Neutrinos, light, matter, and the unification of gravitational and nuclear forces

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The discovery of neutrinos and the measurement of their masses are significant events in the history of science. The Rotating Lepton Model provides a useful basis for understanding particles and nuclear reactions, highlighting the importance of Special Relativity, Gravity, and Quantum Mechanics in our universe. Professor Constantinos G. Vayenas explains

The discovery of neutrinos by Pauli some 90 years ago and the measurement of their masses by Kajita and McDonald [(1)] some 20 years ago constitute significant developments in the history of science. The recent (2023) [(2)] detection of neutrino production during the proton-proton collision experiments at CERN confirms the basic assumption of the Rotating Lepton Model (RLM) (2020), [(3)] i.e. that protons and neutrons comprise rotating neutrino triads, the former with a central positron. This implies that all matter in our Universe, including electromagnetic radiation, [(4)] comprises only five elementary particles: The three neutrinos (v_1, v_2, and v_3), the electron, and the positron. It also implies that two forces (gravity and electromagnetism) suffice for describing the interactions between these five particles and the concomitant production of all other composite particles, such as hadrons and bosons.

Understanding the nature and structure of matter has been a long-sought goal. This subject was already discussed by Plato and his student Aristotle at the Academy of Athens back in the 4th century BC. They developed two pioneering views, which are both confirmed today via the RLM in an emphatic manner. Thus, Plato writes in his book Timeos: ‘Everything consists of triangles’: (ΤΑ ΠΑΝΤΑ ΕΚ ΤΡΙΓΩΝΩΝ ΣΥΝΕΣΤΗΚΕΝ). While Aristotle wrote a few years later in his book Mechanica B, ‘The cause of everything is the cyclic motion’: (ΠΑΝΤΩΝ ΕΧΕΙ ΤΗΣ ΑΙΤΙΑΣ ΤΗΝ ΑΡΧΗΝ Ο ΚΥΚΛΟΣ).

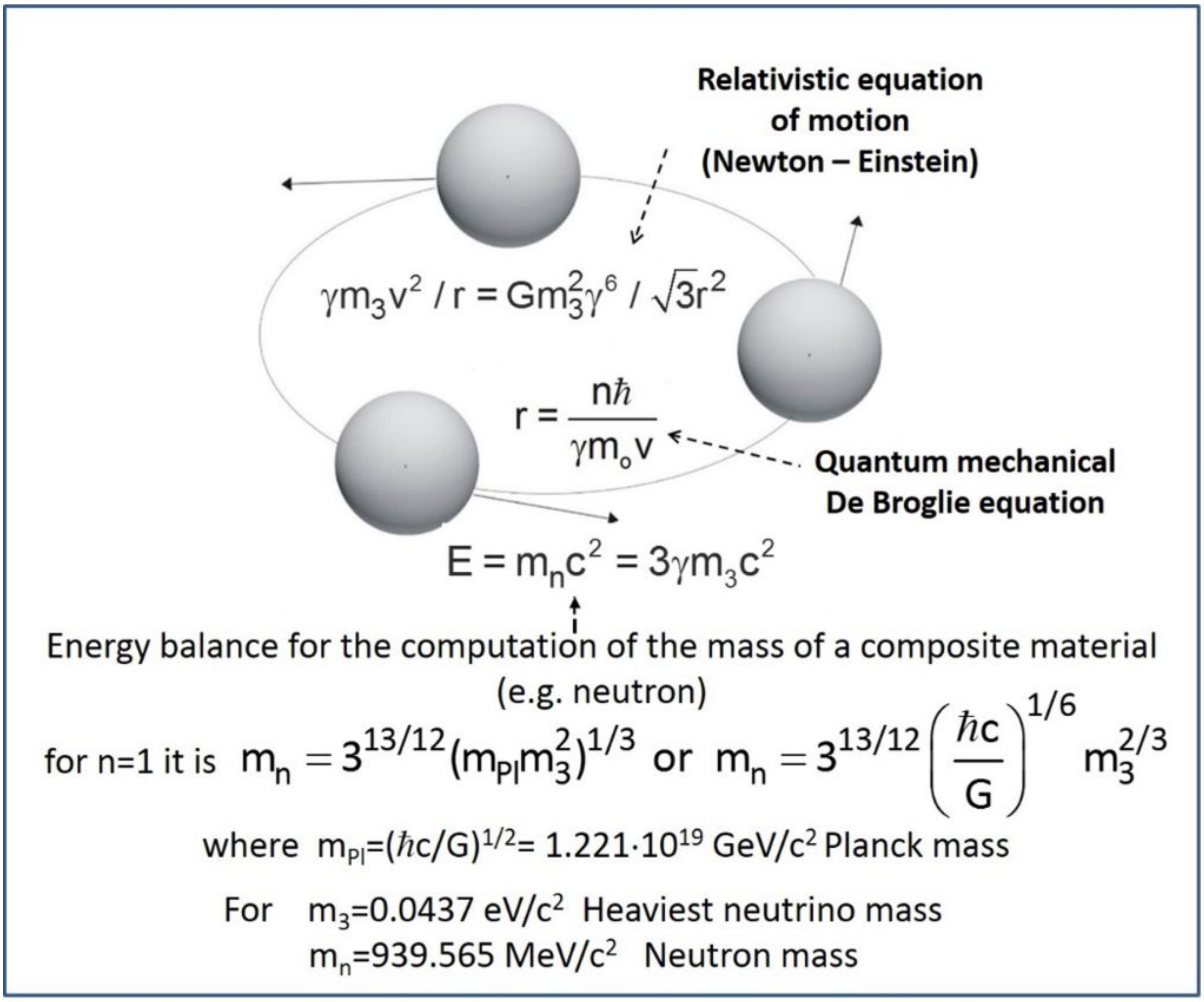

Figure 1: Combining Einstein's Special Relativity [8] with De Broglie's equation of Quantum Mechanics [9] to analyze and mathematically solve the Rotating Lepton Model (RLM) for the computation of the neutron mass from the rest mass, m_3, of the heaviest neutrino. [5]

Rotating Lepton Model

As shown from the recent literature [3,5,6] and also in this article, both of these brave statements-prognoses of the 4th BC century are in close agreement with the most recent findings on the structure of matter in the interior of atoms as described by the Rotating Lepton Model (RLM) of elementary particles. [5]

Figure 1 shows the RLM geometry and its two basic equations for a proton or neutron.

Due to their gravitational attraction, the three heavy neutrinos of rest mass m3 each rotate around the center of the triangle they form.

According to the theory of Special Relativity (SR), [7,8] the relativistic mass of each of them is γm_o, and the corresponding gravitational mass is $\gamma^3 m_o$ where $\gamma = (1-v^2 / c^2)^{-1/2}$ is the Lorentz factor:

Thus, the gravitational force between two rotating neutrinos is given by

$$\textbf{(1)} \quad F = Gm_3^2\gamma^6 / \sqrt{3}r^2$$

and thus the equation of motion of each rotating particle can be written as:

$$\textbf{(2)} \quad \gamma m_3 v^2 / r = \frac{Gm_3^2\gamma^6}{3^{1/2}r^2}$$

Upon introducing the de Broglie equation [9] of quantum mechanics, i.e.

$$\textbf{(3)} \quad \gamma m_3 v r = n\hbar$$

where n is an integer, into equation (2), one obtains from equations (2) and (3)

$$\textbf{(4)} \quad 3\gamma m_3 = m = 3^{13/12}(m_{P1}m_3^2)^{1/3} = 3^{13/12}\left(\frac{\hbar c}{G}\right)^{1/6} m_3^{2/3}$$

where

$$\textbf{(5)} \quad m_{P1} = (\hbar c/G)^{1/2} = 1.221 \cdot 10^{28}\ \text{eV}/c^2$$

is the Planck mass. For m3=0.0437 eV/c^2, which is the heaviest neutrino mass, [10] equation (4) yields

$$(6) \quad m_n = 939.565 \ MeV/c^2$$

which is the literature value of the neutron mass. [11]

The amazing agreement between equation [6] and the experimental neutron mass value (Fig. 1) confirms, beyond any reasonable doubt, the validity of the RLM, which has also been used to compute the masses of some twenty-five hadrons and bosons with the same level of agreement between RLM and experiment. [3]

This level of agreement between the RLM and the experimental results for the masses of composite particles (protons, neutrons, mesons, and bosons) becomes even more impressive if one takes into account that the RLM does not contain any unknown or adjustable parameters but only uses:

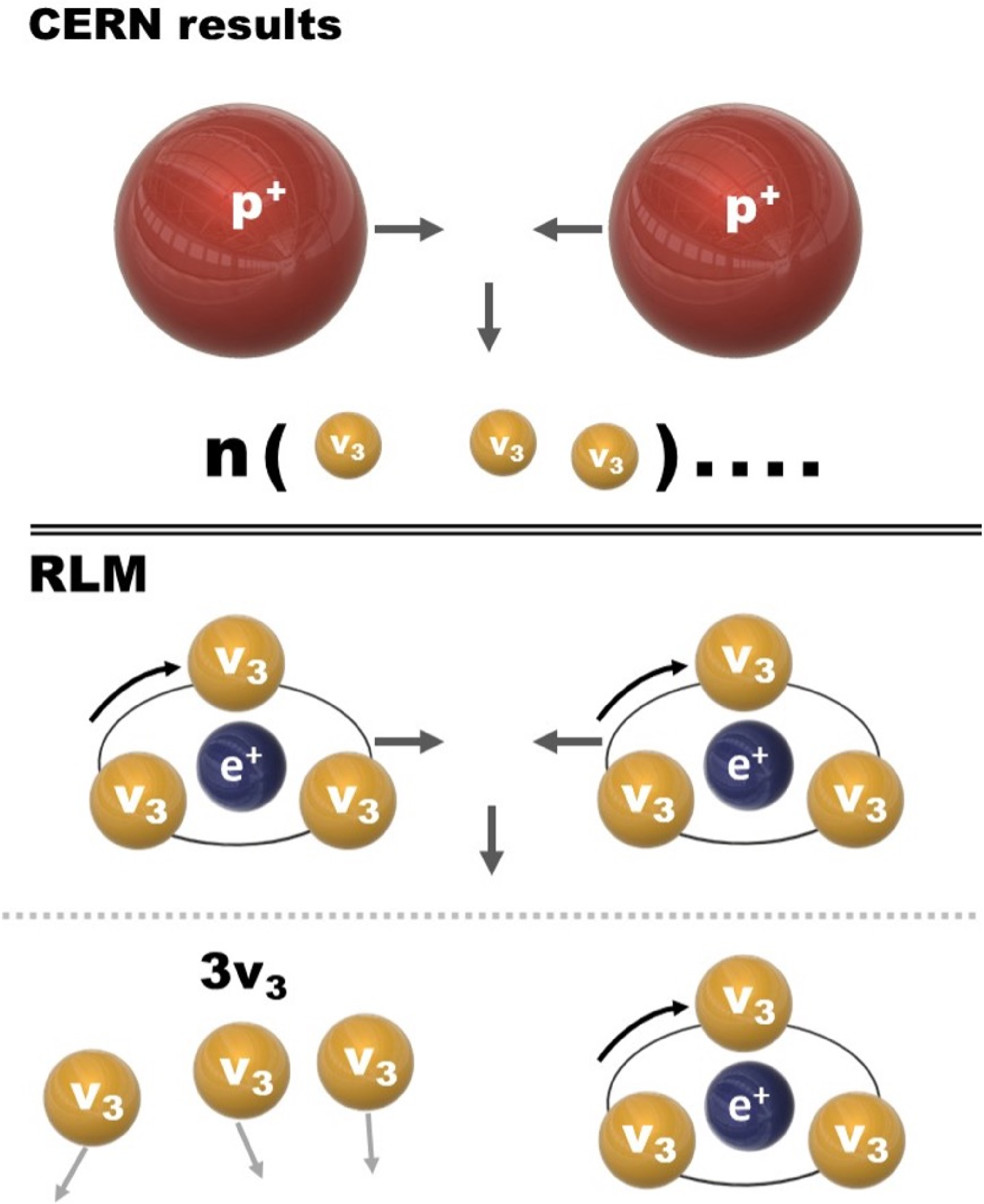

Figure 2. Schematic of the pioneering CERN experiments showing that proton-proton collisions produce neutrinos [(2)] (top) and interpretation according to the rotating lepton model (RLM) of composite particles (bottom). [(3)]

- a. Newton’s gravitational law
- b. Einstein’s theory of Special Relativity (SR)
- c. The simplest equation of quantum mechanics, which describes the quantization of angular momentum.
- d. Energy conservation

- e. The recent experimental measurements of the masses of the three neutrinos by Kajita and McDonald [1] (Nobel Prize in Physics, 2015)

One may wonder why this level of agreement between model and experiment achieved via the RLM in Particle Physics cannot be obtained in Chemistry, where a tedious numerical solution of the Schrödinger equation is inevitable in order to compute the energy levels of atoms. The answer comes from Heisenberg's uncertainty principle (i.e., $\Delta p \Delta r \approx \hbar$). In Physics, the value of

$$\textbf{(7)} \quad \Delta p = \Delta(\gamma m_o v)$$

is huge since particle speeds are of the order of c; thus, Δr is very small, while in Chemistry, speeds are barely 1/100 th of c and γ=1, thus leading to at least a hundredfold larger uncertainty in r and the concomitant computed energy levels.

The validity of the RLM was also recently confirmed by the pioneering proton-proton (pp) collisions at CERN [2], which demonstrated that protons contain neutrinos, as shown in Figure 2.

Figure 3 shows the huge gap between the masses of neutrinos and of the hadrons and quarks. How is it thus possible for the extremely light neutrinos (masses of the order of 40 meV/c^2) to form quarks and hadrons, which are 100 billion (10^{11}) times heavier? The answer is directly provided by Einstein's theory of Special Relativity, which dictates that the masses of particles moving close to the speed of light increase dramatically by a factor of γ, which, as shown in Figure 3, is computed via the RLM [3] to be of the order of 10^{10}, thus bridging the huge mass gap.

The same Figure 3 shows that quarks are rotating relativistic neutrinos. When a hadron decays, then the constituent quarks become immediately very hardly detectable neutrinos. Such neutrinos were nevertheless detected in the pioneering CERN experiments.[2]

To conclude, the discovery of neutrinos by Pauli and the measurement of their masses by Kajita and McDonald represent very important events in the history of Science and the concomitant effort for the understanding of our Universe. In the same way that the Bohr model established the basis of the molecular understanding of chemical compounds and reactions, the Rotating Lepton Model seems to provide a useful basis for understanding hadrons, bosons, nuclei (e.g., deuteron), and also nuclear reactions. The RLM shows the tremendous importance of Special Relativity, Gravity, and Quantum Mechanics for understanding our Universe.

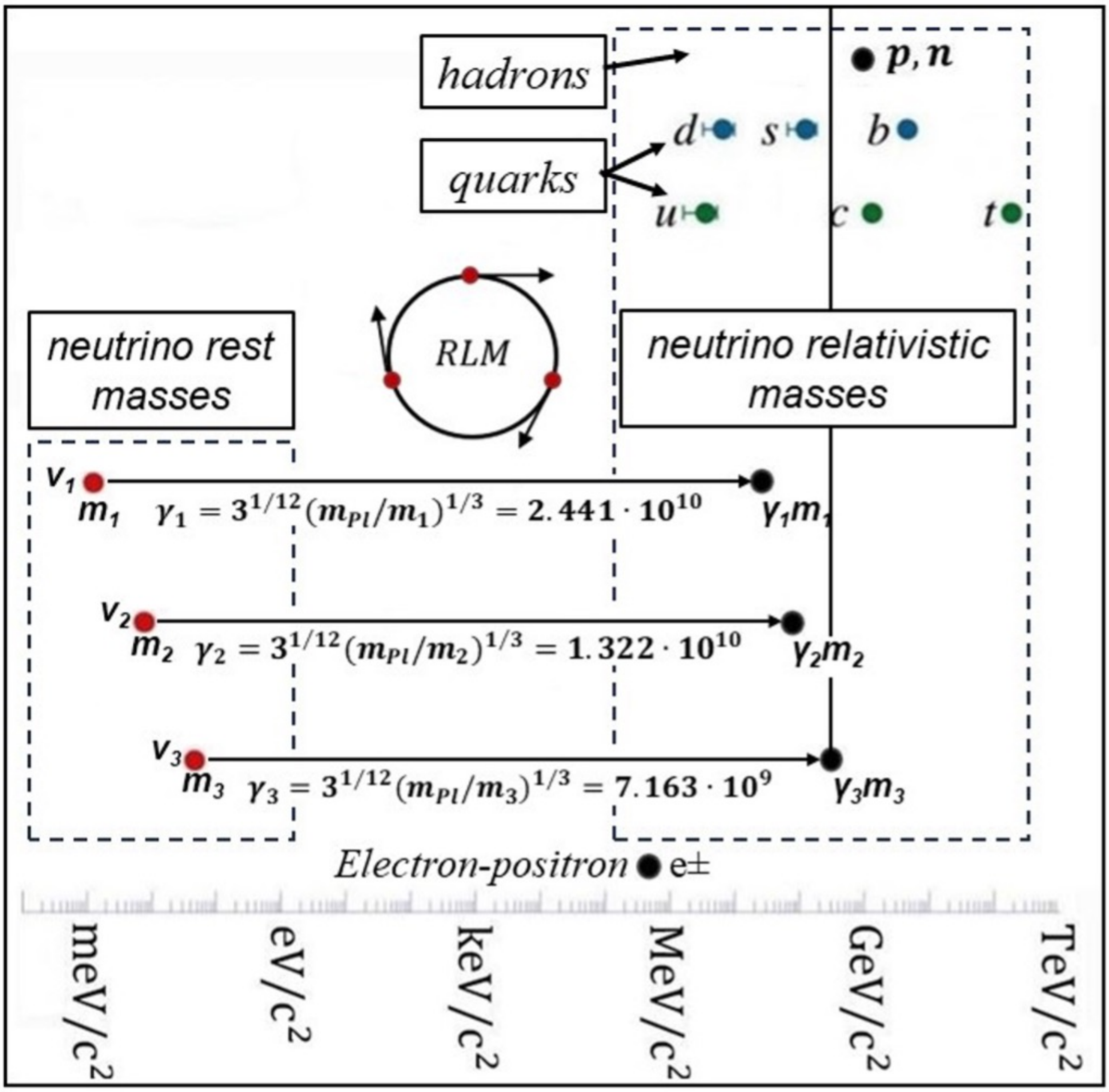

Figure 3. The marvel of neutrino hadronization via Special Relativity: Rest masses (m_1, m_2 and m_3) and relativistic masses ($\gamma_1 m_1$, $\gamma_2 m_2$, and $\gamma_3 m_3$) of the three neutrinos v_1, $v_2$and $v_3$compared with the masses of protons (p) and neutrons (n) and with the masses of quarks (u, d, c, s, t and b). Note how these huge ($\sim 10^{10}$) γi values bring the corresponding neutrino masses from the rest neutrino mass range (~ meV/c^2) to the relativistic neutrino mass range (~ GeV/c^2), which is in the quarks and hadrons mass range. Note also that protons and neutrons are formed from the heaviest neutrinos v_3 of rest mass m_3 via the action of special relativity.

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