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Research Article

New Formulation of the Law of Universal Gravitation

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Abstract

New relationships for the force of gravity, gravitational acceleration, gravitational potential and escape velocity have been formulated. It has been shown that these quantities are dependent on the difference of relativistic gravitational coefficient measured at the ends of the Compton wave for a body placed in a gravitational field. The dependence force of gravity on the Compton period is presented. Formulas of force of gravity are presented in both relativistic and nonrelativistic form.

Introduction

The law of universal gravitation is one of the best known physical theories. According to Einstein's general theory of relativity, gravitational interaction is a consequence of space-time curvature caused by the presence of gravitational field source mass [1]. The gravitational impact and its consequences have been confirmed in both the classical and relativistic versions. Unfortunately, despite the great compatibility of experience with the theory of gravity, the mechanism of gravitational interaction has not yet been explained. According to experience, strong, weak and electromagnetic interactions are a consequence of the exchange of appropriate field particles [2]. The theory of gravity postulates the presence of interaction particles called gravitons [3]. However, they have not been experimentally discovered so far. This is mainly due to the postulated negligible mass of these particles, which causes difficulties in constructing a suitable detector. It seems that the only way to learn about gravitons is through a relevant theory that explains the mechanism of spacetime curvature. From the four dimensions of space-time, time seems to be the most susceptible to the effects of gravity particles. It is even postulated that the passage of time is a consequence of the universal presence of gravitons. This paper attempts to explain how the passage of time affects gravitational interaction.

Result and discussion

The most controversial calculation in this paper is the calculation of the black hole event horizon radius. The controversy is that constant gravity was used to calculate it. Subsequent calculations will not require this constant. The Schwarzschild equation for spherical symmetrical mass was used here. It has the form (1):

$$R_g = \frac{2GM}{c^2} \tag{1}$$

where G is the gravitational constant, M is the source mass and c is the speed of light. It seems that this is not the only way to calculate the radius of the event horizon, but its search will not be the content of this work.

The calculations will concern the model shown in Figure 1.

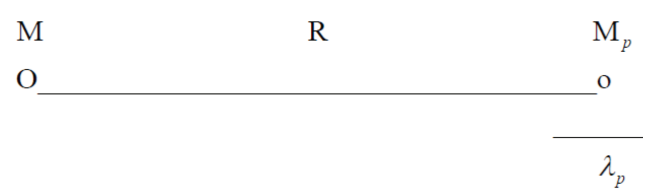

Figure 1: Compton wave location relative to model masses.

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Another calculation underlying this study is the calculation of the gravitational field correction of a spherical-symmetrical mass. It has the form (2):

$$\alpha_0 = \sqrt{1-\frac{R_g}{R}} \qquad (2)$$

The gravitational interaction applies to both real and relativistic masses. Real masses are made of atoms. The simplest atom is a hydrogen atom whose mass is mainly concentrated in the nucleus. The simplest hydrogen isotope nucleus is proton. For this reason, the following calculations were formulated for a proton but it can be easily proved that they are appropriate for any mass not only subatomic but also mass from the macro scale. The proton Compton wavelength has a value (3):

$$\lambda_p = \frac{h}{M_p c} \qquad (3)$$

where h is Planck's constant and M_p is the mass of the proton [4].

A body moving under the influence of a gravitational field increases its mass.

This affects Compton's wavelength, which value for a proton is (4):

$$\lambda_{pr} = \frac{h\alpha_0}{M_p c} \qquad (4)$$

Assuming that the Compton wave is parallel to the straight line connecting the mass of the source M with the mass of the proton M_p, you can calculate the relativistic corrections (5) and (6) in the beginning and end of the Compton wave in accordance with Figure 1.

$$\alpha_1 = \sqrt{1-\frac{R_g}{R-0.5\lambda_{pr}}} \qquad (5)$$

$$\alpha_2 = \sqrt{1-\frac{R_g}{R+0.5\lambda_{pr}}} \qquad (6)$$

Another parameter necessary for calculations is the relativistic time of Compton. It is calculated with the formula [5]:

$$T_{pr} = \frac{h\alpha_0}{M_p c^2} \qquad (7)$$

It turns out that the force of gravitational interaction of the spherically symmetrical mass M with the proton M_p takes the form (8):

$$F_{gr} = \frac{M_p c}{T_{pr}}(\alpha_2-\alpha_1) \qquad (8)$$

where force:

$$F_{pr} = \frac{M_p c}{T_{pr}} \qquad (9)$$

can be called proton Compton's relativistic force (9). The equation for the interaction force can also be represented by the formula (10):

$$F_{gr} = F_{pr}(\alpha_2-\alpha_1) \qquad (10)$$

and it is directly proportional to the Compton force and the difference of relativistic shortcuts at the end and beginning of the proton Compton wave. This equation can be treated as a new formulation of the law of universal gravitation. It can also be said that the force of gravity is inversely proportional to the proton Compton's extended relativistic time at the proton Compton wave ends. Using the data we get the formula

$$F_{gr} = \frac{M_p^2 c^3}{h\alpha_0}(\alpha_2-\alpha_1) \qquad (11)$$

It can be easily checked that the gravitational force calculated with this formula is equal to the gravitational force calculated for the Schwarzschild spherically symmetrical mass expressed in the following way, (12):

$$F_{gr} = \frac{GMMP}{R^2\alpha_0} \qquad (12)$$

In non-relativistic conditions, gravitational corrections and the force of gravity take form (13)

$$F_g = \frac{M_p^2 c^3}{h}(\alpha_2-\alpha_1) \qquad (13)$$

so it equals the force calculated from the expression (14):

$$F_g = \frac{GMMp}{R^2} \qquad (14)$$

Acceleration, like the gravitational field potential is the same under relativistic and non-relativistic conditions and is inversely proportional to Compton nonrelativistic time:

$$T_p = \frac{h}{M_p c^2} \qquad (15)$$

and is expressed by the formula (16) and (17):

$$a_g = \frac{c}{T_p}(\alpha_2-\alpha_1) \qquad (16)$$

$$\Phi_g = -\frac{cR}{T_p}(\alpha_2-\alpha_1) \qquad (17)$$

which is equal to the values calculated from the formulas (18) and (19):

$$a_g = \frac{GM}{R^2} \qquad (18)$$

$$\Phi_g = -\frac{GM}{R} \qquad (19)$$

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The escape speed is calculated from the formula (20):

$$v_g = \sqrt{\frac{2cR}{T_p}(\alpha_2 - \alpha_1)} \quad (20)$$

which is equal to the value calculated from the known expression (21):

$$v_e = \sqrt{\frac{2GM}{R}} \quad (21)$$

Let's return for a moment to the relativistic and non-relativistic formulas subjection on the gravitational force. Let us present them in the version with the proton Compton time in a form reflecting the relation of the Compton period and the gravitational corrections α_1 and α_2. They look like this:

$$F_{gr} = \frac{M_p c}{\alpha_0}\left(\frac{1}{(\frac{T_P}{\alpha_2})} - \frac{1}{(\frac{T_P}{\alpha_1})}\right) \quad (22)$$

$$F_g = M_p c\left(\frac{1}{(\frac{T_P}{\alpha_2})} - \frac{1}{(\frac{T_P}{\alpha_1})}\right) \quad (23)$$

As can be seen in the presented relationships (22) and (23), the gravitational force is inversely proportional to the quotient of the Compton period and the gravitational correction. Knowing that gravitational corrections are α_1<1 and α_2<1 the proton Compton time is extended. Hence the conclusion that the gravitational force is inversely proportional to the difference in Compton's extended time measured at the beginning and end of a proton Compton wavelenght. Interestingly, in place of M_p you can put any mass and after counting the corrections at the ends of the Compton mass wave we get the correct value of gravitational force. It seems that the differences in Compton's time increase at the ends of the wave may be due to differences in the intensity of interaction with emitted by the source's mass gravitons.

Summary

New relationships for the force of gravity, gravitational acceleration, gravitational potential and escape velocity have been formulated. It has been shown that these quantities are dependent on the difference of relativistic gravitational corrections measured at the ends of the Compton wave for a body placed in a gravitational field. The dependence force of gravity on the Compton period is presented. It was found that the force of gravity depends on the difference in the Compton time extension at the ends of the Compton wave. Formulas of force of gravity are presented in both relativistic and non-relativistic form. It is postulated that the difference in the extension of the Compton period by relativistic corrections is due to differences in interaction with gravitons at the ends of the Compron wave of the test body.

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