# The Search for a Super Light Particle

(Draft version)

*The quantum gravitational formula for the mass of the electron suggests the existence of a super light particle yet to be observed. However, it is not clear whether this particle is an electrino, a new type of neutrino, a neutralino (a neutral particle that is neither a neutrino nor a darkino) or a darkino (a neutral particle "responsible" for the mysterious dark matter contents of the Universe). The formula also suggests four possible values for the rest mass of this super light particle.*

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## 1. Introduction

One of the biggest problems with the Standard Model of particle physics is that it does not include the effects of gravity. Because gravity is the weakest of all forces, most people assume that gravity may be neglected with no observable consequences or, in the worse case, with negligible consequences. However, this assumption is erroneous. Newton's gravitational constant, $G$, is important not only at macro scales but also at micro scales. This can be easily illustrated by the Planck length and other Planck units such as the Planck time and the Planck mass. The Planck length is believed to describe the minimum distance with physical meaning. This means that the Planck length describes, along with other physical constants, the micro level of the Universe. Because the Planck length contains three of the fundamental constants of Nature: the speed of light ($c$), the Planck's constant ($h$), and the gravitational constant ($G$), it is clear that Newton's gravity constant plays a fundamental role at micro scales, and therefore it should be included in any quantum mechanical description of Nature (the inclusion of gravity into particle physics, or the inclusion of quantum mechanical principles into any gravity theory, such as General Relativity, is known as quantum gravity). This is also evident when we consider particle interactions. Because particles interact with other particles through spacetime, and because space and time have super-microscopic lower limits: the Planck length and the Planck time, respectively, the gravitational constant, and hence gravity, must rule out the micro-cosmos as well. The formula presented in this paper, and introduced in a previous paper, illustrates precisely this point. Also according to a new cosmological model [1] that I developed, the Universe began with the size of a sphere of radius equal to the Planck length and a mass equal to the Planck mass over 2. Because the formula for the Planck mass also includes the Newton's gravitational constant, it is essential to include this constant if we want to make valid predictions in particle physics under all situations and get results that match the observations.

## 2. The Quantum Gravitational "Alpha-23" Formula for the Mass of the Electron

The quantum gravitational formula for the mass of the electron (or "Alpha-23" formula) [2] is given by

$$m_e = \frac{m_p^2}{4\alpha^6 M_P}\left(\sqrt{1+\frac{4e^2\alpha^{23} M_P}{\pi\,\epsilon_0 G\, m_p^3}}-1\right) \qquad (3.2.1)$$

The quantity

$$m^2 = \frac{4}{\pi}\frac{e^2\alpha^{23}}{\epsilon_0 G} \qquad (3.2.2)$$

must be a square of a mass $m$. Because of the constants: 4 and $\pi$, we have four possible masses: $m_1$, $m_2$, $m_3$ and $m_4$ and the corresponding formulas. These four formulas, its values and the corresponding mass ratios with respect to the electron are shown on Table 1.

| INDEX i | FORMULA $m_i$ | MASS $(Kg)$ | MASS RATIO $(m_e/m_i)$ |
|---|---|---|---|
| 1 | $m_1 = \frac{e}{\sqrt{\pi}}\sqrt{\frac{\alpha^{23}}{\epsilon_0 G}}$ | $0.993\times 10^{-33}$ | 917.729 |
| 2 | $m_2 = e\sqrt{\frac{\alpha^{23}}{\epsilon_0 G}}$ | $1.759\times 10^{-33}$ | 517.773 |
| 3 | $m_3 = \frac{2e}{\sqrt{\pi}}\sqrt{\frac{\alpha^{23}}{\epsilon_0 G}}$ | $1.985\times 10^{-33}$ | 458.865 |
| 4 | $m_4 = 2e\sqrt{\frac{\alpha^{23}}{\epsilon_0 G}}$ | $3.519\times 10^{-33}$ | 258.887 |

**TABLE 1:** *The four possible predicted values for the mass of an unknown super light particle. Note that* $m_1$ *is the lightest particle and* $m_4$ *is the heaviest one.*

## 3. Conclusions

In summary, the formulas presented in this paper could correspond to the following mysterious particles:

(a) **Electrino**
If this particle has electrical charge, then it is likely that this particle to be a charged lepton, in which case it should be an electrino [3].

(b) **Phantom Neutrino (New Type of Neutrino)**
If this particle turns out to be electrically neutral, and is neither a neutralino nor a darkino (see next two possibilities), then the particle could be a new type of neutrino.

(c) **Neutralino**
If this particle turns out to be electrically neutral, and is neither a neutrino nor a darkino (see next possibility), then the particle could be neutralino. A neutralino is a hypothetical neutral particle that has, at least, one property neither found in neutrinos nor in darkinos. Neutralinos are not part of the dark matter contents of the Universe.

(d) **Darkino**
If this particle turns out to be electrically neutral, and is neither a neutrino nor a neutralino, then the particle could be a darkino. A darkino is a super light particle that contributes to the dark matter contents of the Universe. In other words, a darkino is a particle made of a new type of matter known as dark matter (there could be several "dark matter" particles).

It is worthwhile to remark that the phantom neutrino, the neutralino and the darkino are super light particles not included in the Standard Model of particle physics.

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**REFERENCES**

[1] R. A. Frino, *The Quantum Gravitational Cosmological Model without Singularity,* vixra.org: vixra 1508.0203, (2015).
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[3] R. A. Frino, *On the Mass of the Electrino,* vixra.org: vixra 1503.0009, (2015).