Postulates and Prejudices in Fundamental Physics

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Abstract. A new view on quantum gravity is presented, among others a new step toward quantization of gravity is presented. A model is also developed, where the elementary particles are black holes. This disagrees with the Higgs mechanism. An explanation is also shown why three space dimensions exist, and what is uncertainty of masses of black holes. A new view on consciousness theory is shown. Regardless of the correctness of the above theories it is shown, what postulates are and what prejudices are.

1. Introduction

The main unsolved problems of physics today are quantum gravity theory (QG) [1] and consciousness. If we had answers to them, it would not be necessary to doubt in physical postulates. Maybe now it is also not necessary to doubt in them, but it is possible that they are wrong.

QG will be a theory with which we try to merge quantum theory (QT) and general relativity (GR). It is supposed that those two theories are not compatible ones, thus it is necessary to change postulates of one or another theory. Thus, in the continuation the author will try to simplify foundations of those two theories and to show his own view on problems of definition of QG.

It is interesting that the period of 82 years was not enough to complete a successful QG.[1] This gives a hint that present-day physical postulates are a bit wrong, or/and that way of thinking is delusive and that system of physical research is not optimized enough.[2, Text in red]

Physical postulates are really ambiguous territory. They are valid only in some areas and it is possible to replace them with different ones which tell the same. The problems are also prejudices which appear together with those postulates and are believed as correct. But the progress in physics will be to confirm those prejudices or to disprove them.

One prejudice in physics is also the Ockham razor, whereas the author agrees to this prejudice and the further essay will follow it.[2] The next prejudice (and theory [4]) is that foundation of everything is information, and it is digital. The author believes to it. The next prejudice is that physical units do not exist [5, 6] and that the speed of light (c), the gravitational constant (G), and Planck constant ($\hbar$) are only conversion factors between these units, so they do not exist physically. This is almost a postulate and the author also believes to it. There are also prejudices which are not believed by the author, and they are presented in the continuation.

In the next sections, QG will be treated as first. At the end, theory of quantum consciousness is treated. Presentation of QG will include simplification of physical postulates, description of some problems at development of QG, a new approach to QG, summarization that the key of QG is in the masses of elementary particles, guessing, how such formula should look like, and description of uncertainty principle in QG.

2. Simplification of postulates of Special Relativity, GR and QT

Theories of special relativity (SR), GR and QT are foundations of QG. More precisely said, they resulted from QG. Thus it is useful to present them from alternative aspects and to try to find what is essential that can help at development of QG. At the same time those simplifications will tell us, what quality of those theories is.

SR essentially reduced a number of parameters in physics. It finds connection between space and time, so duration and distance become similarly describable. It can be deciphered that c is physically unnecessary, because it is only a conversion factor between distance and duration [5, 6]. Distances in space-time become similarly describable as distances in space. The postulates of SR are essential for physics.[3] SR gives also that space-time is emergent so time exists only in matter [8], although, formally, every point in space in SR has attributed time. This is rarely mentioned, but it is very important. Namely, if all matter had been removed from our universe, there would not remain anything, not even space-time. Otherwise, this is given also by GR by its "diffeomorphism invariance" and by the "background free space-time" [9, p. 138]. Similar conclusions are given also by Markopoulou, namely that space-time arises as a consequence of relations between the elementary particles (or other elements of matter) [10].

GR further simplifies Newtonian physics. It explains one of the forces, gravity, as curved space-time. It explains that space-time is without background, so if all matter was removed from our universe, even space-time would not remain; similarly as it is explained above by SR. The principle of equivalence is also important, because it completely equalizes homogeneous gravitational field and uniform acceleration. (The author will show how it is with this in the quantum area).

The essence of simplifications given by QT is that the essence of physical world is information. It can be deciphered with questions which give yes-no answers [4]. This quantum element of information is named *Qubit*.

The essence of all calculations of QT is, otherwise, wave function, but Brukner indirectly shows that it is only a consequence of information and complementarity [4]. Thus, he shows, that cosine nature of wave function is a consequence of complementarity of angular momentum in various directions. Otherwise, Isham also did not automatically assume existence of wave functions (and complex numbers) in QG [1, p. 8]. The common QT is based on non-curved continuous space-time. Besides, Brukner-Zeilinger's information a little bit ignores this background space-time, which so should be a consequence and not a cause for physical world.

Additionally, let us ask ourselves, what is more fundamental, a wave function or principle of uncertainty (UP_x).‡ Namely, UP_x talks about information in physics, and at the same time it is something very simple and all-embracing in QT. UP_x can be derived with the help of wave functions for location and momentum, so it is a

‡ The shortcut UP_x is mentioned for momentum and location, not for energy and time.

direct consequence of cosine nature of wave functions. The Fourier transformation of a wave function in position representation gives a wave function in momentum representations. If width of wave function in position representation is enlarged, the width in momentum representation is reduced, and vice versa, thus UP_x arises. But, maybe this dependency can also go in opposite direction; the Brukner derivation gives a hint for this.

Otherwise, quantum mechanics and its successors quantum field theory (QFT) and quantum electrodynamics (QED) explain many things in physics, for instance, why some forces are attractive and some are repulsive, including gravitational force, although it is not yet quantized [11].

The further simplification, given by all three theories, is that c, G, and $\hbar$ are not physically necessary, but are only consequences of various elementary units, thus they are only conversion factors between elementary units [5, 6]. This also means reduction of fundamental physical parameters. As further, it follows that dimensionless natural units exist, thus the masses of elementary particles can be expressed dimensionlessly, the same is true for the elementary charge, and those ones are really fundamental physical quantities. Physics is mathematics in principle, and mathematics almost exclusively uses dimensionless quantities.[4] Thus, for the sake of shorter further formulae in the article, it will be defined

$$c = \hbar = G = k_\mathrm{B} = 1, \tag{1}$$

where k_B is Boltzmann's constant.

We people imagine physics, as we have learned it from birth, for instance, when baby sees a spoon falling from the table, s/he begins to understand gravity. This physics is Newtonian one, thus we do not have almost any experience for SR, GR and QT [12]. The contribution of those three theories to dimensionless physics is an intuitive excuse for them, especially for QT, which is the most anti-intuitive of them. An expected QG still additionally dissuades continuous Euclidean space, because it is very probable that space-time is grained. But we are incorrectly accustomed to Euclidean space as a necessary background of physical world.

A challenge for QG is also an explanation of three space-dimensions. Those three dimensions also remind us that Newtonian physics cannot be taken for granted, but it is necessary to explain three dimensions. It is also necessary to do physics dimensionless and to be describable mathematically, what is done by the three main theories (GR, SR and QM), and it is not done by continuous Euclidean space. Namely, Newtonian physics does not explain why precisely three space dimensions exist. Some possible explanations already exist, one is Weizsaecker's [13]. It includes QT and thus excuses counter-intuitiveness of QT. The author's own explanation is that three dimensions of a photon are a cause or a consequence of three dimensions of space. GR gives that various directions of movements of photons span space-time, thus it can be intuitively expected that three dimensions of photons should span three dimensions of space. It does not contradict to Weizsaecker's proposal. The next explanation is of Loll [14].

It is necessary to be aware that QG is more fundamental than QT, therefore QG should be simpler - thus only the simplest things should be extracted from the above three theories. In principle, QT is valid only in limited area, where QG should be its generalization.

3. Some problems

Nowadays, big problems exist with merging of QT and GR [1]. Thus, it is supposed that the postulates in one or in the another theory should be changed. But the question is, in which one. The both cases are well confirmed experimentally. But QT is more fundamental, because it describes micro-world, where macro-world is built up from micro-world, and additionally, space-time should be emergent. It is supposed that QG is discrete, where QT is closer to this than GR.[5] The time arrow also belongs to physical world, and its explanation seems closer to QT than to GR. Consciousness is also a problem of physics, and it also seems that its explanation is closer to QT than to GR. It seems that QT is much more complicated than GR, so if one theory should be changed, QT should be changed. But, it seems that space-time is grained and, additionally, it is emergent. This maybe causes the changes of space-time, thus changes of GR. A continuation will follow.

Energy of vacuum is also one of problems of merging QT and GR.

But, physicists complicate the problems of merging, where it is not necessary. One problem is singularity of black holes (BHs) and problems, which follow from this. But, if it is assumed that a finite volume contains only finite information, there is no problem with singularity, (thus space-time should be grained).

It is assumed that the smallest possible BH has mass approximately equal to m_{Pl}. In the opposite case, diameter would be smaller than it is allowed by UP_x. Although it is not absolutely clear how it is with this, physicists aggressively attack all theories which contradict to this. Thus, this is a strong prejudice, but it will be shown in this essay, that smaller BHs are a possible option.

If dimensionless masses of particles μ_is are something essential, their gravitational part is also essential, because inclusion of G in them shows that μ_is are not independent from gravity. (Index i means various elementary particles.) Although G does not exist physically, it exists in this sense. Thus, in principle, only rest matter gives gravitational force and rest matter is built up from the elementary particles. This gives that self-force of every particle is based on gravity. It would be strange that gravity would not be a primary reason for the elementary particles, because the elementary particles are foundation of space-time, and the same is true for gravity. But this confirms that the elementary particles are BHs or something very similar to BHs or at least that they are gravitationally built up objects. Besides, it seems that space-time is emergent, but if we respect only principles of matter without space-time, there are no problems with incompatibilities between QT and GR.

As parallel thinking, we see that time arises in rest matter, so basic elements of time arise in one elementary particle and not only in a group of them. So QG is home at one particle.

Now a conflict remains that a BH is only larger than approximately m_{Pl}. But, it is possible to avoid derivation of this conclusion - it can be said that the mass of elementary particle (or of some BH) is a superposition of mass 0 and mass m_{Pl}. This is one of possible models to avoid this, so equality of the elementary particles and BHs is not so firmly forbidden.

Admittedly, the above model is in contradiction with Higgs mechanism. A particle with mass 125.3(6) GeV is found, and it is very probable that this is the Higgs boson [15]. In that case the author's theory that the elementary particles are BHs is wrong. But, as first it is necessary to confirm that this particle is really the Higgs boson [16], and to find how the Higgs mechanism agrees with GR. If Higgs mechanism will be

confirmed after a short period, this is the last chance to present a BH theory of the elementary particles. :)

The next problem is distinct nature of time in QT and GR. Time in QT is absolute, whereas time in GR is relative. In principle, the disagreement is a consequence of interior ob BHs, below horizon, or closed time loops [17, 18]. But, it is a question whether interior of BHs really exists, because this is a similar type of calculation as this which gives tahions. Tahions are in agreement with SR, but intuitively they are not acceptable and no one has ever seen them. Interior of BH has also not been seen by anyone. Yes, intuitively it is more acceptable than tahions, but we can doubt also in the existence of interior of BH.

4. One step toward quantization of gravity

One step at merging of QT and GR was Hawking radiation of BH [19]. It is a semi-classical merging. A promising theory is also that of Markopoulou [10]. Some aspects or steps of merging QT and GR are presented by Hadley [20, 21], Makela [22], and by others.

The author suggests a thought-experiment with a rocket propelled by photons [23], [24, p. 10]. Conclusions of this experiment can be used at uniform gravity field, thus the principle of equivalence will be used, and it is one of the principles of physics.

Thus, such a rocket is accelerated by photons. We try to achieve uniform acceleration as much as possible. This means that a large number of photons of very small energies accelerate a rocket so, that a graduated curve becomes almost smooth. So informational viewpoint of this acceleration appears - namely, a lot of information should be given to supply such big number of photons with precisely defined energy. One avoidance of this problem is to know only average energy of such photons, but their energy is distributed by maximal possible entropy. Thus, their distribution of energy is:

$$\mathrm{d}n/\mathrm{d}E = 1/T \exp(-E/(T)) \tag{2}$$

E means average energy of these photons and T means their temperature, and simplified units are used, as written in (1). E and T in this case are limited to zero. This distribution is thermical. T is still a free parameter.

Let us transfer this idea into the aspect of gravitational acceleration. Thus, gravitational attraction would changing thermically if we were observing it in very short intervals. This is a new suggestion for a QG, which can be tested, of course, theoretically. At the same time we preserve the principle of equivalence. At search for new theories it is better to preserve basic physical principles. The principle of equivalence is one of the most fundamental principles.[6] It is claimed that gravity is not a force, but it is more fundamental than other forces [25, 26].§ Thus, it is useful that this principle survives in QG and that it is not necessary to change physics, or to introduce a new gravitational constant, and new dimensions at micro-scales [27].

5. How formulae for the masses of elementary particles look like

A lot of properties and postulates of QT, GR and SR can be transferred also to QG, or it can be expected that the main postulates and properties are preserved in QG.

§ Anyway, this question is not yet absolutely finished.

For instance, we expect that QG is background free, that gravitational force between two particles is attractive, that information is a key element of QG, that some sort of quantum uncertainty remains etc. As further, if a BH has a temperature, an elementary particle should also have it.[7] The next properties are that time exists only in rest matter, that dimensionless numbers are essential, etc.

Thus the author concludes that an explanation of μ_is is a foundation of explanation of QG. Probably, it is possible to tell still more. Namely, self-gravitational force for a particle in Newtonian physics is proportional with square of mass. Maybe it is so also in quantum gravity and we should search a formula for μ_i^2 and not for μ_i. It exists a similar example respecting electrostatic energy inside of one electron and in principle it is proportional with the fine structure constant (α) and not with $\sqrt{\alpha}$. In truth this is running α, and energy contains also mass energy part. But this does not change the above idea. The 2011 winner of FQXi contents suggests a model where masses of BHs are arranged by a formula [22]

$$E_n = \alpha\sqrt{n} \tag{3}$$

where α is factor of proportionality,‖ n is a natural number, and E_n is energy of BH. We will see that equation (3) agrees that μ_i^2 is more fundamental than μ_i.

Because space-time is emergent, the formula for rest mass should not contain inner distance.

Because the basic properties of the elementary particles are mass, charge and spin, the formula should contain also these other two quantities. Because anti-particles have the same mass as particles, the formula should be independent of sign of charge. Because a lot of main particles have charge, the elementary charge can be a creator of the particle masses. This means that enlargement or reduction of charge in the formula means enlargement or reduction of a particle mass. The formula should also be short and should contain as less as possible bits of information. This is not only in accordance with Ockham razor, but in the opposite case it can happen that a formula cannot be confirmed with a measurement or with a thought-measurement.

A mass of a particle (or of a BH) should also have some quantum uncertainty, and in the continuation it will be shown how to calculate it.

6. The principle of uncertainty

One of foundations of QT is also UP$_x$.

$$\Delta p_x \Delta x \geq 1/2, \tag{4}$$

where Δp_x means uncertainty of momentum p in x direction.

It is important that it should be valid always (in area of definition of QT), and if it was not true somewhere, QT would be ruined. It is also important that it is described with a short formula, which describes information in physics. Its derivation and simplicity are based on Fourier transformation from location representation into momentum representation, and vice versa.

But, validity of QT is in flat space, where space-time is not grained, therefore it is infinitesimally smooth. UP$_x$ in very curved space-time can only be guessed. One proposal is [28, 29]:

$$\Delta x \geq 2\Delta p + 1/(2\Delta p) \tag{5}$$

‖ α in this formula does not mean the fine structure constant. The formula is copied from the article, therefore this confusion with symbols was needed.

If very small distances close to $l_{\rm Pl}$ are studied, it is supposed that space-time is grained. In such case UP$_x$s in (4) and (5) cannot be correct, because they are defined in smooth space-time. At the same time we concluded that space-time is not essential at micro-world, but matter is this essential thing. More precisely said, the elementary particles or their building blocks are essential things. Maybe, principle of uncertainty of rest energy and time (UP$_t$) should be fundamental in such case, not UP$_x$. In such case it can also be expected that a new principle of uncertainty should be simpler than UP$_x$, not more complicated, as, in fact, (5) is.

On a first sight it can be expected that

$$\Delta E \Delta t \geq 1/2 \tag{6}$$

is a complete substitute of UP$_x$ when momentum is transformed into energy and location is transformed into time. But it is known that this is not true [30, p. 6]. Admittedly, (6) sometimes correctly describes physics, but in general it is not correct.

The author has also his own explanation of non-fundamentality of (6), which follows. If we try to use (6) for description of rest energy of the elementary particles, we should be more aware that rest energy cannot be negative, whereas derivation of UP$_x$ is based on allowed negativity of x and p_x. Thus, in general, x and p_x are described with two Gaussian curves, which are symmetric around their central value. The most simply is to choose inertial system, where average momentum and average location are zero. However, the Gaussian distribution also means a distribution with maximal entropy regarding such symmetric cases. Because rest energy cannot be negative, description with Gaussian curve is not appropriate, and derivation of formula UP$_x$ (4) even cannot be a foundation of derivation of any other formula for uncertainty of rest energy of particles. Thus, Gaussian distribution is also very linked with the existence of wave functions.

But, similarly, as Gaussian distribution means the largest entropy at symmetric distribution curve, we have also a distribution curve, where values, for instance, of energy, can be only positive. In this case, the largest entropy is given by the distribution curve

$$\mathrm{d}n/\mathrm{d}E = 1/T \exp(-E/T). \tag{7}$$

T means temperature, thus this is also a thermical distribution. (An unknown parameter is still T, which can be determined.)

We concluded in (3) and in the sentences before that a quantity μ_i^2 is more fundamental than quantity μ_i. Thus, a formula for distribution of μ_i^2 should look like

$$\mathrm{d}n/\mathrm{d}\mu_i^2 = 1/T \exp(-\mu_i^2/T). \tag{8}$$

Above, the author arguments that the elementary particles are BHs. As an option, the system was proposed where the masses of elementary particles are combinations (superpositions) of masses 0 and $m_{\rm Pl}$. The above distribution can tell more about this. Thus μ_i^2 is varying accidentally between 0 and 1, where intermediate values do not exist, but rarely it can occupy values 2, 3, etc. Range of variation thus means uncertainty of μ_i^2 if it is measured in very short time intervals.

Some further details are written in [24, p. 4], where $\langle\mu_i\rangle\mu_i$ is proposed instead of μ_i^2.¶ There is described, how to obtain a formula for the electron:

$$4\mu_e^2/3 = \exp(-3/(4\alpha)), \tag{9}$$

¶ $\langle\mu_i\rangle$ means time average value of μ_i.

where α here means the fine structure constant. In principle, we measure $\langle\mu_i\rangle\mu_i$ in short time intervals and we can see that it changes thermically.

Thus, this is the first embryo for replacement of UP_x at very little distances, thus at masses of very small BHs, or at the masses of elementary particles, as the author suggests. It is only necessary to decipher what fails to be a good replacement of UP_x, and what is a true replacement according to UP_x. Admittedly, an unexplained thing here is what is with uncertainty of time, and how time behaves.

7. Consciousness

Maybe, the most fundamental secret of physics is quantum randomness. At the same time it is the most anti-intuitive. An opinion of physicists is that this randomness is non-causal, and their opinion is also that nothing more can be said about this. The author agrees with the first opinion, but not with the second one, and thinks that this is an unjustified prejudice. Namely, consciousness is also one parameter of physics and it is necessary to explain it somehow. An explanation is offered itself that consciousness is connected with collapse of wave function.

Instead to say that consciousness is a consequence of QT, it can be said a little differently - that some primitive consciousness is everywhere (panpsychism [31]) and every quantum collapse is a consequence of one independent conscious decision [23, 32]. Thus, randomness of quantum collapse can be explained so. For proof of sense of this, it is useful to test this thesis experimentally or with a thought-experiment. The most direct test of such one could be to analyze a decision to move a hand and to find all mechanisms which lead from the conscious decision to the movement. It is possible that a quantum collapse is a direct cause for this movement. In that case this can also be some type of micro-telekinesis.[+]

Another problem at quantum consciousness is a prejudice that processes in a brain are too macroscopic to be supported by any quantum phenomena and that brain temperature is to high to support any long time quantum coherence. For instance, the most known proposals for long time lasting quantum coherence came from Penrose and Hameroff [35, 36, 37, 38, 39]. Tegmark claims oppositely [40]. Of course, hints exist that quantum coherence exists in biological world [41, 42, 43, 44], but those processes are too fast for explanation of consciousness.

But, it can be assumed that still one type of matter exists in our bodies, let us say as an astral body from neutrinos or from other similar type of matter. For such matter it is maybe characteristically that quantum coherence appears at larger temperature than at our common matter which is built up from electrons, protons and neutrons. This can be seen from a formula for critical temperature (T_c) for transition in the Bose-Einstein condensate [45]:

$$T_\mathrm{c} = k/m, \tag{10}$$

where m is the mass of the electron and other quantities are collected in k. The Bose-Einstein condensate needs temperature 10^{-7}K or less, but if masses of particles are small enough, this can happen also at the brain temperature.

[+] Interpretations of Libet experiment claim differently [33, 34]. The author does not agree with these interpretations of Libet experiment. The first possible counter-arguments is that it is possible that a person in the experiment made decision enough early, but s/he forgets its primary decision. The second counter-argument is that it is not enough clearly distinguished what is a free will and what is a physiological reaction of a body, therefore it is not possible to give clear conclusions about this experiment.

Some such light particles are even known - these are the electron-neutrino, the muon-neutrino, and the tau-neutrino. It is also very probably that many other types of light particles exist, it is possible that the dark matter is built up from such particles, which have large coherence time.

The time arrow is also an example where consciousness and physics meet. Cramer enumerates many types of the time arrows, among them also the subjective arrow of time and he puts hierarchy among them [46], but subjective arrow was not the most fundamental. But with inclusion of panpsychism, maybe the subjective arrow of time can become the most fundamental time arrow.

Otherwise, irrespective of the above inference, consciousness is not enough relativized. For instance, if two persons were connected with a lot of connections, probably they would behave as one person. If corpus callosum is cut, a human being behaves as that two persons exist in one body. It is also unclear, what is necessary for minimal consciousness. It is supposed that consciousness arises if enough large number of processes happen in brain [47]. But, if we think more precisely, the memory is what distinguishes one personality from another. If someone forgets everything from past, s/he becomes a new person. Let us say that someone is a demential person and is aware of anything only for few moments, but then s/he forgets everything. In that case all known tests will tell that s/he was unaware. This is also one example of prejudice, and it can be incorrect.

Theories of consciousness are examples for prejudices which can be misleading. Tegmark [40] found that Penrose's and Hameroff's theory [35, 36, 37, 38, 39] is contradictory. But, this was to much generalized into prejudice that quantum consciousness does not exist. But, an example is above, how Tegmark's argument can be avoided. The next general claim is that consciousness is a consequence of matter and not of dualism. The author agrees with this, but it is necessary to ask ourselves, what matter is, what foundations of QT are, and what consciousness is. The examples are given above, how to avoid this conclusion and why quantum randomness is a prejudice. For instance, we imagine matter as matter in Newtonian physics, but Newtonian physics is wrong imagination of physics as the author wrote in this essay.

8. Conclusion

It is said that TOE should be so simple that it would be possible to write it on a t-shirt. It seems that it should be at least so simple that physicists should understand it. The author still ever believes to Feynman that no one understand QT. Many physicists today think that they understand QT, but these are also prejudices. QG is foundation of QT and if QG is unclear, QT is unclear too. If consciousness is unclear, QT is also unclear irrespective of existence of quantum consciousness. Even Feynman had incorrect prejudices. In the essay above, quantum randomness becomes more understandable. The particles as BHs also become more understandable. Understandability is an important argument, it is an argument for correctness, but if some QG is wrong, but clear and simple, it would be an interesting question, how this is possible. So even continuation of measurement of the Higgs boson will tell something.

At the same time the author agrees with a prejudice of QT, that physically real is only what is possible to measure, although with a thought-experiment. The author even thinks that a very complicated formula for the elementary particles will disagree with this measurement of physical reality.

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Technical Notes

[1]After GR and quantum mechanics were completed, the first article about QG was written in 1930 by Rosenfeld. But the first real contribution to QG was written in 1899 by Planck, when he calculated Planck's length, time and mass.

[2]One book which partially presents the Ockham razor in physics, is [3]. It says that inside of space there are no gears, which explain fundamental laws.

[3]Counter-theories are weak according to Ockham razor.The measurement of superluminal neutrinos induced a lot of such new theories [7].

[4]Such dimensionless reduction of physics was introduced already by Planck via his Planck's mass (m_{Pl}), Planck's length (l_{Pl}) and Planck's time (t_{Pl}).

[5]Beside of quantized information [4], angular momentum is quantized as an integer multiplier of $\hbar/2$, and, photons are quantization of electromagnetic field, and it seems that the elementary particles are also some type of quantization

[6]Although the principle of equivalence is no more the essence of GR.

[7]Admittedly, of course, temperature of BH is not 100% sure.