Physics

since

Einstein

Each scientist in physics has the moral responsibility to try to adapt mathematics to physics

Einstein adapted physics to his mathematics in his Special Theory of Relativity, with which the decay of physics began

Sjaak Uitterdijk
Physics since Einstein

Sjaak Uitterdijk

Autumn 2018
Fighting the blunders of modern physics is like fighting a hurricane by yelling at it, "Don’t do it, you’ll kill thousands of people!"

*Sjaak Uitterdijk*
# Contents

Prologue 5

I  Einstein's and Galilei's Principle of Relativity 8

II  \(E=mc^2\): a self-evident non-physical equation 15

III  Maxwell's equations, Einstein's Special Theory of Relativity and the Lorentz transformation: a historical review 17

IV  Analysis of the Around-the-World Atomic Clocks Experiment 20

V  From astronomical to terrestrial light 23

VI  The Doppler shift and the Special Theory of Relativity 25

VII  Definition of Potential Energy Fundamentally Incorrect 30

VIII  Why a photon is not a particle 33

IX  Matter Waves: a fable 47

X  Gravitational Waves: a fable 49

XI  Planck’s Theory of Heat Radiation criticized 50

XII  Correcting for Relativity in GPS makes no sense 66

XIII  Religious Science 69

XIV  Velocity of cosmic muons most likely much higher than \(c\) 72

XV  The Time of the Photon 75

XVI  No Evidence for Spinning Electrons 77

XVII  Light in vacuum behaves like sound in air 85

XVIII  The mystery of vacuum 86

XIX  The umpteenth evidence 87

XX  What went wrong with the atomic mass unit 90

XXI  Why Heisenberg-Schrödinger’s atomic model is invalid 93

XXII  Atomic nuclei modelled without exotic particles and magic forces 98

XXIII  Avogadro constant in combat with atomic mass unit 111

XXIV  Is the Earth an Inertial System? 113

XXV  Velocity of an Electric Current 114

XXVI  How Electro Magnetic radiation raises temperature 117

XXVII  Quantum Electro Dynamics: a fully fuzzy fantasy 120

XXVIII  A Revised Principle of the Sagnac Interferometer 122

XXIX  From Maxwell’s equations to Electro-Magnetic Waves 128

XXX  Special Theory of Relativity based on fraudulent science? 134

Epilogue 138

Acknowledgement 139


Prologue

Common Sense Defies “Physics”

All my theoretical research on physics, created by and since Einstein, have led me to the belief that the higher the level of intelligence of the physicist, the more that can be a threat to the health of physical sciences. Einstein started the decline of this science with his Special Theory of Relativity!
In 1905 Einstein introduced his Special Theory of Relativity (STR). The rumours I heard when I was about 16 years old were that only he and a few other extremely intelligent scientists would be able to understand this theory. A turning point in the history of physics, not only because of this supposed sublime theory, but even more because of the abandonment of the phenomenon 'ether'. Until that turning point no physicist ever thought about the possibility that this phenomenon would not be a realistic one. But the experiment of Michelson and Morley forced them to reject it, especially after Einstein came with his theory in which he did so.

After having successfully completed my academic study Electronics I decided, challenged by the above mentioned qualification of Einstein’s theory, to investigate the STR. Having studied the first 10 pages for the umpteenth time my dilemma was: or I have to admit that only extremely intelligent scientists can understand this theory, or the theory is possibly wrong. I decided to investigate that possibility. The result of that investigation is shown in my first chapter: “Einstein’s and Galilei’s Principle of Relativity”.

A few decades after the STR was published the genie was out of the bottle. Supported by the General Theory of Relativity too, nothing in physics was impossible anymore: light has the magic property of being \( c \) relative to whatever reference: the most unphysical, to express it mildly, hypothesis ever created in physics, mass can be generated by an arbitrary energy just by dividing it by \( c^2 \), time dilation has been used to create space-time, space-time causes black holes, matter and gravitational waves got accepted as realistic physical phenomena, muons got equipped with their own clock in order to adapt their decay time to their velocity, electrons got spinning by creating fundamentally wrong evidence, the particle-wave duality effectively got accepted as a formal theory, leading to the most unrealistic physical models, etc., etc.

Especially the particle-wave duality did attract my attention resulting in a theory, shown in: “Why a photon is not a particle”. This theory perfectly describes, based on Bohr’s atomic model and generally accepted physical laws and constants for centuries, why a photon is no more and no less than an electromagnetic pulse with a very short duration.

During the development of that theory it turned out that the conventional definition of the phenomenon ‘potential energy’ is wrong, meaning that it has the wrong sign. The influence of the presumed flagrant faulty property of orbiting electrons is dramatic: the atomic lowest energy state is supposed to perform when electrons orbit at the smallest distance to the nucleus! In reality the opposite is true. As a result even Bohr’s atomic model has been changed to the Heisenberg-Schrödinger’s atomic model, being full of vague phenomena. See chapter XXI: “Why Heisenberg-Schrödinger’s Atomic Model is Invalid”.

Many articles, accepted by the scientific establishment, give the impression that not physics has been tried to model, but that mathematics, applied by the members of this establishment, determines how physics behaves.

N.B. The craziest ‘physics’ can be created with mathematics. A perfect example is: Emergent Gravity and the Dark Universe, by Erik Verlinde.

While writing the article “Why Heisenberg-Schrödinger’s Atomic Model is Invalid” all of a sudden my eye caught consciously a drawing of the nucleus of a Helium atom. I did accept for decades of years unconsciously this model as a realistic model, but now realized immediately that it is a most unrealistic one, being extremely “explosive” given the repulsive forces between the protons. But the scientific establishment found a solution for that problem: ‘strong’ forces, totally unfounded brought on stage, hold them together.

It looks like this imaginative solution has been camouflaged by the following even more imaginative approach.

Protons as well as neutrons are supposed to be composed of the exotic particles called up and down quarks. Up quarks are supposed to be electric charged as \( +\frac{2}{3}e \), down quarks as \( -\frac{1}{3}e \). Two up and one
down quark in a proton to obtain the electric charge 1e and one up and two down quarks in a neutron to obtain 0 electric charge. Extremely resourceful, but one wonders what the purpose of this fantasy might be. It makes the existing problem even more complex: alike charged quarks will repulse each other and unlike charged quarks will merge together.

But again the fantasy of this establishment is large: gluons have been introduced in order to ‘glue’ the alike quarks together (at a certain distance), while that same magic glue is also able to prevent unlike charged quarks to get merged.

What happens here shows remarkable resemblance with what happened when mankind didn’t, and still doesn’t, understand how nature on earth and mankind itself originated: it created a ‘strong’ force that is supposed to do so and called it God.

The just mentioned religion like modelling of the atomic nuclei has led to chapter XXII: “Atomic Nuclei Modelled Without Exotic Particles and Magic Forces”.

The scientific establishment is organized in such a way that only ideas sprouted from the brains of the members of this establishment are accepted for publishing in magazines created by this establishment itself. The butcher approves his own meat.

I have to admit immediately that many physicists who are not a member of this ‘club’ have generated thousands of the craziest ideas too. Why not? The scientific establishment presents an enormous amount of crazy ideas in their own magazines and Internet offers the amateur physicist ample opportunity to show them.

As a result the only difference between a professional and an amateur physicist is that the professional one gets money for his fantasy!

To show an extreme belief maintained by a, rather restricted I assume, group of amateur physicists: vacuum still contains a certain substance that should be called ‘ether’. Confronting them with the consequence that, given the specification of this substance, its mass density must be about $10^{14}$ kg/m$^3$, they don’t even blink with their eyes, while pretending that such a consequence is not a problem at all.

However, the scientific establishment created an at least as stupid fantasy called Quantum Electro Dynamics, in which the so-called quantum vacuum state plays a dominant role. See chapter XXVII: “Quantum Electro Dynamics: a fully fuzzy fantasy” for the argumentation of the qualification just given to this “theory”.

And last, but not least: scrutinizing Einstein’s article about the Special Theory of Relativity shows that his mistakes in his mathematics are so extremely obvious that one can hardly belief that he didn’t make them purposely. The arguments are presented in chapter XXX: “Special Theory of Relativity based on fraudulent science?”.

I don’t envy the current physicist, neither the professional nor the amateur, but especially not the future physicists. They will be immersed in a completely foolish physical world that may no longer be referred to as physics, but that only deserves the designation "physics".
I  Einstein's and Galilei's Principle of Relativity

Summary - The Special Theory of Relativity (STR) proposed by Einstein in 1905, is based on two presumptions: the first one, labelled by Einstein as the Principle of Relativity (PoR), and the second one defining the supposed property of the speed of light in vacuum. This chapter shows how close Einstein, as well as Lorentz, has been to a solid solution of the problems physicists encountered a century ago, observing electro-magnetic phenomena. It also shows that Einstein’s PoR is a fundamentally restricted version of Galilei’s Principle of Relativity.

1.  Introduction

The so-called negative result of the experiment of Michelson and Morley urged physicists a century ago to find a solution for the fundamental problem showing up by that result. The Special Theory of Relativity emerged as a presumed answer to the problem. In order to try to understand the foundation of this theory, some text written by Einstein has been analysed in detail in this chapter. Doing so, it turned out that it is also important to show some text of Lorentz, written in the year before Einstein presented his article about STR.

2.  The distinction between axiom, postulate, hypothesis and theorem

The common property of the first three concepts is that they all express a presumption. There are as many definitions of these three concepts as there are users of them. For that reason it is considered necessary to show the definitions meant in this chapter.

An axiom is a presumption of which its validity is strongly self-evident.
A postulate is a presumption considered valid as long as it has not been proven to be invalid.
A hypothesis is a presumption of which it is required that its validity has yet to be proven.
A theorem is a logical result of presumptions of whatever kind.

3.  Historical review

The historical review concerns a description, by Lorentz in 1904, of the problems regarding the ether model in relation to the velocity of light, copied in appendix I from reference [1] and a copy of a part of the beginnings of Einstein’s translated article: On the electrodynamics of moving bodies, originally written in 1905. See appendix II.

Appendix I shows that Lorentz must have been looking for a postulate, he called it a fundamental assumption, that would lead to the result:

“…… that many electromagnetic actions are entirely independent of the motion of the system.” (Reference [3] shows that Lorentz was searching for evidence of an absolute frame of reference.) Strange however that he would already have been satisfied if only many, so not all, “electromagnetic actions” would be “independent of the motion of the system”.

That does of course raise the question which actions would have to be excluded and why.

Appendix II shows that Einstein’s word ‘Vermutung’ has been translated into ‘conjecture’ and his word ‘Voraussetzung’ into ‘postulate’. Most likely Einstein (indeed) meant with his word ‘Voraussetzung’ a presumption, considered valid as long as it has not been proven to be invalid, here defined as postulate. Besides these two German words Einstein also used the word “Prinzip”, of course translated as “principle”. The end of Appendix II shows that Einstein should have used the word “postulate”, where he used the word “principle”. “Principle” can hardly be distinguished from “axiom”.

8
The most important, (at least in the opinion of the author,) conclusion that can be drawn from Appendix II is that Einstein’s postulate, named Principle of Relativity (PoR), is not equivalent to the “now-a-days” postulate, also named Principle of Relativity. This postulate (or should it be qualified as an axiom?) sounds:

Each physical law is the same in any inertial system.

This results in the conclusion that:

Each experiment carried out in any inertial system shows the same result.

Einstein’s PoR is a fundamentally restricted version of the now-a-days one: it (only) states that in case of two arbitrary inertial systems, moving w.r.t. each other, it will not make any difference whether the coordinates of the one or the other system are taken as reference for the description of those physical laws that describe the mutual interactions of the physical processes in these two inertial systems. Copied from [2]:

“It is known that Maxwell’s electrodynamics—as usually understood at the present time—when applied to moving bodies, leads to asymmetries which do not appear to be inherent in the phenomena. Take, for example, the reciprocal electro-dynamic action of a magnet and a conductor. The observable phenomenon here depends only on the relative motion of the conductor and the magnet, whereas the customary view draws a sharp distinction between the two cases in which either the one or the other of these bodies is in motion.”

We now can conclude:

- that it was Einstein who introduced the postulate named ‘Principle of Relativity’,
- that he used the word “relativity”, in order to express the mutual interaction of physical processes in two arbitrary inertial systems moving relative to each other,
- that he wanted to express too, by choosing the word relative, that a frame of reference in absolute rest had to be rejected,
- that his PoR is a fundamentally restricted version of the “now-a-days PoR”,
- that the name of the “now-a-days PoR” should therefore not be Principle of Relativity.

As a result it is proposed to qualify:

Each physical law is the same in any inertial system

as an axiom and to name it:

Principle of Galilean Relativity

meant to express the relativity that originally has been proposed by Galileo Galilei and to honour him posthumously for this extraordinary important axiom.

The applied abbreviation for this axiom in this chapter will be PGR.

Reference [4] shows:

“Galileo put forward the basic principle of relativity, that the laws of physics are the same in any system that is moving at a constant speed in a straight line, regardless of its particular speed or direction. Hence, there is no absolute motion or absolute rest. This principle provided the basic framework for Newton’s laws of motion”, but presents a fundamental error by adding: “and is central to Einstein’s special theory of relativity.”, as has been shown above.
4. Einstein’s postulate regarding the speed of light

As shown in Appendix II, Einstein proposed the following postulate regarding the property of the speed of light:

"Any ray of light moves in the “stationary” system of co-ordinates with the determined speed c, whether the ray be emitted by a stationary or by a moving body."

Einstein’s mathematical relations between time, distance and speed of light show his perception of the property of the speed of light in the following situation. A light ray moves in the “stationary” system with speed c in the direction of a moving rod r_{AB} (with speed v w.r.t. that “stationary” system) passing the one end point A of the rod at t_A, reflected at the other end point B of the rod at t_B and again passing A at t'_A. It shows that the speed of light is taken c-v w.r.t. the rod on the way out and c+v w.r.t. the rod on the way back: t_B–t_A = r_{AB}/(c–v) resp. t'_A–t_B = r_{AB}/(c+v).

The fundamental error in Einstein’s second postulate is that he effectively reintroduced with his “stationary” system the ether model, most likely without noticing it, because he rejected the ether model himself in the same article. It is generally accepted that an absolute stationary system does not exist. As a result only a stationary system w.r.t. another system can exist. As a consequence that other system is also stationary w.r.t. the first mentioned one. Therefore the introduction of a “stationary” system is senseless, whether it is put in quotes or not. Einstein even defined it as the “stationary” system:

"Let us take a system of co-ordinates in which the equations of Newtonian mechanics hold good. In order to render our presentation more precise and to distinguish this system of co-ordinates verbally from others which will be introduced hereafter, we call it the “stationary” system." (Note 2: i.e. to the first approximation.)

Regarding this definition it might be that Einstein (only) meant ‘inertial system’. However, there are two reasons to reject that possibility.

In the above quoted postulate Einstein clearly means ‘not moving’ with ‘stationary’: ‘......emitted by a stationary or by a moving body’.

Secondly, the equation t'_A–t_B = r_{AB}/(c+v) shows that after reflection (at point B of the rod) the speed w.r.t. Einstein’s “stationary” system is indeed still supposed to be c, notwithstanding the situation that the propagation direction is reversed and the reflector is moving with speed v w.r.t. that “stationary” system.

The ether model prescribed such a property too, and Michelson and Morley based their experiment on this supposed property: the ether determines the speed of light, not the source or reflector! So Einstein indeed effectively reintroduced an ether-like model with the introduction of his “stationary” system.

This fundamental error could have been the main reason for the fact that the community of physicists changed Einstein’s postulate to: the speed of light is c w.r.t. whatever reference, clearly in contradiction with his postulate and with his two equations shown above. That same community however did not change Einstein’s theoretical considerations. Given the PGR, both postulates can be proven to be incorrect.

5. Theorem Concerning the Reference for c

Based on the PGR, the following theorem can be built up regarding the speed of light:

- The emission of light by a source is based on certain physical laws.
- The speed of light in free space as well as in a tangible medium can be calculated by means of the Maxwell equations.
- Due to the fact that these equations do not show any relation with the source, the calculation of the speed of light in a tangible medium must only concern the situation that the source is in rest w.r.t. that medium. As a result this speed is referenced to the source as well as to the medium.
• Replacing the tangible medium by free space eliminates the last mentioned reference.
• What is left is that the speed of light in free space is $c$ w.r.t. its source.
• The PGR now forces us to conclude that in all inertial systems in free space the speed of light, emitted by a source fixed in that system, is $c$.

Formulated in a shorter way:
A light source in free space emits light with propagation speed $c$ w.r.t. that source.

Due to the fact that a reflection is, just like an emission, a physical process, the mentioned theory is also applicable in case of a reflector.
In case the light source/reflecter is not an inertial system itself, the theorem has to be changed to: the speed of light in free space is $c$ w.r.t. its source/reflecter, at the moment of emission/reflection.

6. Einstein’s perception regarding the Phenomenon of ‘Time’

Einstein’s perception of time was developed from the point of view of his definition of simultaneity. This definition forced him to introduce different times in different inertial systems. Most likely as a result, he did not introduce a formal hypothesis about ‘time’.

The PGR applied to atomic clocks operating in inertial systems leads to the following consideration:
• Atomic clocks measure time, based on certain physical laws.
• The PGR thus prescribes that atomic clocks in principle measure the same time in all inertial systems.
• STR claims that atomic clocks will not measure the same time in inertial systems with mutual different velocities.
• STR thus contradicts the PGR regarding the time transformation as function of speed.

In general: the PGR forces us to conclude that time is universal!
So, all experiments that claim to support time dilation, must have been carried out incorrectly, or interpreted incorrectly, or both.

7. The mysterious observer in STR

Einstein’s idea behind the phenomenon observer is that he created the solution to the following theoretical “problem”: how can we observe/measure the simultaneity of events, applying light signals?
Einstein created two fundamental problems, putting forward the alleged importance of simultaneity.
• There is no simultaneity problem at all: now here equals now there, wherever ‘there’ might be, and independent of speed too, as proven above.
• Einstein ignored pure physics by not carefully distinguishing between Theory on the one hand and Measurement on the other hand.

A theory, by definition, does not rely on measurement. A physical theory describes what happens physically. The measurement of what physically happens is a fundamentally different thing. Several measurements have been carried out in order to verify a theory. Verifying the validity of STR would, regarding the alleged importance of the observer, for example, mean: measure the observation of some mysterious observer, observing the time measurement of two clocks, moving with mutual different speed.

The ridiculousness of such a verification process is self-evident.
8. Einstein’s mathematical manipulation

By manipulating his mathematics at a certain point, Einstein succeeded in presenting consistent transformation formulas. ‘Consistent’ regarding the property of these formulas that, after transforming the coordinates x and t from system S to System S’, the original coordinates in S are found again applying the same formulas with the appropriate variables.

This manipulation concerns the variable x, being a constant in S at the start of his mathematics, defined as $x=ct$ at the point of manipulation and again as constant after that.

Without this manipulation he would not have succeeded in realising these ‘consistent’ transformation formulas.

So, in his heart, Einstein must have known that his assertion below was fanfaronade:

“those who claim to be able to prove experimentally that STR is invalid, carried out / interpreted their experiment wrongly”.

The truth is found by changing the word ‘invalid’ in ‘valid’.

9. Speed of light in a moving medium

Speaking about a moving medium requires in the first place the definition of the reference of the speed of that medium. The most logical reference is the source of the light of which we want to determine the propagation speed. Secondly it is necessary to define the reference for this speed of light. That can be its source, but also the (moving) medium.

In 1818 Fresnel deduced the mathematical expression for the speed of light in a moving medium. His expression shows the so-called drag coefficient of Fresnel. He deduced this expression, assuming that the ‘medium’ ether was necessary for the propagation of light and at the same time being an absolute reference for whatever velocity. Fizeau experimentally proved the correctness of this expression in 1851:

$$c_{m}' = c_m + v(n^2 - 1)/n^2.$$  

If, instead of what Fresnel assumed, not the ether is taken as the reference for all mentioned velocities, but the source of the light, then this equation has to be interpreted with the following definitions:

- $v$ = the speed of the medium w.r.t. the source, positive in the propagation direction of the light
- $n$ = the refractive index of the medium
- $c_m = c/n$ the speed of light w.r.t. its source for $v=0$
- $c$ = the speed of the light w.r.t. its source in vacuum
- $c_{m}' = c_m$ the speed of light w.r.t. its source for $v$ not equal zero

Most likely the expression of Fresnel never has been subject of discussion after the medium ether had been abandoned. So be it. By defining the source as the reference for the speed of light and for the velocity of the medium, Fresnel’s expression can, without any restriction, be maintained.

As the expression shows: for vacuum ($n=1$) yields: $c_{m}' = c_m = c$, the speed of the light w.r.t. its source!

Astronomical light entering the atmosphere of our earth does have a speed, w.r.t. the atmosphere/earth, of say $c+v_{ri}$. The speed $v_{ri}$ represents in first instance, which means at the moment of emission, the mutual speed between the earth and the celestial object at the mentioned moment, an arbitrary time ago. At the moment of receipt the earth is in an arbitrary position in its orbit around the sun and thus has an arbitrary speed compared to the moment of emission. The speed $v_{ri}$ thus is at the moment of receipt $v_{ri}$. So, in general $v_{ri}$ is (completely) unknown. However this speed equals the $v$ in the above shown expression of Fresnel.

The refraction index $n$ in this situation is not uniquely defined, because it starts with a value very close to 1 and it is about 1.0003 near the surface of the earth. But the final so- called drag coefficient of Fresnel: $(n^2 - 1)/n^2$ is of course determined by the refractive index in the neighbourhood of the receiver on earth.
9. **Conclusions**

1. In the development of his STR, Einstein used velocities larger than c, clearly in contradiction with his own conclusion that there are no velocities larger than c.

2. Einstein’s postulate regarding the reference for the speed of light in vacuum has been rejected by the community of physicists and replaced by the postulate clearly in contradiction with the one of Einstein.

3. It has been proven that neither the one nor the other postulate regarding the speed of light is correct, by showing the theorem that the speed of light can only be c w.r.t. its source (at the moment of emission in case the source is not an inertial system).

4. Time must be the same in all inertial systems, based on the Principle of Galilei’s Relativity: each physical law is the same in whatever inertial system.

5. The phenomenon ‘observer’, as introduced by Einstein in his STR, has been proven to be a self-evident ridiculous phenomenon.

6. Einstein created a mathematical error that strongly gives the impression of manipulation.

7. As a result the Special Theory of Relativity is an untenable theory.

8. The introduction of the theorem that the speed of light in vacuum is c w.r.t. its source does not have any influence on the expression of Fresnel, showing the speed of light in a medium moving w.r.t. the source.

**References**


Appendix I
Lorentz’s opinion about the consequences of the negative result of M & M’s experiment.

As shown in [1] Lorentz wrote in 1904:

“§ 2. The experiments of which I have spoken are not the only reason for which a new examination of the problems connected with the motion of the Earth is desirable. POINCARÉ has objected to the existing theory of electric and optical phenomena in moving bodies that, in order to explain MICHELSON’s negative result, the introduction of a new hypothesis has been required, and that the same necessity may occur each time new facts will be brought to light. Surely, this course of inventing special hypotheses for each new experimental result is somewhat artificial. It would be more satisfactory, if it were possible to show, by means of certain fundamental assumptions, and without neglecting terms of one order of magnitude or another, that many electromagnetic actions are entirely independent of the motion of the system. Some years ago, I have already sought to frame a theory of this kind. I believe now to be able to treat the subject with a better result. The only restriction as regards the velocity will be that it be smaller than that of light.”

Appendix II
Einstein’s opinion about the consequences of the negative result of M & M’s experiment.

As shown in [2] Einstein wrote in 1905:

“It is known that Maxwell’s electrodynamics—as usually understood at the present time—when applied to moving bodies, leads to asymmetries which do not appear to be inherent in the phenomena. Take, for example, the reciprocal electro-dynamic action of a magnet and a conductor. The observable phenomenon here depends only on the relative motion of the conductor and the magnet, whereas the customary view draws a sharp distinction between the two cases in which either the one or the other of these bodies is in motion. For if the magnet is in motion and the conductor at rest, there arises in the neighbourhood of the magnet an electric field with a certain definite energy, producing a current at the places where parts of the conductor are situated. But if the magnet is stationary and the conductor in motion, no electric field arises in the neighbourhood of the magnet. In the conductor, however, we find an electromotive force, to which in itself there is no corresponding energy, but which gives rise—assuming equality of relative motion in the two cases discussed—to electric currents of the same path and intensity as those produced by the electric forces in the former case.

Examples of this sort, together with the unsuccessful attempts to discover any motion of the earth relatively to the “light medium,” suggest that the phenomena of electrodynamics as well as of mechanics possess no properties corresponding to the idea of absolute rest. They suggest rather that, as has already been shown to the first order of small quantities, the same laws of electrodynamics and optics will be valid for all frames of reference for which the equations of mechanics hold good. We will raise this conjecture (the jut of which will hereafter be called the “Principle of Relativity”) to the status of a postulate, and also introduce another postulate, which is only apparently irreconcilable with the former, namely, that light is always propagated in empty space with a definite velocity c which is independent of the state of motion of the emitting body. These two postulates suffice for the attainment of a simple and consistent theory of the electro-dynamics of moving bodies based on Maxwell’s theory for stationary bodies. The introduction of a “luminiferous ether” will prove to be superfluous inasmuch as the view here to be developed will not require an “absolutely stationary space” provided with special properties, nor assign a velocity-vector to a point of the empty space in which electromagnetic processes take place.”

Two pages further:

“§ 2. On the Relativity of Lengths and Times

The following reflections are based on the principle of relativity and on the principle of the constancy of the velocity of light. These two principles we define as follows:

1. The laws by which the states of physical systems undergo change are not affected, whether these changes of state be referred to the one or the other of two systems of co-ordinates in uniform translatory motion.

2. Any ray of light moves in the “stationary” system of co-ordinates with the determined velocity c, whether the ray be emitted by a stationary or by a moving body.”
II  \( E=mc^2 \): a self-evident non-physical equation

Summary – This chapter shows, from several points of view, why the equation \( E=mc^2 \) must be an untenable equation.

1. Introduction

The equation \( E=mc^2 \) is a result of the General Theory of Relativity, which is, on its turn, a result of the Special Theory of Relativity.

Mind-blowing, but above all shocking, from a scientific point of view, is the myth around this equation.

2. Kinetic energy considerations

The equation \( E=mc^2 \) suggests a kinetic energy, with the problem that it doesn’t fit with the expression \( E=\frac{1}{2}mv^2 \), replacing \( v \) by \( c \). Because \( E=\frac{1}{2}mv^2 \) is a correct equation without any doubt, \( E=mc^2 \) can’t be correct as well. Why isn’t it possible that \( E=\frac{1}{2}mv^2 \), with \( v=c \)? If there would be a reason for that, might it be then that \( v \) equals \( c-\varepsilon \), where \( \varepsilon \) is arbitrarily small?

The mass in the equation under consideration is not just a normal mass but, according to the GTR, a so-called relativistic mass, of which the value depends on its constant velocity \( v \), mathematically written as:

\[
m = \frac{m_{\text{rest}}}{\sqrt{1 - v^2/c^2}}.
\]

Based on the approximation: \( 1/\sqrt{1-\varepsilon} \sim 1+\varepsilon/2 \), \( m \) can also be written as:

\[
m \sim m_{\text{rest}}(1 + \frac{1}{2}v^2/c^2)
\]

Both sides of this equation multiplied with \( c^2 \) results in:

\[
m c^2 \sim m_{\text{rest}}c^2 + \frac{1}{2}m_{\text{rest}}v^2
\]

Quoted from Wikipedia (a few years ago):

*The first term \( m_{\text{rest}}c^2 \) is large, but stays unchanged in daily live, so we will hardly observe, except in case of, for example, nuclear power.*

The term \( m_{\text{rest}}c^2 \) is called rest energy.

Mind alone the word, its contradiction in itself and the fact that \( m_{\text{rest}} \) can only be in rest relative to an object that has the same velocity as \( m_{\text{rest}} \).

Later on in Wikipedia the “importance” of this equation has been accentuated by stating:

*“Due to the enormous factor \( c^2 \) in the formula, 1 gram mass corresponds with \( 8,988 \times 10^{13} \) joule. This is the heating energy of 15 000 barrels crude oil, but also the energy of a bomb of 21.4 kiloton TNT: the same order of magnitude as the atomic bomb Little Boy that destroyed Hiroshima.”*

Very impressive that, for example, a flint of say 10 gram does have a rest-energy equivalent to the heating energy of 150,000 barrels crude oil, which we hardly “observe in daily live”. An energy also equivalent to an atomic bomb with which 10 Hiroshima’s can be destroyed. A flint as Big Boy.
3. Relativistic mass considerations

Firstly:
A fundamental question regarding the “mass at rest” is: what is the chosen reference for determining a mass at rest? No mass is at rest at all in an absolute sense. It always has a velocity and is only in rest relative to an object with the same velocity.

Secondly:
If a mass does have a velocity $v_1$ relative to reference 1 and velocity $v_2$ relative to reference 2, then it would have, at the same time, different relativistic masses, only depending on the reference that is taken to determine its velocity.

In as well the STR as the GTR such contradictions are “explained” by stating that the mentioned references have to be considered as observers, which observe these mutual different relativistic masses.
In these theories it has never been specified at all how such an observation is carried out.
Besides that, this “explanation” contains two fundamental errors:

1. In genuine physics, theory and measurement are carefully distinguished. A theory describes what physically happens. In order to verify a theory, measurements have to be carried out. In STR and GTR these two things are mixed up: the theory includes already “measurements”.

2. A mass of which its value would depend on its constant velocity contradicts with the Principle of Relativity*, the postulate in physics that states that physical laws are the same in all inertial systems. As a result: certainly the value of a mass is constant.

So, in genuine physics mass does have a certain constant value, independent of its velocity, and if two observers would observe mutual different values, at least one observer carried out a wrong measurement.

Conclusion:
The equation $E=mc^2$ is, considered from several points of view, a nonsense equation, leading to ridiculous conclusions about the amount of energy of masses “in rest”, added to the undefined reference regarding that “in rest”.

*In chapter I named: Principle of Galilean Relativity
III Maxwell’s equations, Einstein’s Special Theory of Relativity and the Lorentz transformation: a historical review

Summary: The chapter shows that a lot of misunderstanding and confusion has been originated after Einstein published his article about the STR. Fundamental errors, manipulative mathematics and an unfounded believe in the transformation formulas of the STR caused this chaos.

1. Maxwell’s equations

The remarkable property of the Maxwell equations is that they don’t show any relation with the source of an EM-field, notwithstanding the fact that one can calculate, by means of the wave equations for the electrical and magnetic field, the propagation velocity of such a field. The outcome for vacuum is the well-known propagation velocity \( c = \frac{1}{\sqrt{\varepsilon_0 \mu_0}} \). So in first instance it looks like \( c \) doesn't have or need a reference. The background for this apparent non-physical property is the following.

Maxwell lived from 1831 until 1879, which is the last part of the, centuries long, period during which the standard opinion was that the intangible medium ether “filled” the whole universe. It was assumed to be in absolute rest and be necessary for the propagation of EM-fields. Moreover, the opinion was that the propagation velocity of an EM-field would only be \( c \) w.r.t. this ether, so independent of the velocity of the source w.r.t. this ether.

N.B. Sound has exactly the same property regarding its propagation velocity in, for example, water and air. It is independent of the velocity of its source w.r.t. that medium.

In 1818 Fresnel deduced the mathematical expression for the velocity of light in a moving tangible medium. This expression shows the so-called drag coefficient of Fresnel. He deduced this expression, based on the same opinion as described above, assuming that the ether is not any more at absolute rest w.r.t. a moving transparent tangible medium. As he described it: the ether is dragged by a small fraction of the velocity between ether and transparent medium. Fizeau experimentally proved the correctness of Fresnel’s equation in 1851. So why would any physicist doubt about this ether!

Michelson and Morley lived in the same century as Maxwell, Fresnel and Fizeau. They developed their well-known experiment based on the just described opinion in the period 1880-1890. The consequence of this opinion namely is that the earth also has to have a measurable velocity in the universe w.r.t. this ether.

No wonder that the whole physical world was astonished by the negative outcome of their experiment!

2. Einstein’s Special Theory of Relativity

Einstein abandoned the ether together with the introduction of his STR. But at the same moment he made a fundamental error: he replaced the ether by an equivalent system “in rest”. The quotes have been added by him. The explanations in his article of 1905 clearly show that his system “in rest” has exactly the same properties as the ether he rejected.

By manipulating his mathematics at one point, he succeeded in presenting consistent transformation formulas. ‘Consistent’ regarding the property of these formulas that, after transforming the coordinates \( x \) and \( t \) from system \( S \) to System \( S’ \), the original coordinates in \( S \) are found applying again the same formulas with the appropriate variables. The mentioned manipulation concerns the variable \( x \), being a constant in \( S \) at the start of his mathematics, defined as \( x = ct \) at the point of manipulation and again this constant after that. See Chapter I.
3. The chaos

At a certain moment the community of physicists seemingly discovered Einstein’s fundamental error, regarding his system “in rest”. Instead of publishing this error loud and clear, it slinky changed Einstein’s hypothesis. The system “in rest” changed to a much more stupid hypothesis: the velocity of light in vacuum from that moment on became \( c \) w.r.t. whatever reference / inertial system!

I found one article that tries to present the mathematics that lead to that same ‘consistent’ transformation formulas as Einstein generated, notwithstanding the fact that he based them on a fundamental different hypothesis! It is written by Professor S. Bentvelsen, in Dutch. http://www.nikhef.nl/~stanb/download/SRT2010/SYLLABUS_2010.pdf
It shows even more manipulative mathematics than the one of Einstein!

4. Lorentz transformation

One of the frequently used arguments that the STR is a correct theory is the claim that the Maxwell equations are invariant under the Lorentz transformation. The background is the following.

What is meant here with the Lorentz transformation is specifically and only the velocity transformation:

\[
v_x' = (v_x - v_{\text{R}})/(1 - v_R v_x/c^2)
\]

with \( v_{\text{R}} \) the relative velocity of S and S', \( v_x \) the velocity of x in S and \( v_x' \) the velocity of x' in S'.

It can be deduced simply from the coordinate and time transformation as produced by Einstein.

See the appendix.

That means that this velocity transformation is not deduced by Lorentz and thus has a misleading name. Lorentz developed his own time and coordinate transformation, most times called contraction formulas. They look like Einstein’s formulas, but are significant different. See Reference.

Einstein: \( t' = \beta (t - v_{\text{Rx}}/c^2) \) and \( x' = \beta (x - v_{\text{Rt}}) \)

Lorentz: \( t' = \beta (t/\beta^2 - v_{\text{Rx}}/c^2) \) and \( x' = \beta x \).

The velocity transformation shows that if \( v_x \) in S equals \( c \), \( v_x' \) in S' also equals \( c \).

However this property is in contradiction with the second hypothesis of Einstein:

Each light beam moves in the coordinate system “in rest” with the specific velocity \( c \), independent of the fact whether this light beam has been emitted by a body at rest or a moving body.

Further on Einstein calculates the time periods that light needs to travel along rod \( r_{\text{AB}} \), as \( r_{\text{AB}}/(c-v_{\text{R}}) \) on the way forth, resp. \( r_{\text{AB}}/(c+v_{\text{R}}) \) on the way back \( r_{\text{AB}} \).

The rod moves with velocity \( v_{\text{R}} \) w.r.t. to the system “in rest”. The light is reflected at point B of this rod. The rod is effectively an inertial system w.r.t. which the velocity of light should be \( c \), according to the velocity transformation, but is clearly not the fact in Einstein’s theory.

The property of the velocity transformation must have led to the situation that Einstein’s original hypothesis has been changed to the one that says that the velocity of light is \( c \) w.r.t. whatever reference and is used to claim that the Maxwell equations are invariant under this transformation.

Given the fundamental contradiction of the ‘Lorentz’ transformation with Einstein’s hypothesis, together with the presented manipulative mathematics, it must be concluded that the claim is worthless.
Conclusion

The Maxwell equations don't have any relation with the STR, nor with the ‘Lorentz’ transformation and can perfectly be applied without these by taking the proven theory that the propagation velocity of light in vacuum is only c w.r.t. its source.

Reference

Electromagnetic Phenomena in a system moving with a velocity smaller than any velocity than that of light. Prof. H.A. Lorentz, Royal Dutch Academy of Sciences 6 (1904), pages 809-831

Appendix

Derivation of the velocity transformation

Einstein’s transformation formulas are:

\[ x' = \beta (x - v_R t) \]
\[ t' = \beta (t - v_R x/c^2) \]
\[ \beta = 1/\sqrt{1 - (v_R/c)^2} \]

with \( x \) and \( t \) defined in \( S \), \( x' \) and \( t' \) defined in \( S' \) and with \( v_R \) the relative velocity of \( S \) and \( S' \). Replacing \( x \) by \( v_x t \), representing a velocity \( v_x \) of \( x \) in \( S \), results in:

\[ x' = \beta (v_x - v_R) t \]
\[ t' = \beta (1 - v_R v_x/c^2) t \]

Defining \( v_x' \) as the velocity of \( x' \) in \( S' \) results in:

\[ v_x' = x'/t' = (v_x - v_R)/(1 - v_R v_x/c^2) \]

If \( v_x = c \) then \( v_x' \) is also \( c \), being fundamentally in contradiction with the hypothesis on which Einstein based his STR: the velocity of light is only \( c \) in the system "in rest"!
Analysis of the Around-the-World Atomic Clocks Experiment

Summary-The description of the experiment, published in 1972 in Science by J.C. Hafele and R.E. Keating, shows in the first part, called: Predicted Relativistic Time Gains, the theoretical background for the calculated time gains. In the second part: Observed Relativistic Time Gains, the results of the measurements are shown. This chapter shows several theoretical errors and a tendentious presentation of the measurements, so clear that the reader cannot avoid a feeling of being deceived in order to get convinced of the correctness of the Special Theory of Relativity.

Analysis

The basic idea is to differentiate the time transformation formula with respect to t, leading to:

\[
\frac{d\tau}{dt} = \frac{d}{dt} \left( \beta (t - \frac{v}{c^2} x) \right), \quad \text{with: } \beta = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}
\]

See Reference.

It turns out that the authors didn’t realize that the variable x, in the theory as described by Einstein, is defined as a constant in the system K in rest (x is projected in the system k, moving with constant velocity v in the direction of the x-axis w.r.t. K, so only this projection is a function of time.) In the differentiation process they have written dx/dt as v, while it is zero.

Doing so, the result is the formula applied by them: \( \frac{d\tau}{dt} = (1 - \frac{v^2}{2c^2}) \). However applying dx/dt=0 would have resulted in: \( \frac{d\tau}{dt} = (1 - \frac{v^2}{2c^2}) \sim 1 - \frac{v^2}{2c^2} \).

This change of sign plays an essential role in the predicted time-gain / time-loss between the stationary and flying clocks.

The table below shows the predicted time-gain / time-loss between the stationary and flying clocks, presented as nsec per day, for \( \frac{d\tau}{dt} = 1 - \frac{v^2}{2c^2} \) (“published”), respectively for \( \frac{d\tau}{dt} = 1 + \frac{v^2}{2c^2} \) (“correct \( \frac{d\tau}{dt} \)”).

<table>
<thead>
<tr>
<th>Effect</th>
<th>Published</th>
<th>Correct ( \frac{d\tau}{dt} )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>eastward</td>
<td>westward</td>
</tr>
<tr>
<td>gravitational</td>
<td>144</td>
<td>179</td>
</tr>
<tr>
<td>kinematic</td>
<td>-184</td>
<td>96</td>
</tr>
<tr>
<td>net</td>
<td>-40</td>
<td>275</td>
</tr>
</tbody>
</table>

Remarks:
1. The measurements have been carried out with a 707 and a Concorde.
2. The gravitational time difference, predicted by the GTR as the authors claim, is calculated as \( gh/c^2 \), with \( g = 9.8 \text{m/s}^2 \) and h the height of the airplane.
3. The value 179 follows from an height of 19000 m, clearly the height of the Concorde.
4. The normal flight height of a 707 is 10000 m, but that height would lead to 94 nsec.
5. The value 144 is found when the height would be 15300 m, clearly the mean value of the heights of the Concorde and the 707.
6. That means that it may be expected that the kinematic contribution is also a mean value of both airplanes.
The following questions can now be asked:

1. Why have these values been mixed? Nothing has been explained about this approach. The reader has to find out this by himself, by checking the presented numbers.
2. There has been a Concorde flying westward, of which the results are presented separately. There must also have been a Concorde flying eastward. Why are the results of this flight not presented separately?
3. The same question can be asked for the 707, flying eastward.
4. Might it be that only the mixed value showed enough similarity?
5. Was the so-called predicted value of these mixed flights really predicted, or calculated after the experiment had been carried out and evaluated?
6. Regarding the accuracy of the observations: isn’t it accidentally that they observed the (wrong) predicted time gains with a claimed accuracy of not more than 10 nsec per day, while, as they wrote:

“However, no two “real” cesium beam clocks keep precisely the same time, even when located together in the laboratory, but generally show systematic rate (or frequency) differences which in extreme cases may amount to time differences as large as 1000 nsec per day.”

and:

“A much more serious complication is caused by the fact that the relative rates for cesium beam clocks do not remain precisely constant. In addition to short term fluctuations in rate caused mainly by shot noise………….”

and:

“These unpredictable changes in rate produce the major uncertainty in our results.”

Besides the error in the expression for $d\tau/dt$ the authors overlooked another fundamental phenomenon. They wrote:

“Because the earth rotates, standard clocks distributed at rest on the surface are not suitable in this case as candidates clocks of an inertial space. Nevertheless, the relative timekeeping behaviour of terrestrial clocks can be evaluated by reference to hypothetical coordinate clocks of an underlying nonrotating (inertial) space (6).

For this purpose, consider a view of the (rotating) earth as it would be perceived by an inertial observer looking down on the North Pole from a great distance. A clock that is stationary on the surface at the equator has a speed $R\Omega$ relative to nonrotating space, and hence runs slow relative to hypothetical coordinate clocks of this space in the ratio $1-R^2\Omega^2/2c^2$, where R is the earth’s radius and $\Omega$ its angular speed. On the other hand, a flying clock circumnavigating the earth near the surface in the equatorial plane with a ground speed $v$ has a coordinate speed $R\Omega+v$, and hence runs slow with a corresponding time ratio $1-(R\Omega+v)^2/2c^2$. Therefore, if $\tau$ and $\tau_0$ are the respective times recorded by the flying and ground reference clocks during a complete circumnavigation, their time difference, to a first approximation, is given by $\tau - \tau_0 = \frac{-2R\Omega v + v^2}{2c^2} \tau_0 / 2c^2$.”

Why did the authors choose for this position of the “inertial observer”, in stead of an observer at such a great distance with respect to earth that ‘it’ would have observed not only the velocities as described, but also the velocity, let say $w$, of the earth due to its rotation around the sun? This velocity not only is much larger than $R\Omega$ and $v$ ($\sim 100000$ km/hour), it would also have led to a completely different theoretical consideration, not only due to the fact that the influence of $w$ is very large on the result, but also due to the fact that $R\Omega$ and $v$ are continuously differently oriented with respect to $w$. 
Incorporating the influence of $w$ would lead to the velocity for the ground reference clock:
\[ v_r = w + R\Omega \cos\Omega t, \]
respectively for the airplane: 
\[ v_a = w + (R\Omega + v)\cos(\Omega t + \phi(t)), \]
with $\phi(t)$ representing the position of the airplane w.r.t. the position of the ground reference clock.

Due to the square of the velocities $v_r$ and $v_a$ in the expression for $\tau - \tau_0$ the influence of $w$ on the this time difference is very large.

Maybe our earth does have yet another velocity, together with our solar system, maybe even much larger than $w$! However (the position in universe of) the reference of this velocity is unknown, so the “hypothetical inertial observer” cannot be placed.

**Conclusion**

Due to the most fundamental theoretical errors and the clear tendentious and biased presentation of their measurements, J.C. Hafele and R.E. Keating have been compelled, or by themselves or by the scientific establishment, to “prove” the correctness of the Special Theory of Relativity, whatever they might have measured.

It is therefore, from a scientific point of view, all the more poignant to have to read in their article their next statement.

“In science, relevant experimental facts supersede theoretical arguments.”

**Reference**

V From astronomical to terrestrial light

Summary: One of the claims that the Special Theory of Relativity is a valid theory is that experiments seem to prove that the velocity of astronomical light reaching the surface of our earth is always \( c \). This chapter shows that such a conclusion is wrong and it also shows that, applying the so-called ballistic theory to light, a sinusoidal shaped Doppler shift of binary pulsars will be detected.

1. Introduction

In chapter I the theorem is proven that the propagation velocity of light in vacuum is only \( c \) with respect to its source, rejecting the hypothesis on which the STR is based.

Chapter III emphasizes the incorrectness of the STR from an historical point of view.

The content of this chapter is based on the mentioned theorem.

2. Astronomical light

Astronomical light is defined as light that has been emitted by astronomical bodies.

Such light reaches our earth normally after a very long time. Based on the theorem mentioned in the Introduction, astronomical light will normally not reach the earth with velocity \( c \) w.r.t. to the earth. In order to be strictly correct and because it is essential in this consideration, the theorem has to be presented as: the propagation velocity of light is \( c \) w.r.t. its source at the moment of emission.

So at the moment light is emitted by an astronomical body and the velocity between that body and earth is \( v \), this light at that moment has the propagation velocity \( c-v \) w.r.t. earth, assuming that \( v \) is in the same direction as the propagation of the light, transmitted in the direction of the earth.

Due to the rotation of the earth around the sun, this \( v \) is a completely different velocity at the moment this astronomical light reaches earth, because the earth has changed his position in its orbit completely.

But still the same symbol \( v \) will be used.

As soon as the astronomical light enters the atmosphere it will be called terrestrial light.

3. The dragcoefficient of Fresnel

In 1818 Fresnel deduced the mathematical expression for the velocity of light in a moving tangible medium. This expression shows the drag coefficient of Fresnel. He deduced this expression, assuming that the ‘medium’ ether was necessary for the propagation of light and at the same time being an absolute reference for whatever velocity. Fizeau experimentally proved the correctness of this expression in 1851:

\[
  c_m' = c_m + \frac{v(n^2 - 1)}{n^2}
\]

If, instead of what Fresnel assumed, not the ether is taken as the reference for all mentioned velocities, but the source of the light, then this equation has to be interpreted with the following definitions:

\[ v \] = the velocity of the medium w.r.t. the source of the light
\[ n \] = the refractive index of the medium
\[ c_m = \frac{c}{n} \] the velocity of light w.r.t. its source for \( v=0 \)
\[ c \] = the velocity of the light w.r.t. its source in vacuum
\[ c_m' \] = the velocity of light w.r.t. its source for \( v \) not equal zero

Most likely the expression of Fresnel never has been subject of discussion after the medium ether had been abandoned. So be it. By defining the source as the reference for the velocity of light and for the velocity of the medium, Fresnel’s expression can, without any restriction, be maintained.
4. Terrestrial light

As soon as the astronomical light enters our atmosphere, the situation as described in the previous paragraph shows up.

The refraction coefficient ‘n’ however is not uniquely defined, because it starts with a value very close to 1 and it is about 1.0003 near the surface of the earth. But the final velocity of the light is of course determined by the ‘n’ in the neighbourhood of the earth.

This atmosphere behaves like a moving tangible transparent medium as described in the previous paragraph, with velocity $v$ w.r.t. the astronomical body at the moment of emission of that light. As mentioned already $v$ is completely undefined, not only because of the fact that normally the relative velocity between that body and earth is unknown at the moment of emission, but also due to the fact that normally such light will reach our earth after such a long period of time that it is at a completely different position in its orbit around the sun, compared to its position at the moment of emission of the light. The velocity $v$ can directly be applied in the expression of Fresnel.

If we now define $c_m''$ as the velocity of the terrestrial light w.r.t. the medium, so w.r.t. the atmosphere, then $c_m''$ is also the velocity of the light w.r.t. earth and thus w.r.t. a receiver on earth.

$$c_m'' = c_m + v(n^2 - 1)/n^2 = c_m - v/n^2 \approx c_m - v$$

Without an atmosphere ($n=1$) this velocity would be: $c_m'' = c - v$.

In case the astronomical light comes from a so-called binary pulsar, for example the Hulse-Taylor, the velocity $v = v_c + v_s$, with $v_s$ a sinusoidal shaped velocity, created by the orbiting pulsar. The order of magnitude of the orbit period is hours to days. This component creates a sinusoidal Doppler shift in such a light signal, after having been received on earth. This Doppler shift can easily be detected by eliminating the unknown but approximately constant component created by $v_c$. Approximately, because during an orbit period of the pulsar the change in orbital velocity of the earth is negligible.

Conclusion

One of the reasons to reject the so-called ballistic theory of light is that the detected smoothly varying Doppler shift of so-called binary pulsars cannot be explained by this theory.

This chapter shows the incorrectness of such an argumentation.
VI The Doppler shift and the Special Theory of Relativity

Summary - This chapter shows the calculations of the Doppler shift in all possible situations and compares the result of one of these situations with the result as predicted by the STR in this same situation. An astonishing contradiction between this predicted result by the STR and the hypothesis on which the STR is built shows up.

Introduction

Four situations are considered:
1. a moving source and receiver in a tangible transparent medium with an arbitrary propagation velocity of the signal w.r.t. this medium,
2. a moving source and receiver in vacuum with a light signal,
3. a moving mirror in a tangible transparent medium with an arbitrary propagation velocity of the signal w.r.t. this medium,
4. a moving mirror in vacuum with a light signal.

The content of this chapter is based on the theorem that the propagation velocity of light in vacuum is \( c \), only w.r.t. its source. The correctness of this theorem is proven in chapter I.

Chapter III emphasizes the incorrectness of the STR from an historical point of view.

The last section shows that the relativistic Doppler shift is also based on the assumption that the velocity of light w.r.t. the receiver is \( c - v \), with \( v \) the relative velocity between source and receiver. This assumption is in contradiction with the hypothesis on which the STR is built: the velocity of light is \( c \) w.r.t. any reference.

1. Moving source and receiver in tangible transparent medium

The consideration hereafter shows the calculation of the Doppler shift in the situation of a moving source that emits an arbitrary single frequency signal through an arbitrary medium. The source is moving w.r.t. that medium and the signal is received by a receiver, also moving w.r.t. that medium. This consideration is helpful in describing and understanding the situation where the signal is replaced by light.

The following variables are defined:

\[ f_s = \text{frequency of the emitted signal} \]
\[ f_r = \text{the frequency of the received signal} \]
\[ v_s = \text{velocity of the source w.r.t. the medium, positive in the propagation direction of the signal} \]
\[ v_r = \text{velocity of a receiver w.r.t. the medium, positive in the propagation direction of the signal} \]
\[ V = \text{velocity of the signal w.r.t. the medium} \]

All velocities are thought on the line source-receiver.

The difference in time between two successive emissions of the same amplitude and the same sign is \( 1/f_s = T_s \). If the first of these two emissions takes place at the moment \( t \), then the second one takes place at the moment that the first one is at a distance \( VT_s \) w.r.t. the place of the source at time \( t \).

This second emission takes place in the position \( v_sT_s \) of the source, again w.r.t. the position of the source at time \( t \).

The wavelength of the, in this situation, compressed signal is \( VT_s - v_sT_s \).
The related frequency \( f' \) is the velocity \( V \) divided by this wavelength:

\[
f' = \frac{V}{(VT_s - v_sT_s)} = \frac{f_s}{V - v_s}
\]

(1)

A receiver at rest w.r.t. the medium thus receives \( f'_s \). The related received wavelength is \( V/f'_s \).

A receiver moving w.r.t. the medium receives in such a situation a frequency shifted w.r.t. \( f'_s \).

This frequency is defined above as \( f_r \). The calculation of this frequency, as function of the defined variables, is as follows.

The geometrical distance between two successive states of the same amplitude and the same sign, given a frequency \( f'_s \), is equal to the wavelength \( V/f'_s \), shown in (1).

A receiver with velocity \( v_r \), positive in the direction of the propagation of the signal, detects the mentioned two successive states during a time period equal to this wavelength divided by \( (V - v_r) \), resulting in: \( (V/f'_s)/(V - v_r) \). The reciprocal value of this time period is \( f_r \).

\[
f_r = f'_s \frac{(V - v_r)}{V}
\]

Given (1):

\[
f_r = f'_s \frac{(V - v_r)}{V - v_s}
\]

(2)

The Doppler shift thus is:

\[
f_r - f'_s = f'_s \frac{(v_s - v_r)}{(V - v_s)}
\]

(3)

The expression shows that a certain velocity of the source w.r.t. the medium does not lead to the same frequency shift as when the receiver moves with the same velocity w.r.t. the medium.

For the extreme situation \( v_s = V \), the received frequency is infinite, while for \( v_s = V \) this frequency is zero, with the remark that the signal will never reach the receiver.

The reason for this asymmetry is that the movement of the source leads to an actual different wavelength in the medium, while the movement of a receiver only results in a change of time periods between two successive equal states of the wave in the receiver.

The expression also shows that whatever \( V \) is, which means whatever the circumstances are, the Doppler shift at the receiver is zero if source and receiver do not move relative each other \( (v_r = v_s) \).

Therefore it can be concluded that most likely the applied mathematics are correct and the physical interpretations behind them too.

In case of a light signal the velocity \( V \) can be expressed in mathematically terms. In ref. [3] it is shown that the velocity of light in a medium, with refractive index \( n \), w.r.t. its source equals \( c/n + v(n^2 - 1)/n^2 \), the so called expression of Fresnel. \( v \) is the velocity of the medium w.r.t. the source, positive in the propagation direction of the signal. In this article \( v_s \) is defined as the velocity of the source w.r.t. the medium, positive in the propagation direction of the signal so \( v = -v_s \). Because \( V \) is defined in section 1 also as the velocity of the signal w.r.t. the medium, it can now be presented as:

\[
V = c/n - v_s(n^2-1)/n^2 + v_s = c/n + v_s/n^2
\]

(4)

For \( n=1 \), \( V \) being \( c + v_s \) expression (2) becomes:

\[
f_r = f'_s \frac{(c + v_s)}{c}
\]

leading to the Doppler shift:

\[
f_r - f'_s = f'_s \frac{v_s}{c}
\]
2. Moving source and receiver in vacuum

The Doppler shift in such a situation is represented by (3) in combination with (4) in which n=1, also calculated at the end of the previous section.

\[ f_r - f_s = f_s \frac{(v_s - v_r)}{(c + v_s - v_r)} = f_s \frac{(v_s - v_r)}{c} = f_s \frac{v_{sr}}{c}, \text{ with } v_{sr} = v_s - v_r. \]

This result can also be obtained in the following way. When a source emits a light signal in vacuum this signal can for two reasons not be compressed or stretched as described in section 1. Reason one is that there is no medium to be compressed or stretched, reason two is that a velocity can not be defined w.r.t. vacuum.

If an arbitrary reference R would be imagined, w.r.t. which a velocity \( v_s \) of the source would be defined, than still the process of emission in vacuum will, of course, not change. That consequently leads to the conclusion that in such a situation the velocity of light is \( c + v_s \) w.r.t. R. This is indeed in contradiction with the STR-hypothesis, but on the other hand only a mathematical tool: the emission process doesn’t change, and neither does its propagation velocity w.r.t. the source by imagining such a reference.

Practically the only reference that is left for a possible velocity of the source, is the receiver. It is also the only relevant one, because we want to describe the frequency shift as received by this receiver. So only the relative velocity \( v_{sr} \), between source and receiver can finally be relevant. In such a situation there is still no reason that the emitted frequency \( f_s \) will be changed during emission. So the wavelength of the signal, arriving at the position of the receiver is \( c/f_s \).

In order to keep as close as possible to the description of the general situation, the relative velocity \( v_{sr} \) is, for the time being, split up in a velocity \( v_s \) and \( v_r \) both referenced to that arbitrary reference R, positive in the direction of the propagation of the light.

As mentioned already, the velocity of the light departing from the source is then \( c + v_s \) w.r.t. R. The velocity of the receiver w.r.t. the light signal is \( c + v_s - v_r \).

The received frequency \( f_r \), is this velocity divided by the mentioned wavelength \( c/f_s \):

\[ f_r = (c + v_s - v_r)/(c/f_s) = f_s \frac{1 + v_{sr}}{c}, \text{ with } v_{sr} = v_s - v_r. \]

The Doppler shift thus is:

\[ f_r - f_s = f_s \frac{v_{sr}}{c}. \]

It shows the agreement with the result obtained with the method of calculation shown in section 1.
3. Moving mirror in a tangible transparent medium

A mirror has to be considered as a combination of receiver and transmitter, in which the received signal is, more or less immediately, transformed into an emitted signal. At the moment of emission the mirror thus is a source. This section will show the calculation of the Doppler shift using the hypothesis that the velocity of light is only \( c \) w.r.t. its source. This model will be applied below in a situation that the original source and the mirror both move with their own velocity w.r.t. a medium and that after reflection the original source will be considered as a receiver. The following frequencies are defined:

- \( f_s \) = frequency of the emitted signal by the original source
- \( f_m \) = frequency at the moment of arrival at the mirror, in case the source does have the velocity \( v_s \) and the mirror the velocity \( v_m \) w.r.t. the medium
- \( f_r \) = frequency of the received signal at the position of the original source, after reflection at the mirror, in the same circumstances as described under \( f_m \)

The mentioned velocities are both defined positive in the propagation direction of the light, leaving the original source.

Using formula (2) we directly can write:

\[
\begin{align*}
    f_m &= f_s \frac{(V_s - v_m)/(V_s - v_s)}{(V_m + v_m)/(V_m + v_m)} & \text{with } V_s &= c/n + v_s/n^2 \\
    f_r &= f_m(V_m + v_s)/(V_m + v_m) & \text{with } V_m &= c/n - v_m/n^2
\end{align*}
\]

So \( f_r \) is:

\[
\begin{align*}
    f_r &= f_s \frac{(V_s - v_m)/(V_s - v_s)}{(V_m + v_s)/(V_m + v_m)} = f_s \frac{(V_s - v_m)(V_m + v_s)/(V_s - v_s)(V_m + v_m)}
\end{align*}
\]

It doesn’t make sense to apply the expressions for \( V_s \) and \( V_m \) in (5).

4. Moving mirror in vacuum

In vacuum (\( n=1 \)) the velocities \( V_s = c + v_s \) and \( V_m = c - v_m \) have to be applied in (5):

\[
\begin{align*}
    f_r &= f_s \frac{(c + v_s - v_m)(c - v_m + v_s)}{(c + v_s - v_s)(c - v_m + v_m)} = f_s \frac{(c + v_s - v_m)^2}{c^2}
\end{align*}
\]

The Doppler shift between the original signal and the signal received back at the original source thus is:

\[
\begin{align*}
    f_r - f_s &= f_s \frac{(c + v_{sm})^2}{c^2 - 1} & \text{with } v_{sm} &= v_s - v_m
\end{align*}
\]

Written as:

\[
\begin{align*}
    f_r - f_s &= 2f_s v_{sm}/c + f_s (v_{sm}/c)^2
\end{align*}
\]

this shows that, even in astronomical situations, the Doppler shift is about \( 2f_s v_{sm}/c \), because \( f_s (v_{sm}/c)^2 \) is negligible w.r.t. \( 2f_s v_{sm}/c \).

The result agrees with reality, again emphasizing that the theory applied in this chapter is correct.
5. Relation with the Special Theory of Relativity

The just found result will be compared with the result that would be obtained if the STR-hypothesis would be applied: light moves in vacuum with velocity \(c\), independent of whatever reference.

At the moment of emission the STR-hypothesis and the theorem that the velocity of light in vacuum is only \(c\) w.r.t. its source, agree in two senses: the one is that light in vacuum does have the velocity \(c\) w.r.t. its source, the other is that during emission in vacuum a frequency change cannot be created.

In case of a tangible medium only a very small frequency change, proportional to the velocity of the source w.r.t. the medium, takes place.

But arriving at the receiver, thus with the original frequency of the source, this velocity is \(c\) w.r.t. the receiver in case of the STR-hypothesis, whatever the velocity of this receiver w.r.t. the source might be. So the receiver will not create a frequency change, in view of the process as described above.

Notwithstanding this contradiction with reality the frequency change based on the STR considerations, is formulated as:

\[ f_r = f_s \sqrt{(c + v_{sr}) / (c - v_{sr})} \]

Elaborating this formula, with, in the first instance, approximating \(1/(c-v_{sr})\) by \((1+v_{sr}/c)/c\) results in:

\[ f_r \sim f_s (1 + v_{sr}/c) \]

This is the same result as presented in section 1 and 2.

Remarkable is that this formula also shows the velocity of light to be not equal to \(c\) in such a situation, which is exclusively excluded in the STR! It even shows the same property of light as proven in chapter I: the velocity of light is \(c+v\), resp. \(c-v\) w.r.t. a reference that is moving with velocity \(v\) w.r.t. the source of the light.

N.B. If light would not have that property, it would not be possible to detect a change in the frequency of the emitted light in such a situation!

Conclusion

The phenomenon “Doppler shift” as prescribed by the Special Theory of Relativity proves that the result is in contradiction with the hypothesis on which this theory is built. The result even emphasizes the theorem, as proven in chapter I, that the velocity of light is only \(c\) with respect to its source.
VII Definition of Potential Energy Fundamentally Incorrect

Summary - The conventional definition of potential energy leads, considered from a fundamental scientific point of view, to absurd consequences. It is strongly advised to eliminate the intermediate variable ‘work’ in the definition of potential energy and, as a result, to reverse the boundaries in the definite integral. Although this chapter historically has been written after chapter VIII it is more logical to present it in front of that chapter.

1. Conventional definition of potential energy and its relation with ‘work’

Potential energy can, in the most general way, be defined as \( E_p = \int F(r) \, dr \), with \( F(r) \) a force along the path \( r \), of which the boundaries have yet to be defined.

Considering an orbital system of two masses \( M \) and \( m \) at a distance \( r \), \( F(r) = GMm/r^2 \).

In the situation of an electron orbiting a proton at distance \( r \), \( F(r) = k_\text{e}q^2/r^2 \).

\( G \) is the so-called gravitational constant, \( k_\text{e} \) the so-called Coulomb’s constant.

The symbol \( q \) represents the electrical charge of an electron as well as of a proton.

For ease of reading, \( F(r) \) will be written as \( C/r^2 \) for both orbital systems.

The result of the indefinite integral is: \( E_p = -C/r \). The definite integral is \( -C/r |^u_l \).

The symbol \( |^u_l \) is meant to express that the boundaries \( l \) and \( u \) have yet to be applied. Traditionally these boundaries are defined as \( (l=\infty, u=r) \) in order to calculate the work to be done in, or the potential energy of an orbital system. The result is (also): \( E_p = -C/r \).

In ref. [1] under: “Potential energy for gravitational forces between two bodies”, the negative sign is explained as follows:

“The negative sign follows the convention that work is gained from a loss of potential energy”

The origin of the confusion is found in the explanation, shown in that reference under ‘Work and potential energy’: the supposed importance of the concept ‘work’. Quoted:

“Potential energy is closely linked with forces. If the work done by a force on a body that moves from \( A \) to \( B \) does not depend on the path between these points, then the work of this force measured from \( A \) assigns a scalar value to every other point in space and defines a scalar potential field. In this case, the force can be defined as the negative of the vector gradient of the potential field.

If the work for an applied force is independent of the path, then the work done by the force is evaluated at the start and end of the trajectory of the point of application. This means that there is a function \( U(x) \), called a "potential," that can be evaluated at the two points \( x_A \) and \( x_B \) to obtain the work over any trajectory between these two points.

It is tradition to define this function with a negative sign so that positive work is a reduction in the potential, that is \( W = \int C F \, dx = U(x_B) - U(x_A) \) where \( C \) is the trajectory taken from \( A \) to \( B \). Because the work done is independent of the path taken, then this expression is true for any trajectory from \( A \) to \( B \). The function \( U(x) \) is called the potential energy associated with the applied force. Examples of forces that have potential energies are gravity and spring forces.”

2. Fundamentally correct definition of potential energy

Taking \( F(r) = C/r^2 \) in the definition: \( E_p = \int F(r) \, dr \), the boundaries in the definite integral will be chosen \( \infty \) for the upper and \( r \) for the lower one. The result then is \( E_p = C/r \). Effectively this potential energy is calculated with respect to zero \( (E_p(\infty)) \), fully in accordance with common sense and always positive.

In order to explain further why \( C/r \) is a better result than \(-C/r\), the kinetic energy in an orbital system will be taken into consideration.
The kinetic energy $E_k$ of an object with mass $m$ and velocity $v$ equals $\frac{1}{2}mv^2$.

The property of a circular orbit is that the centrifugal force $mv^2/r$ equals the gravitational respectively Coulomb force. Both forces have, for ease of reading, been taken $C$, so $mv^2/r = C/r^2$. If $E_p = C/r$ then it follows from $C/r^2 = mv^2/r$ that $E_p = 2E_k$.

Kinetic energy is by definition positive and can in an orbital system also be represented by $\frac{1}{2}C/r$, just like $C/r$ can represent its potential energy.

This is another reason to define potential energy, at least in such a system, as positive.

The total energy $E_k + E_p$ would be, if $E_p$ would be defined as negative, in such a configuration $-E_k$, given the relation $|E_p| = 2E_k$.

It is an absurd consequence that in atoms the total energy would be negative!

Energy should always be defined as positive, except in situations where energy levels are compared in order to show, by means of a negative sign, that one level is less positive than the other.

Another absurd consequence of the conventional definition of potential energy is demonstrated in a description found in ref. [2].

The wrong words have been scratched out and the correct words, obeying the correct definition of potential energy, written behind them in italics.

**Orbital energy**

In atoms with a single electron ..., the energy of an orbital is determined exclusively by $n$. The $n=1$ orbital has the lowest highest possible energy in the atom. Each successively higher value of $n$ has a higher lower level of energy, but the difference decreases as $n$ increases *

For high $n$, the level of energy becomes so high low that the electron can easily escape from the atom.

* The Rydberg expression: $E = hf = hc \times \frac{R}{n}$, $(1/n_1^2-1/n_2^2)$ is meant here.

The example below shows the correctness of the statement: "... the difference decreases as $n$ increases."

<table>
<thead>
<tr>
<th>$n_1$</th>
<th>$n_2$</th>
<th>$1/n_1^2 - 1/n_2^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>0,75</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>0,012</td>
</tr>
<tr>
<td>10</td>
<td>11</td>
<td>0,0017</td>
</tr>
</tbody>
</table>

N.B. *This correctness emphasizes the incorrectness of the three other statements!*

3. **Other consequences of the correct definition of potential energy**

In the previous section it has been argued that negative potential energy should not exist, except to show that a certain energy level is less than the other.

Suppose $m$ moves from $r_1$ to $r_2$ with $r_2 > r_1$.

The question is: what is the difference in potential energy in both situations? In order to answer this question the fundamental question arises: which difference is meant: $E_p(r_1) - E_p(r_2)$, or the opposite?

The correct potential energy is calculated with respect to zero as a positive value if the upper boundary in $\int C/r^2 dr$ is chosen infinite.

Similarly, if $\Delta E_p$ is meant to be $E_p(r_2) - E_p(r_1)$ then seemingly $E_p(r_1)$ is the reference, leading to $r_1$ as upper boundary.

The result is $\Delta E_p = -C(1/r_1 - 1/r_2)$, which indeed is negative, because $E_p(r_2) < E_p(r_1)$. 

31
Special attention has to be paid to the calculation of the “potential energy” of a mass $m$ at height $h$ with respect to earth’s surface. The mass of the earth is represented by $M$, its radius by $r_e$. The generally accepted answer is $E_p = mgh$, with $g = G.M/r_e^2$.

Such an answer makes sense in only one way: the larger $h$ the higher the kinetic energy of $m$, after having been released, just before it reaches earth.

However $mgh$ is not a potential energy but a difference between two (kind of absolute) potential energies as shown hereafter.

\[ E_{ph} = \frac{GMm}{r_e + h} \]

\[ E_{p0} = \frac{GMm}{r_e} \]

For $h \ll r_e$

\[ E_{ph} \approx \frac{GMm}{r_e} \left( 1 - \frac{h}{r_e^2} \right) \]

In case $\Delta E_p$ is taken as $E_{ph} - E_{p0}$, $\Delta E_p \approx -GMmh/r_e^2 = -mgh$.

In case $\Delta E_p$ is taken as $E_{p0} - E_{ph}$, $\Delta E_p \approx +GMmh/r_e^2 = +mgh$.

The choice is up to the “user”.

A remarkable fact is that $\Delta E_p = mgh$ suggests that potential energy increases when the distance increases. But mind the $\Delta$ in the equation!

See also the quoted Orbital energy above, where potential energy is described as increasing with an increasing orbital radius!

Conclusions

1- Given the above presented argumentations the potential energy has to be calculated as $E_p = \int F(r)dr$, using as upper boundary $\infty$ and lower boundary $r$.

2- The phenomenon potential energy does not play any role in an atomic, so circular, orbiting system. The background for this remark is that the centripetal and centrifugal forces, applied to the orbiting electron, are fully and continuously in balance in such an orbit. This conclusion is confirmed by the following definition: “In physics, potential energy is the energy possessed by an object because of its position relative to other objects, stresses within itself, its electric charge, or other factors.”

References

VIII  Why a photon is not a particle

Summary – The variables and parameters of the presented model for the generation of an arbitrary photon fit like the pieces of a jigsaw puzzle and therefore justify the conclusion that the model eliminates the wave-particle duality of the photon by explicitly excluding the possibility that it can be a (massless) particle too. On top of that it has been proven that the energy of the photon is directly delivered by the magnetic energy of the atom, as created by the orbiting electron(s).

1.  Introduction

Considering a photon as an (extremely) short pulse with an electro-magnetic wave as carrier*, eliminates the so-called wave-particle duality. This article shows how the origin of such a pulse can be explained by applying Ampère’s and Faraday’s law in Bohr’s atomic model. Using the Rydberg formula and the assumed energy $E=hf$, the expected pulse lengths and their related EM-powers are presented.

2.  Bohr’s atomic model

In Bohr’s atomic model, in case of a stable atom, an equal number of electrons revolve around the nucleus, as there are protons in this nucleus. These electrons can rotate in orbits with different distances with respect to the nucleus. These distances are discreet. In other words: an electron will never orbit in between the determined circles.

The generally accepted concept is that a photon is emitted if an electron jumps out of an inner orbit into a more outer orbit. The question is: how is such a photon fundamentally and precisely generated?

3.  Forces holding the electron in its orbit

An electron is held in its orbit by three forces:

1. the centrifugal force trying to jump the electron out of its orbit.
2. the centripetal gravitational force between nucleus and electron
3. the centripetal Coulomb force between nucleus and electron

with:

\[
\begin{align*}
  r & \text{ radius of the orbit of the electron} \\
  v & \text{ velocity of the electron along its orbit} \\
  Z & \text{ atom number} \\
  m & \text{ mass of the electron} \\
  m_p & \text{ mass of proton} \\
  m_n & \text{ mass of the nucleus} \\
  G & \text{ gravitational constant} \\
  k_e & \text{ Coulomb’s constant } (1/4\pi\varepsilon_0) \\
  q & \text{ electric charge of the electron}
\end{align*}
\]

The mathematical descriptions of the mentioned forces are:

- Centrifugal force: $F_{cf} = \frac{mv^2}{r}$
- Gravitational force: $F_G = \frac{Gm_n m}{r^2}$
- Coulomb force: $F_C = \frac{k_e Z q^2}{r^2}$

Remarks:

- $r$ has the discreet values $n^2a_0/Z$, with $a_0$ the so called Bohr radius ($n=1, 2, 3, \ldots$)
- The mass of a proton is about equal to the mass of a neutron.
- The number of neutrons is taken equal to the number of protons.
- $F_G \sim 10^{-67}Z/r^2$ and $F_C \sim 10^{-28}Z/r^2$, with the result that $F_G$ is incomparably small compared to $F_C$.

So, the real number of neutrons does not play any role in this article, neither does $F_G$ anymore. As a result, the electron is held in its orbit by $F_{cf} = F_C$.

So, $\frac{mv^2}{r} = \frac{k_e Z q^2}{r^2}$, from which it follows that: $v = (\frac{k_e Z q^2}{mr})^{\frac{1}{2}}$
4. The basic idea behind the generation of a photon

The fundamental part of the investigated model is the assumption that the orbit of an electron around the nucleus of an atom is equivalent to a circular shaped electric current, creating a magnetic field.

Suppose the “round trip” of an electron is \( t \) seconds and its electric charge is represented by the symbol \( q \). Then the first approximation of the meant electric current is \( q/t = i \) [A]. The mentioned “round trip” is equal to \( 2\pi r/v \), with \( r \) the radius of the orbit of the electron and \( v \) the velocity along that orbit.

Such an electric current causes a static magnetic field \( H \), perpendicular to the plane of the orbit. Only in the centre of the orbit this field yields:

\[
H = \frac{i}{2\pi r} = \frac{qv}{4\pi r^2} = \frac{q^2(keZ/m)^{1/2}}{4\pi r^{2.5}}
\]

As soon as the electron jumps out of its orbit, \( r \) changes, so the strength of this magnetic field changes. And a change of a magnetic field causes a change of an electric field.

*Source of an electro-magnetic wave has been created!*

The purpose of this analysis is to investigate whether this idea makes sense or not in relation to the available information about photons.

The magnetic field is usually symbolically presented as one straight line through the centre of the circular shaped electrical current. In reality the magnetic field consists of an infinite number of bowed lines forming a closed field.

The importance of this statement will show up in section 8. Origin of the energy of the photon

5. The kinetic and potential energy of an orbiting electron

The kinetic energy \( E_k \) of an orbiting electron equals \( \frac{1}{2}mv^2 \).

This type of energy is, as the expression shows, by definition positive. Regarding the potential energy the discrepancy between its positive versus negative value is remarkable, leading to for example the most absurd statements as shown in the reference.

**Orbital energy**

In atoms with a single electron (hydrogen-like atoms), the energy of an orbital (and, consequently, of any electrons in the orbital) is determined exclusively by \( n \). The \( n=1 \) orbital has the lowest possible energy in the atom. Each successively higher value of \( n \) has a higher level of energy, but the difference decreases as \( n \) increases. For high \( n \), the level of energy becomes so low that the electron can easily escape from the atom.

The wrong words have been scratched out and the correct ones have been written behind them in italics. See chapter VII for an extensive explanation of the background of these corrections.

A much more important conclusion is that the phenomenon potential energy does not play any role in a perfect circular orbiting system. The background for this remark is the following. The centripetal and centrifugal forces, applied to the orbiting electron, are fully and continuously in balance due to such an orbit. The only phenomenon that really contains energy is its kinetic energy. This kinetic energy causes that the potential energy of the atom is not relevant anymore in the changes of energy state of the atom.

From now on only the kinetic energy \( E_k = \frac{1}{2}mv^2 \) of the electron is taken into account in the following considerations.

Applying the above found expression \( v^2 = keZq^2/mr \) in \( E_k \) results in: \( E_k = \frac{1}{2}keZq^2/r \).

This expression emphasizes the conclusion that the smaller the orbit, the higher the energy state of the atom.
6. The law of conservation of energy

In physics, the law of conservation of energy states that the total energy of an isolated system remains constant, with isolated system defined as “a system so far removed from other systems that it does not interact with them”.

As just shown above a gravitational orbiting system loses energy when the orbit increases and the other way round. In both cases external energy has to be supplied in order to achieve either situation. In first instance this looks like the law of conservation of energy is violated. However, where the original system was an isolated system, an external force coming from a sufficiently far distance, eventually changes the system under consideration. This makes it complicated to prove that the law of conservation of energy in such an example is not violated. But the end result is not questionable.

The next sections show that this problem is a bit more intricate in case of the generation of a photon.

7. Background of the Rydberg expression

Citation from Wikipedia:
“The Planck constant h has been introduced to express the relation between frequency f and energy E for a light quantum (photon) as: E=hf.”

Another description shows:
”The Planck constant was first described as the proportionality constant between the energy (E) of a photon and the frequency (f) of its associated electromagnetic wave.”

The formula E=hf is a non-physical equation, because it suggests that the energy of a photon is proportional to the frequency of its carrier. It is well known that this can, physically speaking, not be true. Only the amplitude of the electro-magnetic wave can be related to its power, thus to its energy, of the photon. Seemingly there is a measured relation between the frequency of the carrier and amplitude (and/or length) of a photon.

It is generally accepted that the orbits of an electron are discrete. However, up to now nothing in Bohr’s model forces us to such a hypothesis. For whatever radius r, the balance between the Coulomb and the centrifugal force is, by definition, perfect. That would also mean that in principle an arbitrary small orbit radius would be possible. The alternative (common sense) definition of potential energy shows that the total energy of the orbiting electron would increase to infinite if the radius of the orbit would decrease to zero. Therefore an orbiting electron cannot melt together with a proton in the nucleus of the atom. So the question why an electron is only orbiting at discrete distances to the nucleus is still not answered.

The discrete radii are mathematically represented by \( r_n = n^2 a_0 / Z \), with n is an integer.

The radius \( a_0 \) is the so-called Bohr’s radius, the smallest in the neutral hydrogen atom.

The mathematical expression for \( a_0 \) is found as follows.

The idea behind the quantitative presentation of the discrete radii is based on the assumption, for whatever reason, that the angular momentum \( mvr_n \) of the electron is quantized, expressed as:

\[ mvr_n = \frac{nh}{2\pi} \quad \text{so:} \quad m^2v_n = \frac{(nh/2\pi)v}{m} \quad \text{and} \quad v = \frac{(nh/2\pi)}{mr_n} \]

From \( F_{cf} = mv^2/r_n = F_C = k_eZq^2/r_n^2 \) it follows that:

\[ mv^2r_n = k_eZq^2 \]

Also equal to \( (nh/2\pi)v \)

Given \( v = \frac{(nh/2\pi)}{mr_n} \) it follows that:

\[ k_eZq^2 = \frac{(nh/2\pi)^2}{mr_n} \]

So:

\[ r_n = \frac{n^2h^2}{4\pi^2k_eZq^2m} \]
\(r_n\) is defined as \(a_0\) for \(n=1\) and \(Z=1\), so:

\[a_0 = \frac{\hbar^2}{4\pi^2 k_e q^2 m}\]

The *positive* difference in kinetic energy of the electron orbiting in \(n_1\) respectively \(n_2\), is represented by:

\[\Delta E_{kn} = \frac{1}{2}m(v_1^2 - v_2^2), \quad \text{with:} \quad v_i^2 = k_e Z q^2 / m r_i \quad \Rightarrow \text{resulting in:}
\]

\[\Delta E_{kn} = (k_e Z q^2 / 2a_0 / Z) * (1/n_1^2 - 1/n_2^2)\]

Applying the expression for \(a_0\):

\[\Delta E_{kn} = (k_e Z q^2 / (2\hbar^2 / (4\pi^2 k_e q^2 m))) * (1/n_1^2 - 1/n_2^2)\]

\[\Delta E_{kn} = h^2 k_e Z q^2 2\pi^2 m / (1/n_1^2 - 1/n_2^2) \quad k_e = 1/4\pi\varepsilon_0 \quad \Rightarrow \text{so:}
\]

\[\Delta E_{kn} = Z^2 m q^4 2\pi^2 / h^2 (4\pi\varepsilon_0^4 * 4\pi\varepsilon_0) * (1/n_1^2 - 1/n_2^2)\]

\[\Delta E_{kn} = \hbar c * Z^2 m q^4 / (8\pi\varepsilon_0 h^3 c) * (1/n_1^2 - 1/n_2^2)\]

The Rydberg expression is:

\[1/\lambda = R_\infty (1/n_1^2 - 1/n_2^2)\]

with the following parameters:

| \(\lambda\) | wavelength of the carrier |
| \(R_\infty\) | Rydberg’s constant |
| \(h\) | Planck’s constant |
| \(\varepsilon_0\) | dielectric permittivity |
| \(\mu_0\) | magnetic permeability |
| \(c\) | velocity of light in vacuum |
| \(m\) | m |
| \(1.097*10^7\) | m⁻¹ |
| \(6.626*10^{-34}\) | VAs² |
| \(8.854*10^{-12}\) | As/Vm |
| \(4\pi*10^{-7}\) | Vs/Am |
| \(2.999*10^8\) | m/s |

With: \(\hbar c / \lambda = hf\):

\[hf = \hbar c * R_\infty (1/n_1^2 - 1/n_2^2)\]

So, indeed, the energy of an emitted photon equals the change in kinetic energy of the orbiting electron. However that is not the complete story about the energy balance between the atom and its environment.

In a pure gravitational orbital configuration the loss of energy is restricted to \(\Delta E_k\) consisting of only *mechanical* energy.

In the orbital configuration under consideration this loss of *mechanical* energy also equals \(\Delta E_k\). But the atom seemingly also looses \(\Delta E_4\) due to the emitted photon.

The question thus is: which source in the atom decreased its level of energy by the amount \(\Delta E_k\) that equals the energy of the photon? The answer most likely has to be found in the consideration presented in the next section.
8. Origin of the energy of the photon

The only source of energy in an atom, excluded the mechanical one, can be the energy of the magnetic field inside the atom. As claimed before, this magnetic field is the result of the orbiting electron, to be considered as an equivalent electric current.

The magnetic field strength in the centre of the orbit is proportional to $r^{-5.5}$. So this field decreases significantly with the radius of the orbit. It is therefore most unlikely that the magnetic energy would not decrease with this radius. Given the fact that a photon is created while an electron jumps to an outer orbit, it is therefore most unlikely that the energy of the photon would not be delivered by the magnetic energy. Presenting the decrease of the magnetic energy by $\Delta E_H$ the next conclusion must be that $\Delta E_H = \Delta E_k$, because it has just been proven that the energy of the photon $E = hf = \Delta E_k$ and because there is no other energy source available inside the atom, as just mentioned.

In order to prove mathematically that $\Delta E_H = \Delta E_k$, the energy of the magnetic field in the atom has to be expressed in the parameters of the atom. The figure below shows the complexity of this problem.

![Figure 1](image-url)

The figure shows the magnetic field of the Earth. If the equator shown here is imagined as the orbit of an electron, then the figure also shows the magnetic field created by such an equivalent current. The energy of the related magnetic field is the volume integral over the hemisphere of the square of the magnetic field strength multiplied by $\mu_0$ at “each” point inside this hemisphere: $E_H = \mu_0 \int V H^2 dV$. In principle it is possible to express $E_H$ in terms of the parameters ‘equivalent current’ at radius $r$, given one electron orbiting its nucleus. The challenge to deliver this expression for $E_H$ has been postponed, because logical argumentation shows that $E_{Hni} = E_{kni}$. (ni has to interpreted as ni)

As has just been argued $\Delta E_H = \Delta E_k$ for whichever emitted photon. Such a result can only be obtained if $E_{Hni} = C + E_{kni}$. Due to the fact that $E_{Hni}$ equals 0 if $E_{kni} = 0$, C must be zero, q.e.d.

Having proven that the energy of a photon is directly delivered by the magnetic energy of the atom, it now is clear why a photon will not be created in case an electron jumps to an inner orbit.

The next section makes it plausible too that the energy of a photon is delivered by the magnetic energy of the atom.
9. Further elaboration of the model

The basic idea behind the generation of a photon is that an orbiting electron is equivalent to a circular shaped electric current.

Such an electric current causes a magnetic field $H$, with $H = q^2(keZ/m)^{1/2}/4\pi r^{2.5}$, perpendicular to the plane through the orbit of the electron.

So, as soon as the electron jumps out of its orbit, $r$ changes and the strength of this magnetic field changes. A change of a magnetic field causes a change of an electric field, resulting in an EM-field, propagating with velocity $c$ relative to the nucleus of the atom.

Step 1: The jump of an electron from $n=1$ to $n=2$ in the neutral hydrogen atom

The value of $Z$ of this atom is 1
The two radii therefor are: $r_1 = a_0 = 5.29*10^{-11}$ m and $r_2 = 2.12*10^{-10}$ m.

The magnetic field strengths related to the two equivalent electric currents are calculated as follows:

<table>
<thead>
<tr>
<th>$r$</th>
<th>$v$</th>
<th>$t_\circ$</th>
<th>$i$</th>
<th>$H$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$r_1$</td>
<td>$0.53*10^{-10}$ m</td>
<td>$2.19*10^6$ m/s</td>
<td>$1.52*10^{-16}$ s</td>
<td>$9.97*10^6$ A/m</td>
</tr>
<tr>
<td>$r_2$</td>
<td>$2.12*10^{-10}$ m</td>
<td>$1.09*10^6$ m/s</td>
<td>$1.22*10^{-15}$ s</td>
<td>$3.11*10^5$ A/m</td>
</tr>
</tbody>
</table>

The amplitude of the sinusoidal shaped magnetic field of the carrier of the photon will be represented by $A_H$, like $A_E$ will be the amplitude of its sinusoidal electric field.

The relation between $A_H$ and $A_E$ is:

$$A_E = Z_v A_H \text{ V/m}$$

with $Z_v$ the so called characteristic impedance for vacuum.

$$Z_v = (\mu_0/\varepsilon_0)^{1/2} = 377 \text{ } \Omega$$

Based on these two amplitudes the power density of the EM-field is:

$$P_d = A_E/\sqrt{2} * A_H/\sqrt{2} = Z_v A_H^2/2 \text{ } \text{VA/m}^2$$

It is assumed that the surface, related to this power density, is constrained by the orbit of the electron from which it jumps, so the power $P$ of the photon in this example is:

$$P = Z_v A_H^2/2 * \pi r_1^2 \text{ } \text{W}$$

This assumption will be argued under: “Intermediate conclusions regarding step 1”

In order to be able to calculate the energy of the photon, with the model under consideration, this power has to be multiplied with the length (in seconds) of the photon. This length will be represented by the name pulse width, abbreviated as plsw.

In this sense the calculated energy of the photon is mathematically represented by:

$$E_v = \text{plsw} * Z_v A_H^2/2 * \pi r_1^2 \text{ Joule}$$

Both the parameters plsw and $A_H$ are yet unknown.
10. Estimation of the pulse width of the photon

Figure 2 is meant to show how a photon is imagined. The outside shape of the photon, drawn by the red line, is ‘carried’ by the blue EM wave.

It is assumed that the minimum value of the pulse width is one period of the carrier of the photon, because if it would be less it is difficult to imagine that it would be possible to find the energy of the photon to be $E = hf$.

The maximum value of the pulse width is certainly constrained by the round trip time of the orbit to which the electron has been jumped, because after that time period the magnetic field is completely stabilized. Applying the Rydberg expression $f$ in this example is calculated as:

$$f = \frac{c}{\lambda} = \frac{2.999 \times 10^8 \times 1.097 \times 10^7 (1-1/4)}{2} = 2.47 \times 10^{15} \text{ Hz},$$

resulting in $T = 4.05 \times 10^{-16} \text{ s}$

So $4.05 \times 10^{-16} < \text{plsw} < 12.2 \times 10^{-16} \text{ s}$

The estimation for plsw in this example is that it equals 2 times a period of the carrier: $8.1 \times 10^{-16} \text{ s}$.

It is considered unlikely that the carrier stops abruptly at an arbitrary moment within such a period.

The power density of the photon, expressed in $W/m^2$, in this example can now be calculated as:

$$P_d = \frac{hf}{(\text{plsw} \cdot \pi \cdot r^2)} = 6.626 \times 10^{-34} \times 2.47 \times 10^{15} / (8 \times 10^{-16} \times \pi \times (0.53 \times 10^{-10})^2) = 2.29 \times 10^{17} \text{ W/m}^2$$

so:

$$Z_v \frac{A_H}{2} = 2.29 \times 10^{17},$$

resulting in: $A_H = 3.49 \times 10^7 \text{ A/m}$

N.B. This magnetic field strength is of the same order of magnitude as the field strength $H_1$!

In order to obtain more reliance (or maybe not) in the validity of the model, the variable $dH/dt$, at the moment of the jump, is analysed.

It is assumed that $dH/dt$ has its maximum value at the moment the electron jumps.

At a certain moment the magnetic field strength $H(t)$, belonging to the EM field that will be generated, can be represented by: $H(t) = A_H \sin(\omega t)$ and the next assumption is that this sinusoidal function starts also at the moment the electron jumps. So, the maximum value of $dH/dt$ is assumed to be at $t=0$. This maximum value thus is represented mathematically by $A_H \omega$, with $\omega$ the radial frequency of the carrier of the photon.

The first approximation of $dH/dt$ is $\Delta H/\Delta t$, with $\Delta H = H_1 - H_2$ and $\Delta t$ a yet to find appropriate value.

$$A_H \omega = A_H * 2\pi f = 3.49 \times 10^7 \times 2\pi \times 2.47 \times 10^{15} = 5.41 \times 10^{23} \text{ A/ms}$$

Applying $\Delta H = H_1 - H_2 = 9.65 \times 10^6$, leads to $\Delta t = 9.65 \times 10^6 / 5.41 \times 10^{23} = 1.78 \times 10^{-17} \text{s}$

This value for $\Delta t$ is an order of magnitude smaller than the round trip time of the orbit from which the electron jumps.

That doesn’t feel unrealistic and it means that the magnetic field $H_1$, created by the equivalent electric current due to the circular movement of the electron, instantly decreases to a negligible value, compared to this initial field, because $H_2 << H_1$. 

39
Intermediate conclusions regarding step 1

The model applied to the neutral hydrogen atom where an electron jumps from the most inner orbit \(n=1\) to the next outer orbit \(n=2\), learns that:

- The energy of the emitted photon, expressed as \(E=hf\), exactly equals the difference between the kinetic energy of the electron in the inner orbit minus this energy in the outer orbit.
- The length of the photon (in seconds) has to be at least one period of the frequency of its carrier and will certainly be not longer than 3 of these periods.
- Dividing the energy of the photon by its length the power of the photon is found. To find a value for the strength of the magnetic field \([A/m]\), resp. electric field \([V/m]\) of the carrier of the photon, this power has to be divided by the surface to which it belongs. Up to this moment all variables were found to be strongly related to the orbit from where the electron jumps, so the most likely surface is assumed to be the surface \(\pi r^2\) of the orbit from where the electron jumps.
- Application of these variables shows that the magnetic field strengths of the EM carrier of the photon varies from 4.94 to 2.47\(\times10^7\) \(A/m\), all three of the same order of magnitude as the linear magnetic field strength, generated by the orbiting electron in orbit \(n=1\): \(7\times10^6\) \(A/m\). Notwithstanding that feature \(plsw\) will, as a first estimate, be taken two times \(l\).
- These conclusions justify analyses of other photon emissions, based on the model under consideration.

Step 2: The jump of an electron from \(n=1\) to \(n=n_2\) in the neutral hydrogen atom

In step 1 it is assumed that the length of the photon is two times the period of its carrier, also based on the assumption that it will certainly not be longer than \(t_{o2}\). In this step the round trip time \(t_{on}\) with \(n\geq3\), will be much larger than \(t_{o2}\). Notwithstanding that feature \(plsw\) will, as a first estimate, be taken two times the period independent of \(n_2\).

The frequency of the carrier is calculated by means of the Rydberg expression, resulting in as well the length of the photon as \(2/f\), as in its energy \(E=hf\).
This result divided by the surface \(\pi r^2\) equals the power density of the photon.

The magnetic field strength \(A_0\) is calculated from: \(A_0 = (2P_d/Z_e)^{1/3}\) and \(\Delta t\) from: \(\Delta t = \Delta H/(A_0 \omega)\). This last calculation learned that \(\Delta H\) has to be interpreted as: \(\Delta H = H_{n1} - H_{n2}\) and not as \(H_{n1}\) notwithstanding the fact that \(H_{n2} \ll H_{n1}\).

The relatively small error in the calculation of \(E_c\) for \(n_2 \geq 3\), in case \(\Delta H\) is chosen to be \(H_{n1}\), is completely eliminated for \(\Delta H = H_{n1} - H_{n2}\) !

Effectively this remarkable result has been found in step 3, due to the fact that the error in \(E_c\) grew explosively to > 100% in the Brackett series.

The importance of the correct calculation of \(\Delta t\) will be shown later.
Intermediate conclusions regarding step 2

- The presented values don’t show any abnormality, as could be expected, because only the orbit to which the electron jumps has been changed, while the orbit from where it jumped proved to be the most important parameter for the quantification of the variables (see step 1).

- $\Delta H$ in the expression $\Delta t = \Delta H/(A_H \omega)$, has explicitly to be interpreted as: $\Delta H = H_{n1} - H_{n2}$ and not as: $\Delta H = H_{n1}$.

- The results of the calculations justify analyses of other photon emissions, based on the model under consideration.

Step 3: The jump of an electron from $n=n_1$ to $n=n_2$ in the neutral hydrogen atom

The related frequencies to these jumps, as mathematically presented by the Rydberg formula, have been measured by and named after the shown scientists.

<table>
<thead>
<tr>
<th>$n_1$</th>
<th>$n_2$</th>
<th>Name</th>
<th>series</th>
<th>wave length</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2 → $\infty$</td>
<td>Lyman</td>
<td>first $n_2$</td>
<td>$n_2 \rightarrow \infty$</td>
</tr>
<tr>
<td>2</td>
<td>3 → $\infty$</td>
<td>Balmer</td>
<td>121.486*10^{-9}</td>
<td>91.1144*10^{-9}</td>
</tr>
<tr>
<td>3</td>
<td>4 → $\infty$</td>
<td>Paschen</td>
<td>1874.35*10^{-9}</td>
<td>820.030*10^{-9}</td>
</tr>
<tr>
<td>4</td>
<td>5 → $\infty$</td>
<td>Brackett</td>
<td>4049.53*10^{-9}</td>
<td>1457.83*10^{-9}</td>
</tr>
<tr>
<td>5</td>
<td>6 → $\infty$</td>
<td>Pfund</td>
<td>7454.82*10^{-9}</td>
<td>2278.61*10^{-9}</td>
</tr>
<tr>
<td>6</td>
<td>7 → $\infty$</td>
<td>Humphreys</td>
<td>12363.5*10^{-9}</td>
<td>3280.12*10^{-9}</td>
</tr>
</tbody>
</table>

The table shows that the Lyman series has been analysed under step 2

For all series the relation $hf = \frac{1}{2}m(v_{n1}^2 - v_{n2}^2)$ has been checked and found to be valid.

The most important conclusion is that the magnetic fields $A_{H(n_1+1)}$, relative to the magnetic field generated by the orbit of the electron from where it jumps, increase from a factor 3 to about a factor 7, along the series, if $plsw = 2/f$.

If $plsw$ is taken $(n_1+1)/f$, this ratio varies over all series from 3.5 to 4.3

If it is taken $(n_1+2)/f$ this range becomes 2.9 to 3.9.

For all three values of $plsw$ the absolute value of $A_{Hn_2}$, within each series, shows, as function of $n_2$, an increase varying from 1.3 in the Lyman series up to 2.7 in the Humphreys series

Based on this information it is considered more likely that $plsw \approx (n_1+1)/f$.

The model under investigation doesn’t give a decisive answer.

Only measurements of the length of the photon will give it.

For all series the same table as presented under step 2 has been calculated and shown in the Appendix: “Series”. N.B. The pulse width in these calculations is $(n_1+1)/f$.

Final step: The jump of an electron from $n=n_1$ to $n=n_2$ in an arbitrary ion

An arbitrary ion in this study is meant to be a nucleus with $Z$ protons around which one electron is orbiting.

The only basic parameters that change in such a situation are the radii of the orbits, because these are represented by $r_n = n^2 a_0/Z$.

So, in fact nothing changes fundamentally, by altering the value of $Z$. 
The Excel sheets (not included in this article), that have been used for the calculations for the series mentioned under step 3, indeed don’t show any abnormalities by changing Z.
As an example: the length of the photon for $n_1=1$ and $n_2=2$ is $\approx 0.01\ \text{femtosecond}$ for $Z=9$, while for $Z=1$ this length is $\approx 1\ \text{femtosecond}$.

11. Röntgen radiation

Röntgen radiation is EM radiation with frequencies in the range $10^{16} - 10^{20}\ \text{Hz}$. It is generated in a (X-ray) tube in which electrons are accelerated between their source (cathode) and an anode.
The most direct and simple way to calculate the frequency of the emitted radiation is the application of the Rydberg equation: $f = \frac{c}{\lambda} = c R_x (\frac{1}{n_i^2} - \frac{1}{n_{i+j}^2})$.
The table below shows possible emitted frequencies in case of a tungsten anode ($Z=74$).

<table>
<thead>
<tr>
<th>n</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$1.4\times10^{19}$</td>
<td>$1.6\times10^{19}$</td>
<td>$1.7\times10^{19}$</td>
<td>$1.7\times10^{19}$</td>
<td>$1.8\times10^{19}$</td>
</tr>
<tr>
<td>2</td>
<td>$2.5\times10^{18}$</td>
<td>$3.4\times10^{18}$</td>
<td>$3.8\times10^{18}$</td>
<td>$4.0\times10^{18}$</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>$8.8\times10^{17}$</td>
<td>$1.3\times10^{18}$</td>
<td>$1.5\times10^{18}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>$4.1\times10^{17}$</td>
<td>$1.5\times10^{18}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>$2.2\times10^{17}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

12. The characteristics of the photon expressed mathematically

In order to understand in detail how a photon looks like, the calculation of the energy is built up by four characteristics of the pulse: frequency, length, power density and surface related to this power density:

$$E_c = Zv A_H^2 / 2 \pi r_1^2 * \text{plsw}(f)$$

With $A_H = (\Delta H / \Delta t) / 2\pi f$ and plsw = $(n_1+1)/f$ this can also be written as:

$$E_c = \left\{ Zv \Delta H^2 \Delta t^2 (2\pi f)^2 \right\} / 2 * \pi r_1^2 * (n_1+1)/f$$

The analyses described under step 2 and 3 proved that $\Delta H = H_{n_1} - H_{n_2}$, from now on presented as $\Delta H_{n_1,n_2}$. $\Delta t$ will be presented as $\Delta t_{n_1,n_2}$, $f$ as $f_{n_1,n_2}$ and $r_1$ as $r_{n_1}$.

As a result $E_c$ will be presented as $E_{n_1,n_2}$ and can be written as:

$$E_{n_1,n_2} = \left\{ Zv \Delta H_{n_1,n_2} \Delta t_{n_1,n_2}^2 (2\pi f_{n_1,n_2})^2 \right\} / 2 * \pi r_{n_1}^2 * (n_1+1)/f_{n_1,n_2}$$

If $\Delta t_{n_1,n_2}$ is now considered as an unknown variable and $E_{n_1,n_2}$ is replaced by the known variable $hf_{n_1,n_2}$, then:

$$\Delta t_{n_1,n_2} = hf_{n_1,n_2} * \left\{ Zv^2 * \Delta H_{n_1,n_2}^2 * (2\pi f_{n_1,n_2})^2 \} * 2 * \pi r_{n_1}^2 * (n_1+1)/f_{n_1,n_2}$$

This equation applied in the formula for power density: $Zv \left\{ (\Delta H / \Delta t) / (2\pi f) \right\}^2 / 2$ leads to:

$$P_d = (hf_{n_1,n_2}^2 / \pi r_{n_1}^2) / (n_1+1)$$, thus $E_{n_1,n_2}$ presented as: “power density * surface * pulse width” to:

$$E_{n_1,n_2} = (hf_{n_1,n_2}^2 / \pi r_{n_1}^2) / (n_1+1) * \pi r_{n_1}^2 * (n_1+1)/f_{n_1,n_2}$$

Presented as: “power * pulse width”:

$$E_{n_1,n_2} = (hf_{n_1,n_2}^2) / (n_1+1) * (n_1+1)/f_{n_1,n_2}$$

42
Presented as generally accepted:

\[ E_{n_1,n_2} = \hbar f_{n_1,n_2} \]

The magnetic resp. electric field strength of the carrier of the photon can, based on the presented model, thus be calculated from an expression that only consists of the Rydberg parameter \( f_{n_1,n_2} \) and the atom parameters \( n_1 \) and \( r_{n_1} \), assumed that the length of the photon is \((n_1+1)/f_{n_1,n_2}\).

\[ A_H = \hbar f_{n_1,n_2}^2/\pi r_{n_1}^2/(n_1+1) \] \( \text{A/m} \) \[ A_E = Z \alpha A_H \] \( \text{V/m} \)

This proves that this model has eliminated the particle-wave duality of a photon.

Besides that: what might have been left yet to qualify a photon as a particle (too)?

**Conclusions**

- The study has proven that the generation of a photon can be explained by considering an orbiting electron in an atom as an electric current. This current causes a magnetic field, perpendicular to plane of the orbit and enclosed by the orbit of the electron. As soon as the electron jumps to a more outer orbit, this magnetic field decreases rapidly and causes through this an electric field. A source of an EM filed has been created.

- Calculations, carried out on this model, proved that this principle indeed works, but above all it also gives an impression of the length of the photon. Real values have to be gained by measurements.

- Based on the educated estimates of the length of the photon, the power of the photon can be calculated and as a result the strength of the magnetic and electric field of the carrier of the photon.

- The model confirms that the energy of the photon equals the kinetic energy of the electron in the orbit where it came from, minus this kinetic energy in the orbit where it jumped to, *but this difference is not the source of the energy of the photon.*

- The model shows that the source of the energy of the photon equals the difference in magnetic energy levels of the atom as created by the orbiting electron(s). In absolute terms speaking: even the kinetic energy of the electron turns out to create an equal amount of magnetic energy in the atom.

- At the end of the day it has to be concluded that this model eliminates the wave-particle duality: no whatever (magic) particle plays whatever role in this model.

Einstein wrote about this duality the following:

"It seems as though we must use sometimes the one theory and sometimes the other, while at times we may use either. We are faced with a new kind of difficulty. We have two contradictory pictures of reality; separately neither of them fully explains the phenomena of light, but together they do".

My words:

Nature doesn’t deal with dualities, paradoxes or contradictions.

Judgments like these are created by mankind, not understanding a certain phenomenon.

Physical science should not accept these kinds of judgements.

See the Appendix ‘Encore’ and chapter I too.

**Reference**

Appendix Encore

The presented model of the generation of a photon is based on Ampère’s and Faraday’s law, bound together in the Maxwell laws, normally called Maxwell’s equations. By working out Maxwell’s equations, the velocity of light in vacuum is calculated as \( c \).

N.B. Maxwell lived in the century that the ether-model was generally accepted within the scientific community. As a result the reference for \( c \) was by definition this ether.

The Principle of Relativity states: all physical laws are the same in all inertial systems.

The inner part of an atom and its direct surrounding is by definition vacuum. Applying the Principle of Relativity in the presented model leads to the conclusion that a photon, generated by an atom, based on the mentioned physical laws, must have a propagation velocity \( c \) w.r.t. this atom, whatever the velocity of this atom might be.

Effectively this is the so-called emission theory, vigorously rejected by the community of physicists.

To quote Wikipedia:
“Emission theories obey the principle of relativity by having no preferred frame for light transmission, but say that light is emitted at speed "c" relative to its source instead of applying the invariance postulate.”

Einstein’s Special Theory of Relativity is based on the hypothesis of a system “in rest” w.r.t. which the velocity of light in vacuum would be \( c \).

The community of physicists realized that this system “in rest” is equivalent to the, by Einstein himself, abandoned ether-model and therefore slinky changed his hypothesis in: \( c \) w.r.t. any inertial system, known under the expression: “invariance postulate”.

In this way a “not-Einstein” Special Theory of Relativity has been created, of which the hypothesis is fundamentally contradictory with Einstein’s hypothesis!

N.B.
A postulate is an assumption, so self-evident that further evidence, if it would be possible to deliver it at all, is not required.
A hypothesis is an assumption that needs yet to be proven.

One of the consequences of the invariance hypothesis is that the velocity of light in vacuum is also \( c \) w.r.t. its source, whatever the speed of that source might be!
But that same community of physicists seemingly excludes this inertial system from all the “any inertial systems”, as put forward in the invariance hypothesis!

This inconsequence, the contradiction between Einstein’s hypothesis and the invariance hypothesis and the contradiction of both these hypotheses with the Principle of Relativity, leads to the unavoidable conclusion that the Special Theory of Relativity has to be rejected.

Regarding the velocity of light: only the emission theory can be valid.
It is indeed a theory, not a hypothesis.
### Appendix Series

#### Lyman series

<table>
<thead>
<tr>
<th>n2</th>
<th>$1/\lambda$</th>
<th>hf</th>
<th>$1/\ell = \text{T}$</th>
<th>plsw</th>
<th>hf/plsw</th>
<th>$P_d$</th>
<th>$A_H$</th>
<th>$\Delta t$</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>8,23E+06</td>
<td>1,64E-18</td>
<td>4,1E-16</td>
<td>8,10E-16</td>
<td>2,02E-03</td>
<td>2,29E+17</td>
<td>3,49E+07</td>
<td>1,78E-17</td>
</tr>
<tr>
<td>3</td>
<td>9,76E+06</td>
<td>1,94E-18</td>
<td>3,4E-16</td>
<td>6,84E-16</td>
<td>2,83E-03</td>
<td>3,22E+17</td>
<td>4,14E+07</td>
<td>1,31E-17</td>
</tr>
<tr>
<td>4</td>
<td>1,03E+07</td>
<td>2,04E-18</td>
<td>3,2E-16</td>
<td>6,48E-16</td>
<td>3,15E-03</td>
<td>3,58E+17</td>
<td>4,36E+07</td>
<td>1,18E-17</td>
</tr>
<tr>
<td>5</td>
<td>1,05E+07</td>
<td>2,09E-18</td>
<td>3,2E-16</td>
<td>6,33E-16</td>
<td>3,31E-03</td>
<td>3,76E+17</td>
<td>4,47E+07</td>
<td>1,12E-17</td>
</tr>
<tr>
<td>6</td>
<td>1,07E+07</td>
<td>2,12E-18</td>
<td>3,1E-16</td>
<td>6,25E-16</td>
<td>3,39E-03</td>
<td>3,85E+17</td>
<td>4,52E+07</td>
<td>1,10E-17</td>
</tr>
<tr>
<td>7</td>
<td>1,08E+07</td>
<td>2,14E-18</td>
<td>3,1E-16</td>
<td>6,21E-16</td>
<td>3,44E-03</td>
<td>3,91E+17</td>
<td>4,56E+07</td>
<td>1,08E-17</td>
</tr>
<tr>
<td>8</td>
<td>1,08E+07</td>
<td>2,15E-18</td>
<td>3,1E-16</td>
<td>6,17E-16</td>
<td>3,48E-03</td>
<td>3,95E+17</td>
<td>4,58E+07</td>
<td>1,07E-17</td>
</tr>
<tr>
<td>9</td>
<td>1,08E+07</td>
<td>2,15E-18</td>
<td>3,1E-16</td>
<td>6,15E-16</td>
<td>3,50E-03</td>
<td>3,98E+17</td>
<td>4,60E+07</td>
<td>1,06E-17</td>
</tr>
<tr>
<td>10</td>
<td>1,09E+07</td>
<td>2,16E-18</td>
<td>3,1E-16</td>
<td>6,14E-16</td>
<td>3,52E-03</td>
<td>4,00E+17</td>
<td>4,61E+07</td>
<td>1,06E-17</td>
</tr>
<tr>
<td>11</td>
<td>1,09E+07</td>
<td>2,16E-18</td>
<td>3,1E-16</td>
<td>6,13E-16</td>
<td>3,53E-03</td>
<td>4,01E+17</td>
<td>4,61E+07</td>
<td>1,05E-17</td>
</tr>
</tbody>
</table>

#### Balmer series

<table>
<thead>
<tr>
<th>n2</th>
<th>$1/\lambda$</th>
<th>hf</th>
<th>$1/\ell = \text{T}$</th>
<th>plsw</th>
<th>hf/plsw</th>
<th>$P_d$</th>
<th>$A_H$</th>
<th>$\Delta t$</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>1,52E+06</td>
<td>3,03E-19</td>
<td>2,2E-15</td>
<td>6,56E-15</td>
<td>4,61E-05</td>
<td>3,28E+14</td>
<td>1,32E+06</td>
<td>7,14E-17</td>
</tr>
<tr>
<td>4</td>
<td>2,06E+06</td>
<td>4,09E-19</td>
<td>1,6E-15</td>
<td>4,86E-15</td>
<td>8,41E-05</td>
<td>5,97E+14</td>
<td>1,78E+06</td>
<td>4,37E-17</td>
</tr>
<tr>
<td>5</td>
<td>2,30E+06</td>
<td>4,58E-19</td>
<td>1,4E-15</td>
<td>4,34E-15</td>
<td>1,05E-04</td>
<td>7,49E+14</td>
<td>1,99E+06</td>
<td>3,56E-17</td>
</tr>
<tr>
<td>6</td>
<td>2,44E+06</td>
<td>4,84E-19</td>
<td>1,4E-15</td>
<td>4,10E-15</td>
<td>1,18E-04</td>
<td>8,39E+14</td>
<td>2,11E+06</td>
<td>3,20E-17</td>
</tr>
<tr>
<td>7</td>
<td>2,52E+06</td>
<td>5,01E-19</td>
<td>1,3E-15</td>
<td>3,97E-15</td>
<td>1,26E-04</td>
<td>8,96E+14</td>
<td>2,18E+06</td>
<td>3,00E-17</td>
</tr>
<tr>
<td>8</td>
<td>2,57E+06</td>
<td>5,11E-19</td>
<td>1,3E-15</td>
<td>3,89E-15</td>
<td>1,31E-04</td>
<td>9,33E+14</td>
<td>2,23E+06</td>
<td>2,88E-17</td>
</tr>
<tr>
<td>9</td>
<td>2,61E+06</td>
<td>5,18E-19</td>
<td>1,3E-15</td>
<td>3,84E-15</td>
<td>1,35E-04</td>
<td>9,60E+14</td>
<td>2,26E+06</td>
<td>2,81E-17</td>
</tr>
<tr>
<td>10</td>
<td>2,63E+06</td>
<td>5,23E-19</td>
<td>1,3E-15</td>
<td>3,80E-15</td>
<td>1,38E-04</td>
<td>9,79E+14</td>
<td>2,28E+06</td>
<td>2,75E-17</td>
</tr>
<tr>
<td>11</td>
<td>2,65E+06</td>
<td>5,27E-19</td>
<td>1,3E-15</td>
<td>3,77E-15</td>
<td>1,40E-04</td>
<td>9,93E+14</td>
<td>2,30E+06</td>
<td>2,71E-17</td>
</tr>
</tbody>
</table>

#### Paschen series

<table>
<thead>
<tr>
<th>n2</th>
<th>$1/\lambda$</th>
<th>hf</th>
<th>$1/\ell = \text{T}$</th>
<th>plsw</th>
<th>hf/plsw</th>
<th>$P_d$</th>
<th>$A_H$</th>
<th>$\Delta t$</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>5,34E+05</td>
<td>1,06E-19</td>
<td>6,3E-15</td>
<td>2,50E-14</td>
<td>4,24E-06</td>
<td>5,95E+12</td>
<td>1,78E+05</td>
<td>1,75E-16</td>
</tr>
<tr>
<td>5</td>
<td>7,80E+05</td>
<td>1,55E-19</td>
<td>4,3E-15</td>
<td>1,71E-14</td>
<td>9,07E-06</td>
<td>1,27E+13</td>
<td>2,60E+05</td>
<td>9,89E-17</td>
</tr>
<tr>
<td>6</td>
<td>9,15E+05</td>
<td>1,82E-19</td>
<td>3,6E-15</td>
<td>1,46E-14</td>
<td>1,25E-05</td>
<td>1,75E+13</td>
<td>3,05E+05</td>
<td>7,57E-17</td>
</tr>
<tr>
<td>7</td>
<td>9,95E+05</td>
<td>1,98E-19</td>
<td>3,4E-15</td>
<td>1,34E-14</td>
<td>1,48E-05</td>
<td>2,07E+13</td>
<td>3,32E+05</td>
<td>6,50E-17</td>
</tr>
<tr>
<td>8</td>
<td>1,05E+06</td>
<td>2,08E-19</td>
<td>3,2E-15</td>
<td>1,27E-14</td>
<td>1,64E-05</td>
<td>2,30E+13</td>
<td>3,49E+05</td>
<td>5,91E-17</td>
</tr>
<tr>
<td>9</td>
<td>1,08E+06</td>
<td>2,15E-19</td>
<td>3,1E-15</td>
<td>1,23E-14</td>
<td>1,75E-05</td>
<td>2,46E+13</td>
<td>3,61E+05</td>
<td>5,54E-17</td>
</tr>
<tr>
<td>10</td>
<td>1,11E+06</td>
<td>2,20E-19</td>
<td>3,0E-15</td>
<td>1,20E-14</td>
<td>1,83E-05</td>
<td>2,57E+13</td>
<td>3,70E+05</td>
<td>5,29E-17</td>
</tr>
<tr>
<td>11</td>
<td>1,13E+06</td>
<td>2,24E-19</td>
<td>3,0E-15</td>
<td>1,18E-14</td>
<td>1,90E-05</td>
<td>2,66E+13</td>
<td>3,76E+05</td>
<td>5,12E-17</td>
</tr>
</tbody>
</table>
### Brackett series

<table>
<thead>
<tr>
<th>n²</th>
<th>1/λ</th>
<th>hf</th>
<th>1/f=T</th>
<th>plsw</th>
<th>hf/plsw</th>
<th>P_d</th>
<th>A_H</th>
<th>Δt</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>2.47E+05</td>
<td>4.91E-20</td>
<td>1.4E-14</td>
<td>6.75E-14</td>
<td>7.26E-07</td>
<td>3.23E+11</td>
<td>4.14E+04</td>
<td>3.40E-16</td>
</tr>
<tr>
<td>6</td>
<td>3.81E+05</td>
<td>7.57E-20</td>
<td>8.8E-15</td>
<td>4.38E-14</td>
<td>1.73E-06</td>
<td>7.68E+11</td>
<td>6.39E+04</td>
<td>1.84E-16</td>
</tr>
<tr>
<td>7</td>
<td>4.62E+05</td>
<td>9.18E-20</td>
<td>7.2E-15</td>
<td>3.61E-14</td>
<td>2.54E-06</td>
<td>1.13E+12</td>
<td>7.74E+04</td>
<td>1.36E-16</td>
</tr>
<tr>
<td>8</td>
<td>5.14E+05</td>
<td>1.02E-19</td>
<td>6.5E-15</td>
<td>3.24E-14</td>
<td>3.15E-06</td>
<td>1.40E+12</td>
<td>8.62E+04</td>
<td>1.13E-16</td>
</tr>
<tr>
<td>9</td>
<td>5.50E+05</td>
<td>1.09E-19</td>
<td>6.1E-15</td>
<td>3.03E-14</td>
<td>3.61E-06</td>
<td>1.60E+12</td>
<td>9.22E+04</td>
<td>1.00E-16</td>
</tr>
<tr>
<td>10</td>
<td>5.76E+05</td>
<td>1.14E-19</td>
<td>5.8E-15</td>
<td>2.89E-14</td>
<td>3.95E-06</td>
<td>1.76E+12</td>
<td>9.66E+04</td>
<td>9.19E-17</td>
</tr>
<tr>
<td>11</td>
<td>5.95E+05</td>
<td>1.18E-19</td>
<td>5.6E-15</td>
<td>2.80E-14</td>
<td>4.22E-06</td>
<td>1.87E+12</td>
<td>9.97E+04</td>
<td>8.64E-17</td>
</tr>
</tbody>
</table>

### Pfund series

<table>
<thead>
<tr>
<th>n²</th>
<th>1/λ</th>
<th>hf</th>
<th>1/f=T</th>
<th>plsw</th>
<th>hf/plsw</th>
<th>P_d</th>
<th>A_H</th>
<th>Δt</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>1.34E+05</td>
<td>2.66E-20</td>
<td>2.5E-14</td>
<td>1.49E-13</td>
<td>1.79E-07</td>
<td>3.25E+10</td>
<td>1.31E+04</td>
<td>5.75E-16</td>
</tr>
<tr>
<td>7</td>
<td>2.15E+05</td>
<td>4.27E-20</td>
<td>1.6E-14</td>
<td>9.31E-14</td>
<td>4.59E-07</td>
<td>8.35E+10</td>
<td>2.11E+04</td>
<td>3.04E-16</td>
</tr>
<tr>
<td>8</td>
<td>2.68E+05</td>
<td>5.31E-20</td>
<td>1.2E-14</td>
<td>7.48E-14</td>
<td>7.10E-07</td>
<td>1.29E+11</td>
<td>2.62E+04</td>
<td>2.19E-16</td>
</tr>
<tr>
<td>9</td>
<td>3.04E+05</td>
<td>6.03E-20</td>
<td>1.1E-14</td>
<td>6.59E-14</td>
<td>9.14E-07</td>
<td>1.66E+11</td>
<td>2.97E+04</td>
<td>1.78E-16</td>
</tr>
<tr>
<td>10</td>
<td>3.29E+05</td>
<td>6.54E-20</td>
<td>1.0E-14</td>
<td>6.08E-14</td>
<td>1.08E-06</td>
<td>1.96E+11</td>
<td>3.22E+04</td>
<td>1.54E-16</td>
</tr>
<tr>
<td>11</td>
<td>3.48E+05</td>
<td>6.92E-20</td>
<td>9.6E-15</td>
<td>5.75E-14</td>
<td>1.20E-06</td>
<td>2.19E+11</td>
<td>3.41E+04</td>
<td>1.40E-16</td>
</tr>
</tbody>
</table>

### Humphreys series

<table>
<thead>
<tr>
<th>n²</th>
<th>1/λ</th>
<th>hf</th>
<th>1/f=T</th>
<th>plsw</th>
<th>hf/plsw</th>
<th>P_d</th>
<th>A_H</th>
<th>Δt</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>8.09E+04</td>
<td>1.61E-20</td>
<td>4.1E-14</td>
<td>2.89E-13</td>
<td>5.57E-08</td>
<td>4.88E+09</td>
<td>5.09E+03</td>
<td>8.88E-16</td>
</tr>
<tr>
<td>8</td>
<td>1.33E+05</td>
<td>2.65E-20</td>
<td>2.5E-14</td>
<td>1.75E-13</td>
<td>1.51E-07</td>
<td>1.33E+10</td>
<td>8.40E+03</td>
<td>4.63E-16</td>
</tr>
<tr>
<td>9</td>
<td>1.69E+05</td>
<td>3.36E-20</td>
<td>2.0E-14</td>
<td>1.38E-13</td>
<td>2.44E-07</td>
<td>2.14E+10</td>
<td>1.07E+04</td>
<td>3.27E-16</td>
</tr>
<tr>
<td>10</td>
<td>1.95E+05</td>
<td>3.88E-20</td>
<td>1.7E-14</td>
<td>1.20E-13</td>
<td>3.24E-07</td>
<td>2.84E+10</td>
<td>1.23E+04</td>
<td>2.62E-16</td>
</tr>
<tr>
<td>11</td>
<td>2.14E+05</td>
<td>4.25E-20</td>
<td>1.6E-14</td>
<td>1.09E-13</td>
<td>3.90E-07</td>
<td>3.42E+10</td>
<td>1.35E+04</td>
<td>2.24E-16</td>
</tr>
</tbody>
</table>
IX Matter Waves: a fable

Summary – This chapter criticises the phenomenon “wave-like behaviour” of matter and shows that the Davisson-Germer experiment, considered as the validation of De Broglie’s hypothesis, can be interpreted in another way too.

1. Introduction

In the chapter: ‘Why a photon is not a particle’ it has been argued that the generation of a photon is caused by a changing orbit of an electron around the nucleus of an atom, based on the principle of a changing magnetic field, resulting in an EM-source. A somewhat similar approach can also be applied in the situation of a linearly accelerated electron, as used in the Davisson-Germer experiment.

2. De Broglie’s hypothesis

The question is: what is physically meant by matter wave?

In ref.[1] the following description is presented:

“All matter can exhibit wave-like behaviour. For example a beam of electrons can be diffracted just like a beam of light or a water wave. Matter waves are a central part of the theory of quantum mechanics, being an example of wave–particle duality. The concept that matter behaves like a wave is also referred to as the de Broglie hypothesis due to having been proposed by Louis de Broglie in 1924. Matter waves are often referred to as De Broglie waves.

The De Broglie wavelength is the wavelength, λ, associated with a massive particle and is related to its momentum p through the Planck constant h: λ= h/p.

Wave-like behaviour of matter was first experimentally demonstrated in the Davisson–Germer experiment using electrons, and it has also been confirmed for other elementary particles, neutral atoms and even molecules. The wave-like behaviour of matter is crucial to the modern theory of atomic structure and particle physics.”

Remarks:

• The word “massive” is most likely meant as ‘having a mass’ because the momentum p of a particle, with mass m, is defined as p=mv, with v being the velocity of the particle. (‘Massive’ normally means ‘gigantic’!)

• The conception “matter-waves” is in first instance and fundamentally meant to belong to pure, so uncharged, matter, given the relation λ= h/mv. However the Davisson–Germer experiment, using electrons, is put forward as the experiment proving the correctness of the original relation of De Broglie. Further on it will be shown that this experiment can be interpreted in another way too, leading to the conclusion that this experiment does not necessarily prove this correctness.

• If De Broglie’s hypothesis would be valid in case of an uncharged particle m with velocity v, then the fundamental question is: what kind of oscillations, with the frequency mvc/h, are meant? The impression is given that no one ever answered this question and no motivation has been found to read all the given references for the following reason.

• Imagine this mass m in vacuum, for example in the universe, then the question is: with respect to what reference is the velocity v of this mass meant? Choosing different references means that the frequency of the matter waves, exhibited by this mass, depends on the chosen reference. Not a likely physical property and, on top of that, in contradiction with the Principle of Galilean Relativity (PGR), because the constant velocity v would show “matter-wave-frequencies” that would depend on this v. The PGR prescribes that all physical laws are the same in all inertial systems, so independent of their constant velocity. See chapter I for more details.

Conclusion: it is, to state it softly, very unlikely that matter waves do exist.
3. The Davisson-Germer experiment

This experiment is carried out with linearly accelerated electrons, as for example written in ref. [2]: “Electrons from a heated filament were accelerated by a voltage and allowed to strike the surface of nickel metal.”

The remarkable thing about this experiment is that the electrons are accelerated, showing a contradiction with De Broglie’s hypothesis, in which the particles are meant to have a constant velocity.

As a result there is no relation between De Broglie’s hypothesis and the circumstances of this experiment and consequently this experiment cannot be used to claim the validity of De Broglie hypothesis.

What might happen in this experiment that would exhibit a wave and what kind of wave might that be?

An electron moving along a straight line is equivalent to an electric current of the same shape. Such a current causes a circular shaped magnetic field around this current with a constant strength. When this electron will be accelerated, like in a Scanning Electron Microscope, the strength of the equivalent electric current will change as function of time. As a result the strength of the mentioned circular magnetic field will also change as a function of time.

Just like as in my model of the generation of a photon: an EM-source has been created.

In this case an EM-source with likely a circular polarization!

Conclusions

- Matter waves are not defined in a physical way.
- It is most unlikely that matter waves exist, because they contradict the PoR.
- The Davisson-Germer experiment does not necessarily prove the validity of De Broglie’s hypothesis. It can be interpreted in another way too.

Encore

De Broglie’s hypothesis was supported by Einstein. Just like Einstein must have missed the crucial importance of the Principle of Galilean Relativity formulating his hypothesis about the velocity of light, he obviously did so too judging De Broglie’s hypothesis.

References


Gravitational Waves: a fable

Summary: This chapter very briefly criticises the phenomenon “gravitational waves” and shows why this concept is mere fantasy, just like the concepts: space-time, black holes and matter waves.

1. Introduction

The combined web site of Hanford and Livingston Observatory describes the start of the LIGO (Laser Interferometer Gravitational-Wave Observatory), that is supported by the National Science Foundation and operated by Caltech and MIT, as follows:

“The Newest Search for Gravitational Waves has Begun

News Release • September 18, 2015

On, Friday, September 18th 2015, the first official ‘observing run’ (O1) of LIGO’s advanced detectors in Hanford WA and Livingston LA quietly began when the clock struck 8 a.m. Pacific time. While this date marks the official start of data collection, both interferometers have been operating in engineering mode collecting data for some weeks already as technicians, scientists, and engineers worked to refine the instrument to prepare it for official data-collection duties. What IS different about today is the scope of the search for gravitational waves. Today, the broader astronomical community has been added to the team. From now on, LIGO will be able to notify any number of 74 astronomical observatories around the world who have agreed to, at a moment’s notice, point their telescopes to the sky in search of light signals corresponding to possible gravitational wave detections.”

In order to gratify National Science Foundation as soon as possible LIGO staff seemingly decided to show already on the 11th of February 2016 world wide that they detected gravitational waves.

2. Misleading propaganda

The phenomena: space-time, black holes, matter waves and gravitational waves are direct consequences of the Special Theory of Relativity.
In chapter I it is proven that this theory is most fundamentally wrong.

So the question now is: what did the “technicians, scientists, and engineers” really measure?

Certainly not gravitational waves.

Anyway, the next years they will get sufficient money from the National Science Foundation to continue their extremely important scientific investigations.
XI Planck’s Theory of Heat Radiation criticized

Summary: Robitaille and Crothers wrote an article [1] with the same purpose: to present the mistakes in Planck’s Theory of Heat Radiation and in Kirchhoff’s law of thermal emission. In this article an alternative approach is taken, leading to a support of the conclusion of Robitaille and Crothers. In my own words: Planck, indeed, made a scientific mess of it! Not only Planck’s theory makes no sense, the current presentation of this theory turns out to be of this low level too.

1. Introduction

Planck’s book about this subject, originally written in 1913, has been translated from the German into the English language by Morton Masius, M. A., Ph. D. (Leipzig) Instructor in Physics in the Worcester Polytechnic Institute. This translated version [2] has been used as reference in this article, just like Robitaille and Crothers did.

The criticism in this article concerns only Part I of his book. The title of Part I is: FUNDAMENTAL FACTS AND DEFINITIONS. This criticism is concentrated on the definition of the variables he introduced and on his expressions and equations based on these variables.

2. Chapter I of Part I of Planck’s theory of heat radiation

The title of chapter I is: General Introduction. We start the investigation at section 6.

“6. Summing up everything said so far, we may equate the total energy in a range of frequency from $\nu$ to $\nu + d\nu$ emitted in the time $dt$ in the direction of the conical element $d\Omega$ by a volume-element $d\tau$ to

$$dt \cdot d\Omega \cdot d\nu \cdot 2\epsilon_\nu$$

(1)

The finite quantity $\epsilon_\nu$ is called the coefficient of emission of the medium for the frequency $\nu$.

It is a positive function of $\nu$ and refers to a plane polarized ray of definite colour and direction."

Remark (1)-1*:
Considering the use of the word ‘energy’ the dimension of expression (1) must be W.s or Joule.

The dimensions of the separate variables are as follows: $[dt]$: s, $[d\tau]$: m$^3$, $[d\Omega]$: no dimension, $[d\nu]$: s$^{-1}$. Multiplying these dimensions results in the conclusion that $[\epsilon_\nu]$ must be: W.s/m$^3$.

In words: volume energy density.

Serious warning (1)-1:
This doesn’t look like the dimension of an emission coefficient. In modern radiation theories $\epsilon_\nu$ is dimensionless, however not called coefficient of emission but emissivity.

Remark (1)-2:
Planck does neither define the conical element $d\Omega$, nor the volume-element $d\tau$. The definition of $d\Omega$ can be deduced from Planck’s text below: $d\Omega$ must have been meant to be the derivative of the so-called solid angle (symbol: $\Omega$).

“Since $\epsilon_\nu$ is independent of the direction, and since the integral over all conical elements $d\Omega$ is $4\pi$, we get:

$$dt \cdot d\tau \cdot 8\pi \int \epsilon_\nu d\nu$$

(2)”

Remark (2)-1:
Since Planck likely is considering a sphere, with whatever radius, $d\tau$ must be meant to be a volume-element of this sphere.

For reasons of completeness we now first copy Planck’s definition of his coefficient of scattering and then jump to section 12 for his definition of the so-called coefficient of absorption.

* “Remark (e)-n” means: remark concerning equation/expression (e)-numbered n.
Whether the scattering depends on reflection, on diffraction, or on a resonance effect on the molecules or particles is a point that we may leave entirely aside. We only take account of the fact that every ray on its path through any medium loses a certain fraction of its intensity.

For a very small distance, \( s \), this fraction is proportional to \( s \), say
\[
\beta, s
\]

where the positive quantity \( \beta \) is independent of the intensity of radiation and is called the 'coefficient of scattering' of the medium.

**Remark (3)-1:**
At this moment we don’t know yet what Planck exactly means with intensity, so we cannot not yet conclude what the dimension of \( \beta \) is.

12. Absorption. - Heat rays are destroyed by “absorption.” According to the principle of the conservation of energy the energy of heat radiation is thereby changed into other forms of energy (heat, chemical energy). Thus only material particles can absorb heat rays, not elements of surfaces, although sometimes for the sake of brevity the expression absorbing surfaces is used.

Whenever absorption takes place, the heat ray passing through the medium under consideration is weakened by a certain fraction of its intensity for every element of path traversed. For a sufficiently small distance \( s \) this fraction is proportional to \( s \), and may be written
\[
\alpha, s
\]

**Remark (4)-1:**
Planck clearly considers fractions of energy, so \([\alpha, s]\) must be W.s, leading to the conclusion that \([\alpha] \) must be W.s/m. Based on this conclusion it may be assumed that \([\beta] \) is also meant to be W.s/m. Later on this assumption indeed will turn out to be correct.

**Serious warning (4)-1:**
The dimension of \( \alpha \) as W.s/m doesn’t look like the dimension of an absorption coefficient.

In modern radiation theories \( \alpha \) is dimensionless!
The same criticism applies of course for the coefficient of scattering \( \beta \).

We jump to equations (5) and (6) in section 15.

“The intensity in this direction is the energy propagated in an infinitely thin cone limited by \( \Theta \) and \( \Theta + d\Theta \) and \( \phi \) and \( \phi + d\phi \). The solid angle of this cone is
\[
d\Omega = \sin \Theta \, d\Theta \, d\phi
\]

Thus the energy radiated in time \( dt \) through the element of area \( d\sigma \) in the direction of the cone \( d\Omega \) is:
\[
dt \, d\sigma \cos \Theta \, d\Omega \, K = K \sin \Theta \, \cos \Theta \, d\Theta \, d\phi \, d\sigma \, dt
\]

**Remark (5)-1:**
This concept of solid angle is not appropriate to apply in such a theory.

Besides that \( d\Omega \), as presented in (5), is indeed the derivative of the solid angle \( \Omega = \int_S \sin \Theta \, d\Theta \, d\phi \), so not a solid angle. See also Remark (1)-2.

**Remark (6)-1:**
One of the consequences of the just mentioned misconception is that the radiated energy, as shown in (6), would not only depend on \( \theta \), but would even be zero for \( \theta = 0 \).

**Remark (6)-2:**
If both sides of (6) are indeed meant to be energies, we have to conclude that \([K] = \text{W.s/s/m}^2 = \text{W/m}^2 \). In words: \( K \) is the surface power density of the radiation.

We now make a big jump to section 22, the text in between considering not relevant enough to investigate. The relevant variable introduced in this part of his theory is \( K' \), defined as the spectral surface power density: \( K = K' \, dv \), with \( v \) representing frequency.

Planck now and then also considers a \( K'' \), with the following background.
“A last characteristic property of a ray of definite direction, intensity, and colour is its state of polarization. If we break up a ray, which is in any state of polarization whatsoever and which travels in a definite direction and has a definite frequency $\nu$, into two plane polarized components, the sum of the intensities of the components will be just equal to the intensity of the ray as a whole, independently of the direction of the two planes, provided the two planes of polarization, which otherwise may be taken at random, are at right angles to each other.”

He concludes with:

$$K = \int (K_\nu + K'_\nu) \, dv$$

(9)

Remark (9)-1:

This splitting up in two different polarized components doesn’t make sense, given his ultimate purpose: define a spectral surface power density $K_\nu$ by means of $K = K_\nu \, dv$.

“22. Since the energy radiation is propagated in the medium with a finite velocity $q$, there must be in a finite space a finite amount of energy. We shall therefore speak of the “space density of radiation,” meaning thereby the ratio of the total quantity of energy of radiation contained in a volume-element to the magnitude of the latter. Let us now calculate the space density of radiation $u$ at any arbitrary point of the medium. When we consider an infinitely small element of volume $v$ at the point in question, having any shape whatsoever, we must allow for all rays passing through the volume-element $v$. For this purpose we shall construct about any point $O$ of $v$ as centre of a sphere with radius $r$, $r$ being large compared with the linear dimensions of $v$ but still so small that no appreciable absorption or scattering of the radiation takes place in the distance $r$ (Fig. 1).

Every ray which reaches $v$ must then come from some point on the surface of the sphere. If, then, we at first consider only all the rays that come from the points of an infinitely small element of area $d\sigma$ on the surface of the sphere, and reach $v$, and then sum up for all elements of the spherical surface, we shall have accounted for all rays and not taken any one more than once.

Let us then calculate first the amount of energy which is contributed to the energy contained in $v$ by the radiation sent from such an element $d\sigma$ to $v$. We choose $d\sigma$ so that its linear dimensions are small compared with those of $v$ and consider the cone of rays which, starting at a point of $d\sigma$, meets the volume $v$. This cone consists of an infinite number of conical elements with the common vertex at $P$, a point of $d\sigma$, each cutting out of the volume $v$ a certain element of length, say $s$. The solid angle of such a conical element is $f/r^2$ where $f$ denotes the area of cross-section normal to the axis of the cone at a distance $r$ from the vertex. The time required for the radiation to pass through the distance $s$ is $\tau = s/q$.

From expression (6) we may find the energy radiated through a certain element of area. In the present case $d\Omega = f/r^2$ and $\theta = 0$; hence the energy is:

$$\tau \, d\sigma \, f \, r^2 \, K = f \, s \, r^2 \, q^{-1} \, K \, d\sigma$$

(19)”
Comment
In order to try to understand Planck’s way of thinking, all variables defined above have been defined again shortly in sequence of Planck’s description:

- \( p \) - propagation velocity of radiation in a certain medium
- \( u \) - space density of radiation at any arbitrary point of the medium
- \( v \) - infinitely small element of volume, at the point as mentioned just above
- \( O \) - centre of \( v \) (so \( O \) is that point)
- \( r \) - radius of the sphere with \( O \) as centre (sphere is significant larger than \( v \))
- \( d\sigma \) - infinitely small surface at the surface of the sphere with radius \( r \)
- \( P \) - point of \( d\sigma \) from which an infinite number of conical elements reach \( v \)
- \( s \) - length of an element in \( v \) cut out by such a conical element
- \( f \) - the cross section at distance \( r \) from \( P \) of such a conical element
- \( \tau \) - time required for the radiation to pass through the distance \( s \) (\( \tau = s/q \))
- \( d\Omega \) - solid angle of such a conical element (\( d\Omega = f/r^2 \))

Remark (19)-1:

His definition of \( d\Omega \) here is in contradiction with the one he applied in (5) and (6)!

But this definition is at least a correct one.

Remark (19)-2:

Equation (19) would, without the incorporation of a conical element, already be a presentation of the energy of a ray with surface power density \( K \), emitted by surface \( d\sigma \) during time \( \tau \). The addition of the conical element with solid angle \( f/r^2 \) therefore doesn’t make sense.

Remark (19)-3:

The conical element with solid angle \( f/r^2 \) is defined as having its vertex in point \( P \), located in \( d\sigma \), while the area \( d\sigma \) is used to calculate the energy emitted in the direction of \( v \).

That implies a double, but opposite, use if this, already senseless, variable.

Remark (19)-4:

Up to now Planck did not yet define what in fig. 1 has to be considered as the body that emits the radiation. He gives the impression that is the inner side of the sphere with radius \( r \), because finally he multiplies the, homogeneous assumed, intensity \( K \) with this surface: \( 4\pi r^2 \), resulting in a totally emitted energy by that body of \( 4\pi r^2 K \tau \) (Ws).

Remark (19)-5:

Based on the considerations under remark (19)-4 we have to conclude that the introduction of the so-called volume \( v \) doesn’t make any sense.

Planck continues after (19) as follows:

“This energy enters the conical element in \( v \) and spreads out into the volume \( f s \). Summing up over all conical elements that start from \( d\sigma \) and enter \( v \) we have

\[
K \, d\sigma \, r^2 q^{-1} \sum f s = K \, d\sigma \, r^2 q^{-1} \, \tau \, v \quad (19.1)
\]

Remark (19.1)-1: (For the ease of reference this equation is numbered 19.1 by the author.)

Equation (19) represents energy, only due to the fact that a power, generated during a period \( \tau \), is considered. In (19.1) he replaces this multiplication with time \( \tau \) by introducing some arbitrary distance \( s \), divided by the propagation velocity of radiation \( q \). This arbitrary \( s \) leads to an arbitrary volume \( v \) by multiplying \( s \) with surface \( f \).

As a result the expression \( K \, d\sigma \, r^2 q^{-1} \) now represents a volume energy density as function of the propagation velocity of radiation. This is, seen from a physical point of view, illogical.
Remark (19.1)-2:
Assumed that a volume energy density would be of any interest in this stage of the development
of his theory, he simply could have divided the, under Remark (19)-4 mentioned, energy $4\pi r^2 K \tau$
by the volume of the sphere $(4/3)\pi r^3$, resulting in such an energy density of $3K/r \tau$ (Ws/m$^3$) and
a total energy of $v.3K/r \tau$ (Ws) contained in v.
This outcome emphasizes the conclusion as given in Remark (19)-5.
Besides that: the incorporation of the propagation velocity of radiation in an expression for
energy, as shown in (19.1), is illogical from a physical point of view.
These two variables don’t have a physical relation. The power is a property of the emitter and the
energy the time during which this power is emitted.

Planck continues with:

“This represents the entire energy of radiation contained in the volume v, so far as it is caused by radiation through the
element $d\sigma$. In order to obtain the total energy of radiation contained in v
we must integrate over all elements $d\sigma$ contained in the surface of the sphere. Denoting by $d\Omega$ the solid angle $d\sigma/r^2$ of a
cone which has its centre in O and intersects in $d\sigma$ the surface of the sphere, we get for the whole energy:

$$v/q \int K d\Omega$$

(19.2)

Remark (19.2)-1:
Planck changes his definition of $d\Omega$ again, now from $df/r^2$ into $d\sigma/r^2$, with $d\sigma$ being an
infinitely small surface element at distance r, emphasizing that it is “a cone which has its centre in
O”, while df is an infinitely small surface element in the neighbourhood of O.

“The volume density of radiation required is found from this by dividing by v. It is

$$u = q^{-1} \int K d\Omega$$

(20)

Since in this expression r has disappeared, we can think of K as the intensity of radiation at the point O itself. In
integrating, it is to be noted that K in general depends on the direction ($\Theta$, $\phi$). For radiation that is uniform in all
directions K is a constant and on integration we get:

$$u = 4\pi K/q$$

(21)”

Remark (21)-1:
The mistake, mentioned under Remark (19.2)-1, can be neglected by arguing that he finally only
meant to integrate the term $K d\sigma r^2 q^{-1} v$ (19.1) over the surface of the sphere.
K is assumed to be homogeneous, so $d\sigma$ is allowed to be replaced by $4\pi r^2$.
This also results in (21), after dividing by v, like Planck did to get (20) out of (19.2).

Remark (21)-2:
Here the last sentence from Remark (19.1)-2 is recalled and a closer consideration of the
concept ‘volume energy density’ presented.
Multiplying the surface power density K of an emitter by a certain surface, results in the power
of the emitter at the place of and integrated over that surface. If this surface would be the
surface of a sphere with radius r, assuming that the emitter indeed homogeneously emits its
power in all directions, then the value of this power is $K.4\pi r^2$.
However it is impossible to transform this quantity to a volume energy density, because it would be
required to multiply this power with, for example, a time period $\tau$ to get energy and a volume
to divide by. But which volume has to be related to this surface and time?
The misunderstanding regarding the concept ‘volume energy density’ starts at the introduction of the
concept ‘spectral surface power density’ as already shown in (9).
The dimension of spectral surface power density is W/m$^2$/Hertz = W.s/m$^2$, which can also be
interpreted as surface energy density, but is clearly not meant to be.
The misconception ‘volume energy density’ is only found in the weird definition of $\varepsilon_\nu$, as
explained under Remark (1)-1.
“23. A meaning similar to that of the volume density of the total radiation \( u \) is attached to the volume density of radiation of a definite frequency \( n \). Summing up for all parts of the spectrum we get:

\[
u = \int u_n \, dv
\]  

Further by combining equations (9) and (20) we have:

\[
u_n = q^{-1} \int (K_n + K'_n) \, d\Omega \]  

and finally for unpolarized radiation uniformly distributed in all directions:

\[
u_n = 8\pi K_n / q \]

Remark (24)-1:

Planck here makes the mistake by replacing \( K \) in (20) by \( K_n + K'_n \) instead of only \( K_n \). See Remark (9)-1 for the explanation. The factor 8 therefor has to be 4, given the definition of \( K_n \) implicitly in: \( K = K_n \, dv \). The \( K_n \) in (24) effectively is \( \frac{1}{2} K / dv \).

Here Chapter I of Planck’s book ends.

3. Chapter II of Part I of Planck’s theory of heat radiation

The title of chapter II is:

Radiation at thermodynamic equilibrium. Kirchhoff’s law. Black radiation

From this chapter in principle only relevant formulas are scrutinized, because a lot has already been investigated in the previous chapter I.

We start at page 30 with:

“The amount of energy of this ray absorbed in the distance \( s \) in the time \( dt \) is, according to (4),

\[
\frac{dt}{\alpha_n} s 2 d\sigma / r^2 K_n \, dv
\]

For the explanation of and the criticism about \( \alpha_n \) see above, before and after (4).

Remark (n1)-1:

A fundamental mistake is made by Planck in this equation. As shown in Remark (4)-1 the dimension of \( \alpha_n \) is Ws/m (see also “Serious warning (4)-1”). With this (wrong) dimension of \( \alpha_n \), the dimension of the expression under consideration becomes:

\( s \ (\text{Ws/m}) \ m \ m^2 \ m^2 \ (\text{Ws/m}^2) \ s^1 = W^2 \ s^2! \)

This dimension has to be Ws, as follows from the words “amount of energy” in the description. Besides that: what might W^2 s^2 physically mean?

The “Serious warning (4)-1” therefor is confirmed with this observation. There can be only one reason for such a blunder, however resulting in an even more worse one: he all of a sudden must have changed the dimension of \( \alpha_n \) at the start of Chapter II into m^{-1}, notwithstanding his reference to (4), realizing otherwise the stupid dimension W^2 s^2 of (n1).

Fatal error 1:

Doing so he ruins the contents of Chapter I. But if he would have left it like that, it would have ruined the contents of Chapter II.

Besides that: the dimension m^{-1} for the absorption coefficient \( \alpha_n \), and as a result also for the coefficient of scattering \( \beta_n \), is anyway a weird one.

At this place there are two possibilities to do: stop the investigation and declare Planck’s work on heat radiation completely false, or change the dimension of \( \alpha_n \) in m^{-1}, disregarding for the moment this at least weird dimension too and see what will happen after that.
The second possibility is chosen, only for reasons of curiosity, because he ruined already his previous work by many other mistakes as shown above and in ref. [1].

We jump to the following, neither numbered, equation on the same page 30 at the end;

"By equating the emitted and absorbed energy we obtain:

\[ \int \varepsilon \nu \, d\nu = \int \alpha \nu \, K \nu \, d\nu \]

Remark (n2)-1:

With the new dimension of \( \alpha \nu \) (m\(^{-1}\)), the dimension of the right hand side of this equation is m\(^{-1}\) \( \times \) (Ws/m\(^3\)) \( \times \) s\(^{-1}\) = W/m\(^3\).

If we take the original dimension of \( \varepsilon \nu \), being Ws/m\(^3\), as shown in Remark (1)-1 as well as in ref.[1], the dimension of the left hand side of the equation is also W/m\(^3\).

Great, we will continue, however still with the weird dimensions for \( \varepsilon \nu, \alpha \nu, \) and \( \beta \nu \)!

In section 28 Planck comes back with the phenomenon ‘scattering’, defining the scattering coefficient \( \beta \nu \) in exactly the same way as the absorption coefficient (see also (2) and (3)):

"Hence we get an expression similar to (25), namely,

\[ dt \pi 8 \int \beta \nu \, K \nu \, d\nu \]

In (25) \( \alpha \nu \) instead of \( \beta \nu \) is taken in exactly such a presentation.

We jump to section 30

30. Let a certain volume-element of the pencil be bounded by two cross-sections at distances equal to \( r_0 \) (of arbitrary length) and \( r_0 + dr \) respectively from the vertex O. The volume will be represented by \( dr \cdot r_0^2 \, d\Omega \). It emits in unit time toward the focal plane \( d\sigma \) at O a certain quantity \( E \) of energy of monochromatic plane polarized radiation. \( E \) may be obtained from (1) by putting

\[ dt = 1, \quad d\tau = dr \cdot r_0^2 \, d\Omega, \quad d\Omega = d\sigma / r_0^2 \]

and omitting the numerical factor 2. We thus get

\[ E = dr \cdot d\Omega \, d\sigma \, e \nu \, d\nu \]  

(31)

Of the energy \( E \), however, only a fraction \( E_0 \) reaches O, since in every infinitesimal element of distance \( s \) which it traverses before reaching O the fraction \( (\alpha \nu + \beta \nu) \) is lost by absorption and scattering. Let \( E_r \) represent that part of \( E \) which reaches a cross-section at a distance \( r < r_0 \) from O. Then for a small distance \( s = dr \) we have

\[ E_{r+dr} - E_r = E_r (\alpha \nu + \beta \nu) \, dr, \]

or,

\[ dE_r / dr = E_r (\alpha \nu + \beta \nu), \]

(3n)

Remark (3n)-1:

The introduction of the constant \( r_0 \) is superfluous, but more serious: misleading. If \( r_0 \) would be replaced by \( r \), nothing changes up to and including equation (3n).

"and, by integration,

\[ E_r = E \int e^{\alpha \nu + \beta \nu} \sqrt{1 - r^2} \, d\nu \]

since, for \( r = r_0 \), \( E_r = E \) as given by equation (31). From this, by putting \( r = 0 \), the energy emitted by the volume-element at \( r_0 \), which reaches O is found to be

\[ E_0 = E \int e^{\alpha \nu + \beta \nu} \, d\nu = dr_0 \, d\Omega \, d\sigma \, e \nu \, e^{\alpha \nu + \beta \nu} \, d\nu \]

(32)"
Fatal error 2:
The chosen approach here is fundamentally wrong!
The misleading mentioned under remark (31)-1 pops up here. Equation (31) should have been written as $E_\Omega = d\Omega$, $d\sigma = d\nu$. If $r$ instead of $r_0$ would have been used, (31) would have been written on the left side as $E_\nu$. So the equation $E_\nu = E$ is misleading, because in fact it means $E_\nu = E_0$. Writing the equation $dE_\nu/dr = E_\nu(\alpha_\nu + \beta_\nu)$ as $dE_\nu/dr = f_\nu E_\nu$ it is clear that the solution of this differential equation is: $E_\nu = C e^{f_\nu r}$, left with the question what $C$ might be.

It is not allowed to answer this question by introducing an arbitrary distance $r_0$, as is done by Planck. In fact one has to answer the question what $E_\nu$ might be for $r=0$.

So the final solution of the differential equation is: $E_\nu = E_0 e^{(\alpha_\nu + \beta_\nu) r}$ with $E_0$ yet undefined.

The solid angle $d\Omega$ is valid for every $r$, so $d\sigma = d\Omega r^2$. If $r$ approaches 0, $d\sigma$ approaches 0 too, leading to $E_0 = 0$, as follows from (32).

Norwithstanding this second fatal error, and not to forget all the other errors, we still continue by jumping to section 33 where the famous figure 3 is presented, because we still want to consider Planck’s argumentations for Kirchhoff’s law of thermal emission.

The reference for most of the relevant mathematics below is found in the just mentioned figure below, presented in Planck’s book as figure 3.

![Figure 3](image-url)

The figure is meant to present the situation in which two media are considered, separated by the so called bounding surface and that “every ray coming from the first medium and falling on the bounding surface is divided into two rays, the reflected and the transmitted ray.”

The variable $\rho$ is introduced as the coefficient of reflection representing the fraction of the energy of the incident ray that is reflected and $1-\rho$ as the fraction of the energy of the incident ray that is transmitted into the second medium.

Comment Fig. 3-1:
The figure doesn’t show the transmitted ray into the second medium. It only shows the reflected one into the first medium. The ray in the second medium is meant as an incident ray, as can be concluded from the following text.

Planck continues with: “Similar remarks apply to $\rho'$ the coefficient of reflection of a ray coming from the second medium and falling on the bounding surface.”
Somewhat earlier in his text he stated: “….. and, in general, let all quantities referring to the second medium be indicated by the addition of an accent.”

Comment Fig. 3–2:
The figure would have been complete if Planck would have drawn a conical element \( d\Omega' \) in the lower left hand quadrant at an incident angle of \( \Theta' \). That conical element would have represented as well the transmitted energy from the incident ray out of the first medium, as the reflected energy in the second medium.

At this place Planck makes a crucial statement:

"Now according to (11)* we have for the monochromatic plane polarized radiation of frequency \( \nu \), emitted in time \( dt \) toward the first medium (in the direction of the feathered arrow upper left hand in Fig. 3), from an element \( d\sigma \) of the bounding surface and contained in the conical element \( d\Omega \),

\[
\begin{align*}
\frac{dt}{dt} \frac{d\sigma}{d\sigma} \cos \Theta \frac{d\Omega}{d\Omega} K_\nu d\nu
\end{align*}
\]

where

\[
\frac{d\Omega}{d\Omega} = \sin \Theta \frac{d\Theta}{d\Theta} \frac{d\phi}{d\phi}
\]

This energy is supplied by the two rays which come from the first and the second medium and are respectively reflected from or transmitted by the element \( d\sigma \) in the corresponding direction (the unfeathered arrows)."

* Equation (11) is equal to (34) with the application of (35) in (34)

Fatal error 3:
See remark (5)-1 copied here:
This concept of solid angle is not appropriate to apply in such a theory.
Besides that \( d\Omega \), as presented in (5), is indeed (see Remark (1)-2 ) the derivative of the solid angle \( \Omega = \int S \sin \Theta \, d\Theta \, d\phi \), so not a solid angle.

Planck also wrongly 'proved'

\[
q^2 K_\nu = q^2 K'_\nu
\]

by applying the same misconception of \( d\Omega \).

Fatal error 4:
N.B. The variable \( K'_\nu \) in this equation doesn’t have anything to do with the \( K'_\nu \) as introduced in (9), as shows his description below!

He states in section 39:
"The second formula (41) establishes a relation between the intensities of radiation in the two media, for it states that, when thermodynamic equilibrium exists, the specific intensities of radiation of a certain frequency in the two media are in the inverse ratio of the squares of the velocities of propagation or in the direct ratio of the squares of the indices of refraction.
By substituting for \( K_\nu \) its value from (27) (\( K_\nu = \epsilon_\nu / \alpha_\nu \)) we obtain the following theorem:
The quantity

\[
q^2 K_\nu = q^2 \epsilon_\nu / \alpha_\nu
\]

does not depend on the nature of the substance, and is, therefore, a universal function of the temperature \( T \) and the frequency \( \nu \) alone.”

We applied the dimension \( m^{-1} \) of \( \alpha_\nu \) , notwithstanding the background as shown in Fatal error 1.
In the mean time Planck did not change the dimension of \( \epsilon_\nu (\text{W.s/m}^3) \).
So at this moment \( [\epsilon_\nu / \alpha_\nu] = \text{W.s/m}^2 \), indeed equal to the dimension of \( K_\nu (\text{W/m}^2/\text{Hertz}) \).
In the next section of this article the criticism will be concentrated on Kirchhoff’s law of thermal emission as presented by Planck.

In the section after that attention will be paid to the modern way of presenting this law.

4. Kirchhoff’s law of thermal emission presented by Planck

Planck based Kirchhoff’s law on (41). The consequences of that will be investigated below.

“42. We shall now consider a system in a state of thermodynamic equilibrium, contained within an enclosure impermeable to heat and consisting of n emitting and absorbing adjacent bodies of any size and shape whatever. As in Sec. 36, we again confine our attention to a monochromatic plane polarized pencil, which proceeds from an element $d\sigma$ of the bounding surface of the two media in the direction toward the first medium (Fig. 3, feathered arrow) within the conical element $d\Omega$. Then, as in (34), the energy supplied by the pencil in unit time is

$$d\sigma \cos \Theta d\Omega K_\nu d\nu = I$$

(43)”

By stating: “...the energy supplied by the pencil in unit time is...” Planck implicitly gave the variable $I$ the dimension power, instead of energy, not in contradiction (this time!) by the fact that $[K_\nu d\nu] = \text{W/m}^2$.

Based on the text: “...consisting of $n$ emitting and absorbing adjacent bodies...” he then creates

$$I = I_1 + I_2 + I_3 + \ldots I_n$$

(44)

The variable $J$ is set equal to $I$ by the following consideration.

“43. The most adequate method of acquiring more detailed information as to the origin and the paths of the different rays of which the radiations $I_1$, $I_2$, $I_3$, ...$I_n$ consist, is to pursue the opposite course and to inquire into the future fate of that pencil, which travels exactly in the opposite direction to the pencil $I$ and which therefore comes from the first medium in the cone $d\Omega$ and falls on the surface element $d\sigma$ of the second medium. For since every optical path may also be traversed in the opposite direction, we may obtain by this consideration all paths along which rays can pass into the pencil $I$, however complicated they may otherwise be. Let $J$ represent the intensity of this inverse pencil, which is directed toward the bounding surface and is in the same state of polarization. Then according to Sec. 40,

$$J = I$$

(45)”

Planck means, in the end, by “Then according to Sec. 40,” according to the conclusion that $q^2 K_\nu = q^2 K'_\nu$.

As has been proven above this conclusion is wrong, so (45) is invalid.

The variable $J$ is, just like $I$, split up in $n$ components claiming that

$$I_i = J_i$$

(46)

continuing with:

“44. Following G. Kirchhoff (Gesammelte Abhandlungen, 1882, p. 574) we call the quantity $I_2$, i.e., the intensity of the pencil emitted from the second medium into the first, the emissive power $E$ of the second medium, while we call the ratio of $J_2$ to $J$, i.e., that fraction of a pencil incident on the second medium which is absorbed in this medium, the absorbing power $A$ of the second medium. Therefore

$$E = I_2 (\leq I), \quad A = J_2/J (\leq 1)$$

(47)”

Remark (47)-1:

It is extremely careless to qualify $A$ as an absolute power, clearly showing that it is a relative one, being related to the power $J$.

Notwithstanding this pertinent error he comes up with the following statement, repeating that $A$ is a power:
“With these assumptions, according to equations (46), (45), and (43), Kirchhoff’s law holds,

\[ \frac{E}{A} = I = d\sigma \cos\Theta d\Omega K_v dv \]  

i.e. , the ratio of the emissive power to the absorbing power of any body is independent of the nature of the body.”

Indeed, if E is set equal to I\(_2\) and A to J\(_2\)/J then E/A = J. (I\(_2\)/J\(_2\) = I, because Planck assumed as well I = J as I\(_1\) = J\(_1\). However it has not been proven at all that I = J. The outcome (48) would have been the same if he directly would have written: E=I and A=J/J=1, clearly showing to be a complete useless exercise.

Planck did so in section 45:

“45. When in particular the second medium is a black body (Sec. 10) it absorbs all the incident radiation. Hence in that case J\(_2\) = J, A = 1, and E = I, i.e. , the emissive power of a black body is independent of its nature. Its emissive power is larger than that of any other body at the same temperature and, in fact, is just equal to the intensity of radiation in the contiguous medium.”

While (48) thus is meant to represent the second medium as a not-black body, so seemingly not “absorbing all the incident radiation”, still E would equal I. A contradiction in terminis.

So all the words in section 42 up to and including 45 are senseless, because the start point was the same as the end point: equation (43), ornate with an inapplicable conical element d\(\Omega\).

As a result Kirchhoff’s law of thermal emission is an empty, but above all misleading, law.

5. Kirchhoff’s law of thermal emission in modern presentations

If one looks for “Kirchhoff’s law of thermal emission” on the Internet, the result is for example just: \(\alpha\nu = \varepsilon\nu\). Given the weird definitions of these variables by Planck, it might be interesting to look for them on the Internet too.

Copied from: https://en.wikipedia.org/wiki/Kirchhoff’s_law_of_thermal_radiation having changed \(\lambda\) into \(\nu\). (The text itself starts with frequency!)

“In the second system, therefore, at each frequency, the walls must absorb and emit energy in such a way as to maintain the black body distribution. For the condition of thermal equilibrium, the absorptivity \(\alpha\) is the ratio of the energy absorbed by the wall to the energy incident on the wall, for a particular frequency. Thus the absorbed energy is \(\alpha\nu E_{b\nu}(\nu,T)\) where \(E_{b\nu}(\nu,T)\) is the intensity of black body radiation at frequency \(\nu\) and temperature T. Independent of the condition of thermal equilibrium, the emissivity of the wall is defined as the ratio of emitted energy to the amount that would be radiated if the wall were a perfect black body. The emitted energy is thus \(\varepsilon\nu E_{b\nu}(\nu,T)\) where \(\varepsilon\nu\) is the emissivity at frequency \(\nu\). For the maintenance of thermal equilibrium, these two quantities must be equal, or else the distribution of photon energies in the cavity will deviate from that of a black body. This yields Kirchhoff’s law: \(\alpha\nu = \varepsilon\nu\)”

In order to understand what is exactly meant here, this text will be scrutinized.

We start with:

“\(E_{b\nu}(\nu,T)\) is the intensity of black body radiation at frequency \(\nu\) and temperature T.”

This description forces us to define unambiguously the term ‘black body radiation’. For that reason several sources on the Internet have been opened.

It is found that definitions of only black body and of black body radiation are mixed up.
The conclusion is that the best definition of a black body is:

**A blackbody absorbs all radiation, incident on its surface**

It is chosen as the best one, because it clearly implies that a body would not be called black if it would not absorb all radiation incident on its surface, ending up at the white body that doesn’t absorb radiation at all.

The best definition of black body radiation is found to be the following:

**Black body radiation is radiation that shows a specific, mathematically presented spectrum as function of frequency ν and temperature T.**

In [2] the following presentations are found for this black body radiation:

\[ K = \frac{h\nu^3}{c^2} \left( \exp\left(\frac{h\nu}{kT}\right) - 1 \right) \]  \hspace{1cm} (274)  

and

\[ E_\lambda = \frac{hc^2}{\lambda^5} \left( \exp\left(\frac{hc}{k\lambda T}\right) - 1 \right) \]  \hspace{1cm} (276)  

With K described as: “…….the specific intensity of a monochromatic plane polarized ray…….” and \( E_\lambda \) as: “…..the specific intensity of a monochromatic ray not to the frequency ν but, as is usually done in experimental physics, to the wavelength \( \lambda \)”.

With \( [h] = Ws^2 \) the dimensions of K and \( E_\lambda \) become: \( [K] = W/m^2/Hertz \) resp. \( [E_\lambda] = W/m^2/m. \)

Regarding the dimension of K, Planck should have written \( K_\nu \), but it can be that the outcome indeed was K, considering the many mistakes he usually made. It is not considered worth to investigate this further.

From now on we will use for this spectral surface power density the expression

\[ P_d(\nu) = \frac{h\nu^3}{c^2} \left( \exp\left(\frac{h\nu}{kT}\right) - 1 \right) \]

assuming its correctness. The dimension of \( P_d(\nu) \) is correct, just like the one of \( hv/kT \). (The dimension of the so-called Boltzmann constant \( k \) is \( W/s.K^{-1} \))

Planck wrote the following more precise specification of black body radiation:

“This is the specific intensity of a monochromatic plane polarized ray of the frequency ν, which is emitted from a black body at the temperature T into a vacuum in a direction perpendicular to the surface”.

Mind the addition: “into a vacuum in a direction perpendicular to the surface”.

Having found applicable definitions for black body and black body radiation, we go back to the text to be scrutinized:  [https://en.wikipedia.org/wiki/Kirchhoff’s_law_of_thermal_radiation](https://en.wikipedia.org/wiki/Kirchhoff’s_law_of_thermal_radiation)

We started with:

“\( E_{\nu_0}(\nu,T) \) is the intensity of black body radiation at frequency ν and temperature T.”

Conclusion: \( E_{\nu_0}(\nu,T) = P_d(\nu) \).
The next text to be considered is:
“Independent of the condition of thermal equilibrium, the emissivity of the wall is defined as the ratio of emitted energy to the amount that would be radiated if the wall were a perfect black body. The emitted energy is thus $\varepsilon_\nu E_{b\nu}(\nu, T)$ where $\varepsilon_\nu$ is the emissivity at frequency $\nu$.”

So only for $\varepsilon_\nu = 1$ that wall is a black body wall.
Back to the first sentence in that text:
“In the second system, therefore, at each frequency, the walls must absorb and emit energy in such a way as to maintain the black body distribution.”

The second system is defined as follows:
“One may suppose a second system, a cavity with walls that are opaque, rigid, and not perfectly reflective to any wavelength, to be brought into connection, through an optical filter, with the blackbody enclosure, both at the same temperature.”

It is clear that the second system is meant to be a not-black body, with the consequence that we have to read the sentence under consideration as:
In the not-black body, therefore, at each frequency, the walls must absorb and emit energy in such a way as to maintain the black body distribution.
The word “therefore” refers to the condition that both systems are at the same temperature.
This means that, due to the fact that both systems are at thermo equilibrium, the not-black body transfers, as well as in the aspect absorptivity as emissivity, into a black body!

**Magic physics!**

Next phrase:
“For the condition of thermal equilibrium, the absorptivity $\alpha_\nu$ is the ratio of the energy absorbed by the wall to the energy incident on the wall, for a particular frequency. Thus the absorbed energy is $\alpha_\nu E_{b\nu}(\nu, T)$ where $E_{b\nu}(\nu, T)$ is the intensity of black body radiation at frequency $\nu$ and temperature $T$”

As if the condition of thermal equilibrium would determine the absorptivity of a body! Absorptivity is an independent, regarding the circumstances, property of material.
The definition of $\alpha_\nu$ is correct: “the ratio of the energy absorbed by the wall to the energy incident on the wall, for a particular frequency”, but the conclusion thereafter is not.
Multiplying the absorptivity of a not-black body with the spectral power density of the emission of a black body and qualifying the result as “the absorbed energy” in the not-black body is extremely unphysical and illogical.

The final conclusion in the reference under consideration:
“For the maintenance of thermal equilibrium, these two quantities ($\alpha_\nu E_{b\nu}(\nu, T)$ and $\varepsilon_\nu E_{b\nu}(\nu, T)$ ) must be equal, ............... This yields Kirchhoff’s law: $\alpha_\nu = \varepsilon_\nu$.”

Clearly a completely irresponsible conclusion.

**Just like has been found in Planck’s theory, the modern Kirchhoff’s law turns out to be an empty law too, but more serious a misleading one and a shame for physical science.**
6. Encore: consideration of the relation $E=\hbar \nu$

The first time that Planck quotes the quantity $\hbar \nu$ in his book is in equation (264), where he describes it as: “energy of an oscillator $\varepsilon=\hbar \nu$.”

For a more extended definition, the following reference is taken:
https://en.wikipedia.org/wiki/Planck_constant saying:

“The Planck constant (denoted $h$, also called Planck’s constant) is a physical constant that is the quantum of action, central in quantum mechanics. First recognized in 1900 by Max Planck, it was originally the proportionality constant between the minimal increment of energy, $E$, of a hypothetical electrically charged oscillator in a cavity that contained black body radiation, and the frequency, $\nu$, of its associated electromagnetic wave. In 1905 the value $E$, the minimal energy increment of a hypothetical oscillator, was theoretically associated by Einstein with a "quantum" or minimal element of the energy of the electromagnetic wave itself. The light quantum behaved in some respects as an electrically neutral particle, as opposed to an electromagnetic wave. It was eventually called the photon.

The Planck–Einstein relation connects the particulate photon energy $E$ with its associated wave frequency $\nu$: $E = h\nu$.”

In chapter VIII it is proven, and if not, at least made very likely, that a photon is not a particle, but an EM pulse, with a width in the order of magnitude of femto seconds.

The energy of (such) a photon turned out to be the difference in kinetic energy of an electron jumping from orbit $n_1$ to $n_2$ and doing so, causing an EM source that has to be considered as the source of a photon.

This relation between the difference of these two kinetic energies of an electron and the energy of a photon is described extensively in chapter V and will be repeated here very shortly.

It is generally accepted that electrons have discreet orbits around the nucleus of the atom.

These discreet radii are mathematically represented by $r_n = n^2 a_0/Z$, with $n$ is an integer and $Z$ the so-called atom number, the number of protons in the nucleus of the atom.

The radius $a_0$ is the so-called Bohr’s radius, the smallest in the neutral hydrogen atom.

The mathematical expression for $a_0$ is found as follows.

The idea behind the quantitative presentation of the discrete radii is based on the assumption, for whatever reason, that the angular momentum $m_e v_e r_a$ of the electron is quantized, expressed as:

$$m_e v_e r_a = \frac{nh}{2\pi}$$

with:
- $m_e$ mass of the electron $9.1*10^{-31}$ kg
- $v_e$ velocity of the electron along its orbit $m/s$
- $h$ Planck’s constant $6.626*10^{-34}$ kg m$^2$s$^{-1}$

Applying this to the relations:

$$F_{cd} = m_e v_e^2 / r = F_C = k_e Z q_e^2 / r^2$$

With:
- $F_C$ the so called Coulomb force
- $k_e$ Coulomb’s constant $(1/4\pi\varepsilon_0) = 8.99*10^9$ Nm$^2$C$^{-2}$
- $\varepsilon_0$ electric charge of the electron $1.6*10^{-19}$ C

it follows that:

$$r = n^2 h^2 / (4\pi^3 k_e Z q_e^2 m_e) \quad \text{and} \quad v_e^2 = k_e Z q_e^2 / m_e r$$
\( r \) is defined as \( a_0 \) for \( n=1 \) and \( Z=1 \), so:

\[
a_0 = \frac{\hbar^2}{(4\pi^2 e_0 q_e^2 m_e)}
\]

The difference in kinetic energy of the electron orbiting in \( n_1 \) respectively \( n_2 \), is represented by:

\[
\Delta E_{kn} = \frac{1}{2} m_e (v_{e1}^2 - v_{e2}^2),
\]

Resulting in:

\[
\Delta E_{kn} = \hbar c * Z^2 m_e q_e^4 / (8\epsilon_0^2 \hbar^3 c) * (1/n_1^2 - 1/n_2^2)
\]

The Rydberg expression is:

\[
\frac{1}{\lambda} = R_\infty (1/n_1^2 - 1/n_2^2)
\]

with the following parameters:

<table>
<thead>
<tr>
<th>( \lambda )</th>
<th>wavelength of the carrier ( \text{m} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( R_\infty )</td>
<td>Rydberg’s constant ( (Z^2 m_e q_e^4)/(8\epsilon_0^2 \hbar^3 c) ) 1.097*10(^7 ) ( \text{m}^{-1} )</td>
</tr>
<tr>
<td>( \epsilon_0 )</td>
<td>dielectric permittivity ( \text{As/Vm} ) 8.854*10(^{-12} )</td>
</tr>
<tr>
<td>( c )</td>
<td>velocity of light in vacuum ( \text{m/s} ) 2.999*10(^8 )</td>
</tr>
</tbody>
</table>

The coefficient of \( \Delta E_{kn} \) can also be written as: \( Z^2 m_e q_e^4 / (8\epsilon_0^2 \hbar^3 c) \), thus still showing the dimension of energy. This coefficient does not incorporate \( c \) anymore, presented here also to emphasize the correctness of the content of Remark (19.1)-2.

The original coefficient thus is an artificial one, obtained by multiplying nominator and denominator in the just shown reduced one by \( \hbar c \).

We have to bear in mind that the Rydberg expression is fundamentally based on experimental data, where Rydberg succeeded in deducing this expression from (all) his measurements.

Rydberg’s expression can be multiplied by \( c \) in order to obtain frequency \( (f) \) on the left hand side and then define \( R'_\infty = R_\infty c = Z^2 m_e q_e^4 / (8\epsilon_0^2 \hbar^3 c) \), resulting in:

\[
f = R'_\infty (1/n_1^2 - 1/n_2^2)
\]

But still no expression of energy is obtained in this equation of course.

Due to the fact that the dimension of \( \hbar \) is such that \( [\hbar f] \) equals the dimension of energy, we can write now:

\[
h f = R''_\infty (1/n_1^2 - 1/n_2^2) \quad \text{with} \quad R''_\infty = R'_\infty \ h = R_\infty \ c \ h
\]

It is clear that this artificial way of applying mathematics can not be used to claim that in general \( E=hf \). It can only be claimed that the energy of photon equals the difference in kinetic energy of the orbiting electron, based on the theory and mathematics shown from \( m_e v_{e1} r_{n_1} = \hbar/2\pi \) up to and including \( \Delta E_{kn} = (Z^2 m_e q_e^4 / (8\epsilon_0^2 \hbar^3 c)) * (1/n_1^2 - 1/n_2^2) \).

The crucial and fundamental question that is left is: why is the equation \( m_e v_{e1}, r_{n_1}, v_{e2}, r_{n_2} \) valid?

The answer is that \( h \) is only a help variable!

From \( m_e v_{e1} r_{n_1} = \hbar/2\pi \) it follows that \( n_i = 2 \pi m_e v_{e1} r_{n_1} / \hbar \).

Applying this in \( (1/n_1^2 - 1/n_2^2) \) results in the conclusion that \( (1/n_1^2 - 1/n_2^2) = \hbar^2 F(m_e v_{e1}, r_{n_1}, v_{e2}, r_{n_2}) \)

This is multiplied by \( Z^2 m_e q_e^4 / (8\epsilon_0^2 \hbar^3 c) \), so, indeed, finally \( \Delta E_{kn} \) is not a function of \( \hbar \)!
The fact that Rydberg found that the frequency \( f \) of photon is proportional to \( (1/n_1^2 - 1/n_2^2) \) and the fact that it can mathematically be proven that the difference in kinetic energy of an electron, jumping from orbit \( n_1 \) to \( n_2 \), is also proportional to \( (1/n_1^2 - 1/n_2^2) \), doesn’t guarantee that the energy of a photon is \( hf \).

**Basically the energy of a photon is not \( hf \), but the difference in the kinetic energies of an electron, orbiting the nucleus of an atom and jumping from one orbit to another.**

Quote regarding the Rydberg constant:

“The constant first arose as an empirical fitting parameter in the Rydberg formula for the hydrogen spectral series, but Niels Bohr later showed that its value could be calculated from more fundamental constants, explaining the relationship via his "Bohr model". As of 2012, \( R_\infty \) and electron spin g-factor are the most accurately measured fundamental physical constants.”

Niels Bohr’s measurements seem to prove that it is allowed to present the energy of a photon as \( hf \), with \( f \) the frequency of the carrier of the photon.

This must be qualified as extremely coincidental, because it is fundamentally speaking impossible.

**So the relation \( E = hf \) should exclusively be applied to the energy of a photon.**

**Conclusions**

1. Planck’s Theory of Heat Radiation as presented in Part I in [1] contains an unbelievable large number of errors, of which several of the level ‘fatal’, with the consequence that we are forced to fully reject this part of his book.

2. As a result of conclusion 1 Kirchhoff’s law has to be rejected too.

3. The modern version of this law turns out to be an empty one too.

4. Given the extremely bad quality of Planck’s Theory of Heat Radiation, the correctness of his spectral surface power density function of a black body cannot be guaranteed.

5. As an encore it has been emphasized, as already put forward in chapter VIII, that basically the energy of a photon is not \( hf \), but the difference in the kinetic energies of an electron, orbiting the nucleus of an atom, jumping from one orbit to another.

6. In that encore it is argued too that the relation \( E = hf \) is, from a physical point of view, unrealistic but, according to measurements of Niels Bohr, applicable to the energy of a photon. It is therefore recommended to express this extremely coincidental phenomenon strictly by means of the equation \( E_{\text{photon}} = hf \).

**References.**


Pierre-Marie Robitaille and Stephen J. Crothers

Volume 11 (2015) PROGRESS IN PHYSICS Issue 2 (April)


XII  Correcting for Relativity in GPS makes no sense

Summary – Show that the Special Theory of Relativity is an untenable theory, many times leads to the reaction that the GPS is so accurate thanks to the STR corrections. This chapter shows that the supposed relativity errors are by far negligible relative to the errors caused by atmospheric circumstances.

1. Introduction

In [1] the impact of the Special Theory of Relativity, by means of the supposed so-called time dilation, on the accuracy of a Global Positioning System is presented. For more background information a reference herein is made to [2], from now on also referred to by means of “Ashby”. This article shows a phenomenon that has a much larger impact on the accuracy of the GPS than the one claimed by the concept “time dilation”. It also shows that this phenomenon leads to errors of the same order of magnitude as shown in [3].

2. GPS configuration

In [2] the GPS configuration is described as follows.

“The orbiting component of the GPS consists of 24 satellites (plus spares): four satellites in each of six different planes inclined 55° from Earth’s equatorial plane. The satellites are positioned within their planes so that, from almost any place on Earth, at least four are above the horizon at any time. Orbiting about 20,000 km above Earth’s surface, all satellites have periods of 11 hours and 58 minutes.”

So the angular velocity of the satellites is twice as high as the one of the earth.

The basic equations are:

| r - r_i | = c(t - t_i)  with i representing satellite number 1 up to and including 4

r  position of the receiver (on or near the earth’s surface)

r_i  position of the i_th satellite

(t_i  time of emitting a signal from the i_th satellite

t  time of the clock of the receiver when it receives the 4 signals simultaneously

The “variable” c is described in [2] as:

“The fundamental principle on which GPS navigation works is an apparently simple application of the second postulate of special relativity – namely, the constancy of c, the speed of light.”

3. Error budgets

If the above shown definitions of the variables are correct then the system is seemingly be able to detect the simultaneousness of the receiving of the 4 signals. To prevent discussions about this it is also possible to look at the equations in another, more easier, way: t is the time that at position r a signal is simultaneously transmitted to 4 satellites at position r_i, where they are received at time t_i respectively.

Ashby’s argumentation, regarding the impact of the STR on the accuracy of the value of r, is that, given c as a physical constant, the values of t_i are influenced by time dilation due to the velocity of the satellites. A velocity of 4 km/s is mentioned. That velocity indeed corresponds to an angular velocity twice as high as the one of the earth.

The most important mistake in [2] is that c is considered as constant on the trajectory | r - r_i |. The satellites orbit at a distance of about 20,000km above earth’s surface. In between is the atmosphere. Its mean thickness is about 1000 km. As generally known the velocity of light in air is certainly not c.
N.B. $\mathbf{c}$ is the symbol for the velocity of light in vacuum, leaving out for the moment the reference with respect to which this velocity is defined. Therefore this symbol has not been used properly up to now.

Propagating through air, the velocity $\mathbf{c}$ decreases with the factor $1/n$, with $n$ the so-called refractive index. Due the fact that the refractive index depends on for example temperature, density and relative humidity, the 4 paths along which the 4 signals propagate in general are mutually different and thus is the mean propagation velocity of the light along those 4 paths.

Suppose the distance between the receiver and satellite $i$ is $D_i$, the mean refractive index of the atmosphere along the path of signal $i$ to satellite $i$ is $n_i$ and the thickness of the atmosphere, along which this mean refractive index is applicable, is $d_i$. Then the mean velocity of signal $i$ is:

$$c_i = \{c(D_i - d_i) + (c/n_i)*d_i\} / D_i = c \{ 1 - (d_i/D_i) (1 - 1/n_i) \}$$

N.B. $c_i = c$ for either $d_i = 0$ or $n_i = 1$.

Let us consider the most simple situation, meaning that all $d_i$’s, respectively $D_i$’s, are mutually equal. Then:

$$c_i - c_j = c (d/D) (1/n_i - 1/n_j) = c (d/D) (n_j - n_i) / n_i n_j$$

If $n_i$ is rewritten as $1 + \Delta n_i$, then $c_i - c_j = c (d/D) (\Delta n_j - \Delta n_i)$.

The factor $n_i n_j$ is omitted, because it only represents a multiplication factor, close to 1, for the accuracy $\Delta n_i - \Delta n_j$ to be investigated.

The absolute value of the relative difference between the two velocities, $(c_i - c_j)/c$, is $(d/D) |\Delta n_i - \Delta n_j|$, resulting in relative time errors of the same value. According to Ashby, relative time errors, due to “time dilation”, are considered to be much too large to ignore. He claims relative time errors of about $10^{-10}$.

Ashby writes:

$$t' = \sqrt{(1 - v^2/c^2)} \cdot t$$

(27)

Thus, a clock moving relative to a system of synchronized clocks in an inertial frame beats more slowly.

The square root in Eq. (27) can be approximately expanded using the binomial theorem:

$$\sqrt{(1 - v^2/c^2)} \approx 1 - v^2/2c^2$$

(28)

In the GPS, satellite velocities are close to 4000 m/s, so the order of magnitude of the time dilation effect is $v^2/2c^2 \approx 10^{-10}$. This is also a huge effect.”

The absolute error of a normal GPS is about 15 m [3]: “The standard accuracy of about 15 meters can be..............”. Relatively speaking this is an error of $15/2*10^7 \sim 10^{-6}$. So Ashby claims an error due to “time dilation” 10.000 times smaller than the real error.

The refractive index of air at atmospheric pressure is 1.0003. Above 100 km height the pressure is so low that we can assume a refractive index of 1.

Suppose the mean refractive index of this layer of 100 km is 1.0002, so the mean $\Delta n_i$ is $2*10^{-4}$. Suppose 10% of this mean value causes the difference $|\Delta n_i|$, being $2*10^{-5}$.

Then $(d/D) |\Delta n_i| = (100/20000)*2*10^{-5} = 10^{-7}$.

Compared to the real relative accuracy of $10^{-6}$ it turns out that the assumed mutual differences in refractive indices are most likely too optimistic. But besides that, there are several other sources for inaccuracies [3].

The relative error as a result of the relative velocity between satellite and earth surface ($(4-2)$km/s) is $2/300000000$, being about $10^{-8}$, so negligible. See the chapters: I, V and VI.
4. The misconception: time dilation

Einstein introduced this concept based on, among others, the nonsense hypothesis:

*Any ray of light moves in the “stationary” system of co-ordinates with the determined velocity $c$, whether the ray be emitted by a stationary or by a moving body.*

The result is that (atomic) clocks will run with a speed dependant on their state of constant velocity. But a clock in a state of constant velocity represents an inertial system. So, given the hypothesis: all physical laws are the same in any inertial system, a clock in a state of an arbitrary constant velocity will not show any deviation.

Satellites can, given their large distance relative to the centre of the earth, be considered as inertial systems!

**Conclusion**

Claiming that the GPS is so accurate due to relativity corrections is, for more than one reason, nonsense.

**References**

[1] Every Day Einstein, Philip Yam, Scientific American, Special Issue, September 2004
   https://www.aapt.org/doorway/TGRU/articles/Ashbyarticle.pdf
XIII  Religious Science

Summary – The Special Theory of Relativity is a very “popular” theory among physicists, so don’t dare to state that it is a nonsense theory. The most basic reason for the weirdness of this theory is the acceptance by almost all physicists of the fact that the velocity of light in vacuum in this theory is fully undefined.

1.  Introduction

A velocity of whatever object or phenomenon is only defined if the reference, with respect to which the object / phenomenon moves, is defined. This forces us to the conclusion that, formally, we should always mention the reference speaking about the velocity of an object or phenomenon. If we mention the velocity of for example a car, everybody knows that we only mean the street as reference and so it is omitted. The speed of an airplane is meant as groundspeed, showing implicitly the reference.

By far the greatest part of physicists is satisfied just stating: the velocity of light in vacuum is \( c \). By far the most unscientific statement in physics.

2.  Award for the most unscientific statement

A few years ago the young student Ryan Chester did win an award of $250000 by explaining his way of looking at the STR. See [1].

His crucial statements and my corrections are shown hereafter.

In [1] it is claimed that Einstein’s first postulate sounds: “The laws of physics are the same in any inertial reference frame”.

Comment:
Einstein’s first postulate is a completely different one, sounding:

“The laws by which the states of physical systems undergo change are not affected, whether these changes of state be referred to the one or the other of two systems of coordinates in uniform translatory motion.”

N.B. At that time the concept “inertial system” with the meant property did not yet exist!

Einstein only considers 2 systems, moving with respect to each other with a constant mutual speed.

If we would still call Einstein’s first postulate “The Principle of Relativity”, just as he did himself, then we have to find another expression for the postulate: the laws of physics are the same in any inertial reference frame, now-a-days qualified as “The Principle of Relativity”. See chapter I for an alternative expression.

In [1] it is claimed that Einstein’s second postulate sounds: “Light travels at a constant speed in a vacuum regardless of the speed of the source.”

Comment:
Einstein’s second postulate in his words sounds:

“Any ray of light moves in the “stationary” system of co-ordinates with the determined velocity \( c \), whether the ray be emitted by a stationary or by a moving body.”

The quotes around the word stationary tell us already that there is something peculiar about this concept. It turns out that Einstein effectively re-introduced an ether equivalent model with this concept. See chapter I.
Stating the words: “...at a constant speed in a vacuum regardless of the speed of the source of the light...” means effectively that it is tried to define the speed of light with vacuum as the reference.
The source, left as the only other possible reference, has explicitly been excluded by the addition: “regardless of the speed of the source”.

As is well known, vacuum just means “nothing”.

**Conclusion:** an undefined speed of light has been created

In chapter I it is proven, given the postulate that all physical laws are the same in any inertial system, that the speed of light, emitted by an inertial source in vacuum, is always and only $c$ with respect to its source.

But hardly any physicist does have any problem stating it as: the velocity of light in vacuum is $c$.

Most likely this is the reason that the STR is still considered as the most wonderful theory ever created. And Einstein as the most genius scientist ever born.

3. **Encore**

In chapter I it is explained that the postulate: The laws of physics are the same in any inertial system, leads to the unavoidable conclusion that all clocks in such systems run with the same speed! Fully in contradiction with Einstein’s concept of time dilation.

**Conclusion:** the concept space-time has to be rejected.

The mentioned conclusions above and the fact that hardly any physicist wants to accept the nonsense of the STR, have forced me to send a letter to the members of the Nobel Committee for Physics.

See the attachment

**Reference**

Dear members Nobel Committee Physics,

Would you be so kind to pay attention to the following consideration?

One of the postulates in physics sounds: all physical laws are the same in any inertial system.

A consequence of this postulate is that the time measurement of (atomic) clocks, moving with constant speed, are not influenced by such a speed.

This conclusion is clearly in contradiction with the outcome of the Special Theory of Relativity (STR).

Another consequence of this postulate is that, given the physical laws of Maxwell, the velocity of light in vacuum must be $c$, explicitly and only with respect to its inertial source.

This conclusion is flagrantly in contradiction with one of the hypotheses on which the STR is based.

The past decade I have shown thousands of physicists this fundamental proof of the invalidity of the STR.

Those physicists, inclusive Nobel laureates, who tried to contest this evidence, used the most weird and/or non-scientific counter arguments.

They give me the impression that they believe in the STR like religious people believe in the Koran/Bible.

Publication of my article in magazines/arXiv, designated for this purpose, is impossible.

To my opinion due to this religion like believe in the STR.

As a result you will find my article: “Einstein’s and Galilei’s Relativity” at: http://vixra.org/abs/1611.0111

The described attitude of physicists is of course fatal for physical science, leading to its lowest possible level: science fiction.

I’m looking forward to your opinion about the phenomenon presented above.

Kind regards,

Sjaak Uitterdijk

The Netherlands

FYI:
This e-mail has been received too by 2000 (out of a list of 8000) physicists as blind copy.
They are members of the following universities: All in the Netherlands and Belgium, ETH Zürich, Oxford, Cambridge, Imperial College, University College London, Berkeley, Harvard, MIT, Stanford and Cornell. Besides that: Princeton IAS.
XIV Velocity of cosmic muons most likely much higher than $c$

Summary - It seems to be the most attractive experiment for physicists, who strongly believe in the validity of the STR, to refer to: the supposed half-life time, in combination with their supposed velocity, of muons entering the atmosphere. The crucial part of the experiment is the application of the equation $E=mc^2$. This article shows that, by applying this equation, the one error in STR is used to prove the apparent validity of another error in this theory.

1. Introduction

The word muon is the abbreviation of the meant particle: $\mu$-meson. In 1963 David H. Frisch and James H. Smith published an article in the American Journal of Physics with the title: Measurement of the Relativistic Time Dilation Using $\mu$-Mesons [1]. The abstract starts as follows: “An experiment has been performed to demonstrate the relativistic time dilation as a large effect......”. The mentioned large effect is attributed to the supposed velocities of the muons, being almost $c$. As a result the STR prescribes large time dilations, which are supposed to influence the half-life time of the muons with the same order of magnitude.

The above mentioned article is taken as reference to dispute the claimed evidence that such an experiment proves the validity of the phenomenon time dilation, as predicted by STR.

2. Fundamental assumption

The argumentation of the authors, regarding the claimed similarity between clocks and the half-life time phenomenon, sounds:

“As far as we know the probability of the radioactive decay of subatomic particles, and thus the average time they survive before decaying, is set by forces entirely internal to their structure. Therefore, any dependence of the decay probability of radioactive particles on their speed is an example of a general property of clocks in motion relative to an observer rather than a property of the speed of these particular particles relative to anything else in the universe. It is irrelevant, for example, that up to the present era the observer has happened to be on earth.”

Crucial in this argumentation is the following reasoning:

“any dependence of the........on their speed is an example of a general property of clocks in motion relative to an observer........”

So firstly they take for granted, most likely based on the outcome of the STR, that clocks in motion have a “general property” and that this property only depends on the speed relative to the observer.

Expressed in simple words: each observer, having a different speed relative to the observed clock than another observer, will read a different time on that same clock.

Conclusion: each observer does have its own influence on the frequency of the clock, only depending on the relative motion between clock and observer. Any reference “else in the universe” does not have influence on the frequency of the clock, as they state!

If we would exclude physical influence of (the speed of) any observer on the behaviour of the clock, and thus that the clock will not change its frequency as a function of the speed between observer and clock, then the only conclusion is left that the observer is, in some way or another, influenced by the mutual speed between clock and observer.

See chapter I, section 7 for a critical consideration of the “STR-observer”.

Secondly the authors claim that the decaying of muons is an example of the just described interaction between observer and observed clock.

N.B. These truly science fiction-like fundamentals are taken as the basis for the experiment to be carried out!
3. Measurement of the speed of the muons

The speed of the muons is calculated from their measured energy. The only kind of energy of an object from which its velocity can be calculated is the kinetic energy.

In stead of using $E_k = \frac{1}{2}mv^2$, the authors took the energy prescribed by the STR: $E = m_r c^2$, with $m_r$ the relativistic mass $m_0/\sqrt{1-\frac{v^2}{c^2}}$. $m_0$ is the so called ‘in-rest-mass’.

Let us abbreviate $1/\sqrt{1-\frac{v^2}{c^2}}$ to $\gamma$, as is normally done. So $m_r = \gamma m_0$ and $E = \gamma m_0 c^2$.

By measuring $E$ in terms of the so-called ‘in-rest-energy’ $m_0 c^2$, $\gamma$ will have values starting at 1 and higher. The velocity can now be calculated from these measured values of $\gamma$.

In chapter II it has been argued why $E = m_0 c^2$ is a self-evident non-physical equation.

Therefore now the equation $E_k = \frac{1}{2}m_0 v^2$ is taken instead of $E = \gamma m_0 c^2$, using the same measured energy $E$. So $E_k$ is taken as the real measured $E$.

Writing $E_k$ as $\frac{1}{2}m_0 c^2*(v/c)^2$, shows that $E_k/m_0 c^2 = \frac{1}{2} v^2/c^2$ in genuine physical terms.

In the experiment the outcome of the measurement of the energy $E$, in terms of $m_0 c^2$, is a dimensionless number, from now on indicated as $\gamma_m$, because $\gamma_m = E/m_0 c^2$.

In the experiment under consideration the speed of the muons is calculated from this $\gamma_m$, applying $1/\sqrt{1-\frac{v^2}{c^2}} = \gamma_m$, so the outcome is, by definition, not higher than $c$.

However if this $\gamma_m$ is used to calculate the speed of the muons by applying $\frac{1}{2} v^2/c^2 = \gamma_m$, then an arbitrary large $v$ can be measured.

See table 1, in which $\gamma_m$ has been calculated as $\gamma_m = 1/\sqrt{1-\frac{v^2}{c^2}}$, given the chosen values of $v/c$, instead of taking arbitrary values.

<table>
<thead>
<tr>
<th>$v/c$</th>
<th>$\gamma_m(v/c)$</th>
<th>real $v/c$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>1,4</td>
</tr>
<tr>
<td>0,900</td>
<td>2</td>
<td>2,1</td>
</tr>
<tr>
<td>0,950</td>
<td>3</td>
<td>2,5</td>
</tr>
<tr>
<td>0,990</td>
<td>7</td>
<td>3,8</td>
</tr>
<tr>
<td>0,995</td>
<td>10</td>
<td>4,5</td>
</tr>
<tr>
<td>0,999</td>
<td>22</td>
<td>6,7</td>
</tr>
</tbody>
</table>

Table 1

The results show that the one error in STR is used to prove the apparent validity of another error in this theory.
Conclusions

Given the postulate: all physical laws are the same in any inertial system, clocks must run synchronously, independent of their velocity, so time dilation does not exist.

Based on the same postulate: the mass of an object can not be influenced by its velocity. The postulate justifies the statement that each physical experiment carried out in any inertial system shows the same result. The following mind experiment proves the mentioned conclusion. Suppose two masses at mutual distance $r$ in an inertial system. Measuring the mutual gravitational force $\frac{Gm_1m_2}{r^2}$, will result in the same outcome, independent of the velocity of the inertial system.

Based on the same postulate: the velocity of light in vacuum can only be $c$ relative to its source.

As a result:
The STR is invalid, so any restriction on velocities of particles is impermissible.

and thus:
Muons entering the atmosphere most likely do have velocities (much) higher than $c$.

References

The Time of the Photon

Summary: A lot has been philosophized and written about the phenomenon ‘time dilation’. This article shows the consequences applying this phenomenon to a photon, traveling with velocity \( c \), relative to whichever observer, as the Special Theory of Relativity prescribes.

1. Historical background

A definition of time dilation is found in for example [1]:

“According to the theory of relativity, time dilation is a difference in the elapsed time measured by two observers, either due to a velocity difference relative to each other, or by being differently situated relative to a gravitational field.”

The influence of gravitational forces has not been considered in this article.

“As a result of the nature of spacetime, a clock that is moving relative to an observer will be measured to tick slower than a clock that is at rest in the observer’s own frame of reference.”

Spacetime is, in [2], defined as:

“In physics, spacetime is any mathematical model that fuses the three dimensions of space and the one dimension of time into a single four dimensional continuum. Spacetime diagrams are useful in visualizing and understanding relativistic effects such as how different observers perceive where and when events occur.”

Combining the two citations leads to the conclusion that a mathematical model is supposed to have a ‘nature’, which is not the same as ‘property’, and that this ‘nature’ is supposed to be responsible for the phenomenon ‘time dilation’.

‘Time dilation’ is originally defined by Einstein as:
A system \( S \) moves with constant velocity \( v \) relative to system \( S' \). If time \( t \) is related to \( S \) “(this “\( t \)” always denotes a time of the stationary system)” and time \( t' \) to \( S' \) then \( t' \), as function of \( t \) and \( v \), is: \( t' = \beta (t - vx/V^2) \) with \( \beta = 1/\sqrt{1-v^2/c^2} \) and \( V \) now-a-days written as \( c \).

Einstein’s conclusion therefor was: a clock mounted in \( S \), showing time \( t \), will show in \( S' \) time \( t' \).

Pretty soon the variable \( x \), by the scientist under consideration defined as a constant in \( S \), has been neglected in the time-transformation formula. Most likely because it made the expression immediately extremely suspicious regarding its credibility.

So what is left now-a-days is: \( t' = \gamma t = t/\sqrt{1-v^2/c^2} \). Might it be that \( \beta \) has been changed into \( \gamma \) in order to obtain a less suspicious change, after having eliminated the variable \( x \) without any explanation?

2. Influence of the Principle of Relativity

The Principle of Relativity has been postulated by Einstein but is a rather restricted version of the postulate that all physical laws are the same in any inertial system. Therefore the words “Principle of Relativity” will not be used hereafter anymore.

Another problem showed up: the postulate that states that all physical laws are the same in any inertial system, hereafter shortly written as the postulate, leading to the conclusion that the same physical experiment, carried out in any inertial system, will show the same result.

Reading a clock is fundamentally carrying out a physical experiment, because a clock is an instrument developed and produced in order to measure the variable ‘time’.

So mounting a clock, based on the same physical laws, in as well \( S \) as \( S' \) must lead to the conclusion that they will both show the same time.

Normally such a conclusion should mean: exit Special Theory of Relativity.

Given this contradiction with the postulate the approach of the supposed phenomenon ‘time dilation’ has been changed, based on the following consideration.
Clocks indeed do not measure different times in any inertial system, but observers of clocks will observe different 'times' when moving with constant \(v\) relative to clocks! To repeat a citation above:

“As a result of the nature of spacetime, a clock that is moving relative to an observer will be measured to tick slower than a clock at rest in the observer's frame of reference.”

Mind the expression: “a clock ...... will be measured to tick slower ...”!

In sound physical science such a measurement would be qualified as seemingly carried out wrongly, because the postulate prescribes that the clock doesn’t change the speed of its ticks, whatever observer observes it.

Einstein made a second fundamental mistake by stating that a clock mounted in \(S\) and showing time \(t\) will show time \(t'\) in \(S'\).
He forgot, the author assumes, to consider that the speed between \(S\) and \(S'\) is mutual, meaning that not only \(S'\) moves with \(|v|\) relative to \(S\), but also vice versa.

In the expression \(t' = t/\sqrt{1-v^2/c^2}\) it doesn’t matter whether \(v\) is positive or negative!
As a result is doesn’t matter either to what system \(t\) and \(t'\) are assigned.

The expression can also be written as \(t = t' \sqrt{1-v^2/c^2}\) leading to \(t = 0\) for \(v = c\).
This is an interesting phenomenon from the point of view of a photon, propagating in vacuum with \(v = c\) with respect to whichever observer, as the STR prescribes.

As has been argued it is free to define to what system \(t\) resp. \(t'\) belongs. So suppose \(t'\) belongs to the observer and \(t\) to the photon. Then the observer observes that the clock in the photon does not run (\(t\) is zero). What has to be concluded now?
- that the observer did not observe correctly?
- or that time belonging to the photon does not change/exist?

Those who believe in the correctness of the STR will reject the first possibility.
Chapter XIV shows that the concept of time belonging to, for example, a muon is generally accepted.
So time belonging to a photon must also be an unavoidable concept in STR.

Taking the second possibility gives rise to the question whether the (observed) EM-frequency of the photon might change as drastically as time does.
‘Frequency’ is defined as the reciprocal value of ‘period time’. The period time has become as zero as the time of the photon does. So the frequency of the (observed) EM-field in the photon has become infinite, leading to a situation that the photon is outside the visible spectrum/not visible anymore.
Or do we have to conclude that the width of the pulse is zero, in which case the photon is neither visible. See chapter VIII for a detailed model of the photon.
It is up to the STR-defender to solve this dilemma.

Let us change the allocations of the two times, so suppose \(t\) belongs to the observer and \(t'\) to the photon and \(t' = t/\sqrt{1-v^2/c^2}\).
Now the time \(t'\) in the photon is infinite, resulting in an EM-frequency of zero.
Again the photon is not visible and again the STR-defender has to solve this dilemma.

Conclusion

A photon does have a velocity \(c\) relative to whichever observer, as the Special Theory of Relativity prescribes. As a result the time dilation formula eventually prescribes that a photon will not be visible for whichever observer. So no observer will observe light.
It is up to the STR-defender to decide what to do with this deadly contradiction with reality.

References
XVI No Evidence for Spinning Electrons

Summary - Otto Stern and Walter Gerlach demonstrated in 1922 experimentally the “existence of space quantization in a magnetic field”, using their own words. The result of this experiment is later on used to introduce the so-called intrinsic spin angular momentum of elementary and other particles. This article describes what went wrong in the applied argumentation. In 1896 Zeeman and Lorentz showed experimentally and theoretically that atoms emit “shifted” frequencies when exposed to an external magnetic field. This phenomenon has been used to demonstrate the existence of spinning electrons. However, it is shown that this demonstration is not convincing at all.

1. Introduction

Even the quoted text from Stern and Gerlach in the summary already shows an imperfection: the words “angular momentum” don’t represent the real issue: an angular momentum is meant to express a pure mechanical property of the subject under consideration. What should have been written is “magnetic moment”. The origin of the so-called intrinsic spin angular momentum of elementary particles, hadrons and atomic nuclei has to be found in the Stern-Gerlach experiment. Quoted from [1]:

“Otto Stern and Walter Gerlach were carrying out experiments to demonstrate the existence of what they called Space Quantization in a Magnetic Field.” Although the authors focused upon the Space Quantization in a Magnetic Field the significance of the article has become that of the first evidence of the spin of electrons.”

Studying [1] leads to the conclusion that a large step has to be made to come from ‘Space Quantization in a Magnetic Field’ in order to end at ‘spin magnetic moment’ of electrons. This article describes what went wrong in making this large step.

Another phenomenon, called Zeeman-effect, has also been used to prove the existence of spinning electrons. This article shows why this supposed evidence is not valid.

2. Analysis of the Stern-Gerlach experiment

Stern and Gerlach realized an experiment schematically shown in figure 1, copied from [2]:

“silver atoms travel through an inhomogeneous magnetic field and are deflected up or down depending on their spin. 1: furnace 2: beam of silver atoms 3: inhomogeneous magnetic field 4: expected result 5: what was actually observed”.

Figure 1  Schematic diagram of Stern-Gerlach experiment

Text copied from [2]:

“The results show that particles possess an intrinsic angular momentum that is closely analogous to the angular momentum of a classically spinning object, but that takes only certain quantized values.”
Comment:
This text shows another carelessness: “intrinsic angular momentum” on the one hand and “angular momentum of a classically spinning object” on the other hand.
Whatever is meant above, one should only use “angular momentum of an orbiting particle” and “angular momentum of a spinning particle”.
With the text from [2] the mentioned large step has already been made, without presenting any evidence of its correctness. The conclusion of Stern and Gerlach was: “We view these results as direct experimental verifications of space quantization in a magnetic field.” Whatever may be meant by these words, certainly not the above shown conclusion as presented by [2]. Besides the fact that one should have used ‘magnetic moment’ instead of ‘angular momentum’, the question arises why the magnetic moment of orbiting, not spinning, electrons has not been investigated as an explanation for the obtained result? And if it might have been investigated, why is the result of such an investigation not presented?

A silver atom contains 47 orbiting electrons. Each electron represents a circular shaped current that causes a magnetic field as symbolically shown in figure 2.

\[ \mu \]

\[ \begin{array}{c}
S \\
I
\end{array} \]

*Figure 2*

The symbol \( \mu \) in vector notation is meant to express the magnetic moment \( I \times S \) of such a configuration. But the symbol \( H \) could also have been drawn there in order to express symbolically the magnetic field as a result of the equivalent current \( I \).
This current equals \( q/t_0 \), with \( q \) the electrical charge of an electron and \( t_0 \) the period time of an orbit.
If \( r \) is the radius of the orbit and \( m \) the mass of the electron, then the following relations can be presented: 
\[ t_0 = \frac{2\pi}{v} \text{ and } v = q(k_eZ/mr)^{1/2} \text{, with } v \text{ the tangential velocity of the electron, } Z \text{ the atom number and } k_e \text{ Coulomb’s constant (}1/4\pi\varepsilon_0 = 8.99 \times 10^9 \text{ Nm}^2\text{C}^{-2}.\)
Based on \( H = I/2r \) and \( I = qv/2\pi r \), it follows that \( H = qv/4\pi r^2 \).

The importance of the variable \( H \) is that it wants to align with the direction of an external magnetic field as applied to the silver atoms in the Stern-Gerlach experiment.
The magnetic moment \( I \times S \) is the quantity that determines the torque the atom will experience in an external magnetic field when \( H \) is perpendicular oriented with respect to the direction of the external field.
The mathematical expressions show that \( I \times S = qvr/2 \).

This is a remarkable result: while the magnetic field strength decreases as function of the radius, the magnetic moment increases! As shown by the equations, the surface enclosed by the orbit causes this effect.

Given these considerations the question now arises: what is, regarding this magnetic moment in the Stern-Gerlach experiment, the effect of 47 electrons orbiting the nucleus of the silver atom?

Suppose these electrons eventually generate a net magnetic field of whichever strength and with whichever direction with respect to the direction of an external field.
To copy the words of Stern and Gerlach: “In a second communication it was shown that the normal silver atom has a magnetic moment.” N.B. Stern and Gerlach used the right term here!
It is assumed that the atoms that enter the external magnetic field are free to vary the orientation of their magnetic field w.r.t. the external field, because there is a bundle of silver atoms, created by the evaporation of (the metal) silver in a furnace.

Whatever the net magnetic field of each atom individually might be, only the orientation of this field w.r.t. the orientation of the external field, at the moment the atom enters this external field, determines the direction of the rotation of the atom in order to get aligned with the external field. But eventually the magnetic field of all atoms will be oriented in such a way that their north pole points to the south pole of the external field and vice versa. It is assumed that this rotation takes place in such a short time that directly after it enters the external field this rotation will be completed. Now a second process starts: the atom will be attracted by either the north or the south pole of the external field. The result is obvious: if the atom is just outside the middle between the north and south pole of the external field it will move into the direction of the shortest of these two distances with an increasing accelerated speed. If the centre of the original beam would be exactly in the middle of the external field, half of the atoms move upwards, the other half downwards, explaining the result of the measurements of the Stern-Gerlach experiment.

Up till now there is no reason to conclude that evidence of a “space quantization in a magnetic field” has been presented. Whatever these words may mean physically. Neither is there any evidence that only the supposed (intrinsic) spin of (all) the electrons in the beam of silver atoms is responsible for the obtained result.

In [1] it is stated:

“Stern and Gerlach worked with a beam of silver atoms but the effects were due to the valence electrons of the silver atoms so their beam was essentially a beam of massive electrons.”

This is not a logical conclusion, to put it mildly. There is no reason to assume that the evaporation leads to a detachment of an electron from the silver atom. But suppose they would do so and suppose only these separated electrons would cause the measured deflections, how do the words, as shown hereafter in the remark of Stern and Gerlach: the layer of silver, deposited on the receiving plate, have to be interpreted then?

“The "irradiation time" was stretched out to eight hours without interruption. But even after eight hours of vaporization, the layer of silver, deposited on the receiving plate, was so thin because of the very narrow apertures and the great length of the beam that, just as previously reported, it had to be developed.”

A layer of silver is not a layer of electrons, supposed such a layer can be created! And if it would be a layer of electrons, what happened with the silver ions?

3. The concept: intrinsic spin magnetic moment of a charged particle

It has been shown above that there is no reason to introduce the concept intrinsic spin magnetic moment of a charged particle based on the Stern-Gerlach experiment. On the contrary: it has been shown that, based on the results of this experiment, most likely silver atoms have, based on their net magnetic moment due to their orbiting electrons, a fifty-fifty chance to be attracted by the north respectively south pole of the external field. The appendix shows an original drawing of this pattern, copied from [2].

Yet the spinning electron has been introduced. So the question is: how is this done, while there is no evidence of its existence at this moment. Reference [3] shows the following description:

“Magnetic moment and angular momentum
The magnetic moment has a close connection with angular momentum called the gyromagnetic effect. This effect is expressed on a macroscopic scale in the Einstein-de Haas effect, or "rotation by magnetization," and its inverse, the Barnett effect, or "magnetization by rotation."[1] In particular, when a magnetic moment is subject to a torque in a magnetic field that tends to align it with the applied magnetic field, the moment precesses (rotates about the axis of the applied field). This is a consequence of the concomitance of magnetic moment and angular momentum, that in case of charged massive particles corresponds to the concomitance of charge and mass in a particle.”
Comment:
The close connection between the magnetic moment and the angular momentum is effectively 2 times more repeated by means of the words: “the concomitance of magnetic moment and angular momentum”. The second time it is, without any physical explanation, applied to the supposed spinning of a charged particle, simultaneously suggesting that the ratio between charge and mass of such a spinning particle is an important parameter of the concept under consideration, again without any explanation.

The question arises why the mass of such a spinning charged particle would play any role in its supposed magnetic moment. (The word 'spinning', from now on, will only be used to express 'rotating around its own axis'.)

If the particle would spin, it would have an angular momentum equal to the product of its inertial moment (2/5)mr^2 (m is mass and r is radius of the particle, assumed to be shaped spherically) and its angular speed ω = v/r, with v the tangential velocity of the spinning particle.

Might it be that the “concomitance of magnetic moment and angular momentum” of an orbiting charged particle is misused, applying this concomitance to a supposed spinning charged particle?

The quotient ‘magnetic moment/angular momentum’ of an orbiting charged particle is: qvr/2mvr=q/2m.

In case of a spinning (charged) particle its angular momentum is (2/5)mr^2 . v/r = (2/5)mvr.

But its magnetic moment still has to be determined. Although fully unacceptable from a scientific point of view, let us apply the ratio q/2m to a spinning charged particle.

Then its magnetic moment would be q/2m . (2/5)mvr = qvr/5.

Nice to compare with the magnetic moment of an orbiting electron: qvr/2, but that’s all!

What has happened in the scientific literature regarding this phenomenon, assuming that reference [4] fulfils the criteria for “scientific literature”?

It presents the following description:

“In atomic physics, the Bohr magneton (symbol µB) is a physical constant and the natural unit for expressing the magnetic moment of an electron caused by either its orbital or spin angular momentum.

The Bohr magneton is defined in SI units by

µB = eℏ/2me

where

e is the elementary charge [C or A.s]

ℏ is the reduced Planck constant [VAs]

me is the electron rest mass and [kg]

The electron magnetic moment, which is the electron’s intrinsic spin magnetic moment, is approximately one Bohr magneton.”

Comment:

Mind the statement:

“…µB is a physical constant and the natural unit for expressing the magnetic moment of an electron caused by either its orbital or spin angular momentum”

However, µB = eℏ/2me is nothing more than the multiplication of the just calculated quotient ‘magnetic moment/angular momentum’ of an orbiting electron with the arbitrary constant ℏ, without any argumentation, so worthless from a scientific point of view.

The misleading text is that the magnetic moment would be caused by the angular momentum, because the correct text would have been: the magnetic moment of an orbiting electron is caused by its charge q, its tangential velocity v, and the radius r of its orbit. The magnetic moment of an orbiting particle is independent of the mass of that particle, but notwithstanding this fact the ratio e/2me is chosen as a basis of the proposed new unit for magnetic moment.

Stating that “the electron magnetic moment, which is the electron’s intrinsic spin magnetic moment, is approximately one Bohr magneton”, simultaneously presenting that one Bohr magneton equals eℏ/2me, leads to the consequence that an orbiting electron has a magnetic moment of mvr/ℏ [µB].

This in stead of simply qvr/2 [Am²]!
What sense does that make? What is practical about this? It is even misleading, because it suggests that the magnetic moment depends on the mass of the electron. So, still no theoretical physical evidence has been given at all about the magnetic moment of a spinning charged particle. Only a new, but not practical, unit for expressing ‘magnetic moment’ has been introduced.

Let us have a look at the description of the Einstein-de Haas effect. [5]

“The Einstein-de Haas effect is a physical phenomenon in which a change in the magnetic moment of a free body causes this body to rotate.”

Comment 1:
The words “magnetic moment” have to be angular momentum, but then at the same time it is not an Einstein-de Haas effect. Or the text has to be changed in: The Einstein-de Haas effect is a physical phenomenon in which a change in the magnetic moment of a free body in an external magnetic field causes this body to rotate. But this is the so-called Magnetic dipole–dipole interaction.

“The effect is a consequence of the conservation of angular momentum. It is strong enough to be observable in ferromagnetic materials. The experimental observation and accurate measurement of the effect demonstrated that the phenomenon of magnetization is caused by the alignment (polarization) of the angular momenta of the electrons in the material along the axis of magnetization.”

Comment 2:
In this text all the words “angular momentum” have to be changed in magnetic moment, as already suggested in comment 1. Secondly: the word “electrons” has to be changed in atoms.

“These measurements also allow the separation of the two contributions to the magnetization: that which is associated with the spin and with the orbital motion of the electrons.”

Comment 3:
This conclusion is, given the Stern-Gerlach experiment, not correct.

“The effect also demonstrated the close relation between the notions of angular momentum in classical and in quantum physics.”

Comment 4: This conclusion is not correct either, as has been argued above.

Conclusion:
The description of the Einstein-de Haas effect causes a lot of confusion. No demonstration at all is given of the existence of a spinning electron and its magnetic moment. The fundamental question is why the concept ‘angular momentum’ plays such an important role in all the descriptions? It is a pure mechanical property, having nothing to do with the magnetic moment!

Back to reference [3]:
“Viewing a magnetic dipole as a rotating charged particle brings out the close connection between magnetic moment and angular momentum. Both the magnetic moment and the angular momentum increase with the rate of rotation. The ratio of the two is called the gyromagnetic ratio and is simply the half of the charge-to-mass ratio.”

Comment:
Writing “viewing a magnetic dipole as a rotating charged particle” is putting physical science upside down. There are no problems in deducing the magnetic moment of a magnetic dipole. There are problems in demonstrating the existence of spinning charged particles and as a result their assumed magnetic moment. Therefore a better approach would be: Viewing a spinning charged particle as a magnetic dipole. However such an approach doesn’t help either to prove the existence of such a phenomenon.
4. Zeeman-effect: historical review

In order to fully understand the impact of Zeeman his famous experiment, leading to the expression ‘Zeeman-effect’, his scientific work has to be placed in a historical perspective. That history starts with Rydberg’s work on this area.

Copied from [6]:

“Johannes (Janne) Robert Rydberg (8 November 1854 – 28 December 1919) was a Swedish physicist mainly known for devising the Rydberg formula, in 1888, which is used to predict the wavelengths of photons (of light and other electromagnetic radiation) emitted by changes in the energy level of an electron in a hydrogen atom.”

Comment:
In 1888 Rydberg did not know about energy levels of electrons in atoms! He succeeded in finding a relation between the measured frequency of light emitted by hydrogen atoms and a combination of two integers, expressed by:

\[ f = c * R_{\infty} \left( \frac{1}{n_1^2} - \frac{1}{n_2^2} \right) \]

Copied from [7]:

“The Zeeman effect, named after the Dutch physicist Pieter Zeeman, is the effect of splitting a spectral line into several components in the presence of a static magnetic field.”

Comment:
This discovery happened in 1896. Six years later Lorentz and Zeeman got the Nobel Prize for the combination of Zeeman his experiment and Lorentz his theory behind it. In this theory the existence of small electrically charged particles had been postulated, called ‘ions’ at that time. In order to explain the result of Zeeman’s experiment they assumed that these ‘ions’ are (also) part of the atoms and that they are responsible, by means of ‘vibrations’, for the light emitted by the atoms.

N.B. Nothing indicates the existence of spinning electrons. The result of this experiment has been explained by only the existence of ‘vibrating’ electrons inside the atoms.

To resume: Rydberg observed quantified frequencies, Zeeman observed frequencies in between these ‘Rydberg frequencies’ by applying external magnetic fields and Lorentz explained Zeeman’s results by postulating ‘vibrating’ electrons inside the atom.

At that time the phenomenon ‘vibration’ was not defined in more detail.

Today one would wonder whether these vibrating electrons are orbiting or spinning electrons.

In the mean time it has generally been accepted, based on the atomic model of Bohr, presented in 1913, that ‘Rydberg’s frequencies’ are generated by means of photons and that photons are generated by electrons jumping from an inner to an outer orbit in the atom. For a detailed description see chapter VIII, also indicating that the emitted frequencies are fully explained without any influence of possible spinning electrons.

5. Interpretation of the Zeeman-effect

The question thus is: what happens, and specifically why, with the frequency of light emitted by an atom, if an external magnetic field is applied to that atom?

It is important to realize that measurements have shown that the shifts in the ‘Rydberg frequency’ increases with an increasing strength of the external magnetic field. That pleads for the following explanation.

Given the model shown in chapter VIII it is likely that the external magnetic field influences the orbits of all the electrons around the nucleus of the atom, just like the orbit of such electrons determine the strength of the related internal field, based on the equation \[ H = ev/4\pi r^2 \], with \( e \) the electrical charge of the electron and \( v \) resp. \( r \) the tangential velocity along, resp. radius of the orbit of the electron.

Chapter VIII shows, based on the Rydberg formula, that the characteristics of the inner and the outer orbit, represented by the numbers \( n_1 \) resp. \( n_2 \) in this formula, determine the frequency of the emitted photon. So a change in one of the orbits, or in both orbits, will cause a change in that frequency. It can be considered as most likely that the smaller the change of the orbits, the smaller the change in frequency of that photon.
Due to the fact that the orbits are differently oriented in a 3-dimensional space, each orbit will be influenced by the external magnetic field in a different way. If all internal magnetic fields would align with the external field, all electrons would orbit in one and the same plane, which is assumed to be extremely unlikely.

In this way the result of Zeeman’s experiment can be explained without using the phenomenon ‘spinning electron’. Besides that: in which way might a spinning electron, subject to an external magnetic field, have influence on the emitted frequency, fundamentally caused by the change in orbit of that same electron? And also: why does a spinning electron seemingly not have any influence on the emitted frequency if no external magnetic field is applied?

Reference [7] also states:
“Historically, one distinguishes between the normal and an anomalous Zeeman effect (discovered by Thomas Preston in Dublin, Ireland [2]). The anomalous effect appears on transitions where the net spin of the electrons is an odd half-integer, so that the number of Zeeman sub-levels is even. It was called "anomalous" because the electron spin had not yet been discovered, and so there was no good explanation for it at the time that Zeeman observed the effect.”

Comment:
The question is: Was the effect called “anomalous” because the electron spin had not yet been discovered, or was the electron spin introduced in order to try to explain unexpected effects? In general it can be stated that if a phenomenon is not understood, unexpected results will show up.

The introduction of the spinning electron, in order to explain the so-called anomalous Zeeman-effect, has in scientific literature led to a coupling of the orbital angular momentum and the spin angular momentum of the electron into a total angular momentum, presented as quantized angular momentum. As mentioned already in the first part of this article angular momenta do have a pure mechanical nature, having nothing to do with magnetic moment. As long as the supposed spin angular momentum of an electron has not been transformed into a magnetic moment in a scientifically accountable way, the coupling of the magnetic moments of the orbital and spinning electron is impermissible.

At the same time the introduction of spinning electrons is not necessary in order to understand, in principle, the frequency shifts in the situations under consideration. But it has to be realized that the external magnetic field disturbs the multi 3-dimensional orbital configurations of the atom in such a complicated way that a full and accurate prediction of these shifts cannot be calculated, in spite of the now-a-days mathematical models. Besides that: what might, eventually, be the scientific purpose of such an experiment?

Conclusions

1. No evidence at all has been found in the Stern-Gerlach experiment for the existence of spinning charged electrons. The result of this experiment can be explained perfectly by means of the phenomenon: orbiting electrons in an atom, leading to the property of most likely all atoms: they are intrinsically magnetic dipoles.
2. The same conclusion has to be drawn regarding the supposed evidence of spinning electrons delivered by the Zeeman-effect: the observed shift in emitted frequencies, when atoms are exposed to an external magnetic field, is caused by a disturbance of the orbits of the electrons in the atoms.
3. In both experiments the results can be explained by applying the original atomic model of Bohr.
4. No mathematical / theoretical model of the magnetic moment of a supposed spinning charged particle has been found in scientific literature. Only the unit ‘Bohr magneton’ [µ₀] is presented, meant to express the magnetic moment dealing with orbiting or supposed spinning electrons.
5. Scientific literature shows a lot of confusing words about spinning charged particles, of which no one reveals what their magnetic moment might be.
6. In scientific literature much more attention is paid to the pure mechanical concept ‘angular momentum’ of supposed spinning charged particles than to, what is of course only relevant, the concept ‘magnetic moment’ of such particles.
References


Appendix

Drawing shown at the plaque commemorating the experiment at the Frankfurt institute.
XVII  Light in vacuum behaves like sound in air

Summary - At least, to the opinion of convinced supporters of the Special Theory of Relativity.

1. Generally accepted properties of sound

Sound has two fundamental properties: it doesn't propagate in vacuum and its propagation velocity, relative to a tangible medium, is determined by the properties of that medium and independent of the velocity, relative to that medium too, of its source.

2. STR properties of light

Light has, according to the Special Theory of Relativity, two fundamental properties: it propagates (as well in certain tangible mediums as) in vacuum and its propagation velocity in vacuum is $c$, independent of the velocity of its source.

More specific regarding the vacuum:
Light has, according to the Special Theory of Relativity, two fundamental properties: it propagates in vacuum and its propagation velocity, relative to that vacuum, is $c$, independent of the velocity, relative to that vacuum too, of its source.

So indeed, light in vacuum behaves exactly like sound in air, ignoring that vacuum means "nothing".

3. Experiments that prove the correctness of these properties

Several experiments and measurements have been carried out, of which the results are used to claim the correctness of these properties.
A representative example is the observation of so-called (binary) pulsars.
Copied from Wikipedia:
“A pulsar is a neutron star that emits a beam of electromagnetic radiation. This radiation can be observed only when the beam of emission is pointing toward Earth (much the way a lighthouse can be seen only when the light is pointed in the direction of an observer), and is responsible for the pulsed appearance of emission.”

The EM radiation seems to be noisy, so measuring any velocity by means of Doppler shifts is impossible. Only the time-spacings between the received pulses can be used. The parameters that have been determined are: the angular velocity of the spinning of the pulsar, the orbital velocity and radius of binary pulsars and the distance to earth.

N.B. The theoretical outcome of the time-spacings between the received pulses extremely depends on the chosen theoretical behaviour of light in vacuum.

The “scientific” work on pulsars, based on the STR, has been awarded with the Nobel Prize.
To be qualified as “Nobel Prize for fun and fantasy”.

The real property of light in vacuum is found in chapter I.
The mystery of vacuum

Summary - Given the magical statements in physics about the speed of light in vacuum it seems to be difficult to form an image of the propagation of light in vacuum.

1. History

The very first impression of vacuum was the generally accepted idea that it contains an intangible medium in absolute rest, called ether, necessary for light to propagate through it. The negative result of the experiment of Michelson and Morley led to the conclusion that such a property of vacuum could not be maintained anymore. For that reason Einstein rejected this idea in 1905 and postulated:

“Any ray of light moves in the “stationary” system of co-ordinates with the determined velocity $c$, whether the ray be emitted by a stationary or by a moving body”

Note: The italicized text is added by the author.

By introducing the mysterious “stationary” system, Einstein effectively reintroduced the ether concept, without the property of being in absolute rest.

2. Clarification of the mystery

Imagine an infinite space of vacuum with only one object in it: a light source L. Consider two situations: one in which L is stationary and one in which L is moving. In normal life on Earth we don’t have any problem distinguishing a moving object from a stationary object. We all unconsciously take the Earth as our reference system for that observation, but in vacuum this is impossible. This lack of a reference system in an imagined space of vacuum can be confusing and is most likely responsible for the misunderstanding of the concept of light propagating in vacuum.

Suppose L is emitting a short pulse P of light and that its length is, for example, 1 meter. There are now two objects in that infinite vacuum, of which one moves relative to the other (with velocity $c$). It will be more difficult to imagine that L moves with $c$ relative to P than the other way round, but it is the reality.

Suppose a third object O, not having any influence on the behaviour of the emission of L, at an arbitrary distance from L and with an arbitrary velocity relative to L. Now we can determine whether L is a stationary or a moving body, however only relative to O! Obviously such an object neither has any influence on the relative velocity between P and L. The unavoidable conclusion thus is that this velocity must be independent of the velocity of L, relative to whatever reference this velocity is taken.

This conclusion inherently rejects Einstein’s postulate.

Acknowledgment

I’m grateful to my grandson Scott Uitterdijk (18 years young, enrolled in university and not hindered by any knowledge of Electro-Magnetic radiation), who persistently kept on saying that one easily could distinguish a stationary body from a moving body in an infinite space of vacuum. Due to his attitude and the experiences of many discussions with physicists, I wrote this article. This article has solved the mystery for him.
XIX  The umpteenth evidence

Summary - In this chapter section 1 and 2 of Einstein’s article about his Special Theory of Relativity have been scrutinized. The conclusion is that Einstein spent a lot of text on the concepts simultaneity, synchronousness and time, without bringing forth any relevant information. Besides that he made two fundamental mistakes.

1. Introduction

Suppose there are two marks, A and B, in an infinite space of vacuum at a constant distance AB. Imagine a light ray, coming from a source at an arbitrary distance from A, passing A and B at the times t_A respectively t_B. The speed of this light, so in vacuum, on the trajectory AB is, by definition, AB/(t_B-t_A). The reason for printing "this light" is that the velocity of light in vacuum is determined by its source! So each source in for example the universe does have its own velocity in universe. Fully opposite to Einstein’s idea about this phenomenon! So let us have a look at Einstein’s perception of such a situation.

2. Einstein’s stationary system

Einstein wrote his definition of a stationary system right at the beginning of section 1: "Let us take a system of co-ordinates in which the equations of Newtonian mechanics hold good (to the first approximation).” This vaguely defined system looks like what nowadays is called an inertial system. However Newtonian mechanics also include motions as a result of forces. But Einstein’s theory explicitly excludes such motions! So this description doesn’t make sense.

"In order to render our presentation more precise and to distinguish this system of co-ordinates verbally from others which will be introduced hereafter, we call it the 'stationary system' “.

It turns out that the systems “introduced hereafter” simply move with a constant speed, relative to this “stationary” system. So eventually Einstein only considers inertial systems. He should simply have brought it as such, for example by means of the words “non-forced systems”, if the concept “inertial systems” had not been introduced yet.

3. Einstein’s thought experiments in his section 1

He wrote in his article in 1905, copied from [1], from now on printed as italicized text:

“We have so far defined only an ‘A time’ and a ‘B time.’ We have not defined a common ‘time’ for A and B, for the latter cannot be defined at all unless we establish by definition that the ‘time’ required by light to travel from A to B equals the ‘time’ it requires to travel from B to A. Let a ray of light start at the ‘A time’ t_A from A towards B, let it at the ‘B time’ t_B be reflected at B in the direction of A, and arrive again at A at the ‘A time’ t’_A. In accordance with definition the two clocks synchronize if t_B - t_A = t’_A - t_B.”

This philosophy shows that Einstein fully rejects the possibility of a so-called common time for A and B, unless lights travels the distance AB forth and back during the same time. N.B. The light source is located in A, so his criterion in the last sentence is most trivial.

After a short consideration about 3 synchronously running clocks E. continues with:

“Thus with the help of certain imaginary physical experiments we have settled what is to be understood by synchronous stationary clocks located at different places, and have evidently obtained a definition of “simultaneous,” or ‘synchronous,’ and of ‘time.’ “
Einstein seemingly considers simultaneous equivalent to synchronous, notwithstanding the fact that simultaneously simply means: at the same moment, while synchronously means: running with the same frequency/rate.

The ‘time’ of an event is that which is given simultaneously with the event by a stationary clock located at the place of the event, this clock being synchronous, and indeed synchronous for all time determinations, with a specified stationary clock. In agreement with experience we further assume the quantity \( \frac{2AB}{(t_1 - t_0)} = c \), to be a universal constant—the velocity of light in empty space.

Here Einstein makes his first fundamental mistake: he defines \( c \) as the velocity of light in empty space resulting in an undefined velocity. The background for this mistake is that he located the source in \( A \) (Let a ray of light start ........ from A....), but failed to mention this explicitly in his statement.

Einstein declares:

“It is essential to have time defined by means of stationary clocks in the stationary system, and the time now defined being appropriate to the stationary system we call it ‘the time of the stationary system’.”

One might wonder what might be essential in this declaration.

So at the end of section 1 Einstein hasn’t brought up any new concept: simultaneously and synchronously were already well known and have not been changed. He declares clocks running synchronously by means of a most trivial criterion, and time is still time!

4. Einstein’s thought experiments in his section 2

Einstein starts with the postulate:

“Any ray of light moves in the ‘stationary’ system of co-ordinates with the determined velocity \( c \), whether the ray be emitted by a stationary or by a moving body.”

Given the fact that he only considers a stationary light source in section 1, he now postulates, without any argumentation, that it doesn’t matter whether this source is moving or not relative to the “stationary” system.

“Hence velocity = light path/ time interval, where time interval is to be taken in the sense of the definition in § 1.”

That means: measured by synchronously running clocks, located at the beginning and at the end of the related light path.

Einstein now introduces a moving rod, with a constant velocity \( v \) relative to the “stationary” system, defining the ends by means of \( A \) respectively \( B \). He considers two methods to measure the length \( l \) of this rod:

- method “a” directly by means of a measuring rod in the moving system of the rod,
- method “b” by means of clocks and with help of a light ray in the “stationary” system.

“The length to be discovered by the operation (b) we will call ‘the length of the (moving) rod in the stationary system.’ This we shall determine on the basis of our two principles, and we shall find that it differs from \( l \).”

With this statement he made the following fundamental mistake: if the length of the rod is \( l \), as measured by method “a”, and method “b” results in a value that differs from \( l \), than the only correct conclusion is that method “b” has been carried out incorrectly.

The principle that all physical laws are the same in any inertial system forbids that the length of the rod changes in such situations. Effectively Galilei told us already 400 years ago too.
Einstein’s following statement shows another inconsistency in his considerations.

“Let a ray of light depart from A at the time \( t_A \), let it be reflected at B at the time \( t_B \), and reach A again at the time \( t'_A \). Taking into consideration the principle of the constancy of the velocity of light we find that 
\[
\begin{align*}
\Delta t_B - \Delta t_A &= \frac{r_{AB}}{c - v} \\
\Delta t'_A - \Delta t_B &= \frac{r_{AB}}{c + v},
\end{align*}
\]
where \( r_{AB} \) denotes the length of the moving rod—measured in the stationary system.”

The inconsistency concerns the fact that he applies the Newtonian law of addition of velocities, while the end result of his theory forbids such an addition.
Besides that Einstein accepts velocities larger than \( c \) in one of the expressions above, while the outcome of his theory also forbids such velocities.

5. Back to the thought experiment in the Introduction

The situation sketched in the Introduction sounds:
Suppose there are two marks, A and B, in an infinite space of vacuum at a constant distance \( AB \).
Imagine a light ray, coming from a source at an arbitrary distance from A, passing A and B at the times \( t_A \) respectively \( t_B \). The speed of this light, so in vacuum, on the trajectory AB is, by definition, \( AB/(t_B-t_A) \).

As Einstein wrote: 
\[
\Delta t_B - \Delta t_A = \frac{r_{AB}}{c - v}
\]
With \( r_{AB} = AB \) resulting in: 
\[
c - v = \frac{AB}{(t_B-t_A)}.
\]

So the velocity of light in vacuum, emitted by a source having a relative speed \( v \) with respect to the marks A and B, equals \( c - v \) on the trajectory AB. Effectively Einstein’s own words!

Conclusions

1. Einstein introduced an undefined speed of light in empty space, by failing to define an unambiguous reference for this speed in such a space.

2. Einstein mixes up the real physical world and the measurement of it by insinuating that if the real length ‘l’ of a rod is measured by an observer moving with constant velocity relative to the rod, this measurement will differ from that real length (“...we shall find that it differs from l.”). This is in contradiction to the principle that each physical law is the same in any inertial system.

3. Einstein accepts velocities larger than \( c \) at the basis of the creation of his theory, by applying the Newtonian law of addition of velocities, so by applying the ballistic theory of light in vacuum. This is in contradiction to the result of his theory.

4. Light rays in the universe reach the earth with velocity \( c + v \) relative to earth, with \( v \) the velocity of the source at the moment of emission relative to the velocity of the earth at the moment of reception, both projected on the direction of the light ray.

Reference

[1] Translated original article of Einstein:
On the electrodynamics of moving bodies, By A. Einstein, June 30, 1905
To be found at: http://www.fourmilab.ch/etexts/einstein/specrel/www/
**What went wrong with the atomic mass unit**

*Summary - The atomic mass unit has already been applied for more than 200 years. The problem is that the amu nowadays has been defined in two different ways: the Newtonian one and the one based on present physics by applying the magic energy $mc^2$ and the magic atomic nuclear forces, interpreted as nuclear binding energy. This energy is posited as equal to $mc^2$, without any motivation and as such violating the law of mass conservation.*

1. **Introduction**

The atomic mass unit (amu) has changed four times over the past 200 years. After the existence of elemental isotopes was discovered, the atomic mass of the so-called naturally occurring oxygen divided by 16 has been introduced as the amu, replacing the mass of the atom divided by 16 of only $^{16}$O. The last change happened in 1961 when the mass of $^{12}$C divided by 12 was introduced. It is strange that in 1961 it was not realized that $^{12}$C/12 is exactly equal to $^{16}$O/16.

However, present physics caused this confusion by introducing an amu based on unbound nucleons and an amu based on bound nucleons.

2. **History of the amu**

Ultimately the foundation of the amu is a combination of the neutron, proton and electron mass:

\[
\begin{align*}
    m_N &= 1.674927471 \times 10^{-27} \\
    m_p &= 1.672621898 \times 10^{-27} \\
    m_e &= 9.10938356 \times 10^{-31}
\end{align*}
\]

All these masses have a relative uncertainty of $10^{-10}$.

The atomic mass unit is a standard unit of mass that quantifies mass on an atomic or molecular scale. Reference [1] presents the following information under “History”.

The first amu (1803) was $^1$H, being the mass of 1 proton plus 1 electron.

\[\text{amu}_1 = 1.673532848000 \times 10^{-27} \text{ kg}\]

The second amu (1903) was expressed in terms of units of 1/16 mass of oxygen. At that time the existence of elemental isotopes was not yet known, so it concerned $^{16}$O in present terms.

\[\text{amu}_2 = 1.674230153678 \times 10^{-27} \text{ kg}\]

The third amu (1929) was based on the total atomic weight of so-called naturally occurring oxygen, defined as 99.757% $^{16}$O + 0.038% $^{17}$O + 0.205% $^{18}$O.

\[\text{amu}_3 = 1.674699139192 \times 10^{-27} \text{ kg}\]

The ratio $\text{amu}_3/\text{amu}_2$ is indeed 1.00028 as [1] presents:

“The divergence of these values could result in errors in computations, and was unwieldy. The chemistry amu ($\text{amu}_3$) was about 1.000282 as massive as the physics amu ($\text{amu}_2$). For these and other reasons, the reference standard for both physics and chemistry was changed to carbon-12 in 1961. The new and current unit was referred to as the unified atomic mass unit “u”, which replaced the now outdated "amu". Despite this change, modern sources often still use the old term "amu" but define it as 1/12 $^{12}$C. Therefore, in general, "amu" likely does not refer to the old oxygen standard unit, unless the source material originates from the 1960s or before.”

\[\text{amu}_4 = 1.674230153678 \times 10^{-27} \text{ kg}\]

All these (historical) values of the amu are expressed in current neutron, proton and electron masses.

As mentioned already, $\text{amu}_4$ equals $\text{amu}_2$ for the basic reason that $^{12}$C/12 equals $^{16}$O/16. For that same reason $\text{amu}_3$ also equals $(m_N+m_p+m_e)/2$, so referring to a certain element is not necessary. From now on $\text{amu}_4$ will be written as amu.
3. What went wrong with amu

Reference [1] not only presents the information shown above, but starts as follows:

“It (amu) is defined as one twelfth of the mass of an unbound neutral atom of carbon-12 in its nuclear and electronic ground state and at rest, and has a value of $1.660539040(20) \times 10^{-27}$ kg.”

N.B. Nothing in universe is at rest. An object can only be at rest relative to another object. So the restriction “and at rest” is a nonsense restriction.

A neutral atom is an atom with the same number of protons and neutrons.

“Ground state” is defined as the state of the atom where it has the lowest state of energy.

Due to the misunderstanding of the phenomenon “potential energy”, see chapter VII, the atom is defined to have the lowest energy state when its electrons orbit at their lowest radii. The opposite is true!

It turns out that the word “unbound” is misleading. A few sentences further in [1] one reads:

“For standardization a specific atomic nucleus (carbon-12 vs. oxygen-16) had to be chosen because the average mass of a nucleon depends on the count of the nucleons in the atomic nucleus due to mass defect.”

The phenomenon “mass defect” (MD) is explained in [2]:

“Mass defect = (unbound system calculated mass) − (measured mass of system)

i.e. (sum of masses of protons and neutrons) − (measured mass of nucleus)”

What is meant by “unbound atom” is an atom not chemically bound to other atoms.

So the difference between the amu defined as $(m_N + m_P + m_e)/2$ kg versus $1.660539040\times 10^{-27}$ kg is the MD as a result of the assumed so-called binding energy between the nucleons in the atomic nuclei. This is done by applying the unphysical relation (binding) energy = MD*c^2.

See chapter II.

The total mass of six unbound protons, neutrons and electrons is $2.009... \times 10^{-26}$ kg, while these particles, bound in an 12\(^{6}\)C atom, are $12\times 1.660539040\times 10^{-27}$ kg = $1.993... \times 10^{-26}$ kg together.

N.B. The ratio of these amus is 1.0082, being much larger than the, round 1960, unaccepted ratio \(\text{amu}_3/\text{amu}_2 = 1.00028\).

The question is: where does the value $1.660539040(20)\times 10^{-27}$ kg come from?

Based on the definition of MD it has to be concluded that this amu is a result of measurements.

Just like as in the definition of “mass defect”, the mass of the electrons is ignored in [1] too:

“One unified atomic mass unit is approximately the mass of one nucleon (either a single proton or neutron...........)”

A remarkable fact has been observed: the ratio $(m_N + m_P + m_e)/(m_N + m_P) = 1.00027$, ‘about exactly’ equal to the ratio \(\text{amu}_3/\text{amu}_2 = 1.00028\). The question: is that chance?, is therefore justified.

Another question is justified too: how has the “unbound system calculated mass, i.e. sum of masses of protons and neutrons”, as used in the definition of MD, been calculated?

Final questions. The conclusion must be that if an atom is broken up into unbound nucleons and electrons, universe has enlarged its total mass! How can a transformation of (binding) energy into mass be explained? Can heat energy also be transformed into mass?

If de bound system called solar system would be broken up into unbound objects, would then each object gain mass?

How present physics hopelessly leads to more problems and confusions than ever!
4. Application of the real ‘unbound’ amu

The *real* mass in kg of an atom $M_a$ equals:

$$Z(m_N + m_P + m_e) + \Delta N * m_N$$

with:

$Z$ the so-called atomic number, being the number of protons in the nucleus

$N$ the number of neutrons in the nucleus

$\Delta N = N - Z$.

As shown above: $\text{amu} = (m_N + m_P + m_e)/2$

so: $M_a = 2Z\text{amu} + \Delta N * m_N$

resulting in: $M_a/\text{amu} = 2Z + \Delta N * m_N/\text{amu}$

$M_a/\text{amu}$ by definition equals $W$, the atomic mass number.

**Conclusions**

1. Present physics causes at least confusion realizing the atomic mass unit, by assuming that nuclear binding energy represents mass, called mass-defect, via $E=mc^2$. Most likely it even causes a large error in the presented value of the amu.

2. Realistic physics shows, by means of a simple mathematical expression and using the real atomic mass unit, how the real atomic mass number has to be calculated.

3. Present physics leads to magic outcomes and to confusions and problems, more than ever in most situations.

**References**


XXI Why Heisenberg-Schrödinger’s atomic model is invalid

Summary - Outstanding surprisingly the misconception regarding the phenomenon potential energy most likely caused the change from Rutherford-Bohr’s to Heisenberg-Schrödinger’s atomic model.

1. Introduction

In the past 100 years, physics has become a science that is no longer comprehensible and must have led to the most exotic, widely divergent views and at least 100 unsolved problems. This chapter draws attention to this result on the basis of a critical look at the relevant atomic models.

2. Atomic models

2.1 Rutherford-Bohr model

The most common objection against Bohr’s atomic model is found in the words below, copied from Internet sources.

“Electrons that gained energy would jump to higher energy levels and become "excited", and as they jumped back down to the ground state, they would emit that energy. However, this model worked well for only the simple Hydrogen atom. Although this model is now considered obsolete, it is still used to showcase basic understanding of the structure of an atom.”

“The Bohr model depends on a connection between the frequency of light and the energy of the level change. If light of a frequency, corresponding to the energy change, interacts with the atom, the electron can absorb the light and jump up a level. If an excited electron jumps down a level, it loses energy. The energy the electron loses becomes light with a frequency corresponding to a change in energy.”

The common bewildering misconception in these words is the conception that electrons in larger orbits contain more energy than in lower orbits. This misconception has clearly led to the rejection of Bohr’s model and to the search for "better" models.

Chapter VII shows in detail the evidence of what is just qualified as “misconception”. This evidence will be summarized below.

Potential energy can mathematically be represented by \( E_p = \int F(r) \, dr \), with \( F(r) \) a force along a yet to be defined path. The background for this mathematical model is that potential energy is defined as the work-to-be-done to separate two objects from each other in case these objects attract each other. For example: bring a mass to a larger height relative to earth. The fundamental question is: has such energy to be considered as positive or as negative? In the chosen situation it would be strange to imagine such energy as negative, because it actually requires work to separate the mass from the earth.

In this example \( F(r) = C/r^2 \), so \( \int F(r) \, dr = -C/r \). This result is fully in line with the previous reasoning. The smaller this initial distance \( r \) is the more energy it takes to increase the distance between the objects.

Notwithstanding this most logical argumentation, potential energy is, since time immemorial, calculated as negative, by taking the lower boundary as \( \infty \) and the upper boundary as \( r \).

Chapter VII shows that in case of an orbiting electron the absolute value of its potential energy, so avoiding the problem of its sign, equals 2 times its kinetic energy. If the sign of the potential energy were now taken as negative, the total energy of the electron would become negative.

A physical law says that the centripetal force equals the centrifugal force all the way along a perfect circular orbit. As a result, the larger the radius of an orbiting electron, the lower its orbital velocity, so its kinetic energy, because the larger the distance between electron and nucleus the smaller the Coulomb/centripetal force between these two.

Following the generally accepted argumentation, an electron orbiting at a larger radius has a lower kinetic energy, but added to a negative potential energy (that equals in absolute terms two times this kinetic energy) results in a total energy that is less negative.

Seemingly that is qualified as higher energy. A most absurd argumentation.
There is another situation that might have played a role in the misconception about potential energy. That is the calculation of the potential energy of mass \( m \) at height \( h \) relative to earth.

If for the ease of the consideration \( E_p = \int F(r) \, dr \) (= \( C/r \) in the situation to be considered) is defined as absolute potential energy, then the potential energy of mass \( m \) at height \( h \) relative to earth turns out to be the difference between two such “absolute potential energies”: \( E_{ph} \) and \( E_{p0} \), with \( E_{p0} - E_{ph} = mgh \). Indeed the absolute potential energy \( E_{p0} \) at height \( h=0 \) is larger than \( E_{ph} \).

See Chapter VII for a detailed consideration.

Again a result that easily can, and seemingly did, enhance the confusion about potential energy, as well as regarding its sign, its absolute value as its relation to the distance \( r \), respectively \( h \).

As a result of this misconception the text below, copied from Wikipedia, has been generally accepted and has led to the wish to look for a better atomic model than the one of Bohr.

The wrong words have been crossed out and replaced by the correct ones.

**Orbital energy**

In atoms with a single electron ..., the energy of an orbital ... is determined exclusively by \( n \). The \( n=1 \) orbital has the \textit{lowest} possible energy in the atom. Each successively higher value of \( n \) has a \textit{higher} level of energy, but the difference decreases as \( n \) increases. For high \( n \), the level of energy becomes so \textit{low} that the electron can easily escape from the atom.”

Especially the last sentence makes sense, after the correction, because it is well known that the atoms of conductive materials have so called valence electrons in the most outer orbits, which “can easily escape from the atom.” Sure thing, the higher the energy of an orbiting object the more energy it needs to get it out of its orbit. Or the other way round: imagine a planet at a very large distance from the sun. You only have to blow to get it out of its orbit.

A much more important conclusion is that the phenomenon potential energy does not play any role in an orbiting system. The background for this remark is the following. The centripetal and centrifugal forces, applied to the orbiting electron, are fully and continuously in balance due to the perfect circular orbit. The only phenomenon that really contains mechanical energy is its kinetic energy. This kinetic energy causes that the potential energy of the atom is not relevant anymore in the changes of energy state of the atom. Therefor from now on only the kinetic energy of the electron is taken as the mechanical energy of the atom.

Chapter VIII describes in deep detail, based on Bohr’s atomic model, how a photon is generated. The energy sources and changes are summarized below.

The energy of an emitted photon equals the change in kinetic energy of an electron jumping from an inner to an outer orbit. The first impression is that after such an emission the description of the energy exchange between the atom and its environment is completed. However this description is not complete at all.

In an orbital configuration, \textit{only based on gravitational forces}, where an orbiting mass is forced to a larger orbit, the total loss of energy in such a system equals \( \Delta E_k = \frac{1}{2}m(v_1^2 - v_2^2) \) and concerns only \textit{mechanical energy}, because there is no other source of energy in such a system.

If in such a system the orbiting mass is forced to an inner orbit, by definition by the environment, this system itself gains energy. This energy is delivered by the environment, because it carried out work to do so. If the environment carries out work to force this mass to an outer orbit, the system looses energy and it is tempting to simply argue that this energy is absorbed by the environment. However the environment carried out work to do so, thus must have \textit{lost} instead of gained energy. The solution to this apparent contradiction is that the environment necessarily did already have an energy relation with the system before it could apply its force to it. Just like it also had in the first mentioned situation. The modelling of such an interaction requires at least a detailed knowledge of the specific interaction. But, at the end of the day we don’t need to model such an interaction, because only the final result regarding the system under consideration is relevant. The physical law of conversation of energy tells us that energy cannot be lost or gained, but only transferred.
In the orbital configuration of an electron in an atom the total loss of mechanical energy of the atom also equals $\Delta E_k$. But besides that it also looses an amount of energy equal to $\Delta E_k$, taken away by the energy of the emitted photon. Chapter VIII shows that this energy is delivered by the magnetic energy of the atom, generated by the orbiting electron, because such an electron is equivalent to a rotating electric current that creates a magnetic field.

Finally: what happens if the environment forces an electron to jump to an inner orbit? The related atom will gain mechanical as well as magnetic energy in such a situation. However the presented model assumes the generation of a photon if a magnetic field, created by such an orbiting electron, suddenly changes. Indeed, the word “suddenly” is of crucial importance! The problems that arose with this atomic model, most likely indirectly as a result of the misconception about potential energy, were tried to eliminate with "refined" models!

2.2 Heisenberg-Schrödinger model

Copied from [1]:
“In 1926 Erwin Schrödinger, an Austrian physicist, took the Bohr atom model one step further. Schrödinger used mathematical equations to describe the likelihood of finding an electron in a certain position. This atomic model is known as the quantum mechanical model of the atom. Unlike the Bohr model, the quantum mechanical model does not define the exact path of an electron, but rather, predicts the odds of the location of the electron. This model can be portrayed as a nucleus surrounded by an electron cloud. Where the cloud is most dense, the probability of finding the electron is greatest, and conversely, the electron is less likely to be in a less dense area of the cloud. Thus, this model introduced the concept of sub-energy levels.”

Copied from [2]:
“One of his most memorable discoveries of Heisenberg is the Uncertainty Principle. He said this means that electrons do NOT travel in neat orbits. Also, all electrons that contain photons will then change momentum and physics. Heisenberg’s contribution to the atomic theory was that he calculated the behaviour of electrons, and subatomic particles that also make up an atom. Instead of focusing mainly on scientific terms, this idea brought mathematics more into understanding the patterns of an atom's electrons. Heisenberg’s discovery helped clarify the modern view of the atom because scientists can compare the actually few numbers of atoms there are, by their movements of electrons, and how many electrons an atom contains. Surrounding the outside of an atomic nucleus is an electron cloud, which is a name given to the electrons that are widely spreading and moving around. In conclusion, Heisenberg contributed to the atomic theory by including quantum mechanics, the branch of mechanics, based on quantum theory, used for interpreting the behaviour of elementary particles and atoms.”

*That appears like the argumentation has been: the more vagueness the better the understanding!*

A picture of the related electron configuration, copied from Internet, is shown below.

The shapes of the electron clouds give the impression that electrons can also move right through the nucleus! Or, expressed in terms applied to describe this H-S atomic model: the H-S model also “predicts the odds that the location of the electron” is inside the nucleus.

Notwithstanding the minimum chance that such a model has anything to do with reality, it will nevertheless be further analysed on the basis of the corresponding electron configuration.
3. Electron configuration

The “modern” electron configuration has an intricate patron, but the basic idea is still the one used in the R-B model [3]:

“Each shell can contain only a fixed number of electrons. The general formula is that the n\textsuperscript{th} shell can in principle hold up to 2(n\textsuperscript{2}) electrons.”

However, these shells itself have been divided into subshells in the H-S model, making the configuration exceedingly complex:

“Each shell is composed of one or more subshells called s, p, d and f, which are themselves composed of atomic orbitals.”

The following very principle questions now arise:
- How can an electron orbit (inside these shells) if there is no proton in these shells?
- Why have these sub-shells, with these magically orbiting electrons, been introduced?
- What kind of problem do these sub-shells solve?
- If the first shell has only one sub-shell, why has that sub-shell been introduced?
- What do the electrons in this first shell in the H and He atom, besides just orbiting the nucleus?
- Or don’t they just orbit the nucleus?

An answer to the question: “What kind of problem do these sub-shells solve?” might be:

Hide the problem of the energy levels in the atomic model.

4. Wave–particle duality

This duality plays a big role in the creation of quantum physics.

Reference [4] writes:

“Wave–particle duality is the concept in quantum mechanics that every particle or quantic entity may be partly described in terms not only of particles, but also of waves. It expresses the inability of the classical concepts "particle" or "wave" to fully describe the behaviour of quantum-scale objects. As Albert Einstein wrote:

It seems as though we must use sometimes the one theory and sometimes the other, while at times we may use either. We are faced with a new kind of difficulty. We have two contradictory pictures of reality; separately neither of them fully explains the phenomena of light, but together they do.”

Einstein introduced the “particle-wave-duality” that later has been upgraded to a kind of theory. The weirdest result of that “theory” is the idea that an electron is not only a particle, but also a wave. Whatever that physically may mean.

5. QED model

Copied from [5]:

“Quantum electrodynamics (QED) is a theory which deals with the quantisation of the electromagnetic field, rather than focusing on individual particles in isolation, and this predicts several corrections to the electron energy.”

Comment:
This model is created while the phenomenon electron energy was, and is still, fundamentally misunderstood!

Notwithstanding these most exotic models reference [6] shows a list of at least 100 unsolved problems in physics, “grouped into broad areas of physics.”

Or would the formulation “as a result of these most exotic models” be more appropriate?
Conclusions

1. It is considered outstanding surprising that the misconception regarding the phenomenon “potential energy” most likely has led to the rejection of the Rutherford-Bohr model and to the creation of the Heisenberg-Schrödinger model, creating many more unsolved physical problems than solutions.

2. With the Rutherford-Bohr model and the correct calculation of potential energy, the generation of a photon can perfectly modelled, without applying any kind of quantum physics.

3. The general comment on Chapter VIII: “Why a Photon is not a Particle” is: Not valid, because it doesn’t use the QED model of the atom! The question is: How to break through this circle argumentation? The answer is: Repair the wrong definition of potential energy into the correct one.

Encore

Quote:
Wave–particle duality is the concept in quantum mechanics that every particle or quantic entity may be partly described in terms not only of particles, but also of waves. It expresses the inability of the classical concepts "particle" or "wave" to fully describe the behaviour of quantum-scale objects.

Unquote

When a phenomenon is “explained” by a duality or paradox, the reality is that such a phenomenon is not understood and thus cannot be modelled. Upgrading such a duality or paradox to a “theory” is almost the worst a scientist can do. The worst he can do is to apply such ignorance to a well-understood phenomenon (for example: an electron is an electric charged real particle) and come up with a phenomenon that doesn’t make sense at all.

Physical science should not accept judgements like duality and paradox, but solve them without switching to magic physics.

References

XXII Atomic nuclei modelled without exotic particles and magic forces

Summary - Atomic nuclei are normally drawn as a combination of protons and neutrons grouped together as close as possible. Given the enormous repulsive force between two protons such a configuration cannot represent reality. Quantum physics pretends to solve this problem by means of quarks, held together by gluons. This chapter presents a model without such particles and forces.

1. Introduction

The author asked himself the question whether the introduction of the exotic particles called quarks are indeed necessary to hold neutrons and protons in atomic nuclei together, given the enormous repulsive forces between protons. On their turn these quarks need even more exotic particles, called gluons, to hold them together in these protons and neutrons. Such a solution appears to create more problems than solutions for the original problem.

2. Generally accepted configuration of the Helium nucleus

The nucleus of the Helium atom is normally drawn as a combination of two protons and two neutrons grouped together as close as possible. See figure below, being one of a countless number of similar representations.

The possible radii of the orbiting electrons are represented by \( r_n = n^2 \, a_0 / Z \), with \( n \) is an integer and \( a_0 \) the so-called Bohr’s radius: \( a_0 = h^2 / (4 \pi^2 k_e q^2 m_e) \), \( h = 6.626 \times 10^{-34} \) kg m² s⁻¹.

Variables following from these parameters are:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Name</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smallest radius of Helium atom</td>
<td>( r_1 )</td>
<td>2.7 \times 10^{-11}</td>
<td>m</td>
</tr>
<tr>
<td>Centripetal force between orbiting and nucleus</td>
<td>( k_e Z q^2 / r_1^2 )</td>
<td>6.6 \times 10^{-7}</td>
<td>N</td>
</tr>
<tr>
<td>Centrifugal force electron</td>
<td>( m_v \sqrt{2 / r_1} )</td>
<td>6.6 \times 10^{-7}</td>
<td>N</td>
</tr>
<tr>
<td>Orbital velocity of electron (( v = q \sqrt{k_e Z / m_e} ))</td>
<td>( v )</td>
<td>4.4 \times 10^6</td>
<td>m/s</td>
</tr>
<tr>
<td>Radius of grouped protons and neutrons (approximately)</td>
<td>( r_{\text{adl}} )</td>
<td>2 \times 10^{-15}</td>
<td>m</td>
</tr>
<tr>
<td>Repulsive force ( F_C ) between protons (( \approx k_e q^2 / r_{\text{adl}}^2 ))</td>
<td>( F_C )</td>
<td>2 \times 10^2</td>
<td>N</td>
</tr>
<tr>
<td>Gravitational force ( F_G ) between protons or neutrons (( \approx G m_v m_p / r_{\text{adl}}^2 ))</td>
<td>( F_G )</td>
<td>10^{-34}</td>
<td>N</td>
</tr>
</tbody>
</table>

Preliminary conclusions: gravitational forces don’t play any role; the radius of the atom is about 30 thousand times larger than the radius of the nucleus (on the scale of the figure above, the nucleus has to be drawn as 1 micro meter!) and last but not least: the nucleus as presented has to ‘explode’ due to the enormous repulsive force, compared with the centripetal force.
3. Solution of quantum physics to prevent the ‘explosion’ of nuclei

Reference [1] presents the following information:

“An atomic nucleus is shown here as a compact bundle of the two types of nucleons, protons (red) and neutrons (blue). In this picture, the protons and neutrons are shown as distinct, which is the conventional view in chemistry, for example. But in an actual nucleus, as understood by modern nuclear physics, the nucleons are partially delocalized and organize themselves according to the laws of quantum chromodynamics.”

Reference [2] explains what is meant with quarks in a proton

“Three colored balls (symbolizing quarks) connected pairwise by springs (symbolizing gluons), all inside a gray circle (symbolizing a proton). The colors of the balls are red, green, and blue, to parallel each quark’s color charge. The red and blue balls are labeled ‘u’ (for ‘up’ quark) and the green one is labeled ‘d’ (for ‘down’ quark). A proton is composed of two up quarks, one down quark, and the gluons that mediate the forces ‘binding’ them together. The color assignment of individual quarks is arbitrary, but all three colors must be present. Electric charge $+2/3\,e$, $-1/3\,e$”

Net electric charge: $2*2/3\,e-1/3\,e=1e$.

Reference [3] explains what is meant with quarks in a neutron

“The quark structure of the neutron. There are two down quark in and one up quark. The strong force is mediated by gluons (wavy). The strong force has three types of charges, the so called red, green and the blue. Note that the choice of blue for the up quark is arbitrary; the ‘color charge’ is thought of a circulating between the three quarks. Electric charge $0\,e\,(-2\pm8\times10^{-22}\,e$ (experimental limits)”

Net electric charge is $+2/3\,e\,-2*1/3\,e=0$.

The mentioned net electric charge of the proton resp. neutron thus is still $1e$ resp. $0$, so the problem under consideration is not yet solved, in fact magnified, because now the quarks, at an even shorter distance between themselves, have to be held together also. If gluons would to solve the last mentioned problem, the question arises why these magic particles are not applied directly to the proton and neutron in the nucleus.

In the next chapter a philosophy is presented that might solve the problem with conventional physics.
4. Electron-Proton paradox

Before the announced philosophy will be presented the radius of the electron, playing an essential role in this philosophy, has to be defined.

Reference [4] gives the following background:

“The classical electron radius is a combination of fundamental physical quantities that define a length scale for problems involving electrons interacting with electromagnetic radiation. According to modern understanding, the electron is a point particle with a point charge and no spatial extent. Attempts to model the electron as a non-point particle are considered ill-conceived and counter-pedagogic. Nevertheless, it is useful to define a length that arises in electron interactions in atomic-scale problems. The classical electron radius is given as (in SI units)"

\[ r_e = \frac{1}{4\pi\varepsilon_0} \frac{e^2}{m_e c^2} = 2.8 \times 10^{-15} \text{ m} \]

The decimal numbers have been restricted to one, because the order of magnitude turns out to be much more important than the accuracy of the value.

If this definition would be applied to a proton the result would be:

\[ r_p = \frac{1}{4\pi\varepsilon_0} \frac{e^2}{m_p c^2} = 1.5 \times 10^{-18} \text{ m} \]

This value deviates enormously from the generally accepted radius of a proton (8.7 \times 10^{-16} \text{ m}).

The second reason to do so is that the presented radius of an electron is 3 times larger than the generally accepted value of the radius of a proton, while its mass is about 2000 times smaller.

In this chapter it is assumed that the mass density of an electron and a proton is the same.

Given the mass of an electron resp. proton as 9.1 \times 10^{-31} \text{ resp. 1.7 \times 10^{-27} kg and given the radius of a proton as 8.7 \times 10^{-16} m, the radius of an electron is calculated as 7.1 \times 10^{-17} m}

The consequence of this definition is that the electrical charge density of an electron, whether it is expressed in C/kg or in C/m^3, is about 2000 times higher than the one of a proton.

This leaves us with the fundamental question: what is mass?

Might mass eventually be just a carrier for electrical charge and the ultimate fundamental particles only the electron and the proton?

5. Philosophy about an alternative solution for the ‘explosive’ nucleus

The atomic model of Bohr in principle solves an equivalent but opposite problem as the one in the nucleus of the atom: electrons and protons are close together but do not merge.

So the unavoidable conclusion seems to be that the protons in a nucleus cannot exist in a fixed position between themselves.

Therefor it is assumed:

- that a neutron is a proton around which an electron orbits at very short distance
- that a proton in the nuclei orbits such a neutron

N.B. The mass of a neutron is nowadays presented as the mass of a proton plus 2.5 times the mass of an electron. In this model it would simply be the sum of these masses.

An important condition in this model is that the velocity of the orbiting electron in the neutron, from now on expressed as n-electron, is much higher than the orbital velocity of the proton, orbiting such a neutron.

The reason for this condition is that from the point of view of the orbiting proton, the n-electron has to function as a kind of shield between both protons.
The two protons will be distinguished symbolically by \( P_1 \) respectively \( P_0 \). \( P_1 \) is the proton \( \text{Inside the neutron, } P_0 \) is the \( \text{Outside proton, orbiting the neutron.} \)

Considering the orbiting n-electron as a kind of shield between both protons it is assumed that the distance between the n-electron and \( P_0 \) determines the attractive force between these two particles. So if the radius of the orbit of the n-electron is represented by \( r_{n-e} \) and the one of \( P_0 \) by \( r_{P_0} \), the meant distance is \( r_{P_0} - r_{n-e} \).

As a result there are three centripetal forces acting on \( P_0 \):
1. the repulsive force from \( P_1 \) \( (-k_1 q_1^2/(r_{P_0})^2) \), from now on written as \( F_{P_0 P_1} \)
2. the attractive force of the n-electron \( (+k_2 q_2^2/(r_{P_0} - r_{n-e})^2) \), from now on written as \( F_{P_0 e} \)
3. and the fully negligible gravitational force between both protons.

The net result of the two remaining forces, from now on written as \( F_{\text{net}} \), has to keep \( P_0 \) in its orbit, balanced by the centrifugal force \( m v_{P_0}^2/r_{P_0} \) as the result of its orbiting velocity \( v_{P_0} \).

So \( m v_{P_0}^2/r_{P_0} = F_{\text{net}} \), resulting in: \( v_{P_0} = \sqrt{(F_{\text{net}} r_{P_0})/m} \).

The value of \( r_{P_0} \) will be chosen as 10, 8, 6, 4 and 2 times \( r_{n-e} \) in order to investigate the feasibility of the model.

The velocity \( v_{n-e} \) of the n-electron follows from \( r_{n-e} \), by means of the law for a circular orbit: centrifugal force equals centripetal force, so \( m v_{n-e}^2/r_{n-e} = k_2 q_2^2/r_{n-e}^2 \), from now on written as \( F_{n-e} \).

So \( v_{n-e} = \sqrt{(F_{n-e} r_{n-e})/m} \).

The minimum value of \( r_{n-e} \) is considered as at least the radius of a proton plus the radius of an electron, so at least \( 8.7 \times 10^{-10} + 7.1 \times 10^{-10} = 9.4 \times 10^{-10} \), leading to \( 10^{-15} \text{ m} \).

The maximum value of \( r_{P_0} \) in an atom is restricted by its minimum orbit of the electron orbiting the nucleus of this atom.

The first chosen example is the Deuterium atom (\( Z=1 \)) with the minimum atomic orbit radius of \( 5 \times 10^{-11} \text{ m} \), resulting in the maximum possible value for \( r_{P_0} \) as \( 10^{-11} \text{ m} \).

So the maximum value of \( r_{n-e} \) will be chosen as \( 10^{-12} \text{ m} \).

**Table I: \( Z=1 \), \( r_{n-e} \) has the minimum possible value**

<table>
<thead>
<tr>
<th>( r_{n-e} )</th>
<th>( F_{n-e} )</th>
<th>( v_{n-e} )</th>
<th>( F_{P_0} )</th>
<th>( F_{P_0 P_1} )</th>
<th>( F_{P_0 e} )</th>
<th>( F_{\text{net}} )</th>
<th>( v_{P_0} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0E-15</td>
<td>2.3E+02</td>
<td>5.0E+08</td>
<td>1.0E-14</td>
<td>2.3E+00</td>
<td>2.8E+00</td>
<td>5.4E-01</td>
<td>1.8E+06</td>
</tr>
<tr>
<td>1.0E-15</td>
<td>2.3E+02</td>
<td>5.0E+08</td>
<td>8.0E-15</td>
<td>3.6E+00</td>
<td>4.7E+00</td>
<td>1.1E+00</td>
<td>2.3E+06</td>
</tr>
<tr>
<td>1.0E-15</td>
<td>2.3E+02</td>
<td>5.0E+08</td>
<td>6.0E-15</td>
<td>6.4E+00</td>
<td>9.2E+00</td>
<td>2.8E+00</td>
<td>3.2E+06</td>
</tr>
<tr>
<td>1.0E-15</td>
<td>2.3E+02</td>
<td>5.0E+08</td>
<td>4.0E-15</td>
<td>1.4E+01</td>
<td>2.6E+01</td>
<td>1.1E+01</td>
<td>5.2E+06</td>
</tr>
<tr>
<td>1.0E-15</td>
<td>2.3E+02</td>
<td>5.0E+08</td>
<td>2.0E-15</td>
<td>5.8E+01</td>
<td>2.3E+02</td>
<td>1.7E+02</td>
<td>1.4E+07</td>
</tr>
</tbody>
</table>

**Table II: \( Z=1 \), \( r_{n-e} \) has the maximum possible value**

<table>
<thead>
<tr>
<th>( r_{n-e} )</th>
<th>( F_{n-e} )</th>
<th>( v_{n-e} )</th>
<th>( F_{P_0} )</th>
<th>( F_{P_0 P_1} )</th>
<th>( F_{P_0 e} )</th>
<th>( F_{\text{net}} )</th>
<th>( v_{P_0} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0E-12</td>
<td>2.3E-04</td>
<td>1.6E+07</td>
<td>1.0E-11</td>
<td>2.3E-06</td>
<td>2.8E-06</td>
<td>5.4E-07</td>
<td>5.7E+04</td>
</tr>
<tr>
<td>1.0E-12</td>
<td>2.3E-04</td>
<td>1.6E+07</td>
<td>8.0E-12</td>
<td>3.6E-06</td>
<td>4.7E-06</td>
<td>1.1E-06</td>
<td>7.3E+04</td>
</tr>
<tr>
<td>1.0E-12</td>
<td>2.3E-04</td>
<td>1.6E+07</td>
<td>6.0E-12</td>
<td>6.4E-06</td>
<td>9.2E-06</td>
<td>2.8E-06</td>
<td>1.0E+05</td>
</tr>
<tr>
<td>1.0E-12</td>
<td>2.3E-04</td>
<td>1.6E+07</td>
<td>4.0E-12</td>
<td>1.4E-05</td>
<td>2.6E-05</td>
<td>1.1E-05</td>
<td>1.6E+05</td>
</tr>
<tr>
<td>1.0E-12</td>
<td>2.3E-04</td>
<td>1.6E+07</td>
<td>2.0E-12</td>
<td>5.8E-05</td>
<td>2.3E-04</td>
<td>1.7E-04</td>
<td>4.5E+05</td>
</tr>
</tbody>
</table>

\( r_{n-e} \) orbital radius n-electron \( \text{m} \)
\( v_{n-e} \) orbital velocity n-electron \( \text{m/s} \)
\( F_{P_0 P_1} \) repulsive force \( P_0 \) versus \( P_1 \) \( \text{N} \)
\( F_{P_0 e} \) attractive force \( P_0 \) versus n-e \( \text{N} \)
\( F_{\text{net}} \) net force on \( P_0 \) \( \text{N} \)
\( v_{P_0} \) orbital velocity \( P_0 \) \( \text{m/s} \)

In all results the condition: \( v_{n-e} >> v_{P_0} \) is fulfilled!
The next orienting calculation concerns the consideration of an atom with Z=100, leading to a minimum atomic orbit of $a_0/100 = 5 \times 10^{-13}$ m. Inside the volume of this orbit ($6 \times 10^{-37}$ m$^3$) about 100 proton-neutron pairs, as modelled in this chapter, have to fit. The volume of each pair has to be taken twice as large in order to decide whether they will fit in this atomic volume of $6 \times 10^{-37}$ m$^3$. 

So the volume of each pair has to be smaller than $6 \times 10^{-37}/200 = 3 \times 10^{-39}$ m$^3$. The radius belonging to such a volume is $9 \times 10^{-14}$ m. So the maximum possible $r_{pO}$ is $10^{-13}$ m. As a result $r_{e-p} \leq 10^{-14}$ m. 

This result would lead to a table in between table I and II, not giving more relevant information.

The next question is, having created groups of protons and neutrons of which the volume is much larger than the volume resulting from the quantum physics model: do all these particles fit in the volume created by the minimum atomic orbit of all atoms?

The one extreme scenario is the atom with Z=100, just considered, resulting in the conclusion that $r_{e-p}$ has to be smaller than $10^{-14}$ m in order to fulfil the mentioned criterion.

The other extreme scenario is presented in table II for atom number 1.

The volume created by the related minimum atomic orbit ($5 \times 10^{-11}$) is $5 \times 10^{-31}$ m$^3$. 

The volume of a sphere with the maximum value of $r_{pO}$ as radius (10$^{-11}$ m) is $4 \times 10^{-33}$ m$^3$. 

There are certainly no more than 2 neutron-proton pairs. 

Such a volume is $2 \times 2 \times 10^{-33} = 1.6 \times 10^{-32}$ m$^3$, being significantly smaller than $5 \times 10^{-31}$ m$^3$.

Intermediate conclusion: 

The proposed model of a neutron (a proton around which an electron is orbiting at a very short distance, ranging from $10^{-15}$ to $10^{-12}$ m) need at this moment not yet to be rejected. Neither the model of the atomic nucleus: a proton orbiting such a neutron.

An interesting observation is that the higher the atomic number, starting at about 50, the higher its potential radioactive energy. The reason for this phenomenon, based on the proposed alternative model in this chapter, might be that the radius of such a neutron (meaning the radius of its orbiting electron) has to become smaller as more neutrons have to be held inside the nucleus.

N.B. The smaller the orbit of this n-electron the higher its kinetic energy.

Another interesting phenomenon accompanied by this model is the extremely strong magnetic field of the neutron. For $r_{e-p} = 10^{-14}$ m this field strength is $\approx 10^6$ [A/m], multiplied by $\mu_0$ (4$\pi$*10$^{-7}$ [NA$^{-2}$]) resulting in a so-called magnetic flux density of $\approx 10^{10}$ [N/A.m] or [V.s/m$^2$] or Tesla.

A comparable situation is the strength of a magnetar (“a type of neutron star with an extremely powerful magnetic field): 10$^8$ - 10$^{11}$ Tesla”.

The presented model of the neutron in principle shows an equivalent model of the hydrogen atom $^1$H: 1 proton and 1 electron, orbiting the proton. 

The theoretical minimum orbit of an electron in this atom has the radius $a_0$: 5.3*10$^{-11}$ m. 

This radius is much larger than the radius of a proton: 8.7*10$^{-16}$ m. 

The minimum orbit in an atom with number Z is $a_0/Z$. The largest value of Z is 118, so this minimum orbit is still much larger than the radius of a proton.

The theoretical minimum value is $a_0 = h^2/(4\pi^2kq^2m_e)$, with $b = 6.6 \times 10^{-34}$ VAs$^2$.

The idea behind the quantitative presentation of the discrete radii $r_n = n^2a_0/Z$ is based on the assumption, for whatever reason, that the angular momentum $mv_{e-n}$ of the electron is quantized, expressed as: $mv_{e-n} = nh/2\pi$ The minimum value of n is 1, so the minimum angular momentum is assumed to be $b/2\pi$, also written as $\hbar$. But the remark: for whatever reason, remains.

Given the parameters in the expression for $a_0$ the only way to decrease $a_0$ is choosing a smaller $h$.

The next chapter describes a more detailed consideration of the phenomenon “quantum angular momentum” and its consequences for the nuclear model presented here.
6. Philosophy about quantum angular momentum

The $^1$H atom looks like the here proposed neutron model: an electron orbiting a proton, but at a minimum radius of $a_0 = 5.3\times10^{-11}$ m. A photon emitted by such an atom generates an EM radiation as shown in table III. See [6].

<table>
<thead>
<tr>
<th>n</th>
<th>$r_m$</th>
<th>$v_m$</th>
<th>$E_{kin}$</th>
<th>$\Delta E_{kin}$</th>
<th>$f_{dir}$</th>
<th>$f_{direct}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5,3E-11</td>
<td>2,2E+06</td>
<td>2,2E-18</td>
<td>4,4E+05</td>
<td>3,16E+15</td>
<td>3,16E+15</td>
</tr>
<tr>
<td>2</td>
<td>2,1E-10</td>
<td>1,1E+06</td>
<td>5,5E-19</td>
<td>1,64E-18</td>
<td>2,47E+15</td>
<td>2,47E+15</td>
</tr>
<tr>
<td>3</td>
<td>4,8E-10</td>
<td>7,3E+05</td>
<td>2,4E-19</td>
<td>1,94E-18</td>
<td>2,92E+15</td>
<td>2,92E+15</td>
</tr>
<tr>
<td>4</td>
<td>8,5E-10</td>
<td>5,5E+05</td>
<td>1,4E-19</td>
<td>2,04E-18</td>
<td>3,08E+15</td>
<td>3,08E+15</td>
</tr>
<tr>
<td>5</td>
<td>1,3E-09</td>
<td>4,4E+05</td>
<td>8,7E-20</td>
<td>2,09E-18</td>
<td>3,16E+15</td>
<td>3,16E+15</td>
</tr>
</tbody>
</table>

It has been concluded already that the only way to decrease the value of $a_0$ is to introduce a smaller $h$. This has been done by dividing $h$ by an arbitrary number. Doing so, the variables $f_{dir}$ and $f_{direct}$ turned out to stay equal to each other if $f_{dir}$ is calculated as $\Delta E_{kin}/(h/\text{arbitrary number})$ and $f_{direct}$ as $\epsilon*R_w(1/n_i^2-1/n^2)$, with $R_w = R_\infty*\text{arbitrary number}$.

So only changing $h$ into “h/\text{arbitrary number}” would be sufficient to obtain the same kind of results, in terms of the generation of a photon, at atomic level as well as at nuclear level.

Soon the next curious feature came up. If instead of an arbitrary number an atomic weight number is applied, specifically the highest possible one: $W = 238$, belonging to Uranium, an interesting value for the smallest possible radius showed up: just smaller than the sum of the radii of the proton and the electron. Fundamentally speaking this value thus would be too small.

However, since 2010 the so-called “Proton radius puzzle” [5] exists, meaning that in that year the radius of a proton has been measured as $\approx 5\%$ lower than the value applied here: $8.7\times10^{-16}$ m. Applying this lower value, results in the sum of both radii of $9.1\times10^{-16}$ m, so smaller than the minimum value of $r_{ne}$ in table IV. In this table: $h_W = h/238$, $a_{0w} = a_0/238^2$ and $R_{wW} = R_\infty*238^3$.

The frequency of the emitted ‘photon’ $f_{W} = \Delta E_{kin}/h_W$, resp. $f_{direct} = \epsilon*R_{wW}(1/n_i^2-1/n^2)$

<table>
<thead>
<tr>
<th>n</th>
<th>$r_{ne}$</th>
<th>$v_{ne}$</th>
<th>$E_{kin}$</th>
<th>$\Delta E_{kin}$</th>
<th>$f_{W}$</th>
<th>$f_{direct}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9,3E-16</td>
<td>5,2E+08</td>
<td>1,2E-13</td>
<td>9,2E-14</td>
<td>3,33E+22</td>
<td>3,33E+22</td>
</tr>
<tr>
<td>2</td>
<td>3,7E-15</td>
<td>2,6E+08</td>
<td>3,1E-14</td>
<td>9,26E-14</td>
<td>3,33E+22</td>
<td>3,33E+22</td>
</tr>
<tr>
<td>3</td>
<td>8,4E-15</td>
<td>1,7E+08</td>
<td>1,4E-14</td>
<td>1,10E-13</td>
<td>3,94E+22</td>
<td>3,94E+22</td>
</tr>
<tr>
<td>4</td>
<td>1,5E-14</td>
<td>1,3E+08</td>
<td>7,7E-15</td>
<td>1,16E-13</td>
<td>4,16E+22</td>
<td>4,16E+22</td>
</tr>
<tr>
<td>5</td>
<td>2,5E-14</td>
<td>1,0E+08</td>
<td>4,9E-15</td>
<td>1,19E-13</td>
<td>4,26E+22</td>
<td>4,26E+22</td>
</tr>
</tbody>
</table>

The highest orbital velocity in table IV is $\approx 1.7\epsilon$, in modern physics considered as impossible. However, see chapter I for the counter argument.

A ‘photon’ emitted by a neutron/nucleus from now on will be called a n-photon.

Quote: Gamma radiation is penetrating electromagnetic radiation arising from the radioactive decay of atomic nuclei. It consists of photons in the highest observed range of photon energy. It has been discovered in 1900 while studying radiation emitted by radium. Unquote.
Gamma radiation has frequencies of at least $10^{19}$ Hz. The atomic weight of Radium is 226. This type of radiation is not accompanied by the escape of particles from the nucleus. So $\gamma$ radiation is nothing more neither less than the jump of an electron from an inner to an outer orbit in a neutron, as presented in this alternative model of a neutron. For that reason $\Delta E_{\text{kin}}$ has now been calculated as $(E_{\text{kin}} \text{ at orbit } i) \text{ minus } (E_{\text{kin}} \text{ at orbit } i+1)$.

Table V shows the frequencies that can be expected.

In this table: $h_W = h/226$, $a_{0W} = a_0/226^2$ (1.04*10^{-15} m) and $R_{\infty W} = R_\infty* 226^3 = 1.3*10^{14}$ m$^{-1}$.

The frequency of the emitted n-photon $f_{\text{direct}} = c * R_{\infty W}(1/n_i^2 - 1/n_{i+1}^2)$

<table>
<thead>
<tr>
<th>n</th>
<th>$f_{\text{dir}}$</th>
<th>$c_{\text{inc}}$</th>
<th>$E_{\text{kin}}$</th>
<th>$\Delta E_{\text{kin}}$</th>
<th>$f_{\text{inc}}$</th>
<th>$f_{hWf}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.0E-15</td>
<td>4.9E+08</td>
<td>1.1E-13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>4.1E-15</td>
<td>2.5E+08</td>
<td>2.8E-14</td>
<td>8.35E-14</td>
<td>2.85E+22</td>
<td>2.85E+22</td>
</tr>
<tr>
<td>3</td>
<td>9.3E-15</td>
<td>1.6E+08</td>
<td>1.2E-14</td>
<td>1.55E-14</td>
<td>5.28E+21</td>
<td>5.28E+21</td>
</tr>
<tr>
<td>4</td>
<td>1.7E-14</td>
<td>1.2E+08</td>
<td>7.0E-15</td>
<td>5.41E-15</td>
<td>1.85E+21</td>
<td>1.85E+21</td>
</tr>
<tr>
<td>5</td>
<td>2.65E-14</td>
<td>9.9E+07</td>
<td>4.5E-15</td>
<td>2.51E-15</td>
<td>8.55E+20</td>
<td>8.55E+20</td>
</tr>
<tr>
<td>6</td>
<td>3.7E-14</td>
<td>8.2E+07</td>
<td>3.1E-15</td>
<td>1.36E-15</td>
<td>4.64E+20</td>
<td>4.64E+20</td>
</tr>
<tr>
<td>7</td>
<td>5.1E-14</td>
<td>7.1E+07</td>
<td>2.3E-15</td>
<td>8.21E-16</td>
<td>2.80E+20</td>
<td>2.80E+20</td>
</tr>
<tr>
<td>8</td>
<td>6.6E-14</td>
<td>6.2E+07</td>
<td>1.7E-15</td>
<td>5.33E-16</td>
<td>1.82E+20</td>
<td>1.82E+20</td>
</tr>
<tr>
<td>9</td>
<td>8.4E-14</td>
<td>5.3E+07</td>
<td>1.4E-15</td>
<td>3.65E-16</td>
<td>1.25E+20</td>
<td>1.25E+20</td>
</tr>
<tr>
<td>10</td>
<td>1.0E-13</td>
<td>4.9E+07</td>
<td>1.1E-15</td>
<td>2.61E-16</td>
<td>8.91E+19</td>
<td>8.91E+19</td>
</tr>
</tbody>
</table>

N.B. The radius of the orbit at n=10 is still smaller than the $a_0$ of radium (Z=88): 6*10^{-13} m.

For information:

Mega  •  Giga  •  Tera  •  Peta  •  Exa  •  Zetta  •  Yotta  •  Hertz

The new model shows that any nuclear EM-radiation in the range Exa- until Yotta-Hertz can be generated, opposite to what is called Alpha, resp. Beta ‘particle-radiation’, whatever that may be.

‘Particle-radiation’ shows strong similarities with the generally accepted particle-wave duality. As if a particle itself would be able to emit Electro-Magnetic radiation! See [6].

It is remarkable that no frequencies higher than $\gamma$ frequencies seem to have been detected.

On the other hand reference [6] presents:

“The electromagnetic spectrum is the range of frequencies (the spectrum) of electromagnetic radiation and their respective wavelengths and photon energies. The electromagnetic spectrum covers electromagnetic waves with frequencies ranging from below one hertz to above $10^{24}$ Hertz, corresponding to wavelengths from thousands of kilometers down to a fraction of the size of an atomic nucleus.”

Indeed, the highest possible frequency, as shown in table IV, has a wavelength of $\sim 7*10^{-15}$ m, roughly equal to $r_{3e}$ in that same table.
7. Contemplations about nuclear reactions

Ref. [7] presents considerations about nuclear reactions related to Tritium and Lithium.

Tritium

“Tritium symbol $^3_1$H, also known as hydrogen-3, is a radioactive isotope of hydrogen. The nucleus of tritium (sometimes called a triton) has one proton and two neutrons. Tritium is used as a radioactive tracer, in radio luminescent light sources for watches and instruments, and, along with deuterium, as a fuel for nuclear fusion reactions with applications in energy generation and weapons.

\[ ^3_1\text{H} \rightarrow ^3_2\text{He}^+ + e^- + \nu_e \quad \nu_e \text{ is the symbol for an electron antineutrino}\]

Comment:

Based on the alternative nuclear model and the abbreviations: p means proton, n means neutron and e means electron, it can be concluded that:

\[ ^3_1\text{H} \quad \text{has} \quad 1p + 2n + 1e = 3p + 3e \]
\[ ^3_2\text{He}^+ + e^- \quad \text{has} \quad 2p + 1n + 1e + 1e = 3p + 3e \]

Originally there was only one ‘atom-electron’, in H, so the released electron $e^-$ must have been an n-electron. This n-electron jumped out of its orbit, so a very high frequency n-photon must have been emitted too.

Remark: The word photon originates from visible EM radiation and thus is not applicable anymore in this situation. Therefore it has been replaced by n-photon.

 Might it be that such an n-photon has been interpreted as an electron antineutrino, given the generally accepted particle-wave duality?

Lithium

“Tritium is produced in nuclear reactors by neutron activation of lithium-6. “

\[ ^6_3\text{Li} + n \rightarrow ^4_2\text{He} + ^3_1\text{H} \]
\[ ^6_3\text{Li} + n \quad \text{has} \quad 3p + 3n + 3e + 1n = 7p + 7e \]
\[ ^4_2\text{He} \quad \text{has} \quad 2p + 2n + 2e = 4p + 4e \]
\[ ^3_1\text{H} \quad \text{has} \quad 1p + 2n + 1e = 3p + 3e \]

“High-energy neutrons can also produce tritium from lithium-7...”

\[ ^7_3\text{Li} + n \rightarrow ^4_2\text{He} + ^3_1\text{H} + n \]
\[ ^7_3\text{Li} + n \quad \text{has} \quad 3p + 4n + 3e + 1n = 8p + 8e \]
\[ ^4_2\text{He} \quad \text{has} \quad 2p + 2n + 2e = 4p + 4e \]
\[ ^3_1\text{H} + n \quad \text{has} \quad 1p + 3n + 1e = 4p + 4e \]

Comment:

In both situations the number of protons doesn’t change, so seemingly no neutron was split into a proton and electron and thus no radiation will be detected, unless an n-electron would jump from an inner into an outer orbit during such a process.

Carbon-14 decay

Carbon-14 decays into Nitrogen-14, symbolically expressed as: $^{14}_6\text{C} \rightarrow ^{14}_7\text{N}$.

In terms of the here presented model the n-electron of a neutron in the carbon nucleus jumps to an orbit at radius $2\alpha_0/Z$, with Z in first instance 6, later on 7. The nucleus now has 7 instead of 6 protons, while the number of electrons orbiting the nucleus also changes from 6 to 7, changing the element from Carbon into Nitrogen. The number of neutrons in Nitrogen is also 7.

Each neutron in Nitrogen has a proton orbiting it, resulting in a stable element.

Based on calculations like shown in Table IV, with W=14, such a decay results in the emission of an n-photon with a frequency of 8.5 ExaHz.
8. Alpha radiation and the alternative nuclear model

Reference [8] presents the following considerations.

“Alpha decay or $\alpha$-decay is a type of radioactive decay in which an atomic nucleus emits an alpha particle (helium nucleus) and thereby transforms or 'decays' into an atom with a mass number that is reduced by four and an atomic number that is reduced by two. An alpha particle is identical to the nucleus of a helium-4 atom, which consists of two protons and two neutrons. It has a charge of $+2e$ and a mass of 4u. For example, uranium-238 decays to form thorium-234.”

Comment:
The related symbolic equation is: $^{238}_{92}\text{U} \rightarrow ^{234}_{90}\text{Th} + ^4_2\text{He}^2$

On the left and right side of the arrow the total number of protons, respectively neutrons is the same, so no neutron has been split into a proton and an electron. On the left side are 92 electrons. On the right side 90 in Th, so there will be 2 in $^4_2\text{He}^2$, resulting in a normal He atom, not a He nucleus! That would mean that the alleged alpha particle is a normal He atom.

“Approximately 99% of the helium produced on Earth is the result of the alpha decay of underground deposits of minerals containing uranium or thorium. The helium is brought to the surface as a by-product of natural gas production.”

Comment:
So indeed, no Helium ions/nuclei, but $^4_2\text{He}$ atoms!

“Alpha particles have a typical kinetic energy of 5 MeV (or $\approx 0.13\%$ of their total energy, 110 TJ/kg) and have a speed of about 15,000,000 m/s, or 5% of the speed of light.”

Comment:
A Helium atom/nucleus moving with the mentioned speed has indeed a kinetic energy of 5MeV. More interesting is: what might be meant with 'their total energy'? Especially the word 'their'.

This question leads to the more general question: where does essentially the enormous energy-density (110 TJ/kg) come from in nuclear reactions? Certainly not from 'alpha particles'.

In fact the same question can be asked concerning the chemical reaction of hydrogen + oxygen. This reaction also produces a large amount of energy, given its application in rocket launchings.

The essential source has to be found in the atomic/molecular model of hydrogen, oxygen and the result of the reaction: water.

The atomic model of the hydrogen atom $^1_1\text{H}$ is: one proton in its nucleus and one electron orbiting this proton at a distance of $r = a_0$, with $a_0 = 1.3*10^{-15}$ m. See chapter VIII.

After the chemical reaction with oxygen this orbit is eliminated, because the $^1_1\text{H}$ atom has been eliminated as atom. The total number of electrons before resp. after this reaction has not been changed, so that specific electron is now orbiting somewhere in the water molecule at a (much) lower speed. As a result it lost its former kinetic energy partly.

To get an idea about the level of this lost energy in the former atom, so of the level of gained energy in its surroundings, the following calculations have been carried out.

Chapter VIII presents a model of a photon based on the idea that an electron orbiting a nucleus at an inner orbit and jumping to an outer orbit creates a photon. This model also shows that the energy of the photon is not generated by the loss of the kinetic energy of the electron, but the loss of the magnetic energy created by the electron due to its orbit. So two types of energy are converted: the magnetic energy into EM-radiation energy and kinetic energy into an energy not defined in the presented model of the photon. Given the information in chapter VIII it now can logically be assumed that this loss of kinetic energy will be converted into heat energy.
Remark:
The wrong definition of the sign of potential energy, chapter VIII, causes an incorrect image of atoms. The incorrect words below from [9] (Orbital energy) have been replaced by the correct ones.

“In atoms with a single electron ...., the energy of an orbital .... is determined exclusively by n. The n=1 orbital has the lowest possible energy in the atom. Each successively higher value of n has a lower level of energy, but the difference decreases as n increases. For high n, the level of energy becomes so high that the electron can easily escape from the atom.”

Besides that, the phenomenon potential energy does not play any role in an atomic orbiting system. The background for this conclusion is that the centripetal and centrifugal forces, applied to the orbiting electron, are fully and continuously in balance in such an orbit. The only phenomenon that contains real energy is the kinetic energy of the orbiting electrons.

The table below shows the kinetic energy levels of the orbiting electron in an $^1\text{H}$ atom.

<table>
<thead>
<tr>
<th>n</th>
<th>$r_n$</th>
<th>$v_{en}$</th>
<th>$\frac{1}{2}mv_{en}^2$ (J)</th>
<th>$\Delta E_{\text{kin}}$</th>
<th>$\Delta E_{d}$ (MJ/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5.29E-11</td>
<td>2.19E+06</td>
<td>2.18E-18</td>
<td>1</td>
<td>977</td>
</tr>
<tr>
<td>2</td>
<td>2.12E-10</td>
<td>1.09E+06</td>
<td>5.45E-19</td>
<td>3.03E-19</td>
<td>181</td>
</tr>
<tr>
<td>3</td>
<td>4.76E-10</td>
<td>7.29E+05</td>
<td>1,64E-18</td>
<td>977</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>8.47E-10</td>
<td>5.47E+05</td>
<td>1,06E-19</td>
<td>63</td>
<td></td>
</tr>
</tbody>
</table>

$r_n$ radius of the orbiting electron
$v_{en}$ orbiting velocity
$\frac{1}{2}mv_{en}^2$ kinetic energy of electron
$\Delta E_{\text{kin}}$ $\frac{1}{2}mv_{e(i)}^2 - \frac{1}{2}mv_{e(i+1)}^2$
$\Delta E_{d}$ $\Delta E_{\text{kin}}$ expressed in energy density

The conversion factor between $\Delta E_{\text{kin}}$ and $\Delta E_{d}$ is the Avogadro constant, expressing that 1 gram $^1\text{H}$ contains $6\times10^{23}$ atoms $^1\text{H}$. Conversion to MJ/kg means: multiply $\Delta E_{\text{kin}}$ by $6\times10^{20}$.

Reference [10] tells that the ‘heating value’ of hydrogen is 120 à 140 MJ/kg. This value is roughly equal to the 181 value in the table, but significantly lower than the, in first instance, expected 977, because that is the loss of kinetic energy generated if the electron jumps from orbit 1 to an outer orbit. Most likely the reason for the difference is the following.

The hydrogen mentioned in [10] is not $^1\text{H}$, but the molecule $\text{H}_2$. Such a molecule consists in principle of two $^1\text{H}$ atoms, but not just simply 'sitting' together. Their orbiting electrons are assumed to interfere with each other in order to realize a stable molecule. Assuming that this interference does not happen at orbit 1 but at orbit 2 would explain that the value 181 in the table is more appropriate, because it represents $\Delta E_{\text{kin}} = \frac{1}{2}mv_{e2}^2 - \frac{1}{2}mv_{e3}^2$.

Back to the ultimate question: where does the enormous energy density come from in nuclear reactions? Suppose we take the $^2\text{H}$ atom, but we now consider its nucleus, especially its neutron.

The here presented model is that a neutron is a proton around which an electron or orbits at a much smaller distance than the $r_1$ shown in the example above.

In table VII this radius has been given 4 values, of which $r_1 e$ is 1.5 times the radius of a proton. The variable $E_{dn}$ is the conversion of $\frac{1}{2}mv_{en}^2$ to the energy density expressed in TJ/kg.

<table>
<thead>
<tr>
<th>n</th>
<th>$r_{ne}$</th>
<th>$v_{en}$</th>
<th>$\frac{1}{2}mv_{en}^2$ (J)</th>
<th>$E_{dn}$ (TJ/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1,3E-15</td>
<td>4,4E+08</td>
<td>8,7E-14</td>
<td>52</td>
</tr>
<tr>
<td>2</td>
<td>5,3E-15</td>
<td>2,2E+08</td>
<td>2,2E-14</td>
<td>13</td>
</tr>
<tr>
<td>3</td>
<td>1,2E-14</td>
<td>1,5E+08</td>
<td>9,7E-15</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>2,1E-14</td>
<td>1,1E+08</td>
<td>5,5E-15</td>
<td>3</td>
</tr>
</tbody>
</table>
Reference [11] mentions:
“The practical maximum yield-to-weight ratio for fusion weapons (thermonuclear weapons) has been estimated to 25 TJ/kg.”

This value fits very well in table VII!

The conversion from $\frac{1}{2}mv^2$ to TJ/kg for element $Z+N$ is:

$$1000 \text{ gram} / Z \text{ gram (of the element)} \times N \text{ (neutrons per atom)} \times 6 \times 10^{23} \times 10^{-12} = N / Z \times 6 \times 10^{14}$$

A radius of $10^{-15}$ would result in $\sim 70$ TJ/kg for N=Z and in $\sim 1.4 \times 70 = 100$ TJ/kg for Uranium.

9. Possible orbits of the n-electron in the atom with number Z

The here presented model of the nucleus of an atom allows to calculate the minimum orbit of the n-electron, mathematically described as $a_0/2$, with $W$ the atomic weight number of the atom under consideration. If $Z$ is the atomic number of this atom then $a_0/Z$ is the minimum radius of the electron orbiting the nucleus.

The interesting question is how much space there is for the n-electron to orbit the proton of the neutron at distances larger than $a_0/Z$.

For that purpose the volume belonging to the radius $a_0/Z$, so the total volume $V_{a_0Z}$ disposable for the nucleus belonging to atom number $Z$, has to be calculated: $V_{a_0Z} = (4/3)\pi \left( a_0/Z \right)^3$.

The next step is to calculate the volume belonging to a neutron-proton pair, in which the n-electron orbits the proton of the neutron at a radius $r_{n-e}$ (as shown in table IV and V) while the radius of the orbit of the outside proton (orbiting such a neutron) is represented by $r_{PO}$.

The minimum orbital radius of the n-electron $r_{1-e} = a_0/W^2$.

The maximum volume of the nucleus of atom $Z$ is restricted by the volume $V_{a_0Z}$ and can be calculated as the total number of neutron-proton pairs ($Z$) multiplied with 2 (exact value is 1.91) times the volume of the sphere with radius $r_{PO}$.

Expressed mathematically: $(4/3)\pi r_{PO}^3 \times 2 \times Z < V_{a_0Z}$, resulting in the maximum possible $r_{PO}$.

Calculations show that, starting at $Z=1$ in Deuterium and ending at $Z=108$ in Hassium, the as such calculated maximum admitted $r_{PO}$ equals $3 \times r_{1-e}$ for Deuterium, gradually increasing to $r_{PO} > 100 \times r_{1-e}$ for $Z>85$.

The radii of an electron orbiting the nucleus of an atom are expressed as $r_n = n^2 a_0/Z$.

If the radii of the orbit of the n-electron in the nucleus of an atom with atomic weight number $W$ would be expressed as $r_{on} = n^2 a_0/W^2 = n^2 a_0/W^2$, then calculations show that $n_n = 1$ for $Z \leq 2$, gradually increasing to $n_n = 9$ for $Z > 80$. See the appendix for all elements $\leq 108$.

The basic reason for this phenomenon is that the minimum orbit in element $Z$ is $a_0/Z$, while the minimum orbit in the nucleus of such an element is $a_0/W^2 \approx a_0/(2Z)^2$.

N.B. The higher $Z$, the larger is $W/Z$. For $Z=1$ the ratio is 2. The highest ratio is 2.6 for Plutonium.

The appendix shows that $a_0/W^2$ is smaller than the sum of the radii of the proton and neutron for $Z>93$. But there is space enough to orbit at a larger distance in reality.

Intermediate conclusion.

According to the properties of the here presented atomic nucleus model:

The higher the atom number $Z$, the smaller the radii of its neutrons and neutron-proton-pairs.
Conclusions

1. The proposed model of a neutron: an electron orbiting a proton at a very short distance, results to the following consequences:
2. The repulsive forces between protons in nuclei are ‘eliminated’ by assuming that these protons orbit such neutrons.
3. The exotic particles quarks and gluons, held together by magic forces, have become unnecessary in the new model.
4. The frequency of a ‘photon’, emitted by a nucleus of an atom with weight number W, can be calculated in the same way as at atomic level, by applying h/W instead of h in E=hf.
5. The new model shows that the so-called alpha and beta radiation is normal EM-radiation, in the range Zetta/Yotta Hertz, instead of magic “particle-radiation”.
6. Gamma radiation is in the new as well as in the quantum physics model EM-radiation in the Exa Hertz range.
7. When a 146C decays into a 147N atom an extremely short EM-pulse of 8.5 ExaHz is emitted.
8. The so-called alpha particle, described as a 42He nucleus (and therefor held responsible for alpha ‘radiation’ in the quantum physics model) turns out to be a normal 42He atom.
9. The new model shows that nuclear reactions create energy densities, expressed in J/kg, of which the order of magnitude is in accordance with publicly presented values.
10. The spherical available space of the nucleus of element Z has a radius proportional to Z-1, while the radii of its neutrons and neutron-proton-pairs in this model are proportional to Z-2, leading to the conclusion that a neutron does not have a fixed radius.
11. Based on the same phenomenon: the space for an n-electron to orbit around the proton is larger, the larger the atomic number Z is.
12. The radius of an electron, based on kee2/mec2, causes a significant contradiction with the generally accepted radius of a proton, applying this expression to a proton.
13. The presented model might lead to the conclusion that universe consists of only electrons and protons.

References

### Appendix:

**Properties of nuclei in elements Z=1 to Z=108 for new atomic nuclear model**

<table>
<thead>
<tr>
<th>Element</th>
<th>Symbol</th>
<th>Z</th>
<th>N</th>
<th>W</th>
<th>w_{exp}/max n_w</th>
<th>a_{exp}/max n_a</th>
<th>max n_a</th>
<th>max n_w</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deuterium</td>
<td>H</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1.3E-11</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Helium</td>
<td>He</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>3.3E-12</td>
<td>5</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Lithium</td>
<td>Li</td>
<td>3</td>
<td>4</td>
<td>7</td>
<td>1.1E-12</td>
<td>9</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Beryllium</td>
<td>Be</td>
<td>4</td>
<td>5</td>
<td>9</td>
<td>6.5E-13</td>
<td>10</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Boron</td>
<td>B</td>
<td>5</td>
<td>6</td>
<td>11</td>
<td>4.4E-13</td>
<td>11</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Carbon</td>
<td>C</td>
<td>6</td>
<td>7</td>
<td>12</td>
<td>3.7E-13</td>
<td>10</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>N</td>
<td>7</td>
<td>8</td>
<td>14</td>
<td>2.7E-13</td>
<td>12</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Oxygen</td>
<td>O</td>
<td>8</td>
<td>9</td>
<td>16</td>
<td>2.1E-13</td>
<td>13</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Sulfur</td>
<td>S</td>
<td>16</td>
<td>17</td>
<td>32</td>
<td>5.2E-20</td>
<td>20</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Chlorine</td>
<td>Cl</td>
<td>17</td>
<td>18</td>
<td>35</td>
<td>4.3E-14</td>
<td>22</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Argon</td>
<td>Ar</td>
<td>18</td>
<td>19</td>
<td>39</td>
<td>3.5E-14</td>
<td>24</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Potassium</td>
<td>K</td>
<td>19</td>
<td>20</td>
<td>39</td>
<td>3.5E-14</td>
<td>24</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Calcium</td>
<td>Ca</td>
<td>20</td>
<td>21</td>
<td>40</td>
<td>3.3E-23</td>
<td>23</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Scandium</td>
<td>Sc</td>
<td>21</td>
<td>22</td>
<td>45</td>
<td>2.6E-18</td>
<td>28</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Titanium</td>
<td>Ti</td>
<td>22</td>
<td>23</td>
<td>46</td>
<td>2.3E-18</td>
<td>30</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Vanadium</td>
<td>V</td>
<td>23</td>
<td>24</td>
<td>51</td>
<td>2.0E-14</td>
<td>32</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Chromium</td>
<td>Cr</td>
<td>24</td>
<td>25</td>
<td>52</td>
<td>2.0E-14</td>
<td>31</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Manganese</td>
<td>Mn</td>
<td>25</td>
<td>26</td>
<td>55</td>
<td>1.8E-14</td>
<td>33</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Iron</td>
<td>Fe</td>
<td>26</td>
<td>27</td>
<td>56</td>
<td>1.7E-14</td>
<td>32</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Cobalt</td>
<td>Co</td>
<td>27</td>
<td>28</td>
<td>59</td>
<td>1.5E-14</td>
<td>34</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Nickel</td>
<td>Ni</td>
<td>28</td>
<td>29</td>
<td>59</td>
<td>1.5E-14</td>
<td>32</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Copper</td>
<td>Cu</td>
<td>29</td>
<td>30</td>
<td>65</td>
<td>1.3E-14</td>
<td>36</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Zinc</td>
<td>Zn</td>
<td>30</td>
<td>31</td>
<td>65</td>
<td>1.3E-14</td>
<td>36</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Gallium</td>
<td>Ga</td>
<td>31</td>
<td>32</td>
<td>70</td>
<td>1.1E-14</td>
<td>40</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Germanium</td>
<td>Ge</td>
<td>32</td>
<td>33</td>
<td>73</td>
<td>1.0E-14</td>
<td>42</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Arsenic</td>
<td>As</td>
<td>33</td>
<td>34</td>
<td>75</td>
<td>9.4E-15</td>
<td>42</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Selenium</td>
<td>Se</td>
<td>34</td>
<td>35</td>
<td>78</td>
<td>8.5E-15</td>
<td>45</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Bromine</td>
<td>Br</td>
<td>35</td>
<td>36</td>
<td>80</td>
<td>8.3E-15</td>
<td>44</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Krypton</td>
<td>Kr</td>
<td>36</td>
<td>37</td>
<td>84</td>
<td>7.5E-15</td>
<td>47</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Rubidium</td>
<td>Rb</td>
<td>37</td>
<td>38</td>
<td>85</td>
<td>7.3E-15</td>
<td>47</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Strontium</td>
<td>Sr</td>
<td>38</td>
<td>39</td>
<td>88</td>
<td>6.8E-15</td>
<td>48</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Yttrium</td>
<td>Y</td>
<td>39</td>
<td>40</td>
<td>90</td>
<td>6.7E-15</td>
<td>48</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Zirconium</td>
<td>Zr</td>
<td>40</td>
<td>41</td>
<td>91</td>
<td>6.4E-15</td>
<td>48</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Niobium</td>
<td>Nb</td>
<td>41</td>
<td>42</td>
<td>93</td>
<td>6.1E-15</td>
<td>49</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>Mo</td>
<td>42</td>
<td>43</td>
<td>96</td>
<td>5.8E-15</td>
<td>50</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Technetium</td>
<td>Tc</td>
<td>43</td>
<td>44</td>
<td>98</td>
<td>5.5E-15</td>
<td>51</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Ruthenium</td>
<td>Ru</td>
<td>44</td>
<td>45</td>
<td>101</td>
<td>5.2E-15</td>
<td>52</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Rhodium</td>
<td>Rh</td>
<td>45</td>
<td>46</td>
<td>103</td>
<td>5.0E-15</td>
<td>53</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Palladium</td>
<td>Pd</td>
<td>46</td>
<td>47</td>
<td>106</td>
<td>4.7E-15</td>
<td>54</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Silver</td>
<td>Ag</td>
<td>47</td>
<td>48</td>
<td>110</td>
<td>4.5E-15</td>
<td>55</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Cadmium</td>
<td>Cd</td>
<td>48</td>
<td>49</td>
<td>112</td>
<td>4.2E-15</td>
<td>57</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Indium</td>
<td>In</td>
<td>49</td>
<td>50</td>
<td>115</td>
<td>4.0E-15</td>
<td>59</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Tin</td>
<td>Sn</td>
<td>50</td>
<td>51</td>
<td>119</td>
<td>3.7E-15</td>
<td>61</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Antimony</td>
<td>Sb</td>
<td>51</td>
<td>52</td>
<td>122</td>
<td>3.6E-15</td>
<td>62</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Tellurium</td>
<td>Te</td>
<td>52</td>
<td>53</td>
<td>128</td>
<td>3.2E-15</td>
<td>67</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Iodine</td>
<td>I</td>
<td>53</td>
<td>54</td>
<td>131</td>
<td>3.1E-15</td>
<td>67</td>
<td>7</td>
<td>7</td>
</tr>
</tbody>
</table>

110
XXIII  Avogadro constant in combat with atomic mass unit

Summary - In May 2019 a new value for the Avogadro constant will be introduced. However its proposed value is in contradiction with the value of the atomic mass unit, whichever amu is taken: the one based on normal mass values, or the one based on mass values influenced by binding energies in atomic nuclei, via $E(nergy) = mc^2$. This chapter presents an alternative approach.

1. Introduction

In chapter XX it is shown how the value of the amu is influenced by the binding energy in the nuclei of atoms. Reference [1] shows the history of the Avogadro constant. It concludes with:

“Pending revisions in the base set of SI units necessitated redefinitions of the concepts of chemical quantity. Avogadro’s number, and its definition, was deprecated in favor of the Avogadro constant and its definition. Based on measurements made through the middle of 2017 which calculated a value for the Avogadro constant of $N_A = 6.022140758(62) \times 10^{23}$ mol$^{-1}$, the redefinition of SI units is planned to take effect on 20 May 2019. The value of the constant will be fixed to exactly $6.02214076 \times 10^{23}$ mol$^{-1}$.”

2. Presentation of contradictions

Reference [1] shows:

“A much simpler definition is that Avogadro’s constant is the conversion factor for converting grams to atomic mass units.”

Reference [2] shows the history of the atomic mass unit (amu) and starts as follows:

“It (amu) is defined as one twelfth of the mass of an unbound neutral atom of carbon-12 in its nuclear and electronic ground state and at rest, and has a value of $1.660539040 \times 10^{-27}$ kg.”

The consequence of this value of the amu is that the atomic weight of $^{12}$C is not 12, but $12.011$ amu.

See reference [2] under Examples:

“A conventional value for standard atomic weight of carbon is 12.011 u (12.011 Da).”

Applying these values to the reference element $^{12}$C results in the following table:

<table>
<thead>
<tr>
<th>atomic weight $^{12}$C</th>
<th>12.011 amu</th>
</tr>
</thead>
<tbody>
<tr>
<td>amu</td>
<td>1.660539040*10$^{-27}$ kg</td>
</tr>
<tr>
<td>atomic weight $^{12}$C</td>
<td>1.994473441*10$^{-26}$ kg</td>
</tr>
<tr>
<td>12 gram $^{12}$C has</td>
<td>6.016256184*10$^{23}$ atoms</td>
</tr>
</tbody>
</table>

Remarks:
The atomic weight of C in kg is the product of the first two values in the table above. 12 gram C has 0.012 (kg)/atomic weight of C (kg) = 6.016256184*10$^{23}$ atoms.

The deviation from the value that will be introduced in May 2019 is significant: -0.09%.

One of the reasons of such a contradiction is described in reference [1].

This reference, shortly summarized, shows that the value of amu has been changed from 1.674......*10$^{-27}$ kg to the already mentioned value 1.660......*10$^{-27}$ kg, based on the alleged influence of the so-called binding energy in a nucleus.

The previous value of the amu (1. 674......*10$^{-27}$) was $(m_N+m_P+m_e)/2$ with:

$m_N = 1.674927471\times10^{-27}$  \quad $m_P = 1.672621898\times10^{-27}$  \quad $m_e = 9.10938356\times10^{-31}$ kg

being masses not influenced by binding energies.
If the same table is made with this amu, the result is:

<table>
<thead>
<tr>
<th>atomic weight $^{12}$C</th>
<th>12 amu</th>
</tr>
</thead>
<tbody>
<tr>
<td>amu</td>
<td>1.674230154x$10^{-27}$ kg</td>
</tr>
<tr>
<td>atomic weight $^{12}$C</td>
<td>2.009076184x$10^{-26}$ kg</td>
</tr>
<tr>
<td>12 gram $^{12}$C has</td>
<td>5.972894454x$10^{+23}$ atoms</td>
</tr>
</tbody>
</table>

Again the deviation from the value that will be introduced in May 2019 is enormous: -0.8 %

3. Alternative amu and Avogadro constant based on alternative model of neutron

In chapter XX an alternative model of the atomic nucleus is proposed, based on the model of the neutron as a proton around which an electron orbits at a much smaller distance from the proton than is modelled in the hydrogen atom $^1\text{H}$.

In this model the mass of a neutron equals the mass of a proton plus an electron, while presently this mass is presented as the mass of a proton plus 2.531 times the mass of an electron.

Neglecting the influence of binding energy the amu would change from $(m_N+m_P+m_e)/2$ to $m_P+m_e$.

The related value for the amu is $1.6735328364\times10^{-27}$ kg. The tables presented above now become as follows:

<table>
<thead>
<tr>
<th>atomic weight $^{12}$C</th>
<th>12 amu</th>
</tr>
</thead>
<tbody>
<tr>
<td>amu</td>
<td>1.6735328364x$10^{-27}$ kg</td>
</tr>
<tr>
<td>atomic weight $^{12}$C</td>
<td>2.0082394036x$10^{-26}$ kg</td>
</tr>
<tr>
<td>12 gram $^{12}$C has</td>
<td>5.9753832030x$10^{+23}$ atoms</td>
</tr>
</tbody>
</table>

Reference [1] writes:

“For instance, to the first order approximation, 1 gram of hydrogen element (H), having the atomic (mass) number 1, has $6.022\times10^{23}$ hydrogen atoms. Similarly, 12 grams of $^{12}\text{C}$, with the mass number 12 (atomic number 6), has the same number of carbon atoms, $6.022\times10^{23}$”

Mind the words: “to the first order approximation”!

Applying the alternative model for the neutron and for the atomic nucleus results in the table shown below:

<table>
<thead>
<tr>
<th>atomic weight $^1\text{H}$</th>
<th>1 amu</th>
</tr>
</thead>
<tbody>
<tr>
<td>amu</td>
<td>1.6735328364x$10^{-27}$ kg</td>
</tr>
<tr>
<td>atomic weight $^1\text{H}$</td>
<td>1.6735328364x$10^{-27}$ kg</td>
</tr>
<tr>
<td>1 gram $^1\text{H}$ has</td>
<td>5.9753832030x$10^{+23}$ atoms</td>
</tr>
</tbody>
</table>

4. Summarized results of the alternative approach

1. The alternative amu is $1.6735328364\times10^{-27}$ kg, in case a neutron is assumed to be a proton and an orbiting electron at a much shorter distance from the proton than in an $^1\text{H}$ atom.

2. The atoms of element $Z+N$ have a mass number of $(Z+N)$, except for $Z=1$, together with $N=1$. $Z$ is the so-called atomic number, being the number of protons and $N$ the number of neutrons.

3. The alternative Avogadro constant is 5.9753832030x$10^{+23}$ mol$^{-1}$, resulting in: $(Z+N)$ gram of the element $Z+N$ contains 5.9753832030x$10^{+23}$ atoms, except for $Z=1$, together with $N=1$.

References


XXIV  Is the Earth an Inertial System?

Summary – The earth rotates almost exactly along a circle around the sun, notwithstanding the fact that the sun lies significantly outside the centre of this circle. Assuming a perfect circle, the question is whether the earth in such a situation is an inertial system or not.

1. Introduction

The question can be found on the Internet too [1], but including into the consideration the rotation of the earth around its North-South pole axis too has generated confusion. This rotation is excluded in this paper. The so-called Foucault pendulum demonstrates this rotation.

2. Definition of an inertial system

An inertial system is a system that does not decelerate, neither accelerate in whatever direction. As a result its velocity is constant. No forces are exerted on the system.

3. Properties of a circular orbiting system

The velocity of such a system is constant, notwithstanding the fact that its components in the plane of the orbit are not constant. The forces that are exerted on the system (centripetal and centrifugal force) eliminate each other perfectly. So eventually, no forces are exerted on the system.

4. Answer to the question

A circular orbiting system is an inertial system, because net there is no force exerted on the system.

Conclusion

No experiment, not making use of external references, can be carried out on earth that will measure its orbital velocity.

XXV Velocity of an Electric Current

Summary - This chapter argues that the velocity of an electric current in a solid conductive wire most likely equals the orbital velocity of the valence electron(s) in the atom of the matter of the wire.

1. Introduction

This chapter considers two approaches to calculate the velocity of an electric current: one based on the current itself as starting point, the other one based on the source of the current as starting point. Only currents in a solid conductive (copper) wire are considered, so excluding the propagation velocity of EM-waves, of which their velocity in a medium, not moving relative to the source of the EM-wave, can simply be expressed by the equation: \( v_p = 1/\sqrt{\varepsilon \mu} \), with \( \varepsilon \) the dielectric permittivity and \( \mu \) the magnetic permeability of the medium under consideration.

In vacuum leading to: \( c = 1/\sqrt{\varepsilon_0 \mu_0} \), relative to its source in the absence of another possible relevant reference.

2. The current as starting point

From the point of view of the phenomenon “electrical charge” \( Q \), an electric current \( I \) is represented as \( Q/t \), with \( t \) the time during which a charge \( Q \) passes a certain area where the current flows. This principle has been applied developing a model of the generation of a photon. See chapter VIII. Copied from this chapter:

“The fundamental part of the investigated model is the assumption that the orbit of an electron around the nucleus of an atom is equivalent to a circular shaped electric current, creating a magnetic field.

Suppose the “round trip” of an electron is \( t \) seconds and its electric charge is represented by the symbol \( q \). Then the first approximation of the meant electric current is \( q/t = i \).

At the end of the day it turned out that the words “the first approximation of” are superfluous.

However, in the situation under consideration (an electric current through a solid wire) the starting point is the current instead of a (moving) charge. From this point of view \( Q \) will be calculated as \( Q = n_e q S \), with:

- \( Q \) the electric charge per meter wire [C/m]
- \( n_e \) the density of the valence electrons of copper [m\(^{-3}\)]
- \( q \) the electric charge of an electron [C]
- \( S \) the surface of the cross section of the wire [m\(^2\)]

The purpose of the addition “per meter wire” in the definition of \( Q \) is to be able to introduce a velocity of the current in terms of [m/s].

Taking \( v_1 \) as symbol for this velocity we can now write: \( I = Q*v_1 = n_e q S * v_1 \).

The question: why would an arbitrary length and arbitrary cross section of a wire be representative for the velocity of the electric current in that wire, arises. Anyway, the calculation process will be continued.

So: \( v_1 = I_d/n_e q \) [m/s], with \( I_d = 1/S \), being the surface density [A/m\(^2\)] of the current in the wire.

The calculation below shows that \( n_e = 8.5*10^{28} \) [m\(^{-3}\)] (a copper atom has 1 valence electron).

N.B. The accuracy of the values doesn’t play any role in this consideration.
The charge of an electron equals $1.6 \times 10^{-19}$ [C], so $v_1 = I_d/n_e q = I_d \times 7 \times 10^{-11}$ [m/s]

A normal current density is between 1 and 10 A/mm$^2$, with the highest one representing the so-called "house-hold-configuration". This value ($10^7$ A/m$^2$) leads to $v_1 = 7 \times 10^{-4}$ [m/s].

The consequence of this number is that if we switch on a light in a normal room it would take 7 meter / $7 \times 10^{-4}$ [m/s] = $10^4$ s ≈ 2.5 hours before we would see the light!

We clearly have to look for a completely other approach, also looking back to the question asked above: why would an arbitrary length and arbitrary cross section of a wire be representative for the velocity of the electric current in that wire?

3. The source as starting point

It is generally accepted that the source of an electric current can be a generator or a battery.

Copied from [1]:

“Electromotive force, abbreviated emf ....... is the electrical intensity or "pressure" developed by a source of electrical energy such as a battery or generator. A device that converts other forms of energy into electrical energy (a "transducer") provides an emf at its output. “

“In the case of a two-terminal device (such as an electrochemical cell) which is modeled as a Thévenin's equivalent circuit, the equivalent emf can be measured as the open-circuit potential difference or "voltage" between the two terminals. This potential difference can drive an electric current, if an external circuit is attached to the terminals.”

But it can be, for example, also a charged capacitor.

Such an example shows that the source of an electric current in principle is an amount of electrical charge (on an object with respect to another object).

Such a charge will, getting the opportunity, flow from the one to the other object in order to create a balance between the charges on both. A wire, for example, can create such an opportunity.

It is generally accepted (there will always be exceptions) that electrons build up an amount of electric charge and that an electric field exists between opposite electric charged objects.

At the moment a wire is connected between such a pair of electric opposite charged objects, the mentioned electric field causes electrons at the one charged object to move to the other object through the wire in one way or another. The wire consists of so called valence electrons. The very first electron that leaves the wire to move to the positive charged object is replaced by a valence electron form an atom more close to the negative charged object. Both electrons can have only a velocity equal to their orbital velocity, because they just jump out of their orbit. This happens through the whole wire successively until an electron from the negative charged object replaces a valence electron most close to this object.

As a result the velocity of an electric current equals roughly the mentioned orbital velocity.

The calculation of this velocity is as follows.

Based on Bohr’s atomic model the radii of the discrete orbits of the electrons are mathematically represented by $r_n = n^2 a_0 / Z$, with $n$ is an integer, representing the $n^{th}$ orbit.

The radius $a_0$ is the so-called Bohr’s radius, the smallest ($n=1$) in the atom under consideration.

The atom is characterized by its atomic number $Z$. $Z=29$ for copper.

$a_0$ is a constant, independent of whatever atom, expressed by: $h^2/(4\pi^2k_eq^2m)$, with:

- $h$ Planck’s constant $6.6 \times 10^{-34}$ VAs$^2$
- $k_e$ Coulomb's constant $(1/4\pi\varepsilon_0)$ $9 \times 10^9$ Nm$^2$/C$^2$
- $q$ electric charge of the electron $1.6 \times 10^{-19}$ C
- $m$ mass of the electron $9 \times 10^{-31}$ kg

Given these values $a_0 = 5 \times 10^{-11}$ m.
The 4th orbit of the copper atom is the orbit of its valence electron, so its radius is:
\[ r_4 = 4^2 * 5*10^{-11}/29 = 3*10^{-11} \text{ m}. \] This result is necessary to calculate the orbital velocity.

The electron is held in its orbit by the centripetal and centrifugal forces applied to it. The centripetal one is the Coulomb force between nucleus and electron. The gravitational force between electron and nucleus is incomparably small compared to the Coulomb force.

The centrifugal force equals \( mv^2/r \), with \( v \) the orbital velocity of the electron.

So \( mv^2/r = k_e Z q^2/r^2 \), resulting in \( v = (k_e Z q^2/mr)^{1/2} \). More background can be found in chapter VIII.

Applying \( r=r_4 \) results in \( v = 2*10^7 \text{ m/s} \).

### 4. Heating of the wire explained at atomic level

An electric current through a wire generates heat in that wire. The generally accepted conception of heat is that the warmer the matter is, the more the atoms of the matter move/vibrate. In case of a gas and liquid the word ‘move’ is more applicable, while ‘vibration’ is used in case of solid matter.

The experience is that the higher the current the warmer the wire becomes. A high current means a lot of (valence) electrons per unit of time moving from one pole to the other. So the question is: what causes the atoms to vibrate more if its valence electrons move from the one to the other atom? Or the question is: is the more heat generation only a result of the fact that more atoms are going to vibrate? Based on the result obtained above, it has to be concluded that the velocity of the current, so of the valence electrons, is independent of the strength of the current.

As a result the most direct and simple answer is that each collision of a valence electron with another valence electron, not only does jump that other valence electron out of its orbit, but also causes the atom to vibrate more than it did already, causing the extra heat. The second part of the answer is that the higher the current the more atoms contribute to this heat generation.

In a light bulb not only the heat generation is high, but also the light emission. Chapter VIII shows why this supports the correctness of the statement: the higher the current the more atoms contribute to this heat generation.

### Conclusion

The velocity of an electric current is more or less equal to the orbital velocity of the valence electrons in the applied material, resulting in velocities of the order of 0.1 à 0.01 times the propagation velocity of light.

### Reference

XXVI  How Electro Magnetic radiation raises temperature

Summary - This theoretical investigation started at the moment the author picked up a hot piece of metal that had lain in the sun during a few hours, by asking himself the question: how can electro-magnetic radiation, considered at atomic level, cause raising the temperature of matter?

1.  Introduction

The relation between pressure, volume and temperature of an ideal gas is PV=CT. Based on this relation the pressure and temperature of one atom can be calculated, leading to interesting physical considerations at atomic level regarding the conversion of radiation to heat energy.  It turned out that asking the question, formulated in the summary, in case of a gas held together in a constant volume, leads to a beginning of understanding the phenomenon.

2.  The ideal gas law

The relation PV=CT, well known as the ideal gas law, expresses the energy of such a gas, held together in the volume V under pressure P and absolute temperature T.

The constant C equals nN_Ak_B, with:

- n  amount of substance of gas  [mol]
- N_A  Avogadro’s constant  [mol⁻¹]  (Avogadro’s number is dimensionless.)
- k_B  Boltzmann constant  [J/K]

The so-called gas constant R is defined as N_Ak_B = 6.0*10²³ *1.38*10⁻²³ = 8.3 [J·K⁻¹·mol⁻¹].

So, the ideal gas law expresses the energy of gas, in the volume V, in two ways: E=PV and E=nRT.

Starting with the arbitrary volume of 1 m³ and the arbitrary pressure of 1 bar, being 10⁵ N/m², the energy of that gas is 10⁵ Joule. For T=300 K, n=40 [mol].

The amount n of substance of gas, expressed in mol, equals N/N_A, with N the total amount of atoms. In the chosen example N=2.4*10²⁵.

Taking N=1 and P and T the same as in the example, n=1.7*10⁻²⁴ mol and V=4*10⁻²⁶ m³.

This has to be compared with the volume of the atom, because one of the conditions of ideal gas is:

“The average distance between molecules is much larger than the size of the molecules.”

So in case of one atom the volume V has to be much larger than the volume of one atom.

Chapter VIII shows what the minimum volume of an H-atom is: (4/3)*π*a₀³, with a₀ the so-called Bohr’s radius (5.3*10⁻¹¹). Higher atom numbers Z have proportional smaller radii (a₀/Z).

The related volume of an H-atom is 6.2*10⁻³¹ m³, being 66000 times less than V.

Intermediate conclusion:
An atom enclosed in a volume of 4*10⁻³⁰ m³ causes a pressure of 1 bar at a temperature of 300 K.

The atom itself does not have a temperature, because the space between nucleus and orbiting electrons is vacuum. It is the surroundings of this volume that determines the temperature.

And this temperature determines the pressure inside the volume.
3. **Theory behind the phenomenon ‘temperature’**

The generally accepted theory behind the phenomenon ‘temperature’ is that atoms make random movements and random elastic collisions with each other and with the boundary of the volume that holds them together. The higher the mean velocity of the atoms the higher the pressure of the gas, but, as has been concluded in the previous section, the temperature of the gas will not increase if the temperature of the surroundings does not “allow” it to do so. As a result the phenomenon: a piece of metal that had lain in the sun during a few hours and got hot, has to be interpreted as: .... and got warmer, just like its surroundings got warmer. At this point the ideal gas situation will be left in order to concentrate on the question how EM radiation can cause atoms to move faster, in whatever circumstances?

There is no possibility that EM radiation directly influences the velocity of the atoms. The only possibility is that EM radiation increases the orbital velocity of the electron orbiting the nucleus of the atom: opposite of the fact that EM radiation is created, by means of a photon, when such an electron is forced by external influences to jump from an inner to an outer orbit. See chapter VIII. This chapter also shows that the smaller the radius of such an orbit is the higher the orbital velocity has to be, in order to fulfil the requirement that centripetal and centrifugal force, applied to the electron, are in balance. Chapter VII shows that this higher orbital velocity represents a higher energy state of the atom, in combat with the generally accepted opinion that the atomic energy decreases with smaller orbit radii. That chapter also shows why this opinion is fundamentally wrong.

Suppose, for the moment being, that the external EM radiation indeed causes orbiting electrons to jump to a lower orbit, thus to a higher orbital velocity. Then first of all the question: how can this higher orbital velocity cause higher velocities of the atom, has to be answered.

To explain what might happen, a comparison with the behaviour of a spinning billiard ball on a billiard table, colliding the inner edge of this table, might help. In such a situation the ball reflects with more energy in its forward direction than it would do without spinning. On the opposite: if in the same situation the spinning of the ball is reversed, the reflection will cause a loss of kinetic energy in its forward direction. In both cases the spinning energy of the ball will decrease. The same happens in case the reflection is w.r.t. another ball, in stead of the edge of the table.

An atom with its orbiting electrons looks, physically seen, like a spinning billiard ball. Assuming the same kind of conversion of energy during a collision, atoms with faster orbiting electrons will thus on the average develop higher velocities. It has to be concluded too that mutual interactions will also lead to atoms with lower velocity, because electrons can also jump to higher orbits during a collision.

Such a model has at least to fulfil the criterion that the velocity of the atom has to be much smaller than the orbital velocity of its electron.

The kinetic energy \( \frac{1}{2}mv^2 \) of one, for example, H-atom, with \( m \) the mass of the atom and \( v \) its velocity, must be equal to \( PV \). With \( V = 4 \times 10^{-26} \text{ m}^3 \) and \( P = 10^5 \text{ N/m}^2 \), \( PV = 4 \times 10^{21} \text{ J} \).

The intrinsic energy of the atom, due to its orbiting electron, must not be added to this kinetic energy. The mass of an \(^1\text{H-atom}\) is the sum of the mass of a proton and an electron. The last one is negligible w.r.t. the first one, so \( m = 1.7 \times 10^{-27} \text{ kg} \) and \( v = 2200 \text{ m/s} \). The orbital velocity of the electron at radius \( a_0 \) is \( 2 \times 10^6 \text{ m/s} \). Such a kind of difference is also found in case of a \(^2\text{H-atom}\).

It is therefore assumed that this model satisfactorily explains the increasing velocity of atoms, when orbital velocities of the electrons increase, still assuming that the external EM radiation causes orbiting electrons to jump to a lower orbit with a higher orbital velocity.
4. From EM radiation to orbital velocity

In section 3 it has been mentioned that a photon is generated in an atom when external forces compel an orbiting electron to jump from an inner to an outer orbit. Chapter VIII describes this in detail and also shows that actually not the kinetic but the magnetic energy of the atom is converted into the energy of the emitted photon. The orbiting electron creates this magnetic energy, due to the fact that such an electron represents a circular shaped electric current.

So such a model describes the phenomenon: from orbital velocity to EM radiation, leaving yet unanswered the question what kind of external force compels the electron to jump from an inner to an outer orbit.

Remark:
Based on the spinning billiard ball model, it is likely that a neighbour atom can, during collision, function as an external force too. Not only to compel an electron from an inner to an outer orbit, but also contrariwise.

The situation to be investigated here is EM radiation as external force. A curious phenomenon, from this point of view, is that a perfect black object will be heated by means of external EM radiation, of whatever frequency, received by this object. A perfect white object, on the opposite, will not be heated at all by EM radiation. In fact a perfect white object does not receive external EM radiation. It just reflects it!

The phenomenon resembles rather much EM radiation entering for example a radio-receiver. If the receiver is not tuned to the frequency of the radiation it doesn't absorb it. Infrared radiation, for example, is much more 'tuned' to heat matter than ultraviolet radiation is.

EM radiation is called as such because it has an electric and a magnetic field. Orbiting electrons create a magnetic field. This field changes when the related electron jumps to another orbit, whether it is to a more inner or more outer orbit. Logically arguing one can state that thus an external magnetic field, entering an atom, must be able to change the radius of the orbiting electron. It is like the internal magnetic field in a coil, created by the electric current through this coil, that is disturbed by an external magnetic field, causing a change in the electric current.

Section 2 closes with the intermediate conclusion that the temperature of the surroundings of the matter under consideration is as important as well. The here proposed model is not in combat with this conclusion: it is already generally accepted that faster moving atoms in the surroundings directly activate the atoms of the matter to higher velocities.

Conclusion

Just like an orbiting electron in an atom jumping to an outer orbit creates EM radiation, external EM radiation will, by means of its magnetic field, be able to force an electron to a jump to an inner orbit. In the first case the atom decreases its energy level, while it increases it in the second case. In the last mentioned situation the electron is orbiting at a higher velocity. These higher orbital velocities cause on average higher velocities of the atoms, due to mutual collisions. Higher velocities of atoms represent a higher temperature of the matter, built up by these atoms.
Quantum Electro Dynamics: a fully fuzzy fantasy

Summary - Quantum Electro Dynamics (QED) is one of the products of physics since Einstein. This chapter argues why it is what the title shows.

Argumentation

The most eye-catching pronouncement, at least to the opinion of the author, in the field of QED is the created phenomenon “quantum vacuum state”.

Ref. [1] writes:

“In quantum field theory, the quantum vacuum state (also called the quantum vacuum or vacuum state) is the quantum state with the lowest possible energy. Generally, it contains no physical particles. Zero-point field is sometimes used as a synonym for the vacuum state of an individual quantized field. According to present-day understanding of what is called the vacuum state or the quantum vacuum, it is "by no means a simple empty space". According to quantum mechanics, the vacuum state is not truly empty but instead contains fleeting electromagnetic waves and particles that pop into and out of existence.”

Comment:
In order to find out what is really written / meant in the first sentence, it is necessary to look for the definition of “quantum state”.

Ref. [2] writes:

“In quantum physics, quantum state refers to the state of an isolated quantum system.”

Comment:
The description in [2] continues with several pages of more descriptions with an uncountable number of references. But in order to find out what is really meant, assumed that such will be possible at all, it is in the first place necessary to look for the definition of quantum system.

Ref. [3] writes:

“A quantum system is a portion of the whole Universe (environment or physical world) which is taken under consideration to make analysis or to study for quantum mechanics pertaining to the wave-particle duality in that system. Everything outside this system (i.e. environment) is studied only to observe its effects on the system. A quantum system involves the wave function and its constituents, such as the momentum and wavelength of the wave for which wave function is being defined.”

Comment:
In stead of leading to a kind of physics that is at least roughly understandable, it only results in an exponential increase of more undefined phenomena. So the comment here will be continued with scrutinizing the rest of the original text from [1].

Ref. [1] further claims that quantum vacuum state generally contains no physical particles. That means that now and then it thus contains such particles. The last sentence indeed confirms this: “it contains............and particles that pop into and out of existence”. As soon as particles would do so, it is no more vacuum, leading to the consequence that the “theory” contradicts itself.

Ref. [1] continues with: “According to present-day understanding of what is called the vacuum state or the quantum vacuum, it is "by no means a simple empty space".” If the quantum vacuum is “not a simple empty space”, then, given the fact that vacuum is, by definition, simply an empty space, the word “vacuum” in quantum vacuum, quantum vacuum state and vacuum state is at least a misleading addition. But leaving it out leads to meaningless words.

The last sentence that has been copied from [1] sounds:
“According to quantum mechanics, the vacuum state is not truly empty but instead contains fleeting electromagnetic waves and particles that pop into and out of existence.”

Mind you: “fleeting electromagnetic waves”. Other words for “fleeting” are: volatile, cursory, flighty, fugitive, casual, quick, fast, rapid, swift, speedy, nimble and spry. No word at all shows any relation with common sense physics.

One sentence from [1] has yet not been scrutinized:

“Zero-point field is sometimes used as a synonym for the vacuum state of an individual quantized field.”

Ref. [4] tells us about zero-point field the following story:

“All these fields have zero-point energy. These fluctuating zero-point fields lead to a kind of reintroduction of ether in physics, since some systems can detect the existence of this energy. However this ether cannot be thought of as a physical medium if it is to be Lorentz invariant such that there is no contradiction with Einstein’s theory of special relativity.”

“Physics currently lacks a full theoretical model for understanding zero-point energy; in particular the discrepancy between theorized and observed vacuum energy is a source of major contention. Physicists Richard Feynman and John Wheeler calculated the zero-point radiation of the vacuum to be an order of magnitude greater than nuclear energy, with a single light bulb containing enough energy to boil all the world’s oceans.”

Are there more words to be spent on this “fantastic” physics?

Chapter XXI shows that, as a result of a fundamental misunderstanding/definition of the phenomenon “potential energy”, a countless number of “fantastic” physics has been created, starting with the rejection of the Rutherford-Bohr model in favour of the Heisenberg-Schrödinger model, eventually resulting in many more unsolved physical problems than solutions.

References

Summary – This chapter describes the behavior of the Sagnac interferometer, based on irrefutable physics. It also shows that the fiber optic gyroscope does not operate like this interferometer.

1. Introduction

Sagnac presented, in the period 1910 to 1913, as fundamental reason for the outcome of his experiment with a rotating interferometer the phenomenon ether wind. See the title of [1]. He used the outcome of his experiment also in order to prove the existence of the luminous ether, notwithstanding, but most likely because of his objection against, Einstein’s rejection of this ether in 1905. See the title of [2].

Sagnac doesn’t mention at all Einstein’s Special Theory of Relativity (STR) in his papers. It will be shown that he didn’t meant an ether wind in the sense Fresnel introduced in 1818. Fresnel introduced the ether wind by assuming that a moving medium forces its containing ether to move too, resulting in a changing speed of light relative to the ‘absolute in rest’ ether. After Einstein came up with his STR, Sagnac’s explanation of the outcome of his experiment didn’t get any attention anymore. The STR was and is still supposed to explain this outcome.

The same happened with Fresnel’s ether wind. In the following considerations it will be shown that Sagnac’s explanation indeed is incorrect, in fact weird, and that Fresnel’s expression is correct, but that it has to be interpreted without the ether as reference. Fizeau proved this experimentally in 1851, so retrospectively.

The outcome of Sagnac’s experiment will be explained based on irrefutable physics. Finally it is shown why the Fiber Optic Gyroscope does not operate like a Sagnac interferometer.

2. Relevant historical background information

2.1 Fresnel’s expression for the velocity of light in a moving medium

Fresnel deduced the following expression for the velocity of light in a moving tangible medium.

\[ c_m' = c_m + v(n^2 - 1)/n^2 \]

This expression shows the drag coefficient of Fresnel. He deduced this expression, assuming that the ‘medium’ ether was necessary for the propagation of light and at the same time assuming it as an absolute reference for whatever velocity. So all three velocities shown in the expression above are meant to have this ether as reference. He used the following (translated) words:

“*The medium ether is in absolute rest, except in a transparent medium, in which it moves at a speed v(n^2−1)/n^2, with v the velocity of that medium w.r.t. the mentioned absolute reference.*”

The confusing part of this statement is that there are two ethers: one is in absolute rest and a small part of it, contained in the moving medium, moves relative to the absolute one.

It must, to the opinion of the author, be considered as an extremely coincidental result, given the fact that the expression is indeed correct, but developed by means of a wrong model.

The component \(v(n^2 - 1)/n^2\) is, where applicable, called “ether wind”.
Fizeau experimentally proved the correctness of Fresnel’s expression in 1851 by means of a setup shown in figure 1. This figure and the explaining text below are copied from [3].

![Figure 1 Setup of the Fizeau Experiment](image)

“A light ray emanating from the source S’ is reflected by a beam splitter G and is collimated into a parallel beam by lens L. After passing the slits O₁ and O₂, two rays of light travel through the tubes A₁ and A₂, through which water is streaming back and forth as shown by the arrows. The rays reflect off a mirror m at the focus of lens L’, so that one ray always propagates in the same direction as the water stream, and the other ray opposite to the direction of the water stream. After passing back and forth through the tubes, both rays unite at S, where they produce interference fringes that can be visualized through the illustrated eyepiece. The interference pattern can be analyzed to determine the speed of light traveling along each leg of the tube.”

It is clear that the reference for all velocities in this experiment is, for example, also the source of the light, because no optical component moves relative to the source except the water. Applying this conclusion to the expression of Fresnel results in the following definitions:

\[
c_{m'} = c_m + v(n^2 - 1)/n^2
\]

with

- \(v\) : velocity of the medium w.r.t. the source
- \(n\) : refractive index of the medium
- \(c\) : velocity of light w.r.t. its source in vacuum
- \(c_m\) : velocity of light through the medium w.r.t. its source for \(v = 0\) (\(c_m = c/n\))
- \(c_{m'}\) : velocity of light through the medium w.r.t. its source for \(v \neq 0\)

So instead of using Fresnel’s description:

“The medium ether moves in a transparent (tangible) medium at a speed \(v(n^2-1)/n^2\) w.r.t. the absolute ether”,

we will now use:

The velocity \(c_m\) of light through a medium, w.r.t. its source, changes with the amount \(v(n^2-1)/n^2\), if the medium moves with velocity \(v\) w.r.t. this source. The medium drags the light (a bit).

The sign of \(v(n^2-1)/n^2\) is determined by the direction of \(v\) in relation to the direction of the propagation of the light.

By defining the source as the reference for the velocity of light and for the velocity of the medium, Fresnel’s expression can be maintained without any restriction.

2.2 Sagnac’s explanation of the outcome of his interferometer

Given the fact that his interpretation is based on the existence of ether and ether winds, it will only shortly be presented by means of copies from his translated papers:

[1] “In a system in general motion with respect to the ether, the propagation time between any two points of the system must be altered as if the system were motionless and subjected to the action of an ether wind....”

“The vortex of air, analogous and less intense, that the interferometer produces when turning, therefore does not act appreciably. The interference effect observed is indeed the optical swirling effect due to the movement of the system with respect to the ether...”

Sagnac rejects at this point the phenomenon ether wind in the sense as presented by Fresnel. Unavoidable, because there is no appreciable circularly moving air generated.
He introduces an ‘optical swirling effect’ without any argumentation and emphasizes this in [2]:

“Sense and magnitude of the optical swirling effect. - In the hypothesis of the Fresnel ether, the light waves T and R propagate in the vacuum ether with a speed $v_0$ independent of the overall motion of the interferometer; the phase of the T-wave direction of propagation clockwise (see the figure) is altered along the closed circuit, as if the luminous ether was driven in a swirl-clockwise, when the circuit turns in the direction......”

It has to be concluded that Sagnac fantasized a whirling ether wind, rotating synchronously with the disc of his interferometer, meant to increase the velocity of the one beam as well as to decrease the velocity of the other beam. This has to be qualified as a strange way of performing science. His mathematical expressions, meant to predict the phase difference, are therefore worthless too.

3. Revised principle of the Sagnac Interferometer

The schematic diagram of the Sagnac interferometer (SIM), as used by him, is shown in figure 2. In this diagram the symbol j is the point where the clockwise (cw) and counter clockwise (ccw) light beams, indicated by T respectively R, are created. In the considerations hereafter this point will be given the symbol S, symbolizing the eventually relevant source of these two light beams. It also is the point where the two beams finally interfere.

Figure 2

Signac used the symbol $S$ to indicate the area enclosed by the beams T and R. He considered the surface of this area as crucial for his mathematical expressions.

For the case of the consideration below the experiment is supposed to be carried out in vacuum.
In figure 3 the reflections on the mirrors M1 and M2 have been drawn in the situations that the disc has been rotated with $\theta$ respectively $\Phi$, compared to no rotation. During the time that the light moves from S to M1 the disc rotates with $\theta$. It rotates with $\Phi$ while it moves from M1 to M2.

The light propagates with velocity $c$ relative to S, as well as relative to all mirrors at reflection.

The mirror M1 is, after arrival of the light there, not anymore at the position where it was at the moment the light left S, neither is it oriented anymore in the direction it was at that moment.

As a result this beam is reflected at point $R_\theta$ at M1.

The same applies for M2 in the situation that the light moves from M1 to M2.

At the moment the light leaves S, resp. M1, it propagates independently from S, resp. M1. That means: whatever the velocity, acceleration or displacement of S, resp. M1 might be after the emission /reflection, the light continues its way as if its Source, resp. Mirror does not exist anymore.
In this extremely exaggerated drawing, representing an extremely high angular speed, the reflection at M1 significantly moves away from the point on M1 in case of no rotation.

If S and M1 would, as such a rigid combination, not rotate but only translate with a constant speed, in whatever direction w.r.t. the direction of propagation of the light, the position of the point of reflection at M1 would not change. Eventually this is the consequence of the property of an inertial system of which its velocity \( v \) cannot be determined by an observer located in this system. Well known as the Principle of Galilean relativity. See chapter I.

The fundamental reason for this phenomenon is that no reference is available for that \( v \).

In case the translation would happen in, for example, air, the expression of Fresnel shows that, due to the velocity \( v \) of the construction, the velocity of the light relative to S, and thus relative to M1 too, will change from \( c_m \) to \( c_m + \frac{v(n^2-1)}{n^2} \), with \( c_m = \frac{c}{n} \). In this situation the reference for the velocity \( v \) is the air!

Figure 3 clearly shows that the cw rotation of the interferometer causes a longer distance for the cw traveling light to propagate from R\( _\theta \) at M1 to M2. While the light propagated from S to M1 mirror M2 of course also rotated with \( \theta \). The rotation \( \Phi \) is obtained during the time the light propagates from R\( _\theta \) to M2.

Let \( T_0 \) represent the length of the optical path between R\( _\theta \) and M2\( _\theta \), and \( T_\theta \) the one between R\( _\theta \) and M2\( _\theta + \Phi \), then \( \Delta d \), shown in figure 3, equals \( T_\theta - T_0 \).

Such an increasing length of the optical path is created at M3 and successively at M4 too.

Figure 3 clearly shows that the increase obtained at M1 is fully negligible compared to \( \Delta d \), so effectively only rotation causes the difference in the optical path lengths.

This total increase of optical path length is amplified by a factor 2 due the fact that the ccw beam results in the same but decreased path length. Together they cause the eventual interference.

Figure 3 shows that a calculation of the final path length difference will be complex and if the mathematical expression would be found it would contain a ‘countless’ number of parameters.

4. The ring laser gyroscope

The ring laser gyroscope uses basically the same principle of working: rotating source and mirrors at a rigid construction. The detection of interference is essentially different.

So its principle operating doesn’t need more attention in this chapter.

5. The fiber optic gyroscope (FOG)

The principle of the FOG is in essence different from the principle of the SIM, because in the FOG the light is forced to follow a circular way by the shape of the fiber. Secondly: the FOG works in the multi mode as well as in the single mode version. In the single mode version the propagation is straight through the center of the fiber, while in the multi mode version the propagation is via reflections at the inside of a tube, similar to the propagation in a waveguide. These reflections suggest a similarity with the SIM, but this is certainly not the case, as follows from the detailed description of this interferometer above. Shortly expressed: in the SIM the light moves independently from the reflectors in between these reflectors, while in the multi mode FOG the light moves from reflector to reflector, forced by the shape of the reflecting inner side of the mentioned tube.

So, given the fact that the FOG also works in single mode, the conclusion must be that reflections, like just described, seemingly don’t play any role in the process.

For that reason another fundamental process will be investigated, in which it assumed that the source of both beams does not move relative to medium glass inside the fiber. This medium moves with the velocity \( \omega \cdot r \), with \( \omega \) the angular speed of the fiber coil and \( r \) its radius.
This assumption is based on the configuration in which the source is supposed to be placed in or near the center of the rotating fiber coil and thus will not experience the velocity \( v \).

Based on this assumption we can now write:

\[
\begin{align*}
c_m' &= c_m + v(n^2 - 1)/n^2 & \text{for the cw beam and} \\
c_m' &= c_m - v(n^2 - 1)/n^2 & \text{for the ccw beam}
\end{align*}
\]

with \( c_m = c/n \)

and \( n \) the index of refraction of the applied glass.

The difference in time at the moment of interference between the two beams is:

\[
\Delta t \approx \frac{v(n^2 - 1)}{n^2} \times 2L/c_m^2 \quad \text{with \( L \) the length of the fiber.}
\]

If \( L = 500 \) m, \( r = 0.05 \) m, \( n = 1.5 \) and \( \omega = 1 \) rad/s then \( \Delta t = 7 \times 10^{-16} \) s.

In case of a frequency of the light of \( 2 \times 10^{14} \) Hz, the phase shift is \( 360 \times 7 \times 10^{-16} \times 2 \times 10^{14} = 50 \) degrees.

**Conclusions**

1. Sagnac fantasized an explanation for the outcome of his experiment by introducing, without any argument, the phenomenon optical swirling effect, supposed to represent an ether wind that circulates synchronously with the rotating disc of the interferometer. A most weird approach, without any scientific value.
2. If Sagnac’s mathematical expressions would predict correctly the shift of the interference patrons, then this result must be considered as extremely coincidental.
3. The principle operating of the Sagnac interferometer can simply be established, without applying any ‘special relativistic’ phenomenon, by drawing the path that the light will follow from the source, via the first mirror, to the second mirror, in a situation representing an unrealistic high angular velocity.
4. The Ring Laser Gyroscope also operates principally in this way, but the interference is realized significantly different.
5. The Fiber Optic Gyroscope operates not at all like the Sagnac interferometer. It has been made plausible that the principle represented by Fresnel’s expression for the velocity of light in a moving medium most likely explains its successful operating.
6. The Michelson & Morley (M&M) interferometer is based on the same principle as the Sagnac interferometer. However, even if M&M had placed their instrument on top of one of the poles of earth, its angular speed would have been \( 1 \) rev/24 hours. Sagnac applied a few rev/second in order to create visible shifting interference patterns.

**References**

[1] PHYSICAL. - The luminous ether demonstrated by the effect of the relative wind of ether in an interferometer in uniform rotation. Note by Mr. G. SAGNAC, presented by Mr. E. Bouty. [https://fr.wikisource.org/wiki/L’éther_lumineux_démontré](https://fr.wikisource.org/wiki/L’éther_lumineux_démontré)


From Maxwell’s equations to Electro-Magnetic Waves

Summary – This chapter shows how Electro-Magnetic source and wave are related and why the propagation velocity of light in vacuum is c, exclusively relative to its source.

1. Introduction

Starting with the explanation of the most basic concepts: static electric and magnetic fields, the Maxwell equations for the dynamic fields are shown to be hypotheses instead of laws. These hypotheses are used to show mathematically how an EM wave must look like.

For this study reference [1] has been used as guidebook.

2. The static electric field

2.1 From force to voltage

About two and a half centuries ago Coulomb discovered the repulsive force between like electrical charges objects and the attractive force between unlike charged objects. Just like Newton discovered the attractive force between masses.

The last mentioned one has been mathematically expressed as \( F_G = \frac{GMm}{r^2} \), with \( [G] = \text{Nm}^2\text{kg}^{-2} \). The distance between the centres of the objects is defined as \( r \).

Coulomb’s force has been mathematically expressed in basically exactly the same way by means of \( F_C = \frac{CQq}{r^2} \), with \( C = \frac{1}{4\pi\epsilon} \) and \( \epsilon \) the so-called dielectric permittivity of the medium in which the objects are located. As a result \( [C] = \text{Nm}^2\text{C}^{-2} \). In order to avoid confusion between both \( C \)'s, the first mentioned one will from now on be presented as \( C_\epsilon \), so \( [C_\epsilon] = \text{Nm}^2\text{C}^{-2} \). The dimension of \( \epsilon \) thus is: \( \text{N}^{-1}\text{m}^{-2}\text{C}^2 \).

Let us describe that sphere of influence of \( Q \) by means of the words 'electric field' of \( Q \). Such a field has, according to Coulomb’s experiences through his experiments, the possibility to attract or repulse an object with an electric charge of \( q \). Let us call the strength of this field \( E_r \) at the distance \( r \) from \( Q \) and the related force \( F_{Cr} = \frac{qE_r}{r} \).

Given the relation \( F_{Cr} = \frac{C_\epsilon Qq}{r^2} \), the electric field strength \( E_r \) has to be presented as \( E_r = \frac{C_\epsilon Q}{r^2} \).

Given the dimension of the variables on the right side of the equation, the dimension of \( E_r \) is \( \text{V/m} \), as normally used.

Remark: \( \text{N/C} \) can also be written as: \( \text{Nm/Cm} = \text{VAs/Cm} = \text{VC/Cm} = \text{V/m} \), because \( \text{Nm} \) and \( \text{VAs} \) are both expressions for energy, so the dimension of \( E_r \) is also \( \text{V/m} \), as normally used.

In order to move, in the electric field of \( Q \), the object \( q \) from \( P_1 \) to \( P_2 \), the integral \( \int_s qE_r ds \) represents the work that has to be carried out in order to do so. The quantity \( qE_r \) represents at any place on that path the force in the direction of the movement. The total mentioned work thus equals the difference in potential energy in the two chosen points.

If the path is a closed curve, the result must be zero, so \( \oint_s qE_r ds = 0 \) and thus \( \oint_s E_r ds = 0 \). *

The quantity \( E_r ds \) represents a voltage/potential, so \( \int_s E_r ds \) from \( P_1 \) to \( P_2 \) results in \( V_{P2} - V_{P1} \), the difference in voltage between the points \( P_1 \) and \( P_2 \).

* The symbols \( \oint_s \), resp. \( \int_s \), are used to express a line integral along a closed, resp. open curve \( s \).
2.2 The static electric flux

The static electric flux $\Phi_E$ is also a measure of the electric field strength at any distance from the charge $Q$, in the sense of the amount of electric field through a certain surface. The mathematical presentation is $\Phi_E = \int_S E \cdot dS$, with $E$ perpendicular to surface element $dS$.

In case of an electric field equally spread over a sphere around object $Q$, the field strength $E$ is the same at each element $dS$ on that sphere.

So the surface integral at distance $r$ from $Q$ is $4\pi r^2 E_r = 4\pi Q/\varepsilon [\text{Vm}]$.

The result effectively shows that, whichever closed surface is chosen around $Q$, $\Phi_E = Q/\varepsilon$.

2.3 The static dielectric flux

The expression in 2.2 for the static electric flux can also be written as: $Q = \int_S \varepsilon E \cdot dS = \int_S D \cdot dS$

The variable $D$ is normally used as symbol for dielectric displacement. This name will be commented in chapter 3.

The equation shows that the dimension of $D$ (from now on written as $D$) equals the dimension of $\varepsilon E$ ($E$ from now on written as $E$) and $Q/S$, being Cm$^{-2}$.

Differentiating to time, the equation $D=Q/S$ results in: $dD/dt = dQ/dt/S = I_D/S$, with $I_D$ used as symbol for dielectric current. But $dQ/dt$ in a static situation is zero.

2.4 The dynamic dielectric flux

In order to obtain a meaningful concept of an electric charge that changes with time, without applying solid conductors in which electrons operate as moving electric charges, we can imagine a moving charge $Q$ in empty space or tangible medium. In empty space the electric permittivity has to be chosen as $\varepsilon_0$, in a tangible medium as $\varepsilon_0 \varepsilon_r$, shortly written as $\varepsilon$.

Imagine a charge $Q$ in a reference system relative to which $Q$ moves with constant velocity $v$, say along the $x$-axis. During time $t$ until $t+\Delta t$, $Q$ moves from $x$ to $x+v\Delta t = x+\Delta r$. At time $t$ the electric field strength at distance $r$ from $x$ can be expressed as in 2.1: $E(t) = C_0 Q/r^2$. At time $t+\Delta t$ the field strength, at this same position relative to $x$, is $E(t+\Delta t) = C_0 (Q/(r+\Delta r))^2$. So $E(t+\Delta t) - E(t) = 2\Delta r C_0 Q/r^3$.

Multiplying both sides with $\varepsilon$, results in: $\Delta D/\Delta t = \varepsilon 2\Delta r C_0 Q/r^3/\Delta t = v Q/r^3/2\pi$ ($\varepsilon C_0=1/4\pi$).

Multiplying both sides with an arbitrary small surface element $dS$ results in $I_D = dSvQ/2\pi r^3 [\text{A}]$.

This is not a surprising result, because what is the fundamental difference between moving charges in an empty space/tangible medium, respectively in a conductor?

This concept has been used in chapter VIII. In the model applied there, orbiting electrons around an atomic nucleus are considered as circular shaped electric currents, generating magnetic fields through the, by these orbits, enclosed surfaces.

In order to look for another approach too, a changing $Q$ as function of time will be considered from the point of view that $Q$ does not change its position, but is value.

Suppose at time $t$ the charge is $Q$ and at time $t+\Delta t$ it is $Q+\Delta Q$. At distance $r$ from this changing electric charge, $D(t) = \varepsilon C_0 Q/r^2 = Q/4\pi r^2$ while $D(t+\Delta t) = (Q+\Delta Q)/4\pi r^2$.

So $\Delta D/\Delta t = (\Delta Q/\Delta t)/4\pi r^2 [\text{Cm}^{-2}\text{s}^{-1} = \text{Am}^{-2}]$.

Multiplying both sides with an arbitrary small surface element $dS$ shows: $I_D = dS\Delta Q/\Delta t/4\pi r^2 [\text{A}]$.

This is the moment to start the investigation of magnetic fields, because electric as well as dielectric currents create magnetic fields.

From now on a current can be either an electric or a dielectric current.

* The symbols $\int S$, resp. $\int_S$, represent the surface integral over a closed, resp. open surface $S$. 

129
3. The magnetic field

3.1 The static magnetic field

Two types of static magnetic fields will be considered: the one created by a current through an infinite long straight conductor, the other by a circular shaped current.

A straight line current creates a circular shaped magnetic field with this current as centre and in a plane perpendicular to this line. Its strength H at distance r from this current is \( \frac{I}{2\pi r} \) [A/m].

A circular shaped current creates a magnetic field through the surface enclosed by this current, perpendicular to this surface. Its strength H in the centre of this circle is equal to \( \frac{I}{2r} \) [A/m].

Remark about the similarity between electric and magnetic fields:

A fundamental difference between a static electric field and a static magnetic field is that the electric field is an open one, leading to the results:

\[ \oint E \, ds = 0 \quad \text{and} \quad \oiint S E \, dS = \frac{Q}{\varepsilon} = \Phi_e, \]

while the magnetic field is a closed one, leading to the results:

\[ \oint H \, ds = I \quad \text{and} \quad \oiint S H \, dS = 0. \]

The last mentioned expression is normally written as \( \Phi_B = \oiint S \mu H \, dS = \oiint S B \, dS = 0 \), with \( \Phi_B \) the so-called magnetic flux [Vs] and B the magnetic flux density [Vs/m²].

From the point of view of similarity with the magnetic field it is strange that the electric flux has not been defined as \( \Phi_D = \oiint S \varepsilon E \, dS = \oiint S D \, dS = Q \). The dimension of \( \Phi_D \) is As (or C) and of \( D \), as an electric flux density, still As m⁻², or Cm⁻².

Such a convention would lead to the following table for static fields:

<table>
<thead>
<tr>
<th>Field strength</th>
<th>Electric field</th>
<th>Magnetic field</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>E</td>
<td>H</td>
</tr>
<tr>
<td>Medium properties</td>
<td>( \varepsilon )</td>
<td>( \mu )</td>
</tr>
<tr>
<td>Flux density</td>
<td>D=( \varepsilon E )</td>
<td>B=( \mu H )</td>
</tr>
<tr>
<td>Flux</td>
<td>( \Phi_D ) As</td>
<td>( \Phi_B ) Vs</td>
</tr>
</tbody>
</table>

Physical laws

<table>
<thead>
<tr>
<th>Closed curve integrals</th>
<th>Electric field</th>
<th>Magnetic field</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \oint E , ds = 0 )</td>
<td></td>
<td>( \oint H , ds = I )</td>
</tr>
<tr>
<td>Closed surface integrals</td>
<td>( \oiint S D , dS = Q )</td>
<td>( \oiint S B , dS = 0 )</td>
</tr>
</tbody>
</table>

3.2 The dynamic magnetic field

The just mentioned equation: \( \oint H \, ds = I \) can simply be proven in case of a straight line current, because \( H = \frac{I}{2\pi rt} \) at each point around the current at distance \( r \), and H and ds do have the same direction in each point too, the closed integral along this circle is \( \frac{I}{2\pi r} * 2\pi r = I \).

Reference [1] at this place declares at page 256:

“Investigation of other magnetic fields finally leads to the conclusion that \( \oint s H \, ds = 1 \), with I the sum of all currents enclosed in s, is a general property of the magnetic field.”

Seemingly a theoretical substantiation of this general property is too complex, maybe even impossible. The expression thus should have been qualified as hypothesis.

Finally the closed curve integral is presented as: \( \oint H \, ds = \frac{d}{dt} \oiint S D \, dS + \oiint S \gamma E \, dS \), with \( \oiint S \gamma E \, dS \) defined as conduction current.

However the expression is not helpful trying to understand how an EM wave is generated, because an EM wave is normally not generated in fields including conduction currents.

The complete equation is officially called: “Ampère’s circuital law (with Maxwell’s addition)”, or shortly Maxwell’s nth equation, with ‘n’ now-a-days undefined!

In this article only \( \oint s H \, ds = \frac{d}{dt} \oiint S D \, dS \) will be used and called Maxwell-Ampère equation.
Remark:

Before we continue with this equation we have to take care of the fact that the equation \( \Phi_D = \oint_S D \, dS \) concerns a closed surface integral over the charge \( Q \) that creates the electric flux density \( D \) in a static situation, while in \( \oint_H \frac{d}{dt} \int_S D \, dS \) the electric flux density is supposed to go through an open surface enclosed by the curve 's' meant in the left side of the equation. We thus have to accept even more penetrating that the expression \( \oint_H \frac{d}{dt} \int_S D \, dS \) is not a law but a hypothesis: valid as long as it has not been proven to be invalid. The second difference between \( \oint_S D \, dS \) and \( \oint_H \frac{d}{dt} \int_S D \, dS \) is that he first mentioned one equals \( Q \) in the static situation, while the second one is supposed to be applied in a dynamic situation, given the fact that the differentiation, applied to it, is supposed to be meaningful. The same kind of remark is applicable to the following consideration.

It is generally accepted that a voltage can be generated in a closed wire by changing a magnetic flux through the open surface enclosed by the wire, mathematically expressed by \( V = \frac{d}{dt} \oint B \, dS \). This \( \Phi_B \) thus is not the same magnetic flux as in \( \Phi_B = \oint_S B \, dS \). So just like in the electric situation the relation \( \oint_E \frac{d}{dt} \int_S B \, dS \) should have been qualified as a hypothesis too.

Summarized:

Maxwell-Ampère equation  \( \oint_H \frac{d}{dt} \int_S D \, dS \)
Maxwell-Faraday equation  \( \oint_E \frac{d}{dt} \int_S B \, dS \)

4. The Electro Magnetic wave

The Maxwell-Ampère equation can also be presented as \( \oint_H \frac{d}{dt} \int_S \varepsilon E \, dS \), like the Maxwell-Faraday equation can be presented as \( \oint_E \frac{d}{dt} \int_S \mu H \, dS \). In this way they clearly show that the generation of an EM wave is based on a feedback loop, unavoidably resulting in an oscillating phenomenon that has lead to the generally accepted model with sinusoidal shaped \( E \) and \( H \) fields, in planes perpendicular to each other.

The propagation of these fields is supposed to be like drawn in figure 1, copied from [1] at page 318. An interesting question is whether the mutual phase between these fields is indeed zero, or possibly 90º, shown in figure 2, like the voltage and current in a LC-oscillator.

![Figure 1 showing zero phase between E and H fields](image1)

![Figure 2 showing 90º phase between E and H fields](image2)
Reference [1] shows a simple derivation of the speed of light based on figure 1. Such a derivation can also be applied to figure 2. The translation of that derivation, a bit adapted here, is shown. It doesn’t matter whether figure 1 or 2 is used.

The propagation direction of the EM wave is assumed to be along the y-axis. The electric resp. magnetic fields at position y₁ resp. y₂ are: E₁ and H₁ resp. E₂ and H₂. Between these moments the EM wave is supposed to travel the distance Δy with speed \( v = \Delta y / \Delta t \).

The Maxwell-Ampère respectively Maxwell-Faraday equation applied, leads to:

\[
\oint_H \, ds = (H_2 - H_1) |l_x| = d/dt \left[ \int_S \mathbf{D} \, d\mathbf{S} \right] = d\mathbf{D}/dt |l_x| \Delta y = \varepsilon \mathbf{E}/\Delta t |l_x| \Delta y = \varepsilon \mathbf{E} \cdot (E_2 - E_1) |l_x|
\]

resp.,

\[
\oint_E \, ds = (E_2 - E_1) |l_x| = d/dt \left[ \int_S \mathbf{B} \, d\mathbf{S} \right] = d\mathbf{B}/dt |l_x| \Delta y = \mu \mathbf{H}/\Delta t |l_x| \Delta y = \mu \mathbf{H} \cdot (H_2 - H_1) |l_x|
\]

N.B. The electric and magnetic fields in the y-direction are zero!

So \((H_2 - H_1) |l_x| = \varepsilon \mathbf{E} \cdot (E_2 - E_1) |l_x|\), respectively \((E_2 - E_1) |l_x| = \mu \mathbf{H} \cdot (H_2 - H_1) |l_x|\).

At this point the difference between figure 1 and 2 shows up! Suppose we take in figure 2 the places along the y-axis around a maximum \( H \), where \( H_1 = H_2 \) and thus \( E = 0 \) where \( E_1 = -E_2 \). At such places \( H_2 - H_1 = 0 \), so the 2 equations are clearly invalid.

Taking figure 1, there are no such places, so this phenomenon is already a sufficient reason to reject the possibility of whatever phase shift between the \( E \) and \( H \) field, other than 0° or 180°.

Applying the first equation in the second equation shows:

\[(E_2 - E_1) |l_x| = \mu \{ \varepsilon \mathbf{E} \cdot (E_2 - E_1) |l_x| \} = \varepsilon \mu \varepsilon (E_2 - E_1) |l_x|, \text{ so } \varepsilon \mu \varepsilon = 1, \text{ resulting in } v = 1/\sqrt{\varepsilon \mu}.
\]

Reference [1] uses from the beginning the assumption \( l_x = l_x \). Not doing so in the next step and defining \( \Delta E \) as \( E_2 - E_1 \) resp. \( \Delta H \) as \( H_2 - H_1 \), leads to: \( \varepsilon (\Delta \mathbf{E} \cdot l_x) = \mu (\Delta \mathbf{H} \cdot l_x)^2 \).

A basically correct approach would be to chose \( l_x \) as well as \( l_y \) infinite, resulting in \( \Delta E = \Delta H \sqrt{\varepsilon \mu} / \varepsilon \), with \( \sqrt{\varepsilon \mu} \) the so-called characteristic impedance of the medium under consideration.

Such an outcome also forces to conclude that the \( E \) and \( H \) fields must be synchronized in phase.

A much more important conclusion of this consideration is the confirmation of the remark made already at the beginning:

“Because an electric charge is a quantity that can exist independent of other quantities, the start of the generation of an EM wave must be found in a source that eventually produces a dQ/dt.”

That means that the very first dQ/dt is generated in the source of the EM wave, with the conclusion that thus the propagation speed of an EM wave is 1/\( \sqrt{\varepsilon \mu} \) relative to its source only.

Secondly: the larger this dQ/dt, given the same dQ, the higher the frequency of the EM wave will be, also confirming that the EM wave and its source are inextricably linked to each other at the moment of emission. In chapter VIII it has already been argued that, given a certain ΔQ, the smaller Δt is, the higher the frequency of the emitted photon.

With this conclusion the hypothesis in the Special Theory of Relativity: the speed of light is c relative to any reference, has to be rejected, and thus this theory! See also chapter I.
5. The integral and differential presentations of the Maxwell equations

5.1 The integral presentation (IP)
In the previous chapter the IP of the Maxwell equations have been used.
An EM wave is a 3-dimensional phenomenon, so the two variables E and H and their related variables, are effectively vectors. In figure 1 these variables are presented as 1-dimensional: E is only defined in the z-direction, like H only in the x-direction.
In order to try to understand what happens 3-dimensionally this caricature has been chosen.
Thus the vectors E and H and their related variables have been presented and used as E resp. H.
Consequently these variables will not leave the x-z plane, thus do not show any propagation of the EM wave out of the source.
Centuries old experiences have learned that these fields do, for some not yet explained reason, not stay in that one plane. The most likely reason is that an E/H field doesn’t cause a H/E field as one line exactly perpendicular to E/H, as suggested up to now. For example, a circular shaped electric current creates H fields curving around this current as closed loops.
So indeed figure 1 is a caricature of reality.

5.2 The differential presentation (DP)
This presentation is as follows:
\[ \nabla \cdot \mathbf{E} = \frac{\rho}{\varepsilon} \quad \text{in stead of} \quad \oint \mathbf{E} \cdot d\mathbf{S} = \frac{Q}{\varepsilon} \quad (\rho = \frac{Q}{m}) \]
\[ \nabla \cdot \mathbf{H} = 0 \quad \text{in stead of} \quad \oint \mathbf{H} \cdot d\mathbf{S} = 0 \]
\[ \nabla \times \mathbf{E} = -\varepsilon \frac{\partial \mathbf{H}}{\partial t} \quad \text{in stead of} \quad \int \mathbf{E} \cdot ds = \frac{d}{dt} \int \mathbf{E} \cdot d\mathbf{S} \]
\[ \nabla \times \mathbf{H} = \mu \frac{\partial \mathbf{E}}{\partial t} \quad \text{in stead of} \quad \int \mathbf{H} \cdot ds = \frac{d}{dt} \int \mathbf{H} \cdot d\mathbf{S} \]
The outcome of \( \nabla \cdot \mathbf{F} \) is the quantity: \( \partial \mathbf{F}_x/\partial x + \partial \mathbf{F}_y/\partial y + \partial \mathbf{F}_z/\partial z \).
The outcome of \( \nabla \times \mathbf{F} \) is the vector: \( (\partial \mathbf{F}_y/\partial z - \partial \mathbf{F}_z/\partial y, \partial \mathbf{F}_z/\partial x - \partial \mathbf{F}_x/\partial z, \partial \mathbf{F}_x/\partial y - \partial \mathbf{F}_y/\partial x) \).

The fundamental problem with these presentations is, at least to the opinion of the author, that in the first instance every feeling with reality is lost.
But \( \nabla \times \mathbf{F} \) can be simplified by looking at it as only a derivative of \( \mathbf{F} \) to 'place'.
Doing so the dimension of \( \mathbf{E} \) changes from V/m to V/m² resp. the one of \( \mathbf{H} \) from A/m to A/m².
In the IP situation on both sides of the equation the dimension is V, resp. A. So, from that point of view there is no principle difference between the two types of presentation.

The DP shows, after applying esoteric \( \nabla \) operations: \( \partial^2 \mathbf{E} / \partial t^2 = c^2 \nabla^2 \mathbf{E} \) and \( \partial^2 \mathbf{H} / \partial t^2 = c^2 \nabla^2 \mathbf{H} \).
Reference [2] presents the following information about such a type of equation:
“Solutions of this equation describe propagation of disturbances out from the region at a fixed speed in one or in all spatial directions, as do physical waves from plane or localized sources; the constant c is identified with the propagation speed of the wave.”
Seemingly the speed c with respect to its “localized source” is meant!
The IP thus is much more clear and much more related to reality in proving that \( c = \sqrt{1/\varepsilon \mu_0} \).
The DP does neither show any indication about the mutual phase between the E and H fields!
It shows that if \( \partial \mathbf{H} / \partial t = 0 \) then \( \nabla \times \mathbf{E} = 0 \). But \( \nabla \times \mathbf{E} \) is in the most simple imagination \( d\mathbf{E} / d\text{place} \), not being able to specify ‘place’ better than an unknown direction at an unknown position.

Conclusion
The article shows in the simplest way how the EM wave can mathematically be deduced from the Maxwell-Ampère and Maxwell-Faraday equations, with, as spin of, the evidence that the reference for the propagation speed of an EM wave can only be its source.
Such a conclusion forces to reject the Special Theory of Relativity.

Reference
[1] Leerboek der natuurkunde, Prof. Dr. R. Kronig, Delft, 1962 (in Dutch)
Special Theory of Relativity based on fraudulent science?

Summary – This chapter makes it highly likely that the question mark in the title has to be an exclamation mark.

1. Introduction

Section 2 shows that Einstein’s mistakes in his mathematics in the Special Theory of Relativity are so extremely obvious that one can hardly believe that he didn’t make them purposely. Section 3 shows that the scientific establishment changed, after his death, Einstein’s hypothesis regarding the speed of light fundamentally, but that it maintained, uncriticised, the result of his theory.

2. Einstein’s unpardonable mistakes

If Einstein would not have made these mistakes he would not have succeeded in presenting his consistent transformation formulas. ‘Consistent’ regarding the following property: after having transformed the coordinates x and t from system K to system k (k moves with velocity v relative to K), the original coordinates in K are found again applying the same formulas with the appropriate variables from k to K. These mistakes will be shown in the italic texts copied from ref [1], being a correct translation of ref [2].

Einstein defined the velocity v as follows:

Now to the origin of one of the two systems (k) let a constant velocity v be imparted in the direction of increasing x of the other stationary system (K), and let this velocity be communicated to the axes of the co-ordinates, the relevant measuring rod....

At the start of § 3 in his article, he writes:

If we place \( x' = x - vt \), it is clear that a point at rest in the system k must have a system of values \( x', y, z \), independent of time. This is a contradiction in itself, because \( x' = x - vt \) shows that \( x' \) is a function of time. Unless \( x \) would be \( x_0 + vt \), with \( x_0 \) independent of time! So the question is: what has \( x \) been meant to be?

To answer this question the final result of the STR has to be considered, especially: \( \xi = \beta(x - vt) \).

Suppose \( x = x_0 + vt \), then \( \xi \) would be \( \beta x_0 \). This has, for sure, not been the purpose of the STR. The transformation \( \xi = \beta(x - vt) \) can, given the relation \( x' = x - vt \), be written as \( \xi = \beta x' \). This result is in accordance with the purpose of the STR, meant to show that, due to the velocity v between k and K, the projection of x in k is not just \( x' \), but an enhanced value \( \beta x' \). Given the fact that \( \beta = 1/\sqrt{1 - v^2/c^2} \), this projection is only \( x' \) if \( v \) would be zero!

Conclusion: Einstein’s description has to be ignored, except the definition \( x' = x - vt \), with \( x \neq x_0 + vt \).

In the following text of Einstein it is found that he chose \( x = ct \), because he introduces there \( x' = ct - vt \).

It will be shown that this has been meant as the first step in Einstein’s manipulative mathematics

Since \( \tau \) is a linear function, it follows from these equations that

\[
\tau = a \left\{ t - v\xi' / (c^2 - v^2) \right\}
\]

where \( a \) is a function \( \phi(v) \) at present unknown, and where for brevity it is assumed that at the origin of k, \( \tau = 0 \), when \( t = 0 \).

With the help of this result we easily determine the quantities \( \xi, \eta, \zeta \) by expressing in equations that light (as required by the principle of the constancy of the velocity of light, in combination with the principle of relativity) is also propagated with velocity c when measured in the moving system. For a ray of light emitted at the time \( t = 0 \) in the direction of the increasing \( \xi \)

\[
\xi = ct \text{ or } \xi = ac \left\{ t - v\xi' / (c^2 - v^2) \right\}
\]

But the ray moves relatively to the initial point of k, when measured in the stationary system, with the velocity \( c - v \), so that

\[
x' / (c - v) = t.
\]
If we insert this value of\( t \) in the equation for \( \xi \), we obtain
\[
\xi = ac^2 x'/(c^2 - v^2)
\]

Hereafter it will be shown that Einstein has made this exceptional transformation on purpose.

In an analogous manner we find, by considering rays moving along the two other axes, that
\[
\eta = ac \{ t - vx'/(c^2 - v^2) \}
\]

when
\[
y/\sqrt{(c^2 - v^2)} = t, \quad x' = 0.
\]

Thus
\[
\eta = acy/\sqrt{(c^2 - v^2)} \quad \text{and} \quad \zeta = acz/\sqrt{(c^2 - v^2)}
\]

Here Einstein introduces, without any explanation, a velocity of light \( \sqrt{(c^2 - v^2)} \) along the \( y \)- and \( z \)-axis.

Such a velocity is contrary to his own hypothesis and thus extremely unscientific.

He continues with:

Comment: Einstein should have presented, given the variables above:

Substituting for \( x' \) its value, we obtain
\[
\tau = \varphi(v) \beta (t - vx'/(c^2)) \\
\zeta = \varphi(v) \beta (x - vt) \\
\eta = \varphi(v) \gamma \\
\zeta = \varphi(v) \gamma \\
\zeta = \alpha \beta z
\]

where
\[
\beta = 1/\sqrt{(1-v^2/c^2)}
\]

and \( \varphi(v) \) is an as yet unknown function of \( v \).

The statement: “Substituting for \( x' \) its value,” means: only in the equations \( \tau = a(t - vx'/(c^2)) \) and \( \xi = ac^2 x'/(c^2 - v^2) \). The questions are which value: \( x' = x - vt \) or \( x' = ct - vt \) and in which equation?

Obviously \( x'' = x - vt \) has been applied in \( t - vx'/(c^2 - v^2) \), because the result is only then \( \tau = a\beta^2 (t - vx/c^2) \).

This is contrary to what he did above when he replaced \( \tau \) in the equation \( \xi = ct \), where he used \( x' = ct - vt \).

This is the fourth step in his manipulative mathematics.

Having found \( \tau = a\beta^2 (t - vx/c^2) \), one would argue that, because \( \xi = ct \), \( \xi \) simply equals \( a\beta^2 (t - vx/c^2) \).

However Einstein presents \( \xi = \varphi(v) \beta (x - vt) \). The question thus is: how did he create \( \xi = \varphi(v) \beta (x - vt) \)?

The first part of the answer has just been presented: he applied initially \( t = x'/(c - v) \) in \( \xi = ct \) in order to obtain \( \xi = ac^2 x'/(c^2 - v^2) \). This is the above mentioned “exceptional transformation on purpose”.

Given the definition of \( \beta \), this \( \xi \) can be written as \( a\beta^2 x' \). The second part of the answer is that he now applied \( x' = x - vt \), so instead of \( x' = ct - vt \), in order to obtain \( \xi = a\beta^2 (x - vt) \).

Conclusion: Einstein only once used the exceptional definition \( x = ct \). Outside of it he used \( x \) as \( x \).

Such a manipulation should be qualified as fraud, if not, then as shocking unscientific behaviour.

The crucial question is: why did, and still does, the scientific establishment not observe such manipulations? Even worse: why did and does it make unpardonable mistakes on top of these?

* The appendix shows that Einstein could have prevented this apparent incorrectness, \( a\beta^2 \) versus \( \varphi(v)\beta \), by simply following the mathematics as presented in this article.
2. Scientific establishment’s unpardonable mistakes

Einstein’s postulate about the speed of light sounds:

“Any ray of light moves in the ‘stationary’ system of co-ordinates with the determined velocity c, whether the ray be emitted by a stationary or by a moving body.”

The fundamental error in this postulate is that he effectively reintroduced, with his ‘stationary’ system, the ether model, most likely without noticing it, because he rejected the ether model himself in the same article. It is generally accepted that an absolute stationary system does not exist. As a result only a stationary system w.r.t. another system can exist. As a consequence that other system is also stationary w.r.t. the first mentioned one. Therefore the introduction of a singly ‘stationary’ system is senseless, whether it is put in quotes or not. Einstein even defined it as the ‘stationary’ system:

“Let us take a system of co-ordinates in which the equations of Newtonian mechanics hold good\(^2\). In order to render our presentation more precise and to distinguish this system of co-ordinates verbally from others which will be introduced hereafter, we call it the ‘stationary’ system. (Note 2: i.e. to the first approximation.)”

The scientific establishment seemingly realized this mistake too. Instead of combining this mistake with Einstein’s mathematical manipulations and as a result reject the STR, it added another mistake to the story:

It changed Einstein’s wrong postulate into another, even more unphysical, postulate, by assuming that the velocity of light in vacuum is c relative to whatever reference.

It is of course allowed to create whatever postulate, however it is fully unscientific to change the postulate of a particular theory fundamentally, but still maintain the result of that theory, without creating a new theory based on that new postulate.

If such an unscientific act is also more or less carried out sneaky, given the fact that there exist no reference explaining this fundamental change of Einstein’s hypothesis, this very much looks like fraud.

Conclusions

1. Einstein's mathematical errors force us to conclude that he should not be regarded as the widespread praised most intelligent scientist ever. He looks much more like a physicist who has, developing his Special Theory of Relativity, practiced physics in a shocking unscientific manner. One can hardly avoid to qualify it as fraudulent science.

2. The scientific establishment has made, about halfway the previous century, an unpardonable mistake by not exposing openly Einstein's unscientific behaviour, regarding his Special Theory of Relativity, but even worse by fundamentally altering Einstein's postulate regarding the speed light and still retaining the same result, without presenting a new theory leading to that same result. Such behaviour also looks much like fraudulent scientific behaviour.

3. The influence of Einstein's unscientific behaviour on the health of physical science is dramatic: all modern physical models and phenomena that are, more or less, based on his Special Theory of Relativity, have to be rejected too. For example: the phenomena space-time, black hole and last but not least: \(E = mc^2\).

References

[1] Translated original article of Einstein:
On the electrodynamics of moving bodies, By A. Einstein, June 30, 1905
http://www.fourmilab.ch/etexts/einstein/specrel/www/

[2] Original article of Einstein in the German language
Appendix

1. Consistency of transformation formulas

Transformation formulas ‘forth’:
\[ \tau = \beta(t - vx/c^2) \]
\[ \xi = \beta(x - vt) \]

To transform back:
Change on the left side of the equal sign: \( \tau \rightarrow t \quad \xi \rightarrow x \)
Change on the right side of the equal sign: \( t \rightarrow \tau \quad x \rightarrow \xi \quad v \rightarrow -v \)

Transformation formulas ‘back’:
\[ t = \beta(\tau + v\xi/c^2) \]
\[ x = \beta(\xi + vt) \]

Apply the \( \tau \) and \( \xi \) of the transformation formulas ‘forth’:
\[
\begin{align*}
\tau &= \beta \{ \beta(t - vx/c^2) + v\beta(x - vt) / c^2 \} \\
x &= \beta \{ \beta(x - vt) + v\beta(t - vx/c^2) \}
\end{align*}
\]
\[
\begin{align*}
t &= \beta^2 \{ t - vx/c^2 + v(x - vt) / c^2 \} \\
x &= \beta^2 \{ x - vt + v(t - vx/c^2) \}
\end{align*}
\]
\[
\begin{align*}
t &= \beta^2 t \{ 1 - v^2/c^2 \} \\
x &= \beta^2 x \{ 1 - v^2/c^2 \}
\end{align*}
\]
\[
\begin{align*}
t &= \beta^2 t(c^2 - v^2)/c^2 \\
x &= \beta^2 x(c^2 - v^2)/c^2
\end{align*}
\]

So:
\[ t = t \quad \text{q.e.d.} \]
\[ x = x \quad \text{q.e.d.} \]

2. The apparent incorrectness of \( a\beta^2 \) versus \( \varphi(v)\beta \)

Suppose the transformation formulas ‘forth’ would be taken in conformity with Einstein’s manipulative mathematics:
\[ \tau = a(v)\beta^2(t - vx/c^2) \]
\[ \xi = a(v)\beta^2(\xi + vt) \]

then the final results of the transformation formulas ‘back’ would be:
\[
\begin{align*}
t &= a(v)a(-v)\beta^4t(c^2 - v^2)/c^2 \\
x &= a(v)a(-v)\beta^4x(c^2 - v^2)/c^2
\end{align*}
\]

So \( a(v)a(-v) \) has to be \( \beta^2 \) in order to obtain \( t = t \) and \( x = x \).

The most obvious solution is: \( a(v) = a(-v) = \beta^1 \).

In that case the original definition of \( a(v) \) in: "\( \tau = a \{ t - vx^\prime/(c^2 - v^2) \} \quad \text{where} \ a \ \text{is a function} \ \varphi(v) \ \text{.........} \)"

would lead to \( \tau = \beta^4 \{ t - vx^\prime/(c^2 - v^2) \} \).
For \( x^\prime = x - vt \) the result is \( \tau = \beta(t - vx/c^2) \).

3. Physics versus mathematics

These consistent transformation formulas, obtained by manipulative mathematics, might easily lead to the conclusion that the STR is a correct theory. However, doing so Einstein adapted physics to mathematics.

Each scientist in physics has the moral responsibility to try to adapt mathematics to physics.
Epilogue

The e-mail below has been sent to about 7500 physicists, ranked from student to professor, inclusive some Nobel Prize Laureates and members of the Nobel Prize Committee for physics.

Dear physicist, date December 2018

You herewith receive my article: “Special Theory of Relativity based on fraudulent science?”, showing the following conclusions:

1. Einstein's mathematical errors force us to conclude that he should not be regarded as the widespread praised most intelligent scientist ever. He looks much more like a physicist who has, developing his Special Theory of Relativity, practiced physics in an extremely unscientific manner. One can hardly avoid to qualify it as fraudulent science.

2. The scientific establishment has made, about halfway the previous century, an unpardonable mistake by not exposing openly Einstein's unscientific behaviour, regarding his Special Theory of Relativity, but even worse by fundamentally altering Einstein's postulate regarding the speed light and still retaining the same result, without presenting a new theory leading to that same result. Such behaviour also looks much like fraudulent scientific behaviour.

3. The influence of Einstein’s unscientific behaviour on the health of physical science is dramatic: all modern physical models and phenomena that are, more or less, based on his Special Theory of Relativity, have to be rejected too. For example: the phenomena space-time, black hole and last but not least: $E = mc^2$.

The so-called CWI at the University of Delft in the Netherlands has been informed separately and explicitly. The Dutch abbreviation CWI means: Commission Scientific Integrity.

Kind regards,

Sjaak Uitterdijk

P.S. The “e-book” titled “Physics since Einstein” is enclosed too. Be so kind to consider this book as a Christmas-2018-gift. 😊

The reason for doing so is that publishers who want to have and keep a good relation with the scientific establishment refuse the mentioned book for publishing. Three of them have been sent a request, immediately resulting in the following replies:

**Cambridge University Press**

“Thank you for your email. I have read the first few pages of your very short book. I’m afraid Cambridge would not be interested in considering it for publication.”

**Springer**

“Thanks for sending your manuscript. I have indeed read the prologue. I am sorry to say that the ideas you wish to publish are not so very new, and that they have been considered and refuted many times by expert theorists. So I am afraid we will not be able to help you publish this work.”

**Wiley-VCH Verlag GmbH & Co**

“Thank you for sending us your proposal, but unfortunately the planned book does not fit into our portfolio.”
Acknowledgement

In the prologue it has been argued why articles, not generated in, or peer reviewed by, the professional scientific community, will not be published in the magazines meant for their own ideas. Thanks to Philip Gibbs, who created ViXra, my articles have been published at Internet, even for free and in the most author-friendly way one can imagine. I am grateful to him.