New Light into the Obscure Nature of Dark Matter

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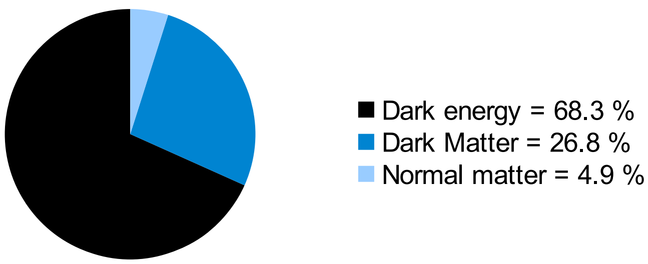
Abstract

The problem I shall address in this paper is concerned with a new particle with a mass of approximately $55.6\, eV / c^2$ *. One of the possibilities is that this elusive particle to be either a new type of neutrino or a completely new type of particle with sufficiently large abundance to account for most of the predicted dark matter content in the Universe. If this formulation were correct then the dark matter mystery, at least to a large extent, would have been solved.*

Keywords: *dark matter, dark energy, quark, leptoquark, neutrino, electron neutrino, muon neutrino, tau neutrino, fine-structure constant, atomic structure constant, electromagnetic coupling constant, generations of matter, Standard Model.*

1. Introduction

Astronomical observations indicate that there is about 5.5 times more mass in clusters of galaxies than we would expect from the normal mass of the clusters and hot gas we can detect. Since clusters of galaxies are the largest known structures in the Universe and since most of the mass that makes up these clusters cannot be seen with telescopes, it is logical to assume that most of the matter in the Universe is *dark matter*: an invisible material of unknown nature. The latest measurements indicate that the contents of the Universe is as shown in the following pie chart



The hypothesis I shall put forward in this paper is that there is, at least, one more type of neutrino (sterile and/or non-sterile) and that this neutrino is massive and extremely abundant (much more abundant that the normal neutrinos). If all neutrinos, including the unknown ones, have even a tiny mass each, they could add considerably to the overall dark matter of the Universe.

2. Nomenclature

I shall use the following nomenclature for the constants used in this paper

α = fine-structure constant, electromagnetic coupling constant, or atomic structure constant.
m_n = neutron rest mass
m_p = proton rest mass
m_e = electron rest mass
m_{ν_L} = mass of the unknown particle
K = dimensionless constant
$F_{JeV} = 1.602\,176\,564 \times 10^{-19}\ J/eV$ = conversion factor from Joules to electron-volts

3. The Fermionic "Alpha" Formula

The fermionic "Alpha" formula is given by the following expression

$$\alpha \approx \frac{20}{\pi - 2}\left(\frac{m_n - m_p - m_e}{m_n + m_p + m_e}\right) \tag{3.1}$$

If we define the dimensionless constant K as

$$K \equiv \frac{20}{\pi - 2} = 17.519\ 383\ 94 \tag{3.2}$$

Now we can rewrite equation (3.1) in terms of K

$$\alpha \approx K\left(\frac{m_n - m_p - m_e}{m_n + m_p + m_e}\right) \tag{3.3}$$

The value this formula yields is

$$\alpha = 0.007\ 296\ 352\ 53 \tag{R1}$$

According to NIST, the value of the electromagnetic constant is

$$\alpha_{NIST\ 2010} \approx 0.007\ 297\ 352\ 569\ 8\,(24) \approx 0.007\ 297\ 352\ 57$$

The fact that the value of formula (3.1) is accurate to 5 decimal places seems to indicate that: a) the formula is not numeric, and b) there is something missing in the formula that, if included, it would make it exact. In the following section I shall find the missing parameter.

4. The Hunt for an Elusive Particle

In this section I propose that what is missing in equation (3.1) is the mass of an unknown particle so that if we were able to include it we would obtain an exact formula. There are two ways of including this mass. a) The first way is by adding another mass term to both the numerator and the denominator (**case 1**). b) The second way is by adding another mass term to the numerator only (**case 2**). All the other cases will produce a negative value for the missing mass and therefore must be discarded. For symmetry reasons (two neutral particles and two charged particles) the missing mass must correspond to a neutral particle. We shall denote this mass with m_{ν_L} . (Because we shall find that the value of this mass is extremely small, it is very likely that this mass corresponds to a new type of neutrino). Now we shall consider the above cases separately.

a) **case 1:** The equation corresponding to this case is

$$\alpha = \frac{20}{\pi - 2}\left(\frac{m_n + m_{\nu_L} - m_p - m_e}{m_n + m_{\nu_L} + m_p + m_e}\right) \tag{4.1}$$

And the solution to this equation is

$$m_{\nu_L} = \frac{m_n - m_p - m_e - \alpha\left(\frac{\pi - 2}{20}\right)(m_n + m_p + m_e)}{\frac{\alpha\pi}{20} - \frac{2\alpha}{20} - 1} \tag{4.2}$$

The value for this mass is

$$m_{\nu_L} \approx 9.908\ 749\ 731 \times 10^{-35}\, Kg \tag{R2 a}$$

or, equivalently

$$m_{\nu_L} \approx 55.58 \frac{eV}{c^2} \tag{R2 b}$$

To have an idea of this mass let us calculate the following ratio

$$\frac{m_{\nu_L}}{m_e} = 0.000\ 108\,8$$

This mass is almost 1/10,000 lighter than the electron. This mass must correspond to a new type of neutrino.

b) **case 2:** The equation corresponding to this case is

$$\alpha = \frac{20}{\pi - 2}\left(\frac{m_n + m_{\nu_L} - m_p - m_e}{m_n + m_p + m_e}\right) \tag{4.3}$$

If we solve this equation for m_{ν_L} we get

$$m_{\nu_L} = \alpha \left(\frac{\pi - 2}{20} \right) (m_n + m_p + m_e) - (m_n - m_p - m_e) \qquad (4.4)$$

The value for this mass is

$$m_{\nu_L} \approx 9.904\ 622\ 437 \times 10^{-35}\, Kg \qquad \text{(R3 a)}$$

or

$$m_{\nu_L} \approx 55.56 \frac{eV}{c^2} \qquad \text{(R3 b)}$$

Note that this result is almost identical to the one we got for **case 1**. Therefore we conclude that the mass of this elusive particle is about $55.6 \frac{eV}{c^2}$

5. Brief Analysis

The mass we obtained in the two previous cases is bigger than the mass of the electron neutrino and smaller than the mass of muon neutrino. This suggests that this new mass corresponds to a new type of neutrino. Because the Standard Model does not predicts the existence of any particle with this mass, we have to look into new theories. Thus, the possible candidates are:

(1) **a leptoquark neutrino**
The leptoquark theory theory, developed by J. A. Gowen [1], proposes the existence of a neutral leptoquarks that would have decayed soon after the Big Bang into a leptoquark neutrinos and other decay products. Because leptoquaks are thought to be heavier than neutrons, the corresponding leptoquak neutrino should be heavier than the electron neutrino, and this is exactly what this formulation predicts.

(2) **a sterile neutrino**
Our elusive particle could be a sterile neutrino that was not part of the decay product of a leptoquark.

(3) **a non-sterile neutrino**
Our elusive particle could be a non-sterile neutrino that was not part of the decay product of a leptoquark. If this is correct, then there is another generation of matter.

(4) **a new type of particle.**
Our elusive particle could be a new composite neutral particle which would not classify neither as a neutrino nor as a hadron. I believe that this is a less likely possibility, however we should not discard it. Note that this new particle could not a lepton because leptons carry an electrical charge.

6. Conclusions

This formulation predicts an elusive new particle with a mass of approximately $55.56\, eV / c^2$. The author also predicts that the abundance of this neutrino (or a new type of particle) is sufficiently large to exceed that of all the known neutrinos together and to account for a considerable part of the overall dark matter in the Universe. In summary, if this theory is correct then the dark matter mystery, at least to a large extent, has been solved.

REFERENCES

[3] J. A. Gowen, *Symmetry Principles of the Unified Field Theory (a "Theory of Everything") - Part I*, html document retrieved 2008 from the web, (2007).