Neutrino Mass Replaces Planck Mass as Fundamental Particle

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Abstract

The following derivation shows that the neutrino mass effectively replaces the Planck mass as a fundamental particle associated to Newton's Gravity Law. The neutrino mass is deduced from the cosmic microwave background and matches a previous obtained experimental value. Using a ratio of forces between two Planck mass pairs in comparison to two neutrino pairs, a proportion to the dimension of the Planck length and a Rindler horizon is formed. The work done on the two pairs are equivalent using this proportion. Additionally, it has been concluded that the cosmic diameter, as a particle horizon, can be written in terms of fundamental constants using Wien's displacement law and the Cosmic Microwave Background temperature.

Keywords: Cosmic microwave background, neutrino mass, neutrino energy, modified gravity law, particle horizon, fundamental particle

1 Introduction

For over a century the Planck mass has been used as a fundamental mass for Newton's Gravity Law. It has been defined as the gravitational potential energy between two Planck masses at a certain distance. However, it is known that many physical particle masses exist that are smaller than the Planck mass. Some examples include the electron, proton, and neutron. Henceforth, it is surmised that the Planck mass is not the fundamental mass that can be affected by the force of gravity. The smallest mass to date seems to be the neutrino. Thus far, only the sum of the masses could be determined until recently. Here it is deduced that the neutrino mass is of a fundamental quantity that can be correlated to the photon energy of the Cosmic Microwave Background (CMB) [8]. Furthermore, an interesting relationship between the gravitational force of two Planck masses and two experimental neutrino masses can found as well. Additionally, the cosmic diameter can be derived only using fundamental constants and the CMB temperature.

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2 Method

2.1 Neutrino CMB

Consider the current CMB temperature measured value which is $T = 2.72548$ K. Now use Wien's displacement law in order to compute the total energy from the observed temperature using $E = kT/\beta$ where k is Boltzmann's constant and $1/\beta = 4.965114$ is Wien's constant [7].

$$E_\nu = \frac{\hbar c}{\lambda} = \frac{kT}{\beta} \tag{1}$$

Next use Einstein's mass energy relation $m_{cmb} = E/c^2$.

$$m_{cmb} = \frac{kT}{\beta c^2} \tag{2}$$

Now, consider Newton's Gravity Law.

$$F_G = \frac{GM_1 M_2}{r^2} \tag{3}$$

Rewrite the gravitational constant using the following relation $G = \frac{\hbar c}{m_p^2}$.

$$F_G = \left(\frac{\hbar c}{m_p^2}\right)\frac{M_1 M_2}{r^2} \tag{4}$$

Consider the following thought experiment. The CMB masses, to be thought of as neutrino masses for this section, will be located at the center of the universe and at a location $R/2$ from the center where R is the Rindler horizon [12] [13] [2]. The Rindler horizon will be, $R = \frac{2\Theta}{\beta\pi^2}$ as defined in quantized inertia [6] but with a correction factor of 2 since a node is located in the middle of the observable universe. This maximum distance is approximately equal to the cosmic diameter, $R \approx \Theta$. Furthermore, after extensive in-depth analysis, it was determined that the experimental energy of a right handed (sterile) neutrino is $E_{\nu exp} = 0.00117$ eV [10] [4] [1] [3] and matches the mass from the computed derivation from the CMB photon temperature above. This right handed neutrino is a sterile neutrino and is assumed to be only affected by gravity and is located beyond the (information) horizon. Now introduce a new factor called the gravitational CMB coupling constant α_G. Assume for now that m_{cmb} is the fundamental mass.

$$F_G = \left(\frac{\hbar c}{m_{cmb}^2}\right)\frac{M_1 M_2}{r^2}\alpha_G \tag{5}$$

To find the coupling constant compute the gravitational force for the two scenarios. The first will be two Planck masses that have a distance of $R/2$ between them. One located at the center of the observable universe and the other right before CMB horizon at a distance of $R/2$. One particle is considered as the observer reference frame (with co-moving information horizon boundary). The Rindler horizon is defined as $R = \frac{2\Theta}{\beta\pi^2}$. This is essential as the nodes must fit exactly at the observer [6] from the emitting CMB. The other are two neutrino masses at a distance of $R/2$. The mass of the neutrino is deduced from the emitted CMB photon at $R/2$. Additionally, the forces of the two Planck masses can be situated with same methodology.

$$F_{m_p} = \frac{Gm_p^2}{(R/2)^2} \tag{6}$$

$$F_{cmb} = \frac{Gm_{cmb}^2}{(R/2)^2} \tag{7}$$

Now, equate the energy of both gravitational force equations. For the neutrino force equation multiply by $2R$. This because the maximum distance of the two non-local neutrinos of an observer mass at a given coordinate is $2R$. Again, this is done because the sterile neutrinos are suggested to only lie past the (experience/information) boundary of the cosmic horizon. For the Planck mass force equation, it was found that multiplication of the Planck length, l_p, finds the equivalent work done on the two Planck masses.

$$2RF_{cmb} = l_p F_{m_p} \tag{8}$$

Finally take the ratio of the two forces and that will be equivalent to the gravitational CMB coupling constant, $\alpha_G = \frac{F_{cmb}}{F_{m_p}}$. Notice this uses a similar concept to the See-saw principle [10] [11].

$$\alpha_G = \frac{m_{cmb}^2}{m_p^2} = \frac{l_p}{2R} \tag{9}$$

Replace $R = \frac{2\Theta}{\beta\pi^2}$ in (9) to obtain the following.

$$\boldsymbol{\alpha_G = \frac{m_{cmb}^2}{m_p^2} = \frac{\beta\pi^2 l_p}{4\Theta}} \tag{10}$$

Recall that $\alpha_G = F_{cmb}/F_{m_p}$ which is the ratio of forces. It can be computed that $1/\alpha_G = \frac{4\Theta}{\beta\pi^2 l_p}$ with an error of only $4.79 \cdot 10^{-4}$. Interesting to note that if the decoupling photon temperature $T_p = 2.726$ K is used the error goes down to $9.8 \cdot 10^{-5}$. Plug in $\alpha_G = \frac{\beta\pi^2 l_p}{4\Theta}$ into (7)

$$F_G = \left(\frac{\hbar c M_1 M_2}{m_{cmb}^2 r^2}\right) \frac{\beta\pi^2 l_p}{4\Theta} \tag{11}$$

Finally, identify the new composite gravitational CMB constant.

$$\boldsymbol{G_{cmb} = \frac{\hbar c}{m_{cmb}^2} \cdot \frac{\beta \pi^2 l_p}{4\Theta}} \tag{12}$$

Where,

$$F_G = \frac{G_{cmb} M_1 M_2}{r^2} \tag{13}$$

Therefore, (13) is simply Newton's Gravity Law using only the CMB mass as the fundamental mass.

2.2 Writing Theta in terms of CMB parameters and constants

Next, use the known gravitational constant $G_H = \frac{c^3 l_p^2}{\hbar}$ and set it equal to the new gravitational constant, G_{cmb} [5] [9].

$$\frac{c^3 l_p^2}{\hbar} = \frac{\hbar c}{m_{cmb}^2} \cdot \frac{\beta \pi^2 l_p}{4\Theta} \tag{14}$$

Solve for the cosmic horizon, Θ.

$$\Theta = \frac{\beta \pi^2 \hbar^2}{4 m_{cmb}^2 c^2 l_p} \tag{15}$$

Finally replace $m_{cmb} = \frac{kT}{\beta c^2}$ to solve for for the cosmic diameter.

$$\Theta = \frac{\pi^2 \beta^3 c^2 \hbar^2}{4 k^2 T^2 l_p} \tag{16}$$

This results in the following value:

$$\Theta = 8.8042 \cdot 10^{26} \quad [\mathrm{m}] \tag{17}$$

2.3 Writing the particle horizon Theta in terms of experimental neutrino mass

As noted in section 2.1 the experimental neutrino energy computed was $E_{\nu exp} = 0.00117$ eV. Using this value, find the neutrino energy and compute the neutrino mass. Note this is very similar to the CMB mass. It is suggested that only mirror non local neutrinos give rise to mass, therefore, only sterile right handed neutrinos are located on the horizon or beyond.

$$m_N = \frac{E_{\nu exp}}{c^2} \tag{18}$$

Next use (9) but replace R with Θ as the exact nodes will be on the cosmic horizon. Also replace m_{cmb} with m_N.

$$\boldsymbol{\alpha_{Gexp} = \frac{m_N^2}{m_p^2} = \frac{l_p}{2\Theta}} \tag{19}$$

This ratio of forces will have an error of $3.3 \cdot 10^{-5}$. Using the same procedure, the new experimental gravitational constant will be the following.

$$\boldsymbol{G_N = \frac{\hbar c}{m_N^2} \frac{l_p}{2\Theta}} \tag{20}$$

Next, use the known gravitational constant $G_H = \frac{c^3 l_p^2}{\hbar}$ and set it equal to the new gravitational constant, G_N like before.

$$\frac{c^3 l_p^2}{\hbar} = \frac{\hbar c}{m_N^2} \cdot \frac{l_p}{2\Theta} \tag{21}$$

Denote this as Θ_{exp} and solve.

$$\Theta_{exp} = \frac{\hbar^2}{2c^2 l_p m_N^2} \tag{22}$$

This results in the following value.

$$\Theta_{exp} = 8.7997 \cdot 10^{26} \quad [\mathrm{m}] \tag{23}$$

3 Discussion

It seems that all particles have their mirror (particle pair production due to information horizon boundary) located beyond the CMB. The CMB acts like an emitter and the energy transmitted is linked to the property of mass. These results may suggest that dimension of the cosmic particle horizon might be interlinked to the phenomenon of gravity, other fundamental forces and composite physical constants.

The errors using the CMB or neutrino mass/energy equivalent have full convergence. The error of each is indicated.

Table 1: Error Table

Equation Number	**Mass Type**	**Error** %
10	m_{cmb}	0.0479
18	m_N	0.0033

4 Conclusion

It is suggested that the fundamental mass of the universe corresponds to the properties of the neutrino. Additionally, the CMB photons provide a direct link to the neutrino mass, and henceforth; to gravity. Additionally, a new composite version of the gravitational constant is found. From this, the cosmic diameter can be computed using only fundamental constants and the CMB temperature. The CMB, as anticipated, is a fundamental mechanism that provides a potential connection between neutrinos and their non-local mirror are due to the horizon.

Furthermore, it could be inferred that charges also behave in a similar fashion and have their non-local mirror particles located beyond the horizon. Further research is suggested to potentially discover more links to the CMB. This also could provide more insight about the importance of neutrinos and perhaps might lead to a future methodology explaining the nature of all four fundamental forces.

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