Dependence of Gravitational Constant on Gravitational-Mass Density

Sylwester Kornowski

Abstract: Here, within the Scale-Symmetric Everlasting Theory (S-SET), the constancy of gravitational constant is discussed. For gravitational-mass density about 48 powers of ten higher than density of the Einstein spacetime, the gravitational constant is equal to zero. Such increase in mass density causes that the Einstein spacetime decays into the modified Higgs field. In our Cosmos, the maximum change in the gravitational constant can be about one part in 37 powers of ten parts i.e. the possible changes are very, very small.

1. Introduction

The Kasner metric [1] is a solution to the vacuum Einstein equations and in the Scale-Symmetric Everlasting Theory (S-SET), [2] and [3], we apply this metric to the modified Higgs field composed of the non-gravitating, non-relativistic, bare, superluminal pieces of space (tachyons). The three additional laws of conservation lead to the scale-symmetric physics. Due to the four succeeding phase transitions, there are in existence the five scales: the tachyon scale, the superluminal-quantum-entanglement scale, luminal Planck scale concerning the Einstein-spacetime components, observed-particles scale and cosmological scale. Within S-SET, we derived the formulae for the physical constants [3] so we can interpret them correctly [3], [4].

During the inflation [5], due to the Higgs mechanism [6], a significant part of the non-gravitating modified Higgs field transformed into the gravitating luminal Einstein spacetime. It consists of the neutrino-antineutrino pairs [3]. The mass of a neutrino-antineutrino pair is very small, about $6.7 \cdot 10^{-67}$ kg [3], and its total weak charge is equal to zero so it is much difficult to detect the Einstein-spacetime components than the neutrinos.

The superluminal binary systems of closed strings (i.e. the entanglons responsible for the quantum entanglement) the Einstein-spacetime components consist of, due to their internal helicity, transform the chaotic motions of the tachyons into divergently moving tachyons [3]. The collisions of tachyons cause that the Einstein-spacetime components produce gradients in the modified Higgs field i.e. produce the gravitational fields [3].

Within S-SET, we derived formula for the gravitational constant G ([3]: formulae (11) and (12))

$$G = g \cdot \rho_N = 6.6740007 \cdot 10^{-11} \text{ m}^3/(\text{kg s}^2), \qquad (1)$$

where the g has the same value for all interactions and is equal to

$$g = v_{st}^4/\eta^2 = 25{,}224.563\ m^6/(kg^2\ s^2), \quad (2)$$

where ρ_N is the inertial-mass density of the modified Higgs field, v_{st} is the mean spin speed on the equators of the tachyons whereas η is the dynamic viscosity of the free tachyons and the bound tachyons in the closed strings.

During the inflation, for radius of the expanding Einstein spacetime significantly big, the gravitational pressure, which tries to squeeze the Einstein spacetime, was higher than dynamic pressure which tries to stretch the Einstein spacetime, i.e. the outer shell of the Einstein spacetime had collapsed and there appeared the stable boundary of our Cosmos. It was the end of inflation. Within the S-SET we can calculate the radius of our Cosmos: about $2.3 \cdot 10^{30}$ m [7]. The stable boundary is nontransparent for the modified Higgs field and Einstein spacetime. The expanding universes appeared in our Cosmos due to the fluctuations in the Einstein spacetime [3].

2. Calculations and summary

An increase in gravitational-mass density of the Einstein spacetime, $\Delta\rho_{E,}$ causes that there appears a mass m of a body which can be detected

$$\Delta\rho_E = m / V = \rho, \quad (3)$$

where V and ρ are respectively the volume and gravitational-mass density of the body.

The gravitational masses of objects appear due to the entanglement and/or confinement of the Einstein-spacetime components [3], [6].

A local increase in gravitational-mass density of the Einstein spacetime causes that the local number densities of the tachyons decrease, i.e. the modified Higgs field is “stretched” i.e. the local inertial-mass densities in the modified Higgs field are lower so gravitational field is stronger. On the other hand, from formula (1) follows that value of the gravitational constant G decreases when intensity of gravitational field increases. It is possible because, as we will show, increase in mass is much greater than decrease in gravitational constant. We will show that the changes in the gravitational constant are very small and the today detectors cannot measure them.

Gravitational constant follows from the internal structure of the Einstein-spacetime components so from the internal structure of neutrinos as well. Calculate the ratio of the divergently moving tachyons produced by a neutrino to total number of tachyons inside the neutrino. This ratio f is the ratio of the volume occupied by all binary closed strings a neutrino consists of V_{CS} (the binary closed strings produce the divergently moving tachyons) to the volume of neutrino $V_{neutrino}$. Number of closed strings a neutrino consists of is the ratio of the mass of a neutrino to the mass of a closed string $R = m_{neutrino} / m_{closed\text{-}string} = 1.4251 \cdot 10^{20}$ ([3]: Table 2). Volume of a closed string is $V_{closed\text{-}string} = K^2\ 4\ \pi\ r^3_{tachyon} / 3 = 2.8119 \cdot 10^{-173}\ m^3$, where K^2 is the number of tachyons a closed string consists of whereas $r_{tachyon}$ is the mean radius of the tachyons ([3]: Table 2). A neutrino is the weak-charge/torus and the condensate in the centre of the torus. But volume of the condensate is much smaller of volume of the torus so in a very good approximation the volume of a neutrino is $V_{neutrino} = 4\ \pi^2\ r^3_{neutrino} / 27 = 2.0457 \cdot 10^{-105}\ m^3$, where $r_{neutrino}$ is the equatorial radius of neutrino ([3]: Table 2]. We obtain

$$f = V_{CS} / V_{neutrino} = R\ V_{closed\text{-}string} / V_{neutrino} = 1.959 \cdot 10^{-48} \approx 2 \cdot 10^{-48}. \quad (4)$$

The divergently moving tachyons decrease number of tachyons inside neutrino. We can see that the ratio of the change in inertial-mass density of the modified Higgs field, $-\Delta\rho_N$, caused by a change in gravitational-mass density of the Einstein spacetime, to the change in gravitational-mass density of the Einstein spacetime, $\Delta\rho_E$, is equal to the f. Notice also that the gravitational constant G corresponds to the mean inertial-mass density ρ_N and to the mean gravitational-mass density ρ_E. Applying formulae (1) and (3), we obtain

$$- \Delta G / G = - \Delta\rho_N / \rho_N = f \Delta\rho_E / \rho_E = f \rho / \rho_E, \quad (5)$$

$$G' = G - \Delta G = G (1 - f \rho / \rho_E). \quad (6)$$

Since $\rho_E = 1.10220055 \cdot 10^{28}$ kg/m^3, [3], so we need gravitational-mass density equal to $\rho' = 0.563 \cdot 10^{76}$ kg/m^3 to obtain $G' = 0$. To obtain such gravitational-mass density, the distance between the Einstein-spacetime components must decrease about $8 \cdot 10^{15}$ times. Since the mean distance is about 3500 times greater than the equatorial radius of a neutrino [3], so the distance for G' = 0 should be about $4.4 \cdot 10^{-48}$ m. This distance is about 430 times smaller than the size of the closed strings. This leads to conclusion that gravitational-mass density equal to ρ' is not possible in our Cosmos. Gravitational-mass density of the Einstein spacetime can increase only about $(3500)^3 \approx 4.3 \cdot 10^{10}$ times and then the gravitational constant is

$$G'_{minimum} = G (1 - 0.86 \cdot 10^{-37}). \quad (7)$$

We can see that in our Cosmos the change in gravitational constant can be very, very small only so we can assume that in our Cosmos the gravitational constant G is constant. A change can be maximum about 1 part in 10^{37} parts.

We can define unite of time as directly proportional to local mean distance of the tachyons. Then, higher gravitational-mass density means that time is going slower.

References

[1] Kasner, Edward (1921). "Geometrical Theorems on Einstein's Cosmological Equations". *American Journal of Mathematics* **43** (4): 217–221.

[2] Sylwester Kornowski (17 September 2014). "The Scale-Symmetric Physics". http://www.rxiv.org/abs/1409.0137 .

[3] Sylwester Kornowski (14 March 2014). "The Everlasting Theory and Special Number Theory". http://www.rxiv.org/abs/1203.0021 [v3].

[4] Sylwester Kornowski (2 October 2014). "The Origin of the Physical Constants in the Scale-Symmetric Physics". http://www.rxiv.org/abs/1410.0007 .

[5] Sylwester Kornowski (26 November 2013). "The Inflation in the Everlasting Theory". http://www.rxiv.org/abs/1311.0174 .

[6] Sylwester Kornowski (18 September 2013). "The Ultimate Picture of Particle Physics and Cosmology". http://www.rxiv.org/abs/1309.0135 .

[7] Sylwester Kornowski (5 September 2013). "The Origin and Fate of the Cosmos and Universes and the Classical-Quantum Asymmetry". http://www.rxiv.org/abs/1308.0138 .