A reconsideration of quantization of gravitational field

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Abstract

The question of quantization of gravitational field is analyzed and reconsidered in this work. Relativistic and non-relativistic models of quantum gravity are considered. elementary mass, energy and momentum. I deduces equations which describe quantum gravitational field in and contain all three fundamental constants G, c, h.

Contents

1 Introduction

Many physicists failed to create quantum theory of gravitation during decades [1-15], thou a big variety of different models and approaches have been published. Many physicists admit:

> "there are fundamental structural and conceptual mismatches between general relativity and quantum theory. This raises the tantalizing possibility that radical new ideas may be needed to construct a quantum theory of gravity." [10] (see also [5]).

> "The problem of finding and understanding the relationship between quantum theory and gravitation is an extremely difficult one...The difficulties, however, are such that we might well need radical changes in our views or completely new ideas before the problem can be solved." [11]

Therefore a reconsideration of quantization of gravitational field is needed and is presented in this work. And I use radical new ideas.

2 Solution of speed-of-light catastrophes in quantum gravity

There is a speed-of-light catastrophe in quantum field theory [16-22]: if massless particles or fields emit massless particles or fields, non-removable singularities appear.

According to graviton hypothesis, graviton is massless [23], hence massless photon emits massless graviton, hence graviton assumption leads to non-removable singularities [16-22]. But "the prediction of a singularity by a physical theory indicates that the theory has broken down, i.e. it no longer provides a correct description of observations" [24]. Hence, the graviton concept "has broken down".

I offer a simple and a radically new solution of the speed-of-light catastrophe: if graviton does not exist, then photon does not emit graviton. Therefore *my model of quantum gravity has not these singularities.*

Graviton was not yet found experimentally [25-27]. A speculation for graviton [28] was refuted in [29].

Of course, my hypothesis about non-existence of graviton is a radical new idea. Let's analyze this hypothesis form other view-points.

3 A new approach: elementary charge emits the quantum of field

3.1 Cause of quantization of electromagnetic field is elementary electric charge

Usually physicists think so: since both energy and momentum are quantized, then gravitational field is quantized too [12]. Therefore there is a hypothesis that gravitational field is built of its quanta - gravitons.

Before quantization of gravitational field, I offer to understand why electromagnetic field is quantized in QED. *It is done because there is elementary electric charge. Electric charge is discrete - there is no charge less than elementary one, and any other charge is rigorously multiple to the elementary charge e.* Free quarks with fractional charge are not found yet, though it's not important here. Electric charge doesn't accept infinitesimal values with continuous spectrum, but is discrete.

Elementary electric charge can emit elementary electromagnetic field - electromagnetic field quantum - virtual photon. Therefore electromagnetic field has quantum structure: it's built of virtual photons. It is obvious.

So, *the fact of existence of elementary electric charge is the cause of quantization of electric field.*

So, *in general, elementary charge emits elementary field.* All leptons and quarks possess elementary weak charge and therefore they are able to emit elementary weak field - its quanta - W and Z bosons.

3.2   Is there elementary energy-momentum tensor?

As you know, according to general relativity, gravitational field is curvature of spacetime caused by energy-momentum tensor of matter T_{ik}:

$$R_{ik} - g_{ik}R/2 = \frac{8\pi G}{c^4}T_{ik}$$

Therefore, using analogy with elementary electric charge, I ask: is there elementary energy-momentum tensor T_{ik}? Is it discrete? Is there elementary mass, elementary energy and elementary momentum in quantum mechanics? Are there such minimal, elementary mass m_{el}, elementary energy E_{el} and elementary momentum p_{el} that all other values of mass, energy and momentum would take strictly proportional values?

$$M = nm_{el}$$

$$E = nE_{el}$$

$$p = np_{el}$$

$$n \in N$$

4   Non-relativistic quantum gravity: elementary mass does not exist

It's obvious that the rest masses of all elementary particles are not proportional to each other. There is no elementary mass in contrary to electric charge. Therefore gravitational field is not quantized in non-relativistic quantum gravity.

This means that gravitational interaction between elementary particles in non-relativistic quantum gravity is described by Newtonian classical theory of gravitation without gravitons.

5 Relativistic quantum gravity: elementary energy and elementary momentum do not exist

5.1 Elementary energy and momentum do not exist for massive particles

Energy and momentum depend on mass and speed. There is no elementary mass. As it's well known, speed is not discrete, is not quantized in quantum mechanics too.

Sometimes quantum gravity models contain hypothesis about discrete space-time [30-31]. However it is easily to prove that *speed is not discrete independently on whether time or space is discrete*. Speed is v=s/t, where s is distance and t is time. If space or time is discrete, then this problem can be solved logically so.

If both time and space are not discrete, then speed is not discrete. If $s \in R$ and $t \in R$, then $s/t \in R$, i.e. speed is not discrete.

If time is discrete and space is not, then speed is not discrete. If $s \in R$, then $s/t \in R$, i.e. speed is not discrete.

If time is not discrete and space is, then speed is not discrete. If $t \in R$, then $s/t \in R$, i.e. speed is not discrete.

If both time and space are discrete, then speed is not discrete anyway. Indeed, even if there are elementary discrete distance s_{el} and elementary discrete time t_{el}, then speed - their ratio - is a rational number, but not not a natural number, i.e. speed is not discrete. Let's prove that elementary speed v_{el} does not exist:

$$v_{el} = \lim_{s \to s_{el}} \lim_{t \to \infty} \frac{s}{t} = 0$$

So, independently on whether space and time are discrete or are not, speed is not discrete! Consequently, there is no elementary speed.

And since energy and momentum of massive particles depend on their speed, then elementary energy and momentum do not exist for massive particles. Energy and momentum of massive particles are not discrete.

5.2 Quantization of gravitational field of massive particles: graviton does not exist

Since energy and momentum of massive particles are not discrete, then energy-momentum tensor T_{ik} of massive particles is not discrete too. Hence left hand side in

$$R_{ik} - g_{ik}R/2 = \frac{8\pi G}{c^4} T_{ik}$$

is not discrete too, i.e. gravitational field is not discrete too, i.e. there are no gravitons.

Indeed, let ΔT_{ik} is a very small growth of energy-momentum tensor caused by a very small growth of the speed of an elementary particle. Since speed is not discrete, then:

$$\lim_{\Delta v \to 0} \Delta T_{ik} = 0$$

Hence,

$$\lim_{\Delta v \to 0} (\Delta(R_{ik} - g_{ik}R/2)) = \frac{8\pi G}{c^4} \lim_{\Delta v \to 0} \Delta T_{ik} = 0$$

This means that gravitational field change may be as small as possible, i.e. graviton does not exist.

5.3 Elementary energy and momentum do not exist for massless particles

Energy and momentum of a photon are $E = h\nu, p = h/\lambda$. Usually physicists believe that $h\nu$ is the elementary energy. However this is wrong because *the frequency ν in $h\nu$ can accept any small values*. Energy $h\nu$ is the energy of a quantum of electromagnetic radiation of frequency ν. But this is not the elementary energy.

Of course, energy is quantized $E = nh\nu$ *for every certain frequency ν*. So is momentum for every certain wavelength.

However is frequency is not discrete, minimal elementary frequency does not exist:

$$\nu_{el} = \lim_{T\to\infty} \frac{1}{T} = 0$$

Therefore there is no elementary energy and elementary momentum:

$$E_{el} = \lim_{T\to\infty} E = \lim_{T\to\infty} h\nu = \lim_{T\to\infty} \frac{h}{T} = 0$$

$$p_{el} = \lim_{T\to\infty} p = \lim_{T\to\infty} \frac{h\nu}{c} = \lim_{T\to\infty} \frac{h}{Tc} = 0$$

$$p_{el} = \lim_{\lambda\to\infty} p = \lim_{\lambda\to\infty} \frac{h}{\lambda} = 0$$

5.4 Quantization of gravitational field of massless particles: graviton does not exist

Since energy and momentum of massless particles are not discrete, then energy-momentum tensor T_{ik} of massless particles is not discrete too. Hence left hand side in

$$R_{ik} - g_{ik}R/2 = \frac{8\pi G}{c^4} T_{ik}$$

is not discrete too, i.e. gravitational field is not discrete too, i.e. there are no gravitons.

There is no elementary mass, elementary energy and elementary momentum able to emit gravitational field quantum - hypothetical graviton. Photon's energy density $T_{00} = E/V = h\nu/\lambda^3 = h\nu^4/c^3$:

$$R_{00} - g_0R/2 = \frac{8\pi G}{c^4} T_{00} = \frac{8\pi Gh}{c^7}\nu^4$$

Consequently,

$$(R_{ik} - g_{ik}R/2) \in R_+ \tag{1}$$

$$\lim_{\nu\to0}\left(R_{00} - \frac{g_{00}R}{2}\right) = \frac{8\pi Gh}{c^7}\lim_{\nu\to0}\nu^4 = 0 \tag{2}$$

i.e. gravitational field is not quantized, there is no gravitational field quantum - graviton.

Therefore, according to my model, *even in quantum theory the gravitational field is only geometrical, is just curvature of spacetime, but not Bose-condensate of virtual gravitons.* Equation (1) is a quantum description of relativistic gravitational field in my quantum theory of gravitation. It describes absence of graviton.

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