gravitational influence of dark matter inside the Solar system). Far from areas with abundance of baryonic matter – in the intergalactic space – it's a different story. Photons, neutrinos, photons from microwave background and hypothetical particles like axions are all still abundant in the intergalactic space but baryonic matter is scarce and the dipole term starts to predominate. Since due to dipole moment particles are still attracted to the center of gravity (galaxy) – they will look like a halo around baryonic mass, like a Debye layer around a charge in electrostatics and thus enhance the gravity (because opposite to electrostatics the gravitational dipoles will be oriented along the field , not opposite to it [13]). Altogether such property of matter would look like dark matter in its present day view.

-The formula itself: dipole moment <h/c is already mentioned in works of Dragan Slavkov Hajdukovic [12]. His idea is that polarization of quantum vacuum generates virtual gravitational dipoles with gravitational dipole moment strictly less than h/c (otherwise they are real). Those dipoles are creating increase in gravitation perceived as dark matter. In my publications the gravitational dipoles are real and indeed have the minimum value of h/c and may be measured experimentally (but multiples are allowed too, say Nh/c or (N+1/2)h/c, not clear at the moment because of the experimentalist approach – all possible values to be checked to discover the correct one).

3.Radiation by the gravitational dipole and tired light.

One of the problems of tired light hypothesis is the absence of the feasible mechanism of energy loss without scattering of light. As it was shown above such mechanism should be obligatory very weak. It must induce enormous number of very small changes in pulse and energy, so that in a sum they are almost uniformly distributed either in any direction or at least in any direction perpendicular to the direction of the propagation of photon. Only then the photon does not change direction but loses energy (the deviation in any direction drops as 1/sqrt(N), N is the number of scatterings and when the number N is huge deviation in any direction is very small). Gravity if actually a good candidate for such interaction – it is indeed very feeble.

The most common misconception of the gravitational dipole radiation is the application of the momentum conservation law to prove that gravitational dipole radiation is impossible. Because the total pulse of the system is conserved the second derivative of the dipole is obligatory zero and no gravitational dipole radiation is possible:

$$d=\sum mr$$

$$d^{\cdot}=\sum p=Const$$

$$d^{\cdot\cdot}=\sum p^{\cdot}=0 \text{ – no radiation}$$

However, during radiation event only the total pulse is conserved:

Pulse of photon before= Pulse of photon after + Pulse of graviton

In that sense the $d^{\cdot}$ for photon itself is not constant (for example direction of dipole flips). And correspondingly $d^{\cdot\cdot}\neq 0$ – radiation is not forbidden. Graviton generated has a pulse, of course, the total pulse is conserved and photon get the recoil pulse – similar to recently measured recoil pulse of the excited atom after emission of the photon. In other words since the pulse of the photon in the tired light hypothesis after emission of the graviton is different from the pulse before radiation first derivative of

the pulse was not zero during the radiation process and second derivative of the gravitational dipole was not zero too.

For the mechanism described, of course, the gravitational dipole itself should not be zero for photon – the postulate of negative mass is necessary (at least virtual one, so that any baryonic particle has a antigravitational vacuum particle in a "dress" and photon has a pair: gravitational quantum vacuum particle plus antigravitational quantum vacuum particle attached to it during propagation). Somewhat similar to virtual electron-positron pair attached to the moving electron.

What relation may have this gravitational dipole to the tired light hypothesis? Even despite the mass of photon may be way too small to explain the Hubble red-shift, the presence of the dipole means the photon is generating gravitons while traveling (exactly in the same way as any dipole is generating electromagnetic waves). It means that this mechanism of energy loss is inevitable for photon and may after all justify **the tired light hypothesis** and explain Hubble red shift **instead of Big Bang** (and that is indeed a revolutionary shift in cosmology since Big Bang is actually the only explanation of Hubble red shift for today).

However, that value h/c is an enormously small. Estimations shows that if the frequency of the oscillations of the gravitational dipole coincides with the frequency of light, this is 30 orders of magnitude not enough to explain red shift (so small is the gravitational dipole for ultra-relativistic particle). In addition it would be enormous (frequency in the power of 4) dispersion of the red shift (like the blue sky explanation through the Rayleigh scattering) which is not observed.

Only postulating that the gravitational dipole is oscillating with the universal for all photons frequency of $\omega=l_f/c$ where c is speed of light (essentially the same for all photons) and $l_f$ is some distance independent of wavelength it is possible to obtain the value close to Hubble shift. In this case $l_f$ would be fluctuations length of quantum vacuum (Compton wavelength of the electrons, because it is assumed that the quantum vacuum fluctuations are determined mainly by the particles with the smallest mass, which is electron). In this model the photon with the smallest possible dipole h/c during its travel across the space stumble on each fluctuation of the space and irradiate the gravitons, thus slowly losing the energy. Below is the evaluation of the energy loss of such a gravitational dipole based on modern understanding of gravitoelectromagnetism.

Despite from my point of view the final theory of gravito-electromagnetism is far from completion [6] the evaluation from the point of view of present day understanding would be useful to complete.

Using the classical formula for the electric dipole radiation in all directions (Joules per second) [14]:

$$P=[\mu_o*\omega^4*p_o^2]/[12\pi c] \quad (18)$$

Here $\mu_o$ magnetic permeability of vacuum, $\omega$ is the frequency, $p_o$ is the electrical dipole, c is speed of light. From this formula the blue light of the sky may be deduced (very strong dispersion).

The gravitoelectromagnetic Pointing vector is 4 times larger than the corresponding Pointing vector in electromagnetism due to Einstein correction [15]. Since the gravitational waves (real waves, not space time distortions observed by LIGO) should have (presumably, question of debates actually) the same speed c (very close to it) the following relation holds:

$$\mu_{og}*\varepsilon_{og}=\mu_o*\varepsilon_o=1/c^2 \quad (19)$$

(multiplication of gravito-electromagnetic permeability and gravito-electromagnetic permittivity and electromagnetic permeability and electromagnetic permittivity are the same and equal to $c^2$)

Then, substituting (19) into (18) it is possible to obtain for gravito-electromagnetic radiation $P_g$:

$$P_g=4P=[\mu_{og}*\omega^4*p_{og}^2]/[3\pi c]=[\omega^4 p_{og}^2]/[3\pi\varepsilon_{og}c^3] \quad (20)$$

Here $p_{og}$ is gravitational dipole (gravito-electric dipole), $\varepsilon_{og}$ is the gravito-electromagnetic permittivity. Similar to Coulomb law the value of G may be written as follows:

$$G=1/(4\pi\varepsilon_{og}) \quad (21)$$

And substituting (21) into (20) yields:

$$P_g=[4G\omega^4 p_{og}^2]/[3c^3] \quad (22)$$

Since the value of gravitational dipole for photon for evaluation may be taken as N*h/c, final result is:

$$P_g=N^2*[4G\omega^4 h^2]/[3c^5] \quad (23)$$

And the minimum possible radiation for photon (because in theory N may be very large number) gravitational dipole is:

$$P_g=[4G\omega^4 h^2]/[3c^5] \text{ or for a different quantization rule } P_g=[G\omega^4 h^2]/[3c^5] \quad (24)$$

This is enormously small value (because both G, h are small and speed of light is huge) but it is not equal to zero (obligatory). So may be the photon traveling for hundreds of millions of years across the universe finally will start to lost energy due to this process.

Evaluation shows that if ω=9*10exp(16) Hz (green light) the energy loss is 30 orders of magnitude below the Hubble shift for green photon. Consider the frequency to be roughly equal to another fundamental frequency:

$$\omega=2\pi\nu=2\pi c/\lambda_c=2\pi m_e c^2/h=7.8*10\text{exp}(20) \text{ Hz} \quad (25)$$

where $\lambda_c$ is Compton wavelength for electron and $m_e$ is mass of electron. This frequency may be interpreted as the “stumbling” of the photon on each fluctuation of space time on its way. In this case from (23) the energy loss (for N=1) is 6*10exp(-36) J/s or for different quantization rule 1.5*10exp(-36) J/s.

For the red shift for the green light (Hubble constant) of V=9000 km/s for 100 Mps [16] (1 ps=3.26 light years) the frequency shift ($\nu-\nu_o$ ) would mean:

$$(\nu-\nu_o)/\nu_o=V/c$$

or for energies: $(h\nu-h\nu_o)/h\nu_o=V/c$ (because $h\nu=E$) $\Delta E/E_o=V/c=9*10\text{exp}(6)/3*10\text{exp}(8)=0.03$

It means that for green photon with energy of around 3.2*10exp(-19) Joule the energy loss is 9.6*10exp(-21) Joule for 326 millions of years (1.03*10exp(16) seconds) or 9.3*10exp(-37) J/s – the value close to the estimation (because the quantization rule only may change the estimation 4 times, this is relatively good agreement).

The largest problem is that energy loss is independent of wavelength and thus dispersion should be present in the spectra (spectra are not only shifts but rather distorts relatively strongly, what was never observed). However, the idea outlined creates a real mechanism which at least gives the correct value for the red shift observed by Hubble without any "Big Bang". Dispersion may appear at more careful analysis: the value of the gravitational dipole may be actually enhanced by the admixture of the higher quantum levels (N=2, N=3 etc, like any statistics – Boltzman's for the initial try).

Of course, this idea may be very wrong. Most probably the assumption about photon stumbling on each quantum fluctuation of vacuum is not really plausible and such red shift should be much smaller and may reveal itself as an addition to the other dominant mechanism of red shift. From philosophical point of view it means however that the "Big Bang" after all do have many alternatives which may be summarized as "tired light hypothesis based on new physical principles".

In my blog [17] I also explained in detail how the other problem associated with infinite and eternal Universe may be sold: why the stars are still present, what is the origin of the material if not Big Bang. In short: there are already discovered mechanisms of conversion energy back into matter (bi and three proton decay of excited nuclei) which allows to create energy-matter cycle with conservation of the barionic number (like water cycle on Earth). The energy is released at nuclear fusion (very visible process, stars) and transferred back into matter in much less visible process of acceleration of protons and other particles in the different fields (2 GeV protons are main component of interstellar radiation) thus utilizing the energy, the interaction (invisible but present everywhere) of such energetic particles with other matter (dust) re-creates protons and eventually atoms of hydrogen, which are condensed back into stars and make fusion again and so cycle repeats again and again. The problem of increase of enthropy still present: if the Universe is so old, how it is possible that not all matter is in the form of black holes already? Because for the very old Universe only black holes and radiation should stay – no energy cycling any more (water cycle on Earth is of course the consequence of open system – the energy of Sun is responsible for the cycle, without this energy it would be stopped completely in some half way). And that is correct idea – some "friction" in the oscillating system matter-energy-matter is inevitable. The problem is how high is "resonator quality factor"? For many quantum oscillators it is enormous – many orders of magnitude. If energy-matter oscillation with includes the star creation and end of life is roughly 1 billion of years, for "quality factor" of 1000 the age of Universe before each such cycle is exhausted is trillion of years, which would correlates with the minimum evaluated age of eternal Universe [17]. Undoubtedly the Universe had a beginning and will have the end, the "eternity" is in the sense that the age by far larger than present day 13 billions of years. Eternity means for all present day observations and known physics the Universe is eternal.

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Chapter 3. Back to simplicity. The simpler the object for investigation the easier to interpret the results.

This chapter will be completely devoted to the history, methodology and philosophy with some political ideas. And it will include more of critique than positive ideas about where to search the new physics. The positive ideas were already published in the first book and partially are expressed in first two chapters, no time to speculate why the crisis in physics happened.

For the long time the physics was checking the simplest possible experiments and got a lot on knowledge on this way. Even today books on physics are opened with kinematic of single point and two bodies problem (which have simple analytical solutions). That was done in the older years not because the computers were not yet invented and the only way to make math was paper and pencil but because the simple system has less number of variables and any underlying law is much easier to ascertain. Sometimes the phenomenon is not easily seen when it is on the simplest object but the scientists are not artists, they should dig into the foundations of the phenomenon and start research at the simplest objects. A good example is dark matter.

Accelerated rotation of galaxies and group of galaxies are relatively easy to see. And from artists point of view the more spectacular the effect the more attention it deserves. Here is the famous simulation video showing how the galaxy with flat rotation curve rotates visibly faster compare to what should be for the pure Newtonian dynamics [1]. Since the discovery of this phenomenon the whole area of research was centered around galaxies and clusters of galaxies which thanks to modern computers may be simulated as a whole, as a multibody systems and generate spectacular videos of stars motion for the enormously complex cases. Indeed, the galaxies have an internal fields, billions of stars, numerous nebulae and stranded planets and gas clouds etc. For some unknown reasons the phenomenon of accelerated rotation ("dark matter") reveal itself most dramatically on the galactic and intergalactic scale, so those are objects for investigation. But scientists know that the most promising object would be as simple as possible – in the case of accelerated rotation that would be binary star or even a planet rotating around a star. Why it would be the ideal object for research? This is because of simplicity – the kinematic and dynamic of two bodies system is well known and even tiny deviation from the appropriate motion would be easy to interpret (not necessarily easy to find, however). That is very clear to any experimentalist: if the device generates new and amazing results, first check the socket to 110 V – any problems there? What about computer connection? Is rough pump working? How experiment reacts on turning on and off light in the room?

Despite such checks sounds funny the experienced physicists know that 90% of "discoveries" are nothing more than experimental errors [2]. Therefore the best way to find the true origin of the phenomenon called dark matter is to simplify the problem as much as possible and the simples object would be one planet plus one star (Solar system). Well, nothing found so far, so the next object would be binary stars (because there are so many of them discovered, some have elongated elliptical orbits compare to the almost circular ones in Solar system). Advantage here is the simplicity of the system.

And history confirms this idea too. Kepler laws and Newton physics were using investigation of the two objects system – planet rotating around the Sun (only much later the interaction between planets allowed to discover new planets – only after the laws are well established and multiple times confirmed on simple objects, the complex objects may be investigated with some feasible results). Quantum mechanics started from the success of Bohr model of the simplest possible object – one simplest possible nucleus and one elementary particle – one proton and one electron. Than success for

more complex objects like helium atom and hydrogen molecule followed and only much later unrestricted Hartree-Fock approach allowed complete and successful calculation of any atom irrespective of the complexity.

From the fastest way to new physics point of view the research in the field of dark matter should be centered around high quality measurements of orbits of binary stars (using most powerful and precise space telescopes) for long time span with the hope to find the unexplainable deviations from Newton-Einstein dynamic and thus making first empirical corrections, than semi-empirical and finally fully developed theory corrections toward galaxies and clusters of galaxies. Unfortunately the stars are rotating slowly, even the most promising candidates will need decades of observation time, but the sooner the experiment is started the faster the results will be obtained. With the present day crisis already developing for 50 years (and expected to be lasting for centuries more) we would already have the undisputable deviations from the classical laws of physics on the table and were able to create the fist theories to go deeper (the new physics). Yet scientists are stuck with analysis of the extra-complex objects like galaxies, where any result may be overcame by the possible explanations involving magnetic fields, gas clouds, influence of supernova, of dark holes and many other unknowns.

Of course as shown in [3] the possible change in the dynamic of binary stars due to the presence of new phenomena is very small. But if they are found, it would be much easier to convince the community that they are real – because the objects are simple, all the present noise factors like planets, fields and gas clouds are easy to eliminate or take into account and there is no much room for speculation on the alternative origin of the phenomenon.

Simplicity unfortunately correlates well with price – the simpler object for research the more expensive the research itself. This is because the core origins of the phenomena for new physics are expected to be tiny. The are combined together to show the spectacular change in complex objects but itself are tiny. And tiny objects needs huge money. Possibly only government may decide that such research is necessary and supply the researchers with money and broadly speaking necessary resources. Thus the idea of **national laboratory** appears (that would be the political idea, in addition to historical, philosophical, methodological ideas). This idea was already expressed in [4]. **Gravito-electromagnetic national laboratory** would create very high masses rotating here on Earth and effectively generating oscillating gravitoelectric and gravitomagnetic fields strong enough to be measured with the help of next generation ultra-sensitive detectors. On astronomy side such laboratory would handle the space telescopes devoted to extra-long (up to century) survey of binary stars. The purpose would be to discover the deviations from the orbits described by the Newton-Einstein equations for the simple objects. This is inevitable because of the principle of continuity: if phenomena is greatly visible on extra-galactic scales (“dark matter”), observable in many galaxies (accelerated rotation), it must be present for binary stars (the phenomenon may not just abruptly stop at a certain distance, such step function is highly unexpected). Unfortunately the scale of the phenomenon is expected to be very small too – that is why the expensive and long term observations are necessary.

Another area of research, where the idea of simplicity is appealing is denial of Big Bang. Actually dark matter and Big Bang is highly correlated – the dark matter is necessary to explain too fast forming of galaxies. Recent discoveries made by James Webb space telescope forced some visionary scientists to claim that the **simpler** idea of eternal Universe with red shift merely being measure of distance is more productive compare to the inevitable cosmological expansion [5]. That idea correlates well with

centuries old switch from too complex epicycles model of star motion to Copernicus idea of Sun being the center for the rotation of the planets. That historical analogy should be considered by physicists all the time – the overcomplex equations are rarely generating good results. Nature is infinitely complex – the new discoveries are inevitable. And everything new usually fit first by simple linear correlation (empirical level) only later being incorporated into some sophisticated theory. In this situation the simpler explanation usually works better (at least for the start). Of course, the simple explanation may eventually lead to crisis (for example the simplest possible explanation that dark matter is actually is a barionic matter not visible worked well 50 years ago but presently brought physics to crisis). It is interesting that even simpler ideas today are considered as more appealing – no dark matter at all and no Big Bang at all.

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Conclusions.

This book is a continuation of first book but with strong emphasis on philosophical, methodological and historical substantiation of most promising ideas. The first book was mainly devoted to the new ideas (where to search new physics) while this one is mainly devoted to the critique of the existing present day approaches. It has less formulas and more word reasoning and is considered as a good addition to the first book.