Convergent Fundamental Constants of the Universe

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Abstract

Several theoretical equations are derived which determine the vacuum permittivity, vacuum permeability, free impedance and speed of light to a highly convergent value on the order of 10^{-8} to 10^{-9}. Their dependence is related to the particle horizon, Hubble horizon, Planck length, proton wavelength and the fine structure constant. Due to these highly convergent equations, an image of both the photon and the vacuum may start to emerge.

1 Introduction

In 2019 Bhatt and Becker discovered an exact neutrino mass and found it was correlated to the CMB (Cosmic Microwave Background) and could be used in Newton's Law of Gravity [3] [5]. By using this knowledge, and rewriting the gravitational constant as a composite, one can equate this to the well-known gravitational constant. By solving for the speed of light and rewriting the terms in a unique way, one can isolate the fundamental electric and magnetic constant and the impedance of free space, vacuum permittivity, and vacuum permeability can be found [2]. Finally, a highly convergent speed of light formula can be found that uses the fine structure constant and various physical lengths and energies.

2 Method

2.1 Fundamental Constants with Energy

We begin by suggesting two forms of the Newton's Gravity law can be equated using G and G_ν.

$$G\frac{M_1 M_2}{r^2} = G_\nu \frac{M_1 M_2}{r^2} \tag{1}$$

Now replace G_ν with $\frac{\hbar c}{m_\nu^2}\frac{l_p}{4R_{PH}}$, gravitational constant, where m_ν is the neutrino mass. This was initially done in 2019 by Bhatt and Becker [3]. Next, one can equate this to the Newton's Gravity Law where it is known $G = \frac{l_p^2 c^3}{\hbar}$. Note, the cosmic horizon radius is $R_{PH} = 4.4 \times 10^{26}$ m while the Hubble radius is $R_H = \frac{8}{27} R_{PH}$.

$$\frac{l_p^2 c^3}{\hbar} \frac{M_1 M_2}{r^2} = \frac{\hbar c}{4 m_\nu^2} \frac{l_p}{R_{PH}} \frac{M_1 M_2}{r^2} \tag{2}$$

Simplify the left and right hand side to the following.

$$\frac{l_p^2 c^3}{\hbar} = \frac{\hbar c}{4 m_\nu^2} \frac{l_p}{R_{PH}} \tag{3}$$

Next, solve for c^2 and use $s = 1$ where shortly we will identify the proper units.

$$c^2 = \frac{\hbar^2}{4 m_\nu^2} \frac{1}{R_{PH} l_p} \cdot \frac{s}{s} \tag{4}$$

The next procedure is a bit interesting and we need to rewrite c in a form that matches the permitivitty and permeablity of free space.

$$c = \sqrt{\frac{1}{\frac{4 m_\nu^2 R_{PH} l_p s}{\hbar^2 s}}} \tag{5}$$

Identify the permitivitty and permeablity of free space from the equation $c = \frac{1}{\sqrt{\epsilon_0 \mu_0}}$. Note that s will have the units [kg m^3 C^{-2} s^{-1}].

$$c = \sqrt{\frac{1}{\frac{64 m_\nu R_{PH} l_p}{\hbar s} \frac{m_\nu s}{16 \hbar}}} \tag{6}$$

$$\epsilon_0 = \frac{64 m_\nu R_{PH} l_p}{\hbar} \cdot \frac{1}{s} \tag{7}$$

$$\mu_0 = \frac{m_\nu}{16 \hbar} \cdot s \tag{8}$$

Now one can replace $m_\nu = \frac{\hbar}{2\sqrt{R_{PH} l_p c}}$ for ϵ_0 and μ_0.

$$\epsilon_0 = \frac{32\sqrt{R_{PH} l_p}}{c} \cdot \frac{1}{s} \tag{9}$$

$$\mu_0 = \frac{1}{32c\sqrt{R_{PH} l_p}} \cdot s \tag{10}$$

$$Z_0 = \frac{1}{32\sqrt{R_{PH} l_p}} \cdot s \tag{11}$$

2.2 Convergent Fundamental Constants

By making the assumption that R_{PH} can be replaced by the golden ratio growth factor and the Hubble radius, use the extended Hubble radius and set it equal to the following $R_B = R_H/b$ where $b = \frac{\pi/2}{\ln \phi}$. Here, b denotes the formal mathematical growth factor for a spiral expansion. The extended universe horizon is equivalent to a trajectory that follows a spiral path which spans the Hubble radius. This converges quite well for all three fundamental constants. The error will be 1.9×10^{-4}. Although this may seem arbitary, a physical connection of b will be discussed next. Next, notice a 16 or 32 factor could be related to pair production and is found in the energy inside a rectangular waveguide [14] [15]. Additionally if that number is taken be 32 or 64, this is the volume or surface area of a torus with large radius ϕ and outer tube radius as 1. The maximum distance from the center to the outer radius edge would be ϕ^2 which was seen to be special value [4] and the shortest length of a Kepler triangle. A potential link to free space impedance and hyperbolic sphere surface area will be suggested in the Appendix B. Finally, consider the thought experiment where a Planck mass is placed inside a cubic structure. The Schwarzchild radius would be $2l_p$ and consider the sphere that would fit inside this cube. This cube would have a volume of 64. A pseudosphere's curvature might also be related to this factor using $1/R^2$. It seems this factor of 16, 32 or 64 could be related to dimensional regularization and the exact physical nature needs more research. Differential cross section in Feynman diagrams is linked to a 32 or 64 factor as well as vacuum loop diagrams [11] [9] [12].

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$$\epsilon_0 = \frac{32\sqrt{R_B l_p}}{c} \cdot \frac{1}{s} \tag{12}$$

$$\mu_0 = \frac{1}{32c\sqrt{R_B l_p}} \cdot s \tag{13}$$

$$Z_0 = \frac{1}{32\sqrt{R_B l_p}} \cdot s \tag{14}$$

Next, using another approach, set $b_{pr} = \frac{\ln \frac{\lambda_p}{2l_p}}{\ln \frac{R_{PH}}{l_p}} = \frac{\ln \frac{r_p}{8l_p}}{\ln \frac{R_{PH}}{l_p}}$ where λ_p is the proton reduced compton wavelength and r_p is the proton charge radius. Here it was discovered that this ratio is almost equivalent to the golden ratio growth factor but is actually physical. (At this point it is hard to know if this is a mathematical coincidence or not.) This is ratio of the fractional energy inside a proton to that of the particle horizon and seems to be linked to the golden ratio growth factor. We speculate this is more exact. Let us set the extended universe horizon $R_E = R_H/b_{pr} = R_H \frac{\ln \frac{R_{PH}}{l_p}}{\ln \frac{\lambda_p}{2l_p}}$. The result will be essentially fully convergent with an error of only 7.1×10^{-8}.

$$\epsilon_0 = \frac{32\sqrt{R_E l_p}}{c} \cdot \frac{1}{s} \tag{15}$$

$$\mu_0 = \frac{1}{32c\sqrt{R_E l_p}} \cdot s \tag{16}$$

$$\boldsymbol{Z_0 = \frac{1}{32\sqrt{R_E l_p}} \cdot s} \tag{17}$$

Until now, the electric and magnetic constant were circular and dependent on either the neutrino mass or the speed of light. To remedy this, a speed of light equation was identified which has extremely high convergence. Here, one can take $k = 1$ [$\mathrm{m}^3\ \mathrm{s}^{-1}$] to identify the hidden units. The error is essentially fully convergent at 4.8×10^{-9}. This could be inserted into both ϵ_0 and μ_0 which now would solely depend on cosmic horizon distances, Planck length, proton wavelength and the fine structure constant. The factor $\tanh \frac{\pi}{2}$ could come from the curvature using hyperbolic geometry [8]. It could come from a Trochoidal-like wave where $\tanh kh = \tanh\left(\frac{2\pi}{R_E/l_p} \frac{R_E}{4l_P}\right)$. Here the $4l_p$ could be related to minimum distance a positron pair needs to recombine after it's disk trajectory. It could also be related to the notion that for a full wave to be determined it needs 4 points. Therefore, looking at the spatial resolution of the waveform, the shortest span can be considered as a segmentation of four times the shortest distance which can be probed; thus a chain of four Planck lengths. The $\frac{R_E}{l_p}\tanh\frac{\pi}{2}$ could also be related to derivative of the arclength of a tractrix which is a slice of a pseudosphere [1] . The α times the natural logarithmic term is an adjustment factor that is near one but may represent an adjusted horizon. Finally, the 2 factor might be attributed to the ratio of electric and magnetic field as a result of a derivative between acceleration and velocity [10].

$$\boldsymbol{c = \frac{2}{R_E l_p}\alpha \ln\left(\frac{R_E}{l_p}\tanh\frac{\pi}{2}\right)\cdot k} \tag{18}$$

Finally, insert the newly discovered c value into ϵ_0 and μ_0 to obtain the following. Here $j = 1$ has units [$\mathrm{C}^2\ \mathrm{s}^2\ \mathrm{kg}^{-1}\ \mathrm{m}^{-6}$] and $m = 1$ has units [$\mathrm{C}^2\ \mathrm{kg}^{-1}$].

$$\boldsymbol{\epsilon_0 = \frac{16(R_E l_p)^{3/2}}{\alpha \ln\left(\frac{R_E}{l_p}\tanh\frac{\pi}{2}\right)}\cdot j} \tag{19}$$

$$\boldsymbol{\mu_0 = \frac{(R_E l_p)^{1/2}}{64\alpha \ln\left(\frac{R_E}{l_p}\tanh\frac{\pi}{2}\right)}\cdot m} \tag{20}$$

One final interesting note is using the well known relationship of $e^2 = 4\pi\epsilon_0\alpha\hbar c$ and replacing it with ϵ_0 as found above one can compute the elementary charge. Note that s will have the units [$\mathrm{kg\ m}^3\ \mathrm{C}^{-2}\ \mathrm{s}^{-1}$].

$$\boldsymbol{e}^2 = 64h\alpha\sqrt{R_E l_p}\cdot\frac{1}{s} \tag{21}$$

3 Discussion

All four fundametal constants converge very well with the CODATA values [13]. Deviations in convergence could be attributed in the error in the Hubble and particle horizon radius. The table below compares the theoretical values to the experimentally determined ones.

Table 1: Comparison of Constants

Equation Number	**Fundamental Constant**	**Error from Experimental Value**
9	ϵ_0	1.66×10^{-2}
10	μ_0	1.66×10^{-2}
11	Z_0	1.66×10^{-2}
12	ϵ_0	1.9×10^{-4}
13	μ_0	1.9×10^{-4}
14	Z_0	1.9×10^{-4}
15	ϵ_0	7.1×10^{-8}
16	μ_0	7.1×10^{-8}
17	$\boldsymbol{Z_0}$	$\mathbf{7.1 \times 10^{-8}}$
18	$\boldsymbol{c}$	$\mathbf{4.9 \times 10^{-9}}$
19	$\boldsymbol{\epsilon_0}$	$\mathbf{7.6 \times 10^{-8}}$
20	$\boldsymbol{\mu_0}$	$\mathbf{6.6 \times 10^{-8}}$

4 Conclusion

Four fundamental constants are suggested to be composites, have been found theoretically, and have strong numerical convergence. Their relationships seem to be linked to Planck length, cosmic horizons, the fine structure constant and proton wavelength. An initial picture of a photon may begin to become illuminated along with the physical meaning of an electric and magnetic field in terms of length and time. The constants' physical nature still require further research but these equations should provide some clues to the fundamental nature of these constants.

5 Appendix A

Here, we attempt to expand both the vacuum impedance and speed of light in terms of electric and magnetic field.

$$c = \frac{\boldsymbol{E}}{\boldsymbol{B}} = \frac{\frac{1}{R_E l_p}}{\frac{1}{2\alpha \ln\left(\frac{R_E}{l_p}\tanh\frac{\pi}{2}\right)}} \cdot k \tag{22}$$

$$Z_0 = \frac{\boldsymbol{E}}{\boldsymbol{H}} = \frac{\frac{1}{8R_E l_p}}{\frac{8}{2\sqrt{R_E l_p}}} \cdot s \tag{23}$$

Now we will try a speculative approach. First consider mass as unitless as suggested by Haug [7]. We take this one step further and also set charge to unitless as well. In additional we presume the ratio of $\frac{1}{R_E l_p}$ is unitless with a hidden area unit in the numerator. Now we set an acceleration term $\hat{a} = 1$ as a minimum acceleration term and $\hat{A}$ as unitary area.. For the magnetic field term, $\boldsymbol{B}$, we have units [s^{-1}] and will use $\hat{f} = 1$. Here it is suspected that the Coulumb unit is related to a factor of 8 so the fractions for electric and magnetic fields are written accordingly. Additionally, if this is assumed an extra 2 factor could be associated with the speed of light and free space impedance. Haug recently suspected a 2 factor pertinent to the speed of light as well [6].

$$c = \frac{\boldsymbol{E}}{\boldsymbol{B}} = \frac{\frac{\hat{A}}{R_E l_p}}{\frac{1}{2\alpha \ln\left(\frac{R_E}{l_p} \tanh \frac{\pi}{2}\right)}} \cdot \frac{\hat{a}}{\hat{f}} \tag{24}$$

$$Z_0 = \frac{\boldsymbol{E}}{\boldsymbol{H}} = \frac{\frac{\hat{A}}{8 R_E l_p}}{\frac{8}{2\sqrt{R_E l_p}}} \cdot \frac{\hat{a}}{\hat{f}} \tag{25}$$

One other speculative option is setting mass to pace units and charge to length. Here $\hat{V}$ is unitary volume.

$$c = \frac{\boldsymbol{E}}{\boldsymbol{B}} = \frac{\frac{1}{\sqrt{R_E l_p}}}{\frac{\sqrt{R_E l_p}}{2\alpha \ln\left(\frac{R_E}{l_p} \tanh \frac{\pi}{2}\right)}} \cdot \frac{\hat{f}}{\frac{1}{\hat{V}}} \tag{26}$$

$$Z_0 = \frac{\boldsymbol{E}}{\boldsymbol{H}} = \frac{\frac{1}{8\sqrt{R_E l_p}}}{\frac{8}{2}} \cdot \frac{\hat{f}}{\hat{f}} \tag{27}$$

Finally one might set mass to pace units and charge as unitless.

$$c = \frac{\boldsymbol{E}}{\boldsymbol{B}} = \frac{1}{\frac{R_E l_p}{2\alpha \ln\left(\frac{R_E}{l_p} \tanh \frac{\pi}{2}\right)}} \cdot \frac{\hat{f}}{\frac{1}{\hat{V}}} \tag{28}$$

$$Z_0 = \frac{\boldsymbol{E}}{\boldsymbol{H}} = \frac{\frac{1}{8}}{\frac{8}{2}\sqrt{R_E l_p}} \cdot \frac{\hat{f}}{\frac{\hat{f}}{\hat{A}}} \tag{29}$$

6 Appendix B

Finally it is suggested that Z_0 can potentially be linked to the surface area of a sphere in hyperbolic space. Here a Kepler triangle is used which has lengths, $(\phi^2, \phi^{2.5}, \phi^3)$. This specific triangle was found to be potentially important [4]. Here we take $r = \phi^3$ and $R = \phi^{2.5}$ and use $s = 1$ [Ω m^{-2}].

$$Z_0 = 4\pi R^2 \sinh \frac{r}{R} \cdot s = 4\pi\phi^5 \sinh \sqrt{\phi} \cdot s \tag{30}$$

The error from experimental Z_0 is 3.1×10^{-4}. Speculating mass and charge are unitless one can obtain the following.

$$Z_0 = 4\pi R^2 \sinh \frac{r}{R} \cdot s = 4\pi\phi^5 \sinh \sqrt{\phi} \cdot \hat{f} \tag{31}$$

Speculating mass as pace and charge as length one can obtain the following.

$$Z_0 = 4\pi R^2 \sinh \frac{r}{R} \cdot s = 4\pi\phi^5 \sinh \sqrt{\phi} \cdot \frac{1}{\hat{V}} \tag{32}$$

Speculating mass as pace and charge as unitless one can obtain the following where $\hat{l}$ is unit length.

$$Z_0 = 4\pi R^2 \sinh \frac{r}{R} \cdot s = 4\pi\phi^5 \sinh \sqrt{\phi} \cdot \frac{1}{\hat{l}} \tag{33}$$

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