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Origin of the Numeric Values of Electron Mass and the Electron-Proton Mass Ratio

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Abstract: In this article I propose an origin of the numeric value of the electron mass and the electron-proton mass ratio. Starting from the hypothesis that we are in an universe with critical energy density, we find a relationship among the electron mass, the inverse square of the electric charge and other fundamental constants.
Keywords: fundamental constants, electron, proton.

In an universe with critical energy density, the value of this depends on the Hubble radius:

$$\rho = 3\ c^2 / 8\ \pi\ G\ R_h^2 \qquad (1)$$

If we consider a sphere with radius R_h (Hubble radius) and center in a point (P), we obtain a total energy M with the following value:

$$M = \rho\ (4/3)\ \pi\ R_h^3 \qquad (2)$$

Substituting in this expression the density value of (1), we obtain:

$$M = c^2\ R_h / 2\ G \qquad (3)$$

Let us to consider a solid angle Ω such as the volume V of the cone that subtends from the point P until R_h is such that the energy density given by M/V, where M is the energy calculated in (2), is numerically equal to the electron mass $m_e = 9.1\ 10^{-28}$ g./cm^3. The considered volume will be $V = \Omega\ \pi\ R_h^3 / 3$. Consequently we obtain:

$$m_e = 3\ c^2\ (1\ \text{cm}^3) / 2\ G\ \Omega\ \pi\ R_h^2$$

$$\Omega = 3\ c^2\ (1\ \text{cm}^3) / 2\ G\ m_e\ p\ R_h^2$$

If we admit a value of the Hubble radius of $1.796\ 10^{28}$ cm, we obtain for Ω the value of 0.021892 rad. that coincides with the triple of the value of the fine structure constant: $\Omega = 3\ \alpha$. Since $\alpha = e^2 / c$ hbar (hbar = $h/2\pi$), we can find an expression function of the fundamental constants that will give us the value of the electron mass:

$$m_e = c^3 \text{ hbar } (1 \text{ cm}^3) / 2 G e^2 \pi R_h^2 \quad (4)$$

The expression $1 / R_h^2$ is the cosmological constant Λ, e^2/c hbar is α, the expression (4) will be:

$$m_e = (1 \text{ cm}^3)\, c^2 \Lambda / 2 G \alpha \pi \quad (5)$$

It is easy to see that this relationship doesn't depend on the length unit that is used, neither on the arbitrary election of their value, using inches instead of centimetres it would continue being valid.

We could apply the expression (5) to the other three charged elementary particles, the quarks. In this case the charges are 2/3 and 1/3 of the electron charge, we would obtain the values of 9 m_e and 9/4 m_e for the masses of the quarks down and up respectively. If we consider that a proton is composed of two up quark and a down quark, the components mass of a proton will be 13.5 m_e, the rest until the proton mass would be due to the connection energy generated by the strong interaction. The value of the proton mass is obtained from the following expression, in which only the electron mass, the fine structure constant and the number 13.5 takes part:

$$m_{pr} = 13.5\, m_e/[\alpha \exp(\Sigma_{n=1,2,3...}\, n^2 \alpha^n)] = 1836.1375\, m_e \quad (6)$$

If we take the value of $9.10938188\ 10^{-28}$ g. for the electron mass and the value of $7.29735254\ 10^{-3}$ for α, the value obtained with the expression (5) for the proton mass with the first four terms of the series is $1.67260775\ 10^{-24}$ g.

The measured real value of the proton mass is $1.67262158\ 10^{-24}$ g.:

$$1.67262158\ 10^{-24} \text{ g} = 1836.1527\, m_e \quad (7)$$

Nevertheless, the expression (6) is valid with the quarks in rest. In the proton the quark is in movement. In consequence the quark sea will suffer an increment in its mass that it justifies the difference among the expressions (6) and (7).

If we substitute in the expression (4) the value of all the well-known constants, we can find the values of the Hubble radius and the Hubble constant:

Hubble Radius: $1.79619\ 10^{28}$ cm.
Hubble Constant: $1.6691\ 10^{-18} \text{sg}^{-1}$.
Cosmological Constant: $3.099536\ 10^{-57}\ \text{cm}^2$

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