Possible Development of the Newton Gravitational Theory of Interactions. An Alternative Approach to the Gravitational Theory

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Abstract

This work is devoted to the discussion of an idea that gravitational interactions might be residual interactions of strong and electromagnetic interactions. Then, absence of the carriers of the gravitational interactions finds a natural explanation in the framework this idea. Besides, since masses (charges of the gravitational interactions) of particles are generated in strong, electromagnetic (and possibly, in other) interactions and if masses of the particles will be not generated in these interactions (i.e. \( m \equiv 0 \)), then the gravitational interactions do not appear. That is also indirect confirmation of the considered idea. Connections between charge of the gravitational and other interactions are considered.

1 Introduction

The Einstein theory of gravitational interactions [1] supposes that all particles and bodies having energy, participate in the gravitational interactions (i.e. gravitational charge is \( m_{\text{eff}} = \frac{E}{c^2} \), \( c \) is the light velocity). The Newton theory of gravity states that only massive particles and bodies (masses are charges) participate in interactions:

\[
E = -G \frac{m_1 m_2}{r},
\]

where \( E, G \) are energy and constant of gravitational interactions, \( m_1, m_2 \) are masses of interacting particles or bodies and \( r \) is distance
between bodies or particles. Here, we see that massless bodies and particles cannot participate in Newton gravitational interactions (photon is such particle). In the Einstein gravity theory photons participate in the interactions since they have energy (but \( m = 0 \)) and effective mass is \( m_{\text{eff}} = \frac{E}{c^2} \). The Einstein gravity theory is constructed as a development of the Newton gravity theory and there is supposed that charge of the gravitational interactions is connected with the forth component of energy-momenta tensor. Afterwards, this theory was checked on practice [2, 3]. But concrete form of interpretation of these experiments is under critical analysis [4-9], and it is hard to come to conclusion that this theory is confirmed. In this connection, there arises necessity of searching (constructing) of the correct theory of gravity, as well as deeper understanding of the nature of origin of the gravity interactions.

2 Alternative Approach to the Theory of Gravitational Interactions

In the work [9] it was shown that in the Newton gravity theory takes place a single shift of atomic and nuclear levels connected to changing effective masses of electrons and nucleons in external gravity fields (similar to the Stark effect [10] in external electric fields or level displacements in external magnetic fields [11]). And in the Einstein gravity theory [1] since the photons participate in gravitational interactions there must arise the same shift at moving photons through the gravitational field, and as a result there must take place double shift. In the experimental results obtained in [2, 3], there is only single shift, i.e. the change of photon frequency at his going through gravitational field does not arise. It means that the hypothesis that gravitational charge can be connected to the tensor energy-momentum is not confirmed. Then, the following question arises: Could we come to this experimental result from the general positions of the theory of interactions? At present, we know four interaction types: electromagnetic, strong, weak and gravitational [12]. The theory of electromagnetic, strong
and weak interactions are constructed on the principle of the gauge invariance. In these theories the charges are scalars and invariant values (i.e. are not changed depending of coordinate system movements). In the Newton gravitational theory, the masses are charges, which are scalars and invariant values, i.e. this theory fulfills the basic demand of the theory of interactions (remark about gauge invariance of gravity theory, see below). In the Einstein theory of gravity the demand of invariance of charge is not fulfilled. Really, on the experiments on measurement frequencies shift the Einstein hypothesis is not confirmed. If the gravitational interactions take place through forth component of energy-momentum then it is possible to connect this interaction with space curvature [1]. Since photons and another massless particles do not participate in the gravitational interactions, then necessity in this approach disappears and it is not necessary to construct the gravity theory on base of the second rank tensor. Then is stayed open the question about what types is the gravitational interactions? Obviously, the more attractive solution in this case is to construct vector theory of gravitation.

An another very interesting approach to the problem of gravity is discussed in work [13].

What do we know about the gravity? The Newton theory of gravity is well proved. These interactions are the long distance ones. The sign of gravity charge $m$ (mass) of particle and antiparticle coincide, i.e. $C$ (charge) parity is completely violated and the charge of particle and antiparticle coincide (it means that in these interactions polarization is absent). The carries of these interactions were not found. Probably it means that there are no any carriers of these interactions. Besides, masses of particles are generated mainly by strong and electromagnetic interactions (probably, there is another source of masses besides the strong and electromagnetic interactions which generate $W, Z$ boson masses [12]). If the particle masses are not generated by these interactions, (i.e. $m = 0$) there cannot be any gravitational interactions. Then, probably, gravitational interactions are residual interactions of the above interactions (by analogy with the Van der Vaalse
forces [14] in the atomic physics) which generate masses (charges) of the gravitational interactions.

It is clear that if we want to construct gauge theory of gravitational interactions it must be $U(1)$ theory since these interactions are long distance interactions. In $U(1)$ gauge theory charge must be discrete (quantized) but in these interactions charge (masses are not discrete values). And there must be charges with opposite signs where charges of the same sign are repulsed (and charges of the opposite sign are attracted). In the gravitational interactions are only charges (masses) of the same sign and they are attracted. So we see that it is impossible to construct gauge theory of the gravitational interactions in a straight manner and probably these interactions are residual ones with violated $U(1)$ gauge symmetry.

Let us connect the charge of the residual (gravitational) interactions to the charge of strong interaction. Mass $M_A$ of a nucleus $A$ in rough approximation is equal to the masses of $Z$ protons and $N$ neutrons forming this nucleus

$$M_A \approx Zm_p +Nm_n. \quad (2)$$

Supposing that $m_p \approx m_n \approx m_N$ ($N$ is nucleon) and the mass of nucleon is formed by the strong interactions, one can write the following expression:

$$m_N = g_{strong}C \approx 1 \ G eV, \quad (3)$$

where $C$ is constant of the scheme where the mass is computed [12].

Then

$$M_A \approx Am_N, \quad (4)$$

and then we can construct gravitational interactions of the nuclei (and matter composing from nuclei). Now, we will return to the nucleon. From the Exp.(3) and supposing that $g_{strong}^2 \approx 0.1$, we have

$$C^2 = \frac{m_N^2}{g_{strong}^2} \approx 10 \ G eV^2.$$

Now, let’s consider energy of gravitational interaction of two nucleons:

$$E_N = -G \frac{m_N m_N}{r} \approx G \frac{C^2 g_{strong}^2}{r} = -G \frac{g_{strong}^2}{r}, \quad (5)$$
where constant $\bar{G}$ is the value having no measurement and it is measure of suppression of the constant of the strong interactions

$$\bar{G}C^2 \approx G \cdot 10 \cdot GeV^2 = 1.66 \cdot 10^{-4}, \quad (6)$$

i.e.

$$E_N \approx -1.66 \cdot 10^{-4} \frac{g_{\text{strong}}^2}{r} = -\bar{G}\frac{g_{\text{strong}}^2}{r}, \quad g_{\text{grav}}^2 = 1.66 \cdot 10^{-4} g_{\text{strong}}^2. \quad (7)$$

We see that in this approach the constant of the gravitational interactions is a value without measurement and $\bar{G}$ is measure of suppression of the strong interactions and residual charge is $g_{\text{grav}}$.

Repeating the same consideration taking into account the electric charge $e$, we get

$$E_N = -2.27 \cdot 10^{-3} \frac{e^2}{r} = -\bar{G}'\frac{e^2}{r}, \quad g_{\text{grav}}^2 = 2.27 \cdot 10^{-3} e^2. \quad (8)$$

Probably, the residual charge of strong and electrical interactions must be equal if the gravitational interactions are universal ones; then the residual gravitational interactions can appear at a joint of strong and electromagnetic interactions.

The objective of this work is to attract opinion to the considered possibility, which explains absence of carriers of the gravitational interactions, and in this case the couple constant of gravitational interactions is a value without measurement.

## 3 Conclusion

In this work, we have discussed the idea that gravitational interactions may be residual interactions of the strong and electromagnetic interactions. Then, absence of the carriers of the gravitational interactions finds a natural explanation. Besides, since masses (charges of the gravitational interactions) of particles are generated in strong, electromagnetic (and possibly in other) interactions, and if masses of the particles are not generated in these interactions (i.e. $m \equiv 0$), then
the gravitational interactions do not appear. That is also indirect confirmation of the considered idea. Connections between the charge of gravitational and other interactions are considered.

In conclusion we would like to do some remarks about verification of the gravitational theory:

1. In the experiments with the Sun participant it is necessary to take into account diffraction, refraction and the strict content of the Sun atmosphere.

2. In the experiments with the light and the radio wave in the Sun system it is necessary to take into consideration strict compositions and distributions of gasses in the Sun system.

3. In the experiments on linsing it is also necessary to take into account strict composition and distribution of gasses in inter star and inter galactic space.

References

1. A. Einstein, Ann. Phys. (Leipzig) 49, 769, (1916);
   L.D. Landau, E.M. Lifshits, Field Theory, M., Nauka, 1988, p.324.
2. R.V. Pound, G.A. Rebka, Phys. Rev. Let. 4, 337, (1960);
   R.V. Pound, J.L. Snider, Phys. Rev. 140, 788, (1965).
3. J.L. Snider, Phys. Rev. Let. 28, 853, (1972).
4. P. Marmet, Einstein’s Theory of Relativity versus Classic Mechanics, Newton Physics Books, Canada, 1997;
5. P. Marmet and C. Couture, Physics Essays, 1999, v.12, p.162.
6. V.N. Strel’tsov, JINR Communic. P2-96-435, Dubna, 1996; JINR Communic. P2-98-300, Dubna, 1998; Apeiron, 6, 55,(1999).
7. V.V. Okorokov, ITEP preprint N 27, Moscow, 1998.
8. L.B. Okun, K.G. Selivanov and V.L. Telegdi, UFN (Russian Journ.) 169, 1140, (1999).
9. Kh. M. Beshtoev, JINR Commun. P4-2000-45, Dubna, 2000; 
   Physics Essays 2000, v.13, p.593; Proced. of the 27-th ICRC, 
   Hamburg, Germany, v.3, p.1183.
10. G. Bethe, E. Solpiter, Quantum Mechanics of Atoms 
    with One and Two Electrons, Moscow, 1960.
11. W. Gerlach, O. Stern, Der Experimentelle Nachwies 
    der Richtungsquantelung in Magnetfield, Z. Phys., 
    1922, Bd.9, s.349.
12. The Europian Phys. Journ. C, Review of Particle Phys. 2000, 
    v.15, N1-4.
13. A. A. Tayapkin, Proceedings of the IV-th Scientific 
    Conference Young Scientists and Specialists of JINR, Dubna, 
    2000, p.49.
14. A. L. Buchachenko, Chimical Polarizations of Electrons 
    and Niclei, Moscow, 1974.