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Planck Scale Particles in the Universe

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ABSTRACT

Planck's units when multiplied by the magic number (10^{61}) give the well-known physical properties of the universe, mass, length and time. Planck's units divided by magic number gives the mass, size and lifetime of the smallest Planck scale particle existing in the universe. These considerations are shown to lead to pleasingly meaningful results.

Keywords: *Planck scale; Planck scale universe; Elementary particles; Magic number.*

1. PLANCK SCALE, MAGIC NUMBER AND THE UNIVERSE

It is generally accepted that the Planck scale defines a minimum scale for the universe [1–6]. More than one hundred years ago, using three fundamental constants, $\hbar$ (related to quantum physics), c (which governs the laws of relativity) and G (related to gravitational phenomena) Planck introduced his famous units of mass, length and time as [7]:

Planck mass, $$M_{pl} = \left(\frac{\hbar c}{G}\right)^{\frac{1}{2}} = 2.2\times 10^{-5}\, gm \quad (1)$$

Planck length, $$L_{pl} = \left(\frac{\hbar G}{c^3}\right)^{\frac{1}{2}} = 1.6\times 10^{-33}\, cm \quad (2)$$

Planck time, $$t_{pl} = \left(\frac{\hbar G}{c^5}\right)^{\frac{1}{2}} = 5\times 10^{-44}\, s \quad (3)$$

These three values play a major role for understanding the physics of elementary particles [8]. [9] has presented the significance of these values as: "It seems more and more probable that physics on a Planck scale determines not only all physics of low energies but also the whole picture of the universe as well".

The number 10^{61} is called as magic number since Planck's units when multiplied by this number give the well-known physical properties of the universe, mass, length and time [10,11]. For example, Planck mass multiplied by magic number gives the mass of the universe, the largest unit existing. Planck mass divided by magic number gives the mass of the smallest Planck scale particle exist in the universe.

Planck mass multiplied by magic number gives mass of the universe the largest unit exist in the universe.

$$10^{61} M_{Pl} = 10^{61}\times 2.2\times 10^{-5}\, gm = 2.2\times 10^{56}\, gm \quad (4)$$

Planck mass divided by magic number will give mass of the smallest Planck-scale particle exist in the universe.

$$10^{-61} M_{Pl} = 10^{-61}\times 2.2\times 10^{-5}\, gm = 2.2\times 10^{-66}\, gm \quad (5)$$

Planck length multiplied by magic number gives radius of the universe the largest unit exists in the universe.

$$10^{61} l_{Pl} = 10^{61}\times 1.6\times 10^{-33}\, cm = 1.6\times 10^{28}\, cm \quad (6)$$

Planck length divided by magic number will give radius (size) of the smallest Planck-scale particle exist in the universe.

$$10^{-61} l_{Pl} = 10^{-61}\times 1.6\times 10^{-33}\, cm = 1.6\times 10^{-94}\, cm \quad (7)$$

Planck time multiplied by magic number gives age of the universe the largest unit exist in the universe.

$$10^{61} t_{Pl} = 10^{61}\times 5\times 10^{-44}\, s = 5\times 10^{17}\, s \quad (8)$$

Planck time divided by magic number will give lifetime of the smallest Planck-scale particle existing in the universe.

$$10^{-61} t_{Pl} = 10^{-61}\times 5\times 10^{-44}\, s = 5\times 10^{-105}\, s \quad (9)$$

Now consider the mass of pion, $m_\pi = 0.140 GeV/c^2 = 2.49\times 10^{-25}$ g. The number of smallest Planck scale particles oscillating in pion =

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$$\frac{m_\pi}{10^{-61} M_{Pl}} \approx 10^{41} \quad . \qquad (10)$$

Similarly, if we consider the mass of up-quark, m_u = 3 MeV/c^2 =5.333×10^{-27} g, down-quark, m_d = 7 MeV/c^2 =1.2444×10^{-26} g, electron, m_e =9.11×10^{-28} g and proton, m_p = 1.673×10^{-24} g. The number of smallest Planck scale particles oscillating are respectively

$\approx 10^{39}$, $\approx 10^{39}$, $\approx 10^{38}$, $\approx 10^{42}$.

It is already established that an elementary particle like a pion can be considered as a result of 10^{40} Planck-scale particles [1]. Thus, our results agree with others to some extent.

Now let us consider the mass of the universe, M_U =$10^{61}M_{Pl}$. We get the number smallest Planck scale particles oscillating in the universe =

$$\frac{M_U}{10^{-61} M_{Pl}} \approx 10^{122} \quad . \qquad (11)$$

This number has some special features : It is just the square of the ratio of the two scales: the universe and the Planck's scale. Again we know that the quantization of a black hole [12] gives the entropy in terms of the number of nodes and considering the universe as a black hole [11], the number of nodes present in the universe is 10^{122} [13]. Furthermore, the quantization of the universe as a black hole by the authors [14] also give ~ 10^{122} bits.

2. CONCLUSIONS

From above discussions, we have come to conclusion that the mass of the smallest Planck scale particle is Planck mass divided by magic number. Its size is Planck length divided by magic number and its lifetime is Planck time divided by magic number. Using this consideration we show that the whole universe is considered to be made up of ~ 10^{122} Planck scale particles and an elementary particle can be considered to be made up of ~ 10^{40} Planck scale particles. These findings have consequences for improving the state of the art of Planck scale universe.

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