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Gravitational Constant under the Strong Electromagnetic Field

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Abstract

The author published a paper on the gravitational force generated by an interaction between matter and the ZPF field in the vacuum. This paper shows a new model of gravitation which is based on the interaction between matter and the ZPF field in a vacuum. From the equation of quantum electrodynamics, it can be derived that a gravity constant is not a constant but it can be decreased by the strong electromagnetic field. From this result, it can be seen that the celestial body with a high intensity electromagnetic field has a gravitational force which is different from the celestial body with no electromagnetic field. If the cutoff frequency of the zero point field is not so high as the Plank frequency, the weight of the material will be decreased by applying extremely high frequency electromagnetic radiation.

Keywords: gravity, ether, ZPF field, electromagnetic fluctuation, gravitational constant, vector potential, strong electromagnetic field.

1. Introduction

As early as 1951, P.A.M. Dirac published two papers where he pointed out that we should take into account quantum fluctuations in the flow of the aether (Dirac, 1951; Dirac, 1952). Inspired by the Dirac ideas, K.P. Sinha, C. Sivaram, and E.C.G. Sudarshan published in 1975 a series of papers that suggested a new model for the aether, in which it is a superfluid state of fermion and anti-fermion pairs, describable by a macroscopic wave function (Sinha et al., 1976; Sinha et al., 1976a; Sinha, Sudarshan, 1978). In their papers, they decided to treat the superfluid as a relativistic matter by putting it into the stress-energy tensor of the Einstein field equations.

Sakharov has proposed a suggestive model in which gravity is not a separately existing fundamental force, but rather an induced effect associated with zero-point fluctuations (ZPF's) of the vacuum, in much the same manner as the van der Waals and Casimir forces. In the spirit of this proposal, Puthoff developed a point-particle–ZPF interaction model that accords with and fulfills this hypothesis (Puthoff, 1989). In the model gravitational mass and its associated gravitational effects are shown to derive in a fully self-consistent way from electromagnetic-ZPF-induced particle motion (Zitterbewegung).

Based on their ideas, the author considered the mechanism of gravitation based on the interaction between matter and the ZPF (zero-point fluctuations) field contrary to Einstein's general relativity theory which claims that the gravitation is due to the curvature of the space (Musha, Pinheiro, 2021).

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2. Results

Gravitation from the standpoint of the ZPF Energy in the Vacuum

Zero-point energy (ZPE) is the lowest possible energy that a quantum mechanical system may have. Unlike in classical mechanics, quantum systems constantly fluctuate in their lowest energy state as described by the Heisenberg uncertainty principle (i.e., the ZPF field). Based on Sakharov's idea, Puthoff proposed a gravitation mechanism by an interaction between elementary particles and the ZPF field (Puthoff, 1989). He considered that gravitational force is an induced effect associated with ZPF of the vacuum in much the same manner as the van der Waals and Casimir forces. But he didn't succeed to fully explain the mechanism of gravitation.

Jordan-Mbeutchou proposed a new model for Newtonian gravity by assuming space is filled with an ether (or aether) fluid (Ngucho, Fleury, 2019). He modeled gravity as an interaction between matter and ether fluid. He assumed that matter can absorb ether fluid proportionally to its mass. This phenomenon can be described by

$$\rho_e \nabla \cdot \vec{v}_e = -\rho / \tau, \quad (1)$$

where ρ_e is a density of ether, $\vec{v}_e$ is its velocity field, ρ is normal matter mass density and τ is a time constant.

Then the radial velocity of the ether which flows in a sphere with a radius r becomes

$$\vec{v}_e = -\frac{1}{4\pi\rho_e\tau}\frac{m(t)}{r^2}\vec{e}_r, \quad (2)$$

where $\vec{e}_r$ is the radial unitary vector.

Then he obtained the formula of gravitation shown as

$$\frac{d}{dt}\vec{P} = -\lim_{r_1\to 0}\int_S \rho_e(\vec{v}_1+\vec{v}_2)[(\vec{v}_1+\vec{v}_2)\cdot\vec{e}_1]dS = \frac{4}{3}\frac{1}{4\pi\rho_e}\frac{m_1 m_2}{\tau^2}\frac{1}{r^2}\vec{e}_z, \quad (3)$$

where $\vec{e}_1 = \vec{o_1 e}/o_1 e$ ($o_1 e = r_1$), $\vec{e}_z = \vec{o_1 o_2}/o_1 o_2$ and $o_1 o_2 = r$ as shown in Figure 1.

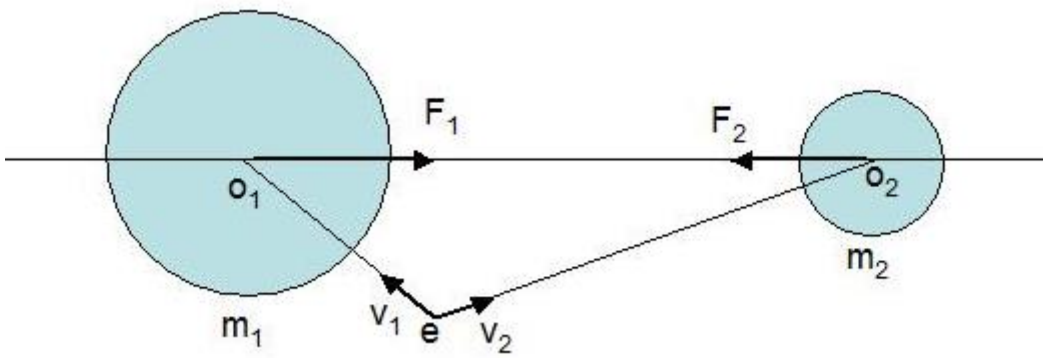

Fig. 1. Two rest masses undergo the force generated the flow of ether

Contrary to the Puthoff model of gravitation, the author considered the gravity mechanism according to the Jordan-Mbeutchou model. The following is the derivation of a gravitational force by the ZPF field.

We assume that virtual particles (most of them are virtual photons) created from the ZPF field in a vacuum push matter, then the momentum flux density of virtual particles can be shown as

$$\nabla \cdot \vec{J} = -\rho_m / \tau_0, \quad (4)$$

where $J = \rho_E / c$ (ρ_E: energy density of the ZPF energy), ρ_m is an equivalent mass density of the ZPF field and τ_0 is a retardation time. For the ZPF filed, we have the equation similar to Eq.(3) as

$$\frac{d}{dt}\vec{P} = -\lim_{r_1\to 0}\int_S (\vec{p}_1 + \vec{p}_2)[(\vec{p}_1 + \vec{p}_2)\cdot \vec{e}_1]/\rho_m \cdot dS . \qquad (5)$$

If $\vec{\omega}$ is defined as $\vec{\omega} = c\vec{k}$ where $\vec{k}$ is a wave vector satisfying $k = \omega / c$, we can write $\vec{p} = \hbar\vec{\omega}/c$ and $\rho_m = \hbar\omega / c^2$, the amount of momentum created by the ZPF field can be shown as

$$\frac{d}{dt}\vec{P} = -\lim_{r_1\to 0}\int_S \frac{\hbar}{c}(\vec{\omega}_1 + \vec{\omega}_2)\frac{c^2}{\hbar\omega}[(\frac{\hbar\vec{\omega}_1}{c} + \frac{\hbar\vec{\omega}_2}{c})\cdot \vec{e}_1]dS$$
$$= -\lim_{r_1\to 0}\int_S \frac{\hbar\omega}{c^2}\left(\frac{c\vec{\omega}_1}{\omega} + \frac{c\vec{\omega}_2}{\omega}\right)\left[\left(\frac{c\vec{\omega}_1}{\omega} + \frac{c\vec{\omega}_2}{\omega}\right)\cdot \vec{e}_1\right]dS , \qquad (6)$$

where $\vec{\omega}_1$ and $\vec{\omega}_2$ are vectors of the radial frequency of the ZPF field at the point e, as shown in Figure 1. According to the Jordan-Mbeutchou model, we have

$$(\vec{\omega}_1 + \vec{\omega}_2)\cdot \vec{e}_1 = \omega_1(r_1) + \omega_2(r_2)\frac{r_1 - r\cos\theta}{\sqrt{r_1^2 + r^2 + 2rr_1\cos\theta}} , \qquad (7)$$

where θ is $\angle o_2 o_1 e$ and $o_1 e = r_1$, $o_2 e = r_2$ in Fig.1.

When we let $c\vec{\omega}_1/\omega \to v_1$ and $c\vec{\omega}_2/\omega \to v_2$, then the force at the point o_1 in Figure 1 becomes the equation, which is similar to Eq.(3), according to the Jordan-Mbeutchou model (Jordan, Y-Mbeutchou, 2021).

$$F = \frac{d}{dt}P = \frac{\hbar\omega}{c^2}\frac{4}{3}\frac{4\pi}{(4\pi\rho_m)^2}\frac{m_1 m_2}{\tau_0^2}\frac{1}{r^2}\vec{e}_z = \frac{1}{3\pi}\frac{c^2}{\hbar\omega\tau_0^2}\frac{m_1 m_2}{r^2}\vec{e}_z , \qquad (8)$$

where a gravitational constant is given by $G = \frac{1}{3\pi}\frac{c^2}{\hbar\omega\tau_0^2}$.

If the cutoff frequency of the ZPF field ω equals to the Plank frequency given by $\omega = 1{,}855\times 10^{43}(Hz)$, the retardation time can be estimated as $\tau_0 = 2.7\times 10^8(\sec)$. The Equation.(8) shows that the gravitational force can be generated by an interaction between matter and the ZPF field in a vacuum. According to this equation, the Newtonian gravitational law can be obtained without ether flow in the vacuum. Hence it is considered that the gravity is an electromagnetic phenomenon induced by the ZPF field in the vacuum and it is not due to the curvature of space as claimed by Einstein.

3. Gravitational Constant is not a Constant under the High Intensity Electromagnetic Field

Under an intense electromagnetic field, it has been theoretically predicted that electron experiences an increase of its rest mass.

Let H_A be the electrodynamic Hamiltonian of the particle under high electromagnetic field, it has the form shown as

$$H_A = \frac{e^2}{2m_0c^2} < A^2 > , \qquad (9)$$

which was analogically discovered by Milonni shown in the paper by Haish, Rueda and Puthoff (Haish et al., 1994), where m_0 is the rest mass of the particle, e is its charge, A is the vector potential of electromagnetic field and c is the light speed.

The similar equation by using terms of the ZPF field was also proposed by Haisch, Rueda and Puthoff shown as (Haish et al., 1994)

$$H'_A = \frac{e^2\hbar}{2\pi\ m_0 c^3}\omega_c^2\ , \qquad (10)$$

where $\hbar$ is a Plank constant divided by 2π and ω_c is a cutoff frequency of ZPF spectrum in the vacuum. Assuming that electrodynamic Hamiltonians, shown in Eqs. (9) and (10), are identical with each other, we have $\Delta H_A = \Delta H'_A$ for the elementary particle under impressed electric field as shown in Figure 2.

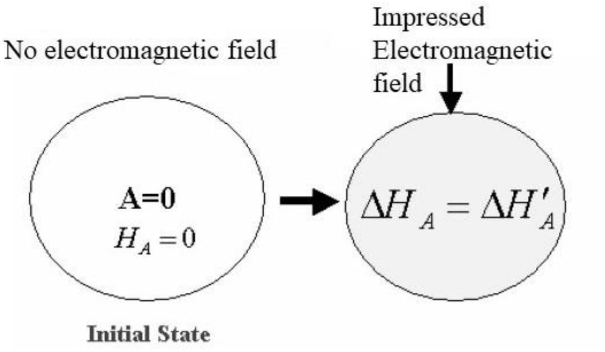

Fig. 2. ZPF field and an impressed electromagnetic field

From which, we have an equation on the mass shift of the particle.

We suppose that the cutoff frequency of the vacuum is shifted as $\omega_C = \omega_0 + \Delta\omega$ when the electromagnetic field is impressed to the elementary particle, $\Delta H'_A$ becomes

$$\Delta H'_A = \frac{e^2\hbar}{2\pi m_0 c^3}\{(\omega_0 + \Delta\omega)^2 - \omega_0^2\} \approx \frac{e^2\hbar}{\pi m_0 c^3}\omega_0\Delta\omega\ , \qquad (11)$$

where ω_0 is the Plank frequency given by $\omega_0 = \sqrt{c^5/\hbar G} \approx 3\times 10^{43}$ Hz.

We can suppose that $H_A = 0$ at the initial state, then we obtain the formula given by (Musha, 2008)

$$\Delta\omega \approx \frac{\pi\ c}{2\hbar\omega_0} < A^2 > . \qquad (12)$$

Then the gravitational constant becomes

$$G = \frac{1}{3\pi}\frac{c^2}{\hbar(\omega + \Delta\omega)\tau_0^2}\ . \qquad (13)$$

From this equation, the gravitational constant decreases when the strong electromagnetic field is impressed to the matter from the equations $B = \nabla\times A$ and $E = -\partial A/\partial t$, or

$$A = \frac{1}{4\pi}\int_V \frac{\nabla\times B}{|r - r'|}d^3r' - \frac{1}{4\pi\ c^2}\int_V \frac{\dot{E}}{|r - r'|}d^3r'\ , \qquad (14)$$

where $\dot{E}$ is a time derivative of E.

From this result, the celestial body with a high intensity electromagnetic field has a gravitational force which is different from the celestial body with no electromagnetic field. If the cutoff frequency of the zero point field ω in Eq.(13) is not so high as the Plank frequency, the weight of the material will be decreased by applying extremely high frequency (EHF) electromagnetic radiation according to these equations.

3. Conclusion

In this paper, the gravity mechanism by an interaction between matter and the ZPF field in the vacuum is discussed. According to the Jordan-Mbeutchou model, it becomes clear that the gravity mechanism can be explained by an interaction between matter and the ZPF field. From which, it can be seen that a gravity constant is not a constant but it can be decreased for the matter under the high intensity electromagnetic field. This result may give us a new insight regarding our Universe.

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