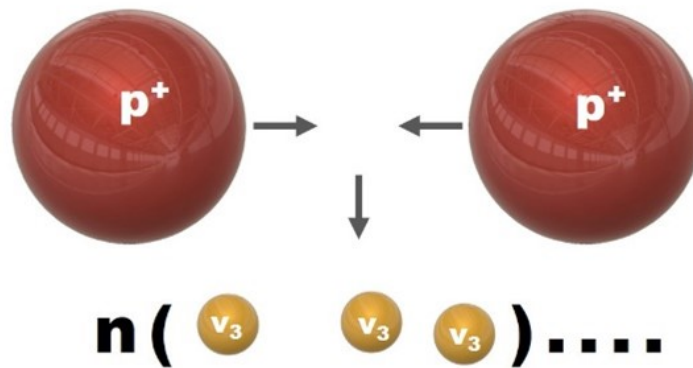


Neutrino production in proton-proton collisions supports the rotating lepton model

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CERN results



RLM interpretation

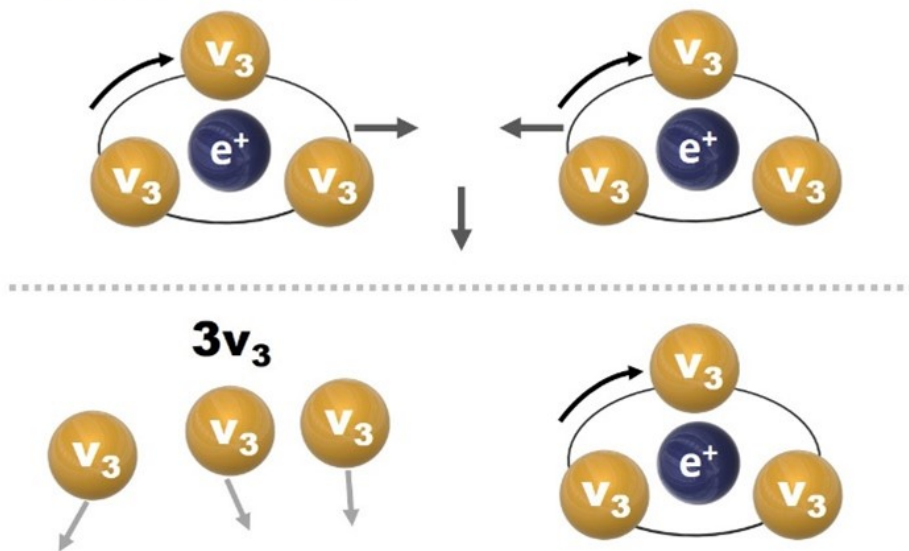
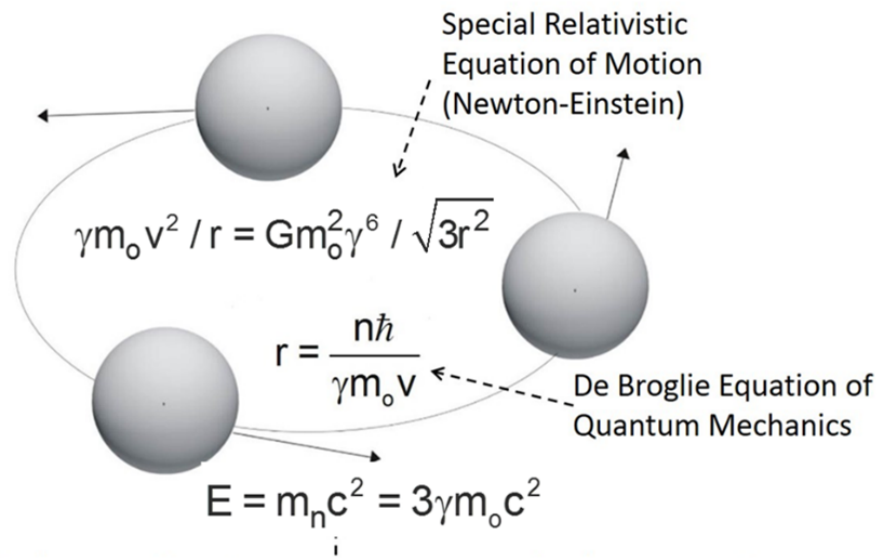


Figure 1. Schematic of the pioneering CERN experiments showing that proton-proton collisions produce neutrinos (1,2) (top) and interpretation according to RLM of composite particles (bottom).(4-6)

Direct observation of neutrino production in proton-proton (pp) collisions at CERN LHC lends strong support to the Rotating Lepton Model, Constantinos G. Vayenas¹, Dionysios Tsousis^{1,2} and Eftyhia Martino¹ (1University of Patras, ²Stanford University) tell us

Understanding the internal structure of hadronic composite particles, such as protons and neutrons and computing their masses from their constituent elementary particles, such as neutrinos and other leptons, has been a long-sought goal in Particle Physics, a goal of central importance for enhancing our understanding of our Universe.



Energy balance for the computation of the mass of a composite material
(e.g. neutron)

$$\text{for } n=1 \text{ it is } m_n = 3^{13/12} (m_{pl} m_o^2)^{1/3} \text{ or } m_n = 3^{13/12} \left(\frac{\hbar c}{G} \right)^{1/6} m_o^{2/3}$$

where $m_{pl} = (\hbar c / G)^{1/2} = 1.221 \cdot 10^{19} \text{ GeV}/c^2$ Planck mass

For $m_o = 0.0437 \text{ eV}/c^2$ Heaviest neutrino mass

$m_n = 939.565 \text{ MeV}/c^2$ Neutron mass

Figure 2. Combining Special Relativity (7,8) and Quantum Mechanics in the RLM for computing the neutron mass. (4-6)

The two groundbreaking CERN experiments and the RLM

The recent pioneering findings at CERN LHC (Fig. 1) ^(1,2) have shown that proton-proton collisions lead to the production of neutrinos, which are the lightest of all particles with masses a hundred billion [10¹¹] times smaller than the proton mass. ⁽³⁾

This can be understood directly ⁽⁴⁻⁶⁾ via the Rotating Lepton Model (RLM) of composite particles ⁽⁴⁻⁶⁾, which describes protons as triangular gravitating neutrino structures which rotate around a central positron and describes neutrons as the same structure after losing its central positron (Fig. 2).

A second equally groundbreaking but until recently not fully understood experimental observation, also originating from CERN ⁽⁹⁾, are the results of the pioneering positron-electron annihilation (PEA) experiments ⁽⁸⁾ (Fig. 3), which produce huge amounts of the Z boson (Fig. 3). These fascinating results can also be immediately understood via the RLM ⁽¹⁰⁾ which has shown that the Z bosons are rotating positron–electron–neutrino triads. ⁽¹⁰⁾ The lifetime of these triads is very short, i.e., of the order of one revolution. ^(3,4)

Therefore, it is now becoming obvious that the Z bosons act as catapults for generating ultrarelativistic neutrinos. This constitutes the first and crucial step for baryogenesis. ^(10,11)

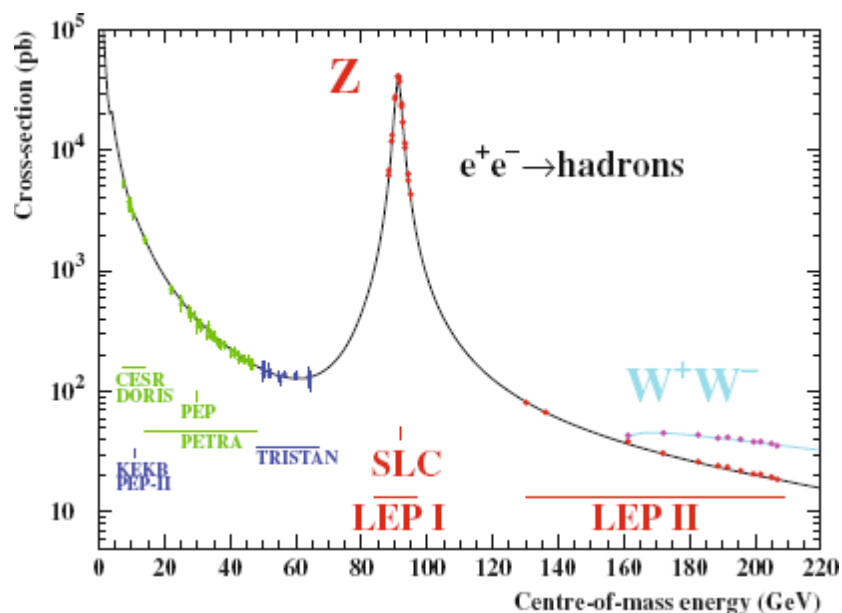


Figure 3. Positron-electron annihilation products observed at CERN.⁽⁹⁾

The mechanism of hadronization (or baryogenesis)

Careful examination of the decay products of several hundreds of composite particles, such as of hadrons (including baryons and bosons) ^(9,12), has shown that the ultimate decay products of all composite particles are only the following five leptons: The electron [e^-], the positron [e^+] and the three neutrinos [ν_1 , ν_2 and ν_3], the masses of which were first measured by Kajita ⁽³⁾ and McDonald ⁽¹³⁾ in their pioneering work. These masses are of the order of 3 to 50 meV/c^2 , i.e., 12 orders of magnitude (a trillion times) smaller than the masses of electrons [$10^6 \text{ eV}/c^2$] and protons/neutrons [$10^9 \text{ eV}/c^2$].

A first question arising from these extremely demanding to measure and dramatically different mass values of neutrinos vs those of the basic constituents of atoms (i.e., protons, neutrons and electrons), is how the tiny masses of neutrinos are related to the huge (by neutrino standards) masses of our familiar electrons and protons which are typically 11 orders of magnitude bigger than those of neutrinos.

The answer to this question is obtained by the ingenious 1905 masterpiece of Einstein, i.e., by Special Relativity, which, in simple words, dictates that what is really important in this world is not what we measure about ourselves but instead what others observe about us.

Thus, the measured relativistic mass, m_o , of a particle, e.g., a neutrino, of rest mass m_0 , travelling with a Lorentz factor of 1010 is of the order of $10^9 \text{ eV}/c^2$, i.e., $1 \text{ GeV}/c^2$, i.e., of the order of proton and neutrino masses. ⁽¹²⁾ [1]. At the same time, its gravitational mass, $3m_o$ ^(8,9) reaches the Planck mass. ^(7,12). This provides the key idea of the RLM of composite particles, a simple Bohr-type model of three gravitating rotating neutrinos

moving with speeds close to the speed of light ⁽⁴⁻⁶⁾. This appears to be how the matter of our Universe has been made ^(5,7) (or is being made even today according to the pioneering CERN experiments. ⁽⁹⁾)

The three basic equations of the RLM are given in Figure 2. They represent Newton's gravitational Law coupled with Einstein's special relativity and with the de Broglie equation of quantum mechanics.

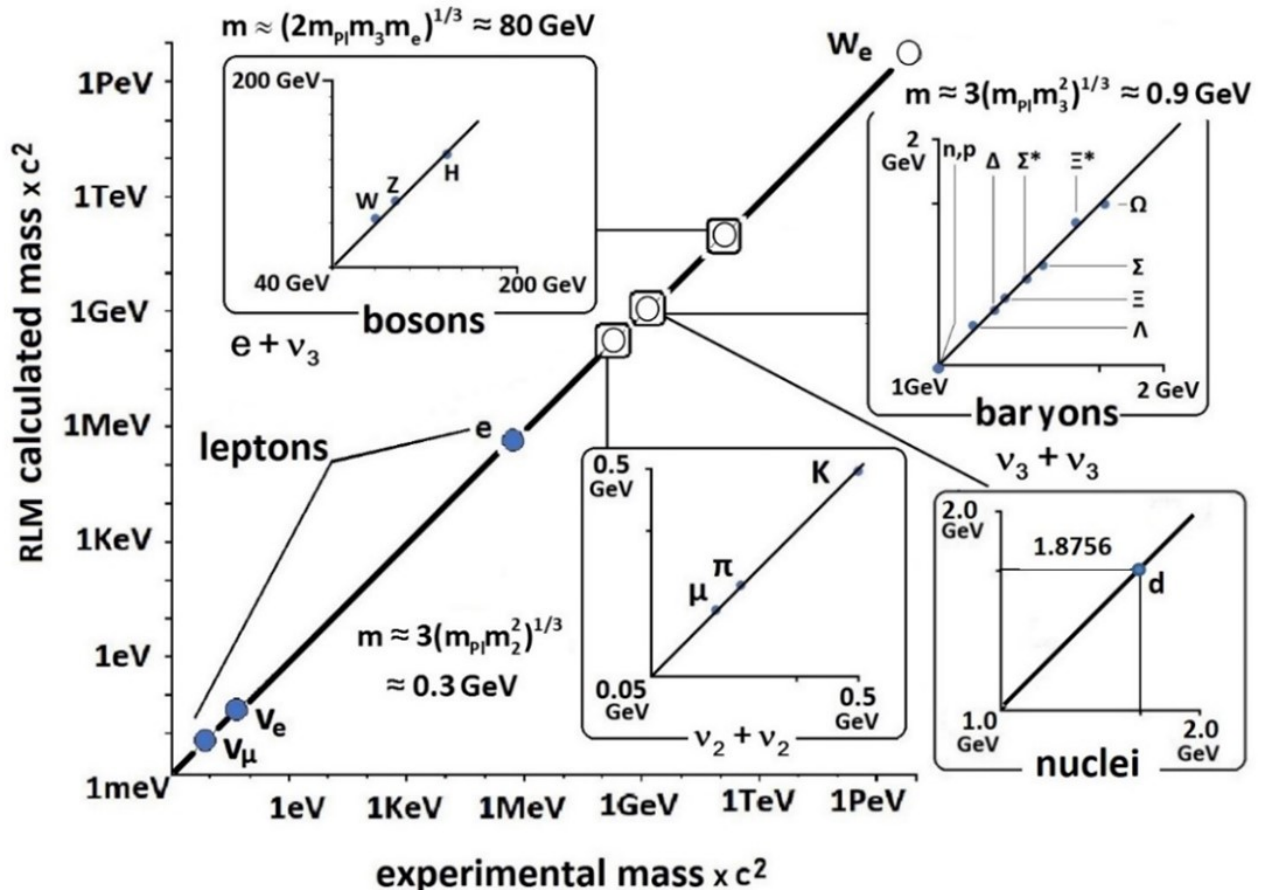


Figure 5. Comparison of the RLM computed masses of composite particles with the experimental values. Agreement is better than 2% without any adjustable parameters. The three approximate mass expressions shown in the Figure provide the order of magnitude of hadron and boson masses. (5)

In addition to these three scientific giants, there are two more exceptional scientists/philosophers who are worth mentioning, i.e., Plato with his famous phrase “Everything consists of triangles” and his student Aristotle with his equally prophetic “The cyclic motion is the origin of everything”, both exactly confirmed today by the RLM geometry.

Figure 4 shows the geometries of the most common hadrons and bosons used to compute their masses via the RLM, while Figure 5 compares these computed masses with the experimental ones. ⁽⁶⁾ Agreement is typically better than 2%.

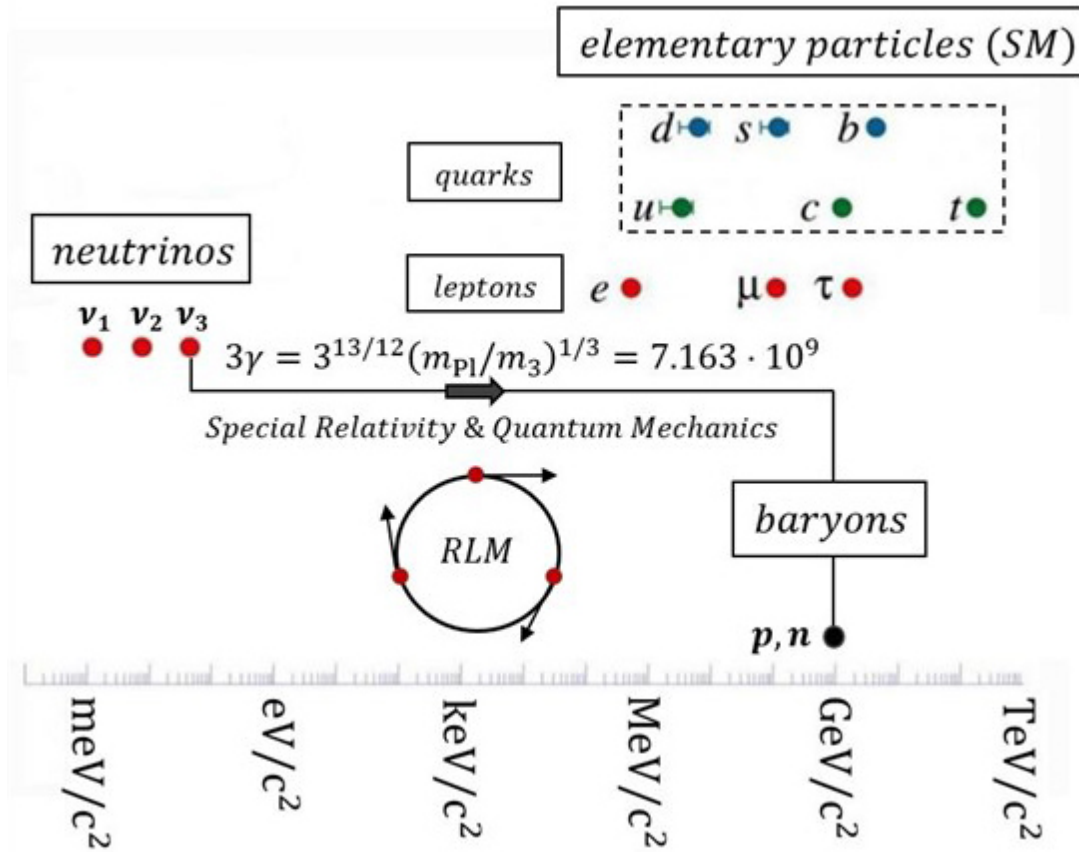


Figure 6. Rest masses of the Elementary Particles of the Standard Model (SM) and of the three neutrino eigenstates. (3,13) The arrow shows how the Rotating Lepton Model (RLM) via Special Relativity increases the heaviest neutrino mass from the rest eigenstate mass value m_3 ($\sim 45 \text{ meV}/c^2$) to the relativistic mass value, $\gamma m_3 \approx 313 \text{ MeV}/c^2$ of the s quark, which corresponds to one-third of the mass of the neutron formed. (12)

Gravitational catalysis

A basic question since the conception of the RLM is how the neutrinos reach or have reached the highly relativistic speeds which, via Einstein's special relativity⁽⁷⁾ bring their masses from rest masses ($\sim 10\text{--}2 \text{ eV}/c^2$) (4,13) to the highly relativistic masses ($\sim 109 \text{ eV}/c^2$) of those rotating in protons and neutrons. (12) The answer has been provided by some recent works^(4,5,6), as shown in Figure 6. It results from an initial catalytic gravitational acceleration of neutrinos by positrons (and/or) electrons to highly relativistic velocities followed by the steady-state gravitational attraction by the other co-rotating neutrinos (Fig. 7). This two-step gravitational catalysis concept appears to be quite effective.^(4,5,6)

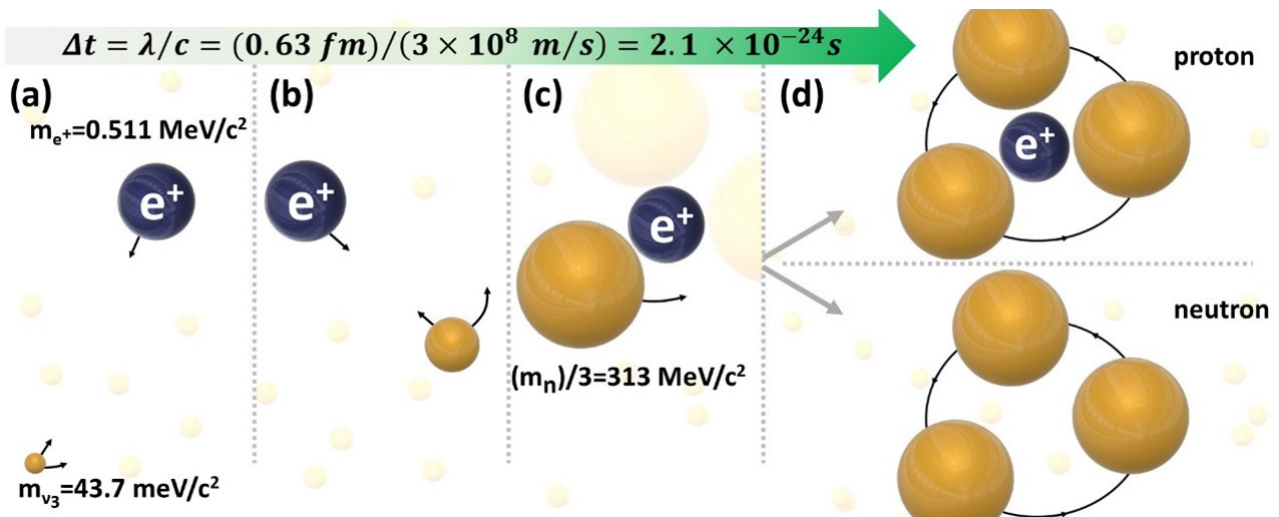


Figure 7. Gravitational catalysis of hadronization by positrons (or electrons). (a) A tiny neutrino at rest is attracted and accelerated by an ambient positron to relativistic ($\gamma \gg 1$) velocities. Its gravitational mass, γm_0 , thus increases dramatically (reaching the Planck mass), as it also starts rotating around the positron (b). Eventually, it joins two similar relativistic neutrinos forming a proton or a neutron, m_{ν_3} is the heaviest neutrino mass and m_n is the neutron mass.

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