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Planck's Energy Density of Intergalactic Space and Gravitational Constant G

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Abstract

We can calculate the value of the gravitational constant G by using Planck units, which define the physical properties of the superfluid universal space. In this perspective, the gravitational constant G should have the same value in the entire universal space and should be stable through time. Different values of gravitational constant G obtained in several measurements in the past are the result of measurement errors and have nothing to do with the motion of Earth's inner crust or variations of G in time.

Keywords: gravitational constant G, gravity, superfluid space

1. Introduction

We can calculate the gravitational constant G using Planck units as follows:

$$G = \frac{l_P^3}{m_P t_P^2} = \frac{1}{\rho_P t_P^2} = \frac{c^2}{\rho_{PE} t_P^2} \qquad (1)$$
$$G = 6.67429939\ m^3 kg^{-1} s^{-2},$$

where ρ_{PE} is the Planck energy density of space in intergalactic areas [1]. We can calculate the energy density of space on Earth's surface as follows:

$$\rho_{Eearth.surface} = \rho_{PE} - \frac{3mc^2}{4\pi(2r)^3} \qquad (2)\ [2].$$
$$\rho_{Eearth.surface} = 4.641266 \cdot 10^{113} Jm^{-3} - 6.121539 \cdot 10^{20} Jm^{-3}$$
$$\rho_{Eearth.surface} = 4.641266 \cdot 10^{113} Jm^{-3}\ ,$$

where m is the mass of Earth and r is the radius of Earth. We observe that Earth diminishes the energy density of space on its surface for insignificantly small values in comparison with the Planck energy density. This indicates that with respect to Eq. (1) the gravitational constant G on Earth's surface exhibits the same value as that in intergalactic space. The radius of the SMBH black hole ASASSN-14li is 2862595420 m. Its mass is 2.5 million solar masses, which is $4{,}9727 \cdot 10^{36} kg$ [2]. The energy density of space in the center of ASASSN-14li is as follows:

$$\rho_{cE-ASASSN-14li} = \rho_{PE} - \frac{3mc^2}{4\pi r^3} \qquad [2].$$
$$\rho_{cE-ASASSN-14li} = 4.641266 \cdot 10^{113} Jm^{-3} - 4.554767 \cdot 10^{24} Jm^{-3}$$
$$\rho_{cE-ASASSN-14li} = 4.641266 \cdot 10^{113} Jm^{-3}$$

The value of the gravitational constant remains unchanged in the center of the black hole with 2.5 million solar masses. This indicates that all possibilities that the value of the gravitational constant would be changed on Earth's surface by the diminished energy density of space due to the motion of Earth's inner core, motion of the Moon, or Sun are excluded.

The change in the variable energy density of space on Earth can be measured using precise clocks. With increasing distance from the Earth's surface, clocks run faster. We can measure this change at each meter of vertical distance. Clocks in a lab run faster on the table than when placed 1 m lower on the floor [3]. In the "Vector model of gravity", the physical origin of gravitational force is the variable energy density of space. A given physical object diminishes the Planck energy density of space in its center by exactly the amount of its mass and energy, according to the following equation:

$$\rho_{cE} = \rho_{PE} - \frac{mc^2}{V} \qquad (3)\ [4],$$

, where m is the mass of the object and V is the volume of the object. Equation. (3) can be written as follows:

$$E = mc^2 = (\rho_{PE} - \rho_{cE})V \qquad (4).$$

Equation (4) describes the extension of the mass-energy equivalence principle in space. Every physical system has tendency toward a homogeneous distribution of energy. The same is true for universal space. In the center of a given physical object, the energy density of space is diminished by exactly the amount of the physical object's mass and energy. As displayed in Figure (1) below, the area of space with a higher energy density pushes toward the area of lower energy density:

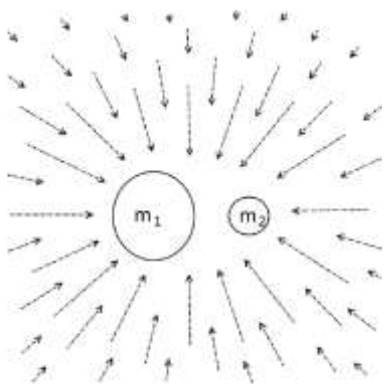

Figure 1: Gravity as a pushing force of space

Consequently, physical objects in the area of lower energy density are also pushed together. The idea of gravity as a pushing force of superfluid space was already developed in the ether model of gravity proposed by Isaac Newton. He proposed that stellar objects reduce the density of superfluid space (ether). The density of space increases with the distance from the stars. Gravity force is the pressure exerted by denser superfluid space (ether) in intergalactic space towards less dense superfluid space (ether) in the centre of stellar objects: "Doth not this aethereal medium in passing out of water, glass, crystal, and other compact and dense bodies in empty spaces, grow denser and denser by degrees, and by that means refract the rays of light not in a point, but by bending them gradually in curve lines? ...Is not this medium much rarer within the dense bodies of the Sun, stars, planets and comets, than in the empty celestial space between them? And in passing from them to great distances, doth it not grow denser and denser perpetually, and thereby cause the gravity of those great bodies towards one another and of their parts towards the bodies; every material body endeavouring to go from the denser parts of the medium towards the rarer?" [5].

The model of gravity as a pushing force of superfluid space area with higher energy density towards the area of superfluid space with lower energy density is a physical model of gravity, and the curvature of space as the source of gravity is a mathematical model of gravity. A physical model of gravity represents an advanced model as it explains the physical origin of gravity and works without the hypothetical graviton. Gravity is the result of a fundamental symmetry between matter energy density and energy density of superfluid space, their sum in every point of the universal space is constant [6]. For example, in the center of a given physical object, the sum of the energy density of matter ρ_{ME} and the energy density of superfluid space ρ_{SSE} equals Planck energy density ρ_{PE}, see Eq (5).

$$\rho_{ME} + \rho_{SSE} = \rho_{PE} \qquad (5).$$

In intergalactic space energy density of matter is zero and the energy density of superfluid space has the value of Planck energy density, see Eq (6).

$$\rho_{ME} = 0 \rightarrow \rho_{SSE} = \rho_{PE} \qquad (6).$$

This fundamental symmetry between the energy of matter and space energy generates gravity, which is a driving force of the universe.

In 2014 NASA measured that universal space has an Euclidean shape: "Recent measurements (c. 2001) by a number of ground-based and balloon-based experiments, including MAT/TOCO, Boomerang, Maxima, and DASI, have shown that the brightest spots are about 1 degree across. Thus, the universe was known to be flat to within about 15% accuracy prior to the WMAP results. WMAP has confirmed this result with very high accuracy and precision. We now know (as of 2013) that the universe is flat with only a 0.4% margin of error. This suggests that the Universe is infinite in extent« [7]. NASA results confirm that curvature of space has no physical existence. This gives further confirmation of the gravity force as the pushing force of superfluid space.

The Cavendish experiment proves the model of gravity as a pushing force of superfluid space. The small metal balls are moving towards bigger metal balls, not because of supposedly curved space. They are moving because the higher energy density of space is pushing in the direction of the lower energy density of the space that is in the center of bigger balls, see Figure (2) below:

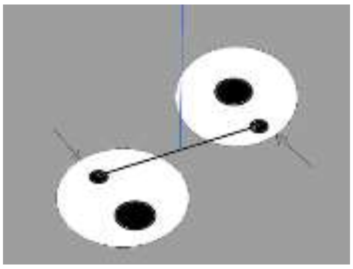

Figure 2: In Cavendish experiment pressure of superfluid space pushes smaller balls toward bigger balls

The pushing force from the direction of superfluid space with higher energy density is not directly on the balls, it pushes the local superfluid space with lower energy density towards the point of lowest energy density, which is in the center of bigger balls. In Einsteinian gravity, mass is curving space and curvature of space is telling mass where to move. In the here presented model, mass diminishes the energy density of space, which generates gravity force. Superfluid space is four-dimensional, and so gravity force is four-dimensional as well. Physical objects are three-dimensional, they are locked in four-dimensional space and they follow its motion. The progress of models of gravity is in understanding that three-dimensional mass diminishes the energy density of four-dimensional space, which causes gravity. This model of gravity works without hypothetical gravitons that were never observed experimentally. Recent research is proposing the existence of gravitons: "We start with deriving Newtonian gravitational formula. Based on a simple setting shown in Fig. 1, mass M radiates gravitons in all directions and some of them are received by mass m. The density of gravitons can be measured by the number of gravitons in a small volume dV, enclosed by two spheres of radius R and $R + dR$. Since gravitons in a ray are attracted by each other and by mass, they establish the attractive force between M and m. The denser the graviton rays, the stronger the gravitational force. As the gravitons in the ray from left to right attract each other, mass M can attract mass m through a great distance. However, as the distance increases, the gravitons density decreases and the attraction between M and m will decrease significantly. Next, we examine these intuitive thoughts mathematically" [8]. The Graviton model has several problems:

A) radiation of gravitons from matter was never observed.
B) graviton rays should move with the light speed and we know gravity force is immediate.
C) when hypothetical gravitons are on the way from one object to another object, they do not have physical contact with them, and so they cannot establish attraction force.

These problems of graviton model will be difficult to solve.
The Vector model of gravity as a pushing force of superfluid space does not face such unbridgeable problems and seems to be a more appropriate candidate for explaining the gravity force phenomena [4].

2. Gravitational constant G has the same value in the entire universal space

The total amount of energy in the entire universal space is the same. Where stellar objects exist, the energy density of superfluid space is lower; however, the gravitational constant has the Planck value in the entire universal space. The presence of stellar objects does not influence the value of the gravitational constant. A few results of the gravitational constant measurements with respect to latitude are stated as follows:

- latitude $47°N$ (Seattle) $G = 6.67421\, m^3kg^{-1}s^{-2}$, local gravity $9.808\, ms^{-2}$[9]
- latitude $47°N$ (Zurich) $G = 6.67425\, m^3kg^{-1}s^{-2}$, local gravity $9.807\, ms^{-2}$[10]
- latitude $30°N$ (Wuhan) $G = 6.67408\, m^3kg^{-1}s^{-2}$, local gravity $9.793\, ms^{-2}$ [11]
- latitude $30°N$ (Wuhan) $G = 6.67349\, m^3kg^{-1}s^{-2}$, local gravity $9.793\, ms^{-2}$ [12].

Local gravity has no impact on the gravitational constant. By measuring G in intergalactic space, we would obtain the same value as that calculated using Planck units. The diminished energy density of space in the center of the supermassive black hole ASASSN-14li does not affect the value of the gravitational constant G. As light speed and Planck time are constants, this indicates that the value of the gravitational constant G in the universe is unchangeable in space and does not change with time. The different results of the measurement of G are the result of methodological errors. If we measured the gravitational constant with the same apparatuses, we would get the same values at all different places on the Earth's surface, and also on the satellite that is orbiting around the Earth. The proposal here is that gravitational constant G should be measured by the same type of apparatus at different places on the globe and all physical circumstances should be the same: temperature, humidity, and pressure of the air should be the same. The best way would be to carry the experiment inside the chamber where air would be pumped out of the chamber. In this way, we would get the same value of the gravitational constant in places that have different latitudes and different above-sea levels.

Research by Anderson et al. suggests that different values of G can also have a physical origin in Earth's inner core motion [13]. Recent research suggests that rotation of the inner core is variating over the period of 70 years and could also stop [14, 15]. We suggest that the motion of the inner core has no impact on the value of the gravitational constant. In our model, the gravitational constant has the same value in the entire universal space. The idea that the gravitational constant G could be affected by the motion of the Earth's inner core or that it could change over time [13] is the result of a superficial understanding of gravitation and the role of the gravitational constant in the gravity equation. If Earth's inner core motion could influence gravity, this would mean that we could not use gravitational constant in the calculation of the galaxies' dynamics. Also, if the gravitational constant would change in time, gravity between stellar objects would also change, galaxies would not be stable, and the dynamics of our Solar system would change in time. This is not the case and confirms, that gravitational constant G has a stable value over time.

Recent research represented the idea that protons and neutrons could have different values of gravitational constant [16]. In our model, protons and neutrons have nothing to do with the gravitational constant G, which is defined by the Planck energy density of intergalactic superfluid space which is the new name for the "ether". Throwing ether out of physics and considering universal space is deprived of physical properties seems a colossal mistake of 20^{th}-century physics [17]. As we can see in equation (1), the energy density of ether in intergalactic space defines the value of the gravitational constant G which has the same value in the entire universe.

The gravitational constant was first measured by Cavendish in 1797–1798: "Cavendish was able to measure the force, the two masses, and the distance, and thus determine the gravitational constant G "[18]. It is shown in this article that in principle the Cavendish balance will give the same result in the entire universal space when physical circumstances are the same. It is proposed to close the same type of today's most advanced measuring devices of gravitational constant in the vacuum chambers where the air will be taken out with the possibility of maintaining a stable temperature. We could place such devices at different places on the Earth's surface, on the Moon's surface, and at the satellites, and measure the value of the gravitational constant G. The expected result is that all devices will give us the same value.

3. Conclusions

The gravitational constant G is one of the fundamental constants of physics. It is incomprehensible that G would be influenced by any kind of local physical phenomenon on the Earth's surface because this would mean that any other physical event related to the mass motion wherever in the universe would change the value of the gravitational constant and consequently the value of gravitational force. The idea that every local area of the universe would have its value of gravitational constant seems unrealistic and against the homogeneity and isotropy of the universe.

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