# GRAVITY OF SUBJECTIVITY

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"Let us assume, for simplicity, that there is the God. Yes. The question is, why He will do explosions? Why show bad example to future terrorists on Earth?.." (Essay "God and explosions" by Evgeny A. Novikov, 2012)

**Abstract**

This work is based on quantum modification of the general relativity, which includes effects of production /absorption of gravitons by the vacuum. It turns out, that gravitons created and continued to influence the universe, including people. The theory (without fitting parameters) is in good quantitative agreement with cosmological observations. In this theory we got an interface between gravitons and ordinary matter, which very likely exist not only in cosmos, but everywhere, including our body and, especially, our brain. Subjective experiences are considered as a manifestation of that interface. This opens a possibility of a "communication" with gravitons. Probable applications of these ideas include health (brain stimulation), communication, computational capabilities and energy resources. Social consequences of these ideas can be comparable with the effects of invention and application of electricity.

The physical nature of our subjective experiences is very old big mystery in science. The qualia (subjectivity) required for its description enormous number of degrees of freedom (NDF) and was historically considered as otherworldly. Another more recent big mystery is dark matter (DM), which, according to cosmic observations, interact with ordinary matter (OM) only gravitationally and, in this sense, can be also considered as otherworldly. It is generally accepted, that qualia is not matter, but some sort of information. At the same time, qualia is imbedded in our body, which is made from OM. And here is a catch. Are we sure, that our body does not have a little bit (mass) of DM? The described below quantum modification of the general relativity (QMOGER) [1- 5], supported by cosmic observations, shows that DM is omnipresent and continuously produced everywhere. These works were presided by invention of a new type of fluid, namely, dynamics of distributed sources/sinks [5*]. Recently, DM was identified with gravitons (elementary particles of gravitation) with small, but finite mass and electric dipole moment (EDM) [4, 5 ]. To explain what is EDM, consider neutral particle, which has two electric charges: positive $q$ and negative $-q$, separated by distance $d$, than EDM is equal to $qd$. Nonzero EDM can explain the baryon asymmetry in the universe (prevalence of negatively charged particles over positively charged antiparticles).

Qualia is very likely to be connected with gravitons. How? By been something in between two different types of matter, say, an interface. Indeed, if we, the people, have some gravitons in our body, than Mother Nature had plenty

of time to make use of it by creating special conditions in our neural system in favor of some form of interaction with gravitons. This special form of interaction may not be easily detectable in cosmic data or in the supercollider. So, our neural system could be the natural detector for a new form of interaction between two different types of matter. Qualia seems to be a manifestation of this interaction.

So, people, animals, plants, planets and stars were created by gravitons and are continually influenced by gravitons. That is really important step in unification and understanding of Nature in the spirit of Newton and Einstein. Application of QMOGER to physics, including cosmology, with all that expensive observational technology, are straightforward. Next will be gravimedicine, gravicommunication, gravicomputation and gravienergy resources. New jobs are expected to be created in these and other areas. Social consequences are hard to predict, but expected to be positive. We can learn something from the times of discovery and application of electricity.

In order to make reliable predictions, particularly, related to subjectivity, we need to know how to model its effects. First, considering one person. Than interactions between persons, group behavior etc. In what follows, we will unveil some details concerning subjectivity. This presentation is in accord with the advice of Einstein "The theory should be as simple as possible, but not simpler". Taking into account that problem of subjective experiences is of great interest and importance for general public, the main text in this paper does not include explicit mathematics (except some definitions). However, for experts, in cited papers and in the Appendix (A1 - A3) there are mathematical modeling and technical details.

There is huge literature on modeling of consciousness ( see a collection of papers [ 6 ] and references there). For the purpose of this paper, we will need only specific aspect of such modeling. The phenomena of consciousness can be considered as hierarchy of observations and control [7]. Hierarchical structures appear naturally in systems with big NDF. Typical signatures of such hierarchy are so-called similarity laws (for example, consider power law $y(x) = ax^b$, where $a$ and $b$ are numbers; if we change scales $y \to \lambda y$, $x \to \mu x$, the power $b$ will not change). Particularly, in turbulence the concept of scale-similarity was developed and was associated with the infinitely-divisible probability distributions (which do not change their essential features when subjected to the scaling, see above) [8, A1]. The activity of the human brain also revealed the regime of scale-similarity, which was discovered by using the multi-channel MEG (magnetoencephalogram) [9, 10] and EEG (electroencephalogram) [11] (see also [12]). Hundreds of billions of interconnected neurons and surrounding sells (particularly, astroglia), apparently, is favorable playground for hierarchical structures in the brain. The electrochemical brain activity is taking place in wet and warm surroundings. To reproduce such activity in artificial systems, even approximately, seems impossible. However, modeling of the effects of consciousness [13-15] can be used to enhance performance of artificial stochastic systems [7].

In the modeling [14, 15], the subjective experiences were divided into three major groups: sensations (S), emotions (E) and reflections (R). Note, that sub-

jective S should be distinguished from the automatic sensory input into the neuron system of the brain [16]. Consider so called quaternion (generalization of complex number, see A2), which in our case has real component (the electric current density perpendicular to the cortical surface) and three imaginary components representing the indicated above (S, E, R, or simply SER) - effects. Corresponding imaginary units satisfy conditions: 1) square of each of them is equal to -1; 2) product of two different imaginary units is antisymmetric (changes sign with transposition) and is equal to the third unit with sign determined by the cyclic order ( say, product of the first and second units is equal to the third unit with sign plus, while product of the third and second units gives the first unit with sign minus). Roughly speaking, if we start with positive sensation, followed by positive emotion, we usually come to positive reflection. But, if we start with positive reflection (expectation) and connected with it positive emotion, in testing the reality, we often get negative sensation. This is, of coarse, oversimplification. The model is dynamical and more delicate.

The quaternion is a function of time and space coordinates on the surface of the cortex. The model equation for this quaternion [14, 15] is a nonlinear partial differential equation, which contains the linear wave terms (with the second order time and space derivatives), linear relaxation term and a nonlinear term representing the sigmoidal firing rate of neurons [A2]. If we omit the (SER) -effects, than equation will be similar in spirit to equation used for interpretation of EEG and MEG spatial patterns (see [17] and references therein). Note, that without (SER)-effects the system behaves robot-like, while with (SER)-effects it is more flexible.

The essential point of (SER) - modeling is that imaginary fields produce real effects (testability) because of the nonlinear firing rate of neurons. Note, that complex fields have been used [18] to eliminate classical electromagnetic divergencies, namely, the infinite self-energy of electrons and the paradoxical self-acceleration of electron. The same (algebraic) approach works for the quantum interaction of charges. In new interpretation of quantum theory [19] imaginary trajectory and corresponding momentum play an important role. Such broad usefulness of imaginary field is indicative of a new form of interaction in Nature (see above).

The (SER) - modeling is designed for description of the effects of consciousness on the electric currents in the human brain. In order to advance in the problem of qualia (subjectivity) we now turn to QMOGER [1-5]. According to this theory, there was no Big Bang at the beginning, but some local bangs during the evolution of the universe are probable. An effective age of the universe is about 327 billion years. At that time there was a spec of matter, which we call Premote, with size of Planck scale $l_P = (G\hbar c^{-3})^{1/2} \sim 1.6 \times 10^{-37} cm$ ($G$ - gravitational constant, $c$ - speed of light, $\hbar$ - Planck constant ) and mass about $10^{-128}\ gram$. Production of gravitons with mass $m_0 \sim 0.5 \times 10^{=66}\ gram$, average concentration $n \sim 0.5 \times 10^{37} cm^{-3}$ and electric dipole moment

$\mu = m_0^{1/2} l_P^2 c^{1/2} \sim 10^{-94} gram^{1/2} cm^{5/2}\, \mathrm{sec}^{-1/2}$, has started later after period of "incubation" about 43 billion years. OM was synthesized from gravitons

and some mediators (see below) with mass $m_\alpha = m_0\nu^\alpha (\nu = l_0/l_P \sim 10^{-21}$, $l_0 = m_0 G c^{-2}$, $\alpha > 0)$ as a result of multiple hierarchical collisions in galaxies, which can be considered as a cosmic analog of indicated above hierarchical processes in neural system.

Gravitons are constantly produced by the vacuum everywhere, including our body and our brain. Perhaps, so called biophotons (see [20] and references therein) are related to production of gravitons. Inside neurons and in surrounding sells we may have special conditions, which can facilitates interaction with gravitons. Every living creature may have inside the body and in a halo an enormous number of gravitons without noticeable gravitational effect. At the same time, hierarchical processes in such system with huge number of gravitons can be associated with qualia. In this way, some macroscopic "objective" degrees of freedom are effectively transforming into structures with internal ("subjective") degrees of freedom. In this sense, qualia is manifestation of an interface between dark and ordinary matter (IDOM) [A3]. An analogue of such interface are the ocean waves. More relevant analogue is the scale-similar intermittency [8] with viscous dissipation on very small scales (for turbulence it is Kolmogorov microscale with intermittency correction [8], for qualia it will be Plank scale with possible intermittency correction).

The best way to investigate these effects is, probably, during events of extremal qualia, such as pain or orgasm (preferable). Orgasm has many definitions [21], none of them totally satisfactory. Generally, orgasm has different feeling depending of sources of stimulation (including mental stimulation) and corresponding nerves. Combinations of sources in simultaneous stimulation produce so-called blended orgasms, which are, generally, more powerful (particularly, in women). The physical nature of orgasm is a total mystery. The electrochemical signals repeatedly reach brain and than something happens, which reminds lightning, but in a "mental world". Another case of extremal qualia is improvisational dance (spontaneously creating movements).

The modeling of the effects of consciousness suggests existence of a particle or a group of particles - mediators between gravitons and ordinary matter, which may have a superluminal component (propagating faster than light), related to imaginary field in modeling [A2]. Gravitons can produce mediators spontaneously, or, more likely, during collisions. Mediators in turn contribute into production of additional ordinary photons during the nonlinear process of neuro-firing. So, the one thing, which can be tested during orgasm (or improvisational dance) is enhanced radiation with a peculiar spectrum (power law with possible log-periodic modulation [A1]).

Similar scheme can be applied to cosmic events. Collisions of gravitons produce mediators - sparks of dark matter. In nonlinear process of hierarchical collisions, the "plasma" of gravitons and mediators produces particles of ordinary matter, including ordinary photons. Note, that only small fraction of collisions produces ordinary matter. Cosmological observations (for example, [22]) indicate that more substantial portion of such interactions produce some lumps and clouds of dark matter (gravitons).

Of course, this is only an outline of future theory. Particularly, mediators

with possible connection to Premote (see above) should be worked out in detail. But the major conclusion that qualia manifests IDOM seems to be insensitive to many details of the theory. Indeed, gravitons are the background, from which emerged OM and than emerged qualia (A3). It is argued above, that qualia remains dependent on the background. So, qualia (information with huge NDF) depends on two different types of matter. Such connection can be considered as an interface [23]. In other words, if we accept that graviton are omnipresent, then IDOM should exist.

Do dark matter (gravitons), which we now observe only by the gravitational effect, has some sort of qualia (perhaps, connected to mediators)? If so, are they similar to indicated above SER-qualia, which we possess? And, finally, can we (perhaps, with a proper equipment) "communicate" with gravitons? The positive answer to this question can lead to revolution in the history of humankind. Particularly, humans can cardinally enhance brain power and get access to enormous energy resources and computational capability, as well as a new type of communication.

The idea of omnipresent substance is, actually, very old and some useful medical recommendations are based on it. We should take a closer look at these (thousands years old) recommendations from the point of view of presented theory.

The next steps in the modeling of subjectivity will be interaction between persons and group behavior.

**Appendix**

**A1**. We should distinguish between discrete and continuous self-similarity. In the discrete case there is a preferable scale factor leading to the logarithmically periodic modulations [3]. For example, power laws, like $y(x) = ax^a$ will be replaced by $y(x) = ax^b F[\ln(x)]$, where function $F[z]$ is periodic: $F[z+\gamma] = F[z]$ and $\gamma$ is the scale factor.

**A2**. Consider quaternion:

$$q = \alpha + i_p \psi_p \tag{1}$$

Here $\alpha(t)$ is the average (spatially uniform) current density perpendicular to the cortical surface, $\psi_p(t)$ represent the indicated above (S, E, R) - effects and summation is assumed on repeated subscripts from 1 to 3. The imaginary units $i_p$ satisfy condition:

$i_p i_s = \varepsilon_{psr} i_r - \delta_{ps}$, where $\varepsilon_{psr}$ is the unit antisymmetric tensor and $\delta_{ps}$ is the unit tensor. It is a compact form of conditions: $i_1^2 = i_2^2 = i_3^2 = -1$, $i_1 i_2 = -i_2 i_1 = i_3$, $i_2 i_3 = -i_3 i_2 = i_1$, $i_3 i_1 = -i_1 i_3 = i_2$.

The model equation for the quaternion $q$ has the form [9, 10]:

$$\frac{\partial q}{\partial t} + kq = f(q + \sigma) + \phi, \quad \sigma = s + i_p \varphi_p \tag{2}$$

Here $k$ is the relaxation coefficient, $f$ represents the sigmoidal firing rate of neurons [for example, $f(\alpha) = \tanh(\alpha)$], $\phi$ represents the external electromagnetic

(EM) excitations (stimulations). The quaternion $\sigma$ is the averaged sensory input, which has real component $s$ and imaginary components $\varphi_p$ (which can be associated with the influence of gravitons and mediators).

For the case of spatially nonuniform $q(t,\mathbf{x})$, $\sigma(t,\mathbf{x})$ and $\phi(t,\mathbf{x})$, we can use more general equation, which include typical propagation velocity of signals in the neuron system of the cortex $v$. Time differentiation of (2), simple algebra and addition a term with the two-dimensional spatial Laplacian $\Delta$ gives [9, 10]:

$$\frac{\partial^2 q}{\partial t^2} + (k+m)\frac{\partial q}{\partial t} + (km - v^2\Delta)q = (m + \frac{\partial}{\partial t})f(q+\sigma) + \frac{\partial \phi}{\partial t} \qquad (3)$$

where $m$ is an arbitrary parameter (see below). Real and imaginary projections of (14) give a system of four partial differential equations for $\alpha$ and $\psi_p$. If we put $\psi_p = 0$ and $\phi = 0$, than equation for $\alpha$ will be similar in spirit to equation used for interpretation of EEG an MEG spatial patterns (see [12] and references therein). In this context we have parameters: $k \sim m \sim v/l_c$ , where $l_c$ is the connectivity scale.

**A3.** Interface between gravitons (dark matter) and ordinary matter (IDOM) with presence of qualia can be described as part of general scheme:

$$\mathrm{Pr}\,emote \rightarrow gravitons \rightarrow mediators \uparrow\rightarrow ordinary\ matter \rightarrow qualia \uparrow \qquad (4)$$

where Premote and mediators are explained above. This simple scheme can have loops (indicated by vertical arrows) for potential "communication" of human with gravitons.

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[23] It did not escape my attention, that this approach has important philosophical consequences. Particularly, nonmaterial entities can be considered as interfaces (or collections of interfaces) between different types of matter. Also, the approach can be imbedded in a mathematical structure, similar to the category theory [24], with morphisms (arrows in A3) and formalized interfaces, but that is another story.

[24] See an excellent review: J. C. Baez and M. Stay, arXiv:0903.0340