The Planck Scale in SST

Sylwester Kornowski

Abstract: In the Scale-Symmetric Theory (SST), we define the Planck Scale as the limit/boundary of the applicability of the Equivalence Principle (i.e. equality of inertial mass and gravitational mass). Surface of the core of the lightest neutrinos is such a boundary so we relate Planck values to it – it is a limit of the ħGc physics. The internal dynamics of such neutrinos is beyond the Gc physics. Near the Planck surface, the quantum effects of gravity dominate so there appears the SST Higgs potential for neutrinos.

1. Introduction

When calculating the values for the Planck scale, we cannot neglect the Planck shape and its sizes, which must result from the Theory of Everything.

In the Scale-Symmetric Theory (SST), we define the Planck Scale as the limit/boundary of the applicability of the Equivalence Principle (i.e. equality of inertial mass and gravitational mass). Surface of the core of the lightest neutrinos is such a boundary so we relate Planck values to it – it is a limit of the ħGc physics [1].

At the Planck scale, unlike the physics described in SST [1], the mainstream physics breaks. Within SST we showed that near the Planck scale, the quantum effects of gravity dominate (see Section **2.14** in [1]). For sizes smaller than the SST Planck length, the Gc physics is not valid. Moreover, we showed that the ħGc physics does not apply to the SST Higgs-field components [1].

In SST, similar as it is in the mainstream physics, the Planck scale is defined by Planck length, Planck mass, Planck time, Planck charge and Planck temperature. Here we present the physical and mathematical descriptions of such quantities.

2. The SST Planck quantities for rotating-spin neutrino

The core of the lightest neutrino, when its spin rotates, occupies a Planck sphere with a radius equal to the equatorial radius of neutrino core, $r_{neutrino} = 1.1184555 \cdot 10^{-35}$ **m** [1], so the SST Planck length, $L_{P,SST}$, we can define as follows

$$L_{P,SST} = 2\ r_{neutrino} = 2.2369 \cdot 10^{-35}\ \mathbf{m}\ . \tag{1}$$

On the other hand, in the ħGc physics, the Planck length is defined as $L_P = \hbar^{1/2}\ G^{1/2}\ c^{-3/2} \approx 1.616 \cdot 10^{-35}$ **m**.

Wavelength, λ, of a wave produced on equator of the Planck sphere is

$$\lambda = 2\,\pi\, r_{neutrino} = \pi\, L_{P,SST} \tag{2}$$

and, for the spin speed equal to c, it corresponds to the SST Planck mass $M_{P,SST}$ (see formula (2.24.8) in [1])

$$M_{P,SST} = \hbar / (r_{neutrino}\, c) = 3.1451 \cdot 10^{-8}\ \mathbf{kg}\ . \tag{3}$$

Indirectly we can see such neutrinos in the cosmic microwave background (CMB) (see Section **2.24** in [1]).

On the other hand, in the $\hbar Gc$ physics, the Planck mass is defined as $M_P = \hbar^{1/2}\, G^{-1/2}\, c^{1/2} \approx 2.176 \cdot 10^{-8}$ **kg**.

Formula (3) follows from the energy-mass equivalence

$$M_{P,SST}\, c^2 = h\, \nu = h / (2\, \pi\, r_{neutrino} / c)\ . \tag{4}$$

In SST, the maximum mass/energy density that follows from the neutrino-spin rotation is the SST Planck energy density $\rho_{P,SST}$

$$\rho_{P,SST} = M_{P,SST} / (4\, \pi\, r_{neutrino}^{\ 3} / 3) = 5.3665 \cdot 10^{96}\ \mathbf{kg/m^3}\ . \tag{5}$$

On the other hand, in the $\hbar Gc$ physics, the Planck energy/mass density is defined as $\rho_P = \hbar^{-1}\, G^{-2}\, c^5 \approx 5.155 \cdot 10^{96}$ $\mathbf{kg/m^3}$.

In mainstream physics, we have a problem to define the Planck charge. In SST, both the elementary electric charge of electron and proton and the weak charge of lightest neutrino are the tori with different sizes [1]. The weak charge of the lightest neutrino consists of the binary systems of the closed strings (entanglons). The interactions of the entanglons with the SST Higgs field produce the lines of the weak-charge forces. Such lines of forces produce a gradient in the SST Higgs field around the lightest neutrino – it is the neutrino gravitational field characterized by the G [1].

On the other hand, the elementary electric charges consist of the neutrino-antineutrino pairs so such charges also produce the lines of the weak-charge forces. But number of entanglons in the elementary electric charges is K^4 times higher than in the weak charges, where $K = 0.789669 \cdot 10^{10}$ [1]. But emphasize that distribution of spins of the entanglons in electric charge and weak charge are different and that the internal dynamics of the lightest neutrino and the internal dynamics of the elementary electric charge are similar but different.

In SST, we showed that value of a Planck charge is not needed to fully describe Nature.

Notice also that mass of the torus/electric-charge in the core of proton is K^4 times higher than mass of the torus/weak-charge in the core of lightest neutrino [1].

The SST Planck temperature, $T_{P,SST}$, is defined by the Wien's displacement law ($T\, \lambda = 2898 \cdot 10^{-6}$ [m · K]) and circumference of the equator of the Planck sphere

$$T_{P,SST} = 2898 \cdot 10^{-6}\ [\mathrm{m \cdot K}] / (\pi\, L_{P,SST}) = 4.124 \cdot 10^{31}\ \mathbf{K}\ . \tag{6}$$

On the other hand, in the ħGc physics, the Planck temperature is defined as $T_P = ħ^{1/2} G^{-1/2} c^{5/2} k_B^{-1} \approx 1.417 \cdot 10^{32}$ **K**, where $k_B = 1.380649 \cdot 10^{-23}$ **J/K** is the Boltzmann constant.

Notice that in our definition of the SST Planck temperature does not appear the Boltzmann constant. In [1] (see Paragraph **1.4.2**), we relate the Wien's displacement law to photon loops.

The SST Planck time, $t_{P,SST}$, is defined as follows

$$t_{P,SST} = L_{P,SST} / c = 7.4615 \cdot 10^{-44}\ \mathbf{s}\,. \qquad (7)$$

On the other hand, in the ħGc physics, the Planck time is defined as $t_P = ħ^{1/2} G^{1/2} c^{-5/2} \approx 5.391 \cdot 10^{-44}$ **s**.

3. The Planck energy/mass of the elementary photon

The SST absolute spacetime consists of the non-rotating spin-1 neutrino-antineutrino pairs. Spin of such pairs can rotate – rotational energy of such a pair composed of the lightest neutrinos is the elementary photon (or elementary gluon when it is moving in fields with internal helicity such as the nuclear strong fields) [1]. Elementary photons can be entangled so there are the composite photons. The photon mass is a part of the local zero-energy field (then the local SST absolute spacetime is insignificantly thickened) so it is locally undetectable [1]. But we can measure a photon's energy (the rotational energy) that is equivalent to its locally undetectable mass. To photons we can apply the ħGc physics.

Most important is the Planck energy/mass because it is the real mass. Other Planck values depend on definitions. The radius of the circle along which the point farthest from the axis of rotation moves, R*, is (Fig.1)

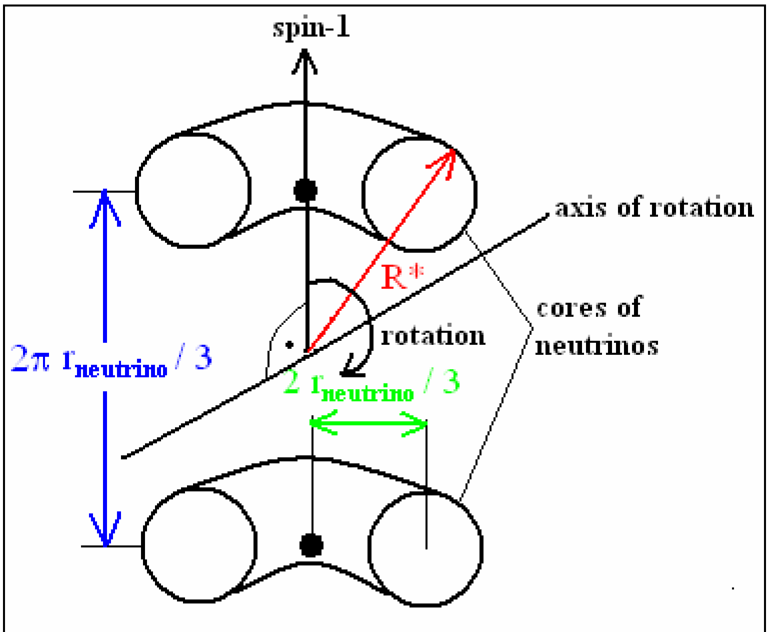

Fig.1.
Rotating spin-1 neutrino-antineutrino pair.

$$R^* = [(\pi\, r_{neutrino} / 3)^2 + (2\, r_{neutrino} / 3)^2]^{1/2} + r_{neutrino} / 3 = 1.5747306\, r_{neutrino} =$$

$$= 1.7613 \cdot 10^{-35}\ \mathbf{m}\,. \qquad (8)$$

In the SST absolute spacetime, there are the spin-1 neutrino-antineutrino pairs because such state has lower energy than the spin-0 pairs. The distance between the neutrinos in a spin-1 pair is $2\pi r_{neutrino}/3$ because such is the circumference of a loop of entanglons produced on the neutrino torus/weak-charge in its poloidal planes [1]. Such planes are perpendicular to the equatorial plane. By the way, such model we can apply also to the pairs of electrons (the Cooper pairs) created in superconductors – it is the spin-triplet state. It is wrongly assumed that in such state can be Majorana fermions. SST shows that Majorana fermions do not exist in Nature so we cannot use them to make error-free quantum computers.

By applying formulae (2), (3) and (4) we obtain the Planck energy/mass of the elementary photon $M_{P,photon,SST}$

$$M_{P,photon,SST} = \hbar / (R^* c) = 1.997 \cdot 10^{-8} \mathbf{kg} . \quad (9)$$

4. Summary

Here we related the Planck scale to both the state of maximum excitation of the lightest neutrino and of the components of the SST absolute spacetime described in the Scale-Symmetric Theory [1]. The ground state of the SST absolute spacetime consists of the non-rotating spin-1 (it relates to $\hbar$) neutrino-antineutrino pairs. In SST, we showed that the gravitational constant G relates just to neutrinos and follows from their internal dynamics [1]. Here we argue that the Planck scale described within the $\hbar Gc$ physics relates, in reality, to surfaces of the cores of the lightest neutrinos described in SST. Emphasize that the $\hbar$, G and c are derived from the SST initial conditions [1].

Notice that the real fundamental Planck shape is a torus/weak-charge with central scalar/condensate [1], not a cube or so. In excited states, spin of the real Planck shape rotates. The shape, its sizes and spin rotation have an influence on Planck's energy density and other Planck's values. On the other hand, the mainstream definitions of the Planck's values ignore such dependencies, so in the $\hbar Gc$ physics we get slightly different Planck values.

We showed that in the fundamental part of the Theory of Everything, the half-integral spin $\hbar/2$ appears first, then the unitary spin $\hbar$, then the G and c [1].

Value of a Planck charge is not needed to fully describe Nature but in the Theory of Everything must appear a physical and mathematical description of such charge.

Notice that mass density of the SST absolute spacetime (in which dynamic pressure prevents it from curving) is about 42 orders of magnitude higher than the inertial-mass density of the SST Higgs field associated with gravitational fields which curve spacetime, and about 54 orders of magnitude higher than the total mass density of baryonic matter, dark matter and dark energy in the Universe so the Universe is practically flat [1] – it is consistent with the observational data.

Notice also that the non-gravitating energy frozen inside each neutrino is about $0.6 \cdot 10^{119}$ times higher than its gravitational mass when its spin does not rotate [1] – it solves the zero-point energy problem that appears in quantum physics.

References

[1] Sylwester Kornowski (28 October 2021). "Particles and Cosmology: Scale-Symmetric Theory (SST)"
http://vixra.org/abs/2110.0171

[2] P.A. Zyla, *et al.* (Particle Data Group)
Prog. Theor. Exp. Phys. **2020**, 083C01 (2020) and 2021 update