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Relativistic Rate of Clocks and Stability of the Gravitational Constant G

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Abstract: The Introduction of Planck metrics in quantum vacuum model shows that the Lorentz factor γ and velocity v of relativistic physical object are related with the diminished energy density of quantum vacuum in the centre of the relativistic object. Mass of a given physical object has the origin in variable energy density of quantum vacuum which allows describing GR relativistic rate of clocks as the phenomenon which has its physical origin in minimal variable energy density of quantum vacuum. The main motto of this paper is to show that the minimal variations of quantum vacuum energy density do not influence the size of gravitational constant G.
Keywords: relativistic rate of clocks, Lorentz factor, energy density of quantum vacuum, gravitational constant G

I. INTRODUCTION

Lorentz factor is at the core of relativistic physics. It's obvious to see that

$$(1)\quad \gamma = \left[\frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} \right]$$

We'll derive how this reletivistic factor is related to the physical property of quantum vacuum on the centre of a given relativistic object. And also the value of energy density of quantum vacuum in the centre of rest physical object with mass m and volume V is [1,2,3]

$$(2)\quad \rho_{qvE} = \rho_{PE} - \frac{mc^2}{V} .$$

So the mass m and the energy E of a given physical object is related with the diminished energy density of quantum vacuum in its centre as

$$(3)\quad E = mc^2 = (\rho_{PE} - \rho_{qvE}) \cdot V$$

$$(4)\quad m = \frac{(\rho_{PE} - \rho_{qvE}) \cdot V}{c^2}$$

Relativistic object is gaining its relativistic energy and mass by taking the energy from the quantum vacuum[4]. We can express absorption of energy with following formula

$$(5)\quad m = \frac{(\rho_{PE} - \rho_{qvE}) \cdot V \cdot \gamma}{c^2}$$

Relativistic mass causes additional diminishing of quantum vacuum energy density ρ_{qvE} in the centre of relativistic physical object, and is directly related to the Lorentz factor. Formula (5) can be developed as following

(6) $$\rho_{qvE} = \left[\rho_{PE} - \frac{mc^2}{V\gamma} \right]$$

ρ_{qvE} is the value of energy density of quantum vacuum in the centre of relativistic physical object. Now the Lorentz factor can be expressed subject to the variable energy density of quantum vacuum as

(7) $$\gamma = \frac{mc^2}{(\rho_{PE} - \rho_{qvE}) \cdot V}$$

Now, one can write following formula for relativistic rate of clocks in SR

$$\Delta t_0 = \Delta t \cdot \frac{mc^2}{(\rho_{PE} - \rho_{qvE}) \cdot V}$$
(8)

Where, Δt_0 is the elapsed time in a moving inertial system (in case of GPS satellite) and Δt is the elapsed time in the stationary inertial system (in case of GPS surface of the Earth).

II. RELATIVISTIC VELOCITY AND VARIABLE ENERGY DENSITY OF QUANTUM VACUUM

From equation-(7), we can write the following formula

$$\frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} = \frac{mc^2}{(\rho_{PE} - \rho_{qvE}) \cdot V}$$

$$\text{or, } \frac{1}{1 - \frac{v^2}{c^2}} = \frac{m^2 c^4}{(\rho_{PE} - \rho_{qvE})^2 \cdot V^2}$$

$$\text{or, } 1 - \frac{v^2}{c^2} = \frac{(\rho_{PE} - \rho_{qvE})^2 \cdot V^2}{m^2 c^4}$$

$$\text{or, } \frac{v^2}{c^2} = 1 - \frac{(\rho_{PE} - \rho_{qvE})^2 \cdot V^2}{m^2 c^4}$$

(9) $$v = \sqrt{\left[c^2 - \frac{(\rho_{PE} - \rho_{qvE})^2 \cdot V^2}{m^2 c^2} \right]}$$

The equation(9) shows that the relativistic velocity v can be expressed in subject to the speed of light, mass, volume of a given relativistic object and diminished energy density of quantum vacuum in the centre of a given relativistic object.

III. RELATIVISTIC RATE OF CLOCKS IN GR

The formula for relativistic rate of clocks in GR is as following

$$\Delta t_0 = \frac{\Delta t}{\sqrt{1 - \frac{2GMr}{c^2}}}$$
(10)

Where, Δt_0 is elapsed at the distance r from the centre of stellar object (in the case of GPS Earth), G is gravitational constant and m is the mass of the stellar object (in the case of GPS Earth), Δt is elapsed time on the stellar object surface (in the case of GPS Earth surface). Applying equation-(4) in formula-(10) we have,

$$\Delta t_0 = \frac{\Delta t}{\sqrt{1 - \frac{2GrV \cdot (\rho_{PE} - \rho_{qvE})}{c^4}}} \quad (11)$$

Which shows that the relativistic rate of clocks in GR depends on the variable energy density of quantum vacuum.

Now, One can calculate energy density of quantum vacuum at the point of where is placed clock which measures elapsed time Δt_0 .Going away from the centre of a given material object energy density of quantum vacuum increases according to the following formalism: [5]

$$(12)\ \rho_{qvE} = \rho_{PE} - \frac{3m \cdot c^2}{4\pi (r + R)^3}$$

where mis the mass of the material object, r is radius of the material object and R is the distance from the centre of the material object to a given point T (figure 1). Having $R = 0$ one gets energy density of quantum vacuum in the centre of stellar object. Having When $R = r$ one gets energy density of quantum vacuum on the surface of the stellar object. Having $R \to \infty$ one gets energy density of quantum vacuum in intergalactic empty space far away from stellar objects which is ρ_{PE} .

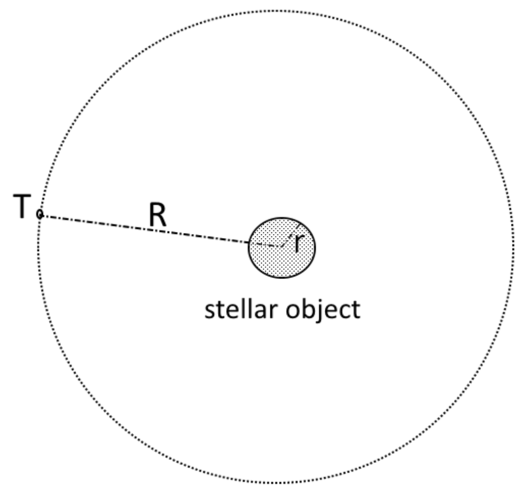

Figure 1: Density of quantum vacuum in the centre, on the surface and distant from stellar object

IV. RELATIVISTIC RATE OF CLOCKS IS VALID FOR ALL OBSERVERS

Relativistic rate of clocks in SR and GR has origin in variable energy density of quantum vacuum and is valid for all observers in all inertial systems. GPS system proves that without any doubt. If “inner” and “outer” observer in SR would experience different time rates of their clocks, GPS could not work. In SR the relative rate of clocks is valid for all observers. Stationary clock on the train station runs with the same rate for the stationary observer on the platform and for the moving observer in the train. The same is valid for moving clock in the train. If this would not be so, GPS could not work. SR effect on rate of clocks on the satellites is 7 microseconds slower per day (regarding clocks on the Earth surface) and GR effect is 45 microsecond faster per day. This 38 microsecond difference is valid for all observers on the satellites and on the Earth surface. SR effect is caused by the additional diminishing of quantum vacuum energy density on the satellite. GR effect is caused by the increasing of energy density of quantum vacuum which in generally increases with the distance from the given physical object [5].

V. VARIABILITY OF ENERGY DENSITY OF QUANTUM VACUUM IS EXTREMELY MINIMAL AND DOES NOT INFLUENCE THE VALUE OF GRAVITATIONAL CONSTANT G.

In intergalactic space, density of DQV has a value of plank density, as

$$\rho_P = \frac{m_P}{l_P^e}$$

$$= 5.15500 \times 10^{96}\, kg/m^3$$

The previous research [6] confirms that the calculation of ρ_{qv} in the centre of black hole with the mass of the sun with radius r of 3000 metres density of DQV is

$$\rho_{qv} = 5.154...9(73 times)...824 \times 10^{96}\, kg/m^3$$

The difference between density of quantum vacuum in the interstellar space and in the centre of black hole is infinitesimal. So the value of gravitational constant G in the intergalactic space far away from the stellar object can be expressed with planks units as

(13) $$G = \frac{l_p^3}{m_p . t_p^2}$$

Where l_p^3 denote plank volume, m_p denote the mass and t_p denote the plank time. SO which can be rewritten as?

(14) $$G = \frac{1}{\rho_p . t_p^2}$$

From the previous latest research [6], it is confirmed that the gravitational constant in the centre of black hole with mass of the sun, which is also valid for all stellar object as-

(15) $$G = \frac{1}{(\rho_p - \frac{3m}{4\Pi(r+d)^3}).t_p{}^2}$$

Where m- mass of the stellar object, r- radius, and d- distance from the centre of the stellar object

A. Case-I: [when d=0]

The gravitational constant seems to be in the centre of the stellar object as

(16) $$G = \frac{1}{(\rho_p - \frac{3m}{4\Pi r^3}).t_p{}^2}$$

B. Case-II: [when d=r]

The gravitational constant seems to be in the surface of the stellar object as

(17) $$G = \frac{1}{(\rho_p - \frac{3m}{32\Pi r^3}).t_p{}^2}$$

C. Case- III : [when d=infinity]

The gravitational constant in the intergalactic space as

$$G = \frac{1}{\rho_p . t_p^2} \quad (18)$$

where ρ_p denote the plank density

The value of gravitational constant in interstellar space is $G = 6.67455758 m^3 kg^{-1} s^{-2}$

The calculation confirms that the value of G is not changing. However the presence of stellar object diminishes density & energy density of quantum vacuum, still the gravitational constant G remains unchanged.

Gravitational constant [at Earth and in its influence]	Value [calculated]
Gequator	$\rho_{qv} = 6.67455758 \times 10^{-11} m^3 kg^{-1} s^{-2}$
Gpole	$\rho_{qv} = 6.67455758 \times 10^{-11} m^3 kg^{-1} s^{-2}$
Gcentre of earth	$\rho_{qv} = 6.67455758 \times 10^{-11} m^3 kg^{-1} s^{-2}$
G2000km above the earth	$\rho_{qv} = 6.67455758 \times 10^{-11} m^3 kg^{-1} s^{-2}$
Gmoon-perihelion	$\rho_{qv} = 6.67455758 \times 10^{-11} m^3 kg^{-1} s^{-2}$
Gmoon-aphilion	$\rho_{qv} = 6.67455758 \times 10^{-11} m^3 kg^{-1} s^{-2}$
Gsun-perihelion	$\rho_{qv} = 6.67455758 \times 10^{-11} m^3 kg^{-1} s^{-2}$
Gsun-aphelion	$\rho_{qv} = 6.67455758 \times 10^{-11} m^3 kg^{-1} s^{-2}$

(Table-1: Credit to Amrit Sorli et al, Cosmology of Einstein's NOW, DOI: 10.11648/j.ajmp.s.2016050401.11)

Table-1 confirms that there is no difference between the values of G in Equator, pole and centre of the earth. Also it shows that the motion of Sun and moon has no influence on G. Recent publication of Caligiuri is suggesting that value of gravitational constant is changing with changing of density of quantum vacuum and is different in the centre of the Earth than on the Earth surface [10]. According to the calculations in this paper planet Earth mass which is much smaller than black hole mass cannot influence value of gravitational constant. Our calculations confirm that presence of massive objects in a given area of quantum vacuum do not influence value of gravitational constant.

The latest calculation [6]confirms that even in the centre of the black hole site of the Sun with the radius 3000 meters gravitational constant G remains unchanged. Seems calculations of G in past decades have some calculation errors [6].Different measurements of gravitational constant G since 1980 have given different results [7,8,9]. The influence of the movement of the Earth score on G is excluded. The difference of different measurements of G is not explicable and remains an open question to be answered. We propose in this article that stability of G in time and in different places on the Earth surface could be verified by the experiment where G would be measured consequently for 12 month first day of each month in three different places on the Earth surface.

VI. CONCLUSIONS

Lorentz factor is showing the relation between stationary and relativistic physical object. Lorentz factor has physical origins in variable energy density of quantum vacuum in the centre of relativistic object. Relativistic physical object is additionally absorbing and so additionally diminishing energy density of quantum vacuum. This effect causes relativistic energy, relativistic mass and relative rate of clocks. GR relativistic rate of clocks also has origin in variable energy density of quantum vacuum. Variable energy density of quantum vacuum is not influencing the value of gravitational constant G . Results of last 30 years of measurement of gravitational constant show that there is some measurement error or either some "strange" influence is affecting most of *GN* measurement: "The situation is disturbing — clearly either some strange influence is affecting most G measurements or, probably more likely, measurements of G since 1980 have unrecognized large systematic errors. The need for new measurements is clear"[11]. Overall saying, we have proposed in this article that the gravitational constant has a stable value, for which we have planned for the verification of this result in three different places on the earth surface.

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