

# What is Ultimately Possible in Physics, Completeness of Quantum Mechanics, Quantum Gravity, and Consciousness

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## Abstract

Firstly, the completeness of quantum mechanics (QM), which is one of the basic limitations of physics, is given under a new judgement. The absence of quantum gravity theory confirms that QM is incomplete. The author asserts that mass is an urgent building block of space-time, and, that foundations of space-time should still be searched - for instance wormholes. So also the speed of light as the maximal speed is no more sure. QM is incomplete also because consciousness is not yet explained. Arguments for quantum nature of consciousness are given. It is shown, how the formalism of QM can be changed if consciousness is included. At the same time the energy law is no more sure if the formalism of QM is so changed.

## 1 Introduction

Otherwise, physicists say that physical laws are never proved, but they can only be disproved. One example is the transition from Newton's gravitational law to the general theory of relativity. All the same, it is a general conviction among physicist that the laws below, the most probably, will never be changed. The main physical laws are

1. the law about conservation of energy,
2. the entropy law,
3. the special relativity or unattainability of the speed of light for material bodies,

4. the quantum mechanics (QM), completeness of QM and complete explanation of it,
5. the conservation of momentum,
6. the conservation of charge, the conservation of leptonic and baryonic number,
7. the principle of equivalence.

Those laws are also limitations of physics in some way. It will be shown that these laws are still debatable.

We expect also other explanations, which will become physical laws, for instance

1. an explanation, why space is three dimensional,
2. an explanation of elementary dimensionless and dimensionful numbers in physics [1],
3. a law that physics is built up from small to large (for instance, it is not known, if gravity arises in micro-world or it is macro-phenomenon),
4. a law that the time arrow direction is only one,
5. (the above-mentioned four laws maybe will be embraced in eventual theory of quantum gravity (QG)),
6. a confirmation or a denial of the supposition that interpretation of QM is unnecessary,
7. that a foundation of physics is information [2, 3, 4],
8. a physical law about origination of consciousness and qualia.

## 2 Incompleteness of QM

The most important and the most fundamental of the above laws is the completeness and the interpretation of QM because QM is a foundation for all physics because the most probably the physics is built up from below upwards. It is a general conviction that QM and interpretation of QM are complete. But, new and new interpretations are taking shape - they are in a contradiction among themselves, but they are not in a contradiction with the formalism of QM - for instance, the hidden non-local variables of

Bohm's theory [5, 6, 7]. It is told that most part of physicists do not admit Bohm's interpretation, but it is necessary to disprove it, not only to tell opinion about it.

A model for Born's  $p = \psi\psi^*$  should exist,<sup>1</sup> for instance, in the Copenhagen interpretation, but it does not exist.<sup>2</sup> Cramer found a model for this equation in Transactional interpretation [8].

The most promising interpretation is the Zeilinger-Brukner interpretation [2, 3, 4]. It is based on a smallest unit of information.

If the interpretation of QM would be complete, the fundamental physics alone should be almost complete. But QG is unknown; it is fundamental also for QM, so QM is incomplete. Masses of particles, space, time, information and consciousness are also not explained, but they are more or less also connected with QM. (QM is too much intertwined with them because it is a part of the fundamental physics.) These elementary concepts should be known to know QG.

It is known that acausality of QM is a problem. Or, differently said, a problem is the absence of a clear intuitive interpretation for phenomena of QM.<sup>3</sup> So it exists an interpretation, which ignores interpretations of QM - this is "shut and calculate" interpretation. For confirmation of this interpretation some people refer to qualia, for whose they assert that they cannot be physically explained [9, 10]. But, in truth, we need QG, which could tell us also more about qualia.

### 3 Incompleteness of other laws

A limitation of physics is also the speed of light, as the maximally possible speed. So, approximately said, we cannot arrive to nearby stars in a period of a human life. Maybe we will overcome this problem, when we will know QG because we can suppose that some sort of wormholes exists, where every point of space is directly connected with all other points.

A limitation, which many people want to overcome it, is the energy law. This law is valid, above all, in macroscopic world. An inequation  $t\Delta W \geq \hbar/2$ , which is similar to the principle of uncertainty, exists in the

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<sup>1</sup> $p$  is probability and  $\psi$  is a wave function

<sup>2</sup>For instance, why it is not  $p = \psi\psi^*\psi\psi^*$ .

<sup>3</sup>Double slit experiment, for instance, is anti-intuitive. But we should be aware that a flat, smooth space is not something primary, but it is secondary product of more primary physical elements. So anti-intuitivity is not contained in space strangeness of this experiment, but in acausality of QM.

quantum world.<sup>4</sup> This inequation describes to us a limitation, how energy law is valid. But, an attention, I said that the interpretation of QM is incomplete - (we will see that a suggested modified QM can be important also in the macro-world). So limitation of the energy law is also not complete and it can be modified also in the macro-world. (A related law is also the conservation of momentum law. It is not attacked as the energy law, but as a physical law is equally important.)

The equivalence principle is also under attack - mostly in the quantum area. But it is not noticed a different approach, so that this principle is universally valid, but Newton's gravitational constant is not constant in very small time intervals, and this influences even on QG [11].

In any case, it seems very strongly that the space-time is a consequence of matter and is not an independent stuff. This can be evident already in the special relativity because time flows only in an inertial system, which can be standstill and for matter it is typically that it can be standstill. If we use the relativistic mass interpretation, this can be visible more clearly. Elementary units of matter are elementary particles. This agrees with F. Markopoulou [12] who says that the mass ratios of particles  $\mu_i$  are base for everything. This also agrees with Duff [1] who says that elementary dimensionless numbers are fundamental for everything. So also mass is an urgent building block of space-time. This hint (not law) is also limitation and guidance, what kind of a theory QG should be and what is ultimately possible in physics.

Even for other "laws" it seems that they are clear and that they do not need explanation, but this is deceptive; or at least, they need explanation why they are such and this can give us a new knowledge.

## 4 Consciousness and QM

The quantum consciousness is rejected today, above all, because of Tegmark's calculation [13] that brains are too much warm for enough lasting quantum coherence. But a model, which solves this problem, can be found very easy. Let us assume that in biological organisms there are also particles much lighter than the electron. Some such light particles are even known - these are the electron neutrino, the muon one, and the tauon one. Very probably is also that many other types of light particles exist, for instance such ones from which the black matter is built up. It is known that quantum coherence time lasts longer at a lower temperature, and it is dependent also from

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<sup>4</sup> $t$  is a time interval,  $\Delta W$  is uncertainty of energy and  $\hbar$  is Planck's constant.

a mass of particles. A formula for a critical temperature  $T_c$  of Bose-Einstein condensate is  $T_c \propto 1/m$ , where  $m$  is the mass per boson. The Bose-Einstein condensate needs temperature  $10^{-7}$  K or less, but if a mass of a particle is small enough, this can happen also at the brain temperature.

We ask ourselves, if either only "chemistry"<sup>5</sup> influences on decisions and movement of a human being, or also consciousness influences on. If consciousness does not influence on movements, so it is only an observer, it cannot be seen its purpose. Evidently consciousness influences on movements and evidently it is a part of physics. A basis for physics is QM, so it is also a basis for consciousness.<sup>6</sup>

The next type of a thought Turing's experiment can also give that consciousness is a quantum phenomenon. The experiment is imagined so that we have a robot, which has a similar computer as a human brain as much as possible. (A movement apparatus should be also similar as a movement apparatus of a human being.) Then, let us search for differences, given by consciousness, so that the robot has different decisions or movements than the human being. Decisions are also consequences of movement inside a brain or inside a computer. So "physics" can be simplified only as a movement, so qualia can be ignored.<sup>7</sup> So movements of the human being and of the robot are compared. If this comparison is made by the assumption of the classical physics, movements of the robot and the human being are not the same. (Otherwise consciousness is only an observer.) If we assume also QM, the quantum uncertainty should be considered. So differences of movements of the human being and the robot can be hidden and explained inside the quantum uncertainty. So "round of the corner" we get a quantum cause for consciousness.

This reflection can also be reversed. As first we can built up a model, where QM is deterministic. This model really exists [14]. This model was righteously criticized because it not let us a free space for a free-will.

One of empirical arguments is that matter without the existence of consciousness losses sense and - matter is always quantum one. Another argument is that a picture of a world in a brain is essential and it is dependent from the brain (so from the consciousness). It is similarly mentioned for qualia in physics.<sup>8</sup>

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<sup>5</sup>this phrase can mean physical laws, so we can change it also to a phrase "physics"

<sup>6</sup>With exception if a "physical concepts" without any movement exists.

<sup>7</sup>For "physics" of this experiment the known physical laws can be enough.

<sup>8</sup>"To make it possible for scientists to describe nature mathematically, Galileo postulated that they should restrict themselves to studying the essential properties of material bodies - shapes, numbers, and movement - which could be measured and quantified. Other

## 5 A model for quantum consciousness

With the above arguments we can prove a connection between QM and consciousness, but below it is also shown a model which gives sense to the interpretation of QM and it suggests that QM should be changed a little. Because free-will is not the same as coincidence - an intentional movement of a hand is not the same as coincidental movements of the hand. (If collapses are coincidental, we can ask ourselves, why time of collapse is also not coincidental.)

For a model of quantum consciousness (or any physical explanation of consciousness) we need an atomization of consciousness, or, differently said, an analysis, what is consciousness. The atomization of consciousness is mentioned as what the elementary units of consciousness are, what is a principle of consciousness, and where in a brain it is located. The atomization should tell us, for instance, if a feeling of pain is divisible and how it is divisible.

One of essences of an ego is a memory. Theoretically, I can be a new person if I forgot everything from past life before yesterday. Consciousness can be divided inside one person (a person with a split personality). Theoretically two people can be one ego, if they are connected with a lot of connections, nerves, etc. Neurons are special regarding other body cells, above all because they have a lot of connections between them. These connections are essential for memory.

If it is so, some sort of consciousness is stored already in an one-cell organism. Only level of consciousness is lower because level of duration and expanse of memory is lower. We can also go still further in a matter of a non-biological world, and there can be also some very low memory (but extremely low one) and a short duration of it.

So we obtain a panpsychism, where consciousness is everywhere. If consciousness is a quantum phenomenon, it should really exist everywhere.

Searching for the atomization of consciousness is important because these questions are not solved enough. (We are used to connect consciousness with logic, but logic is important only for survival, not necessarily for awareness.)

The next step is to include the idea from Strapp's theory [9], which says that a decision is also the collapse of a wave function. These ideas, together with panpsychism, maybe seem anti-intuitive, but it is important that they agree to all measurements in QM. They disagree to expected quantum phenomena in brains, but quantum collapse in the biological world

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properties, like color, sound, taste, or smell, were merely subjective mental projections which should be excluded from the domain of science." [9, 10]

has been almost never measured or calculated. One good theory is made by Turin [15]. As we will see in the next paragraph, different QM in brains can be checked by an experiment.

The experiment can be designed so that the collapse of a wave function occurs as close as possible to the (unknown) center of the consciousness in brain. For a photon collapse this means in the eye<sup>9</sup> or, still better, at the end of the eye-nerve, but not in an external measurement device. This is a similar experiment as the thought experiment with Schrödinger's cat. If the above model is true, the collapse of the wave function could not be the same as calculated with the common QM. (This is also one type of Turing experiment.)

Such experiment can be carried out also with a micro-organism or with some animals with very good sensibility of some senses.

It is still another aspect of consciousness in quantum world, this is the time arrow. Cramer [16] divides the time arrow in a lot of types of time arrows and one of them is also the psychological time arrow. Cramer put it as consequence of other types of time arrows, but with panpsychism it is possible to put it as the foundation of all types of time arrows.

A hint for this model of consciousness was based on incompleteness of QM. One of reasons for incompleteness of QM was also that QG is unknown. So it is possible to expect an objection that influences of QG are on much smaller scale than that of a biological world. But, QG is important because it will explain space, time, matter, information, the time arrow, etc. Similarly, special relativity is defined at velocities close to the speed of light; but its influences are important also in our slow world because we can see the relation between energy and mass, and we can better understand finiteness of the speed of light.

It is also a general opinion that QG will not yet be "a theory of everything". But, every new theory gives an important new step forward, for instance, QM and general relativity gave new knowledge. In our world it is necessary to explain mass ratios  $\mu_i$ , elementary charge, space, time, consciousness, qualia, and other concepts, but these ones are the most important. Why to wait a hundred steps, where QG will be only one step. It seems that we are very close to correct merging of these concepts. But if we exclude consciousness from QM, a clear solution is really not visible in a few steps.

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<sup>9</sup>A human person can detect a few photons.

## 6 Conclusion

So it is given a new motivation for QG, and consecutive for a theory of everything, - QG will tell us more about limitations in physics, and more about limitations, which want to be exceeded by science fiction or by human desire. So it is shown that the present physics does not tell us enough about fundamental questions. The example with quantum consciousness shows that also the (self-evident) physical laws could be changed. It is also indicated that physical laws can stay the same and lead us to new comprehension and knowledge.

Information is one of the foundations of physics. The Zeilinger-Brukner interpretation of QM [2, 3, 4] is in a right direction. The entropy law is also based on information. (Einstein said that it is a more fundamental law than the energy conservation law.) Consciousness and information are connected. It cannot be imagined that information is used only for unconscious robots and unconscious matter.

So it is possible that searching of foundation of consciousness is a path to uncovering the fundamental physical laws. Therefore, mechanism of working of brains and cells will maybe give breakthroughs to fundamental physics. There is a lot of relatively cheap ways to discover brains, cells and biology, which are not yet used.

At the above theory, it is also more important, what are author's more precise opinions about physics. He tries to prove that consciousness has a quantum cause and he suggests an experiment, he tries to prove that interpretations of QM are not correct enough, he does not believe in "shut and calculate" interpretation of QM, he believes that  $\mu_i$  are base for everything, and he believes that QG is necessary for completeness of QM. But, he does not defend Bohm's interpretation, he does not try to make a perpetuum mobile, and he does not research wormholes.

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