Neutrino: A True Particle?

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Abstract: Neutrino, an elementary particle so elusive, just has existence at the abstract or "inner" space that represent the isospin, which contributes to the charge produced at beta decay as the emission of electrons or positrons to the "exterior" space. The neutrino condition of being deprived of charge, mass and electromagnetic energy at the same time, prevent it from having access to that space; in this way, spin and parity can be explained without the concourse of a new particle in ordinary space. The energies of electrons or positrons emitted, which are always depending of velocity and the only measurable one, is coming as a proof of its relativistic masses; its relationship with the wavelike (frequency) and the electromagnetic characteristic, permits the analogy with the blackbody radiation graph, which requires only a purely quantum treatment. Experimental proofs are very poor and do not guarantee the existence of such particles, although the relevant literature has insisted much on it. But instead, we would have a simpler and affordable Standard Model of Particles.

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Introduction:

The perceived inconsistencies in its justification, so much theoretical as experimental, for the establishment of the reality of these particles, induces us to make the present critical study, in order to try to get the true location of the neutrino itself. The placing and keeping in outer space neutrino as a "real" particle, without the ability to interact neither with material particles nor with electromagnetic radiation, it seems beyond reason, leading to the purest idealism, far away from the requirement that an experimental science demands. The emission of electrons or positrons in beta decay is a statistical process and the logical desire of the protagonists of Science in trying to preempt the formulation of such a phenomenon, when it had just discovered the neutron and been Quantum Theory in its early development, has led to the incorrect approach of considering the particles involved as bodies subject to Classical Mechanics. In this line, it turns out surprising the stubborn adherence that the scientific comunity has been providing to the interpretation of the Theory of Relativity on the inertial nature of relativistic mass, even after the formulation of Strong and Weak Interactions and the so-called CCD, where the essential parameter is the charge or coupling constant. Comparing the energies of weak particles with those produced in beta decay interaction, it seems logical to consider the existence of a "inner space", where to locate the high energy of the particles W^-, W^+, Z, quite differentiate from the "ordinary space" in which electrons or positrons emerge. The main argument is found in the adecuated interpretation of electrons's energies, whose graph actually becomes very similar to that of blackbody radiation process, considering the electromagnetic and virtual nature of the relativistic mass of electrons, positrons gauge particles and other, subject to Quantum Theory

Neutrino's reactions:

We show in what follows the most important processes or eschematic reactions, where neutrinos are involved and the alternative insertion into the same:

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n (neutron) ---> p (proton) + e^- (electron) + ν_e^* (electronic antineutrino)

p (proton) ---> n (neutron) + e^+ (positron) + ν_e (electronic neutrino)

π^- (negative pion) ---> μ^- (muon) + ν_μ^* (muonic antineutrino)

π^+ (positive pion) ---> μ^+ (antimuon) + ν_μ (muonic neutrino)

μ^- (muon) ---> e^- (electron) + ν_μ (muonic neutrino) + ν_e^* (antineutrino)

μ^+ (antimuon) ---> e^+ (positron) + ν_μ^* (antineutrino) + ν_e (neutrino)

Time´s arrow indicating the direction of reactions is not unique to a process that takes place in the microcosm of subatomic particles and may be transformed when we switch particles for antiparticles, in accordance with the general principle of CPT Symmetry. Given that neutrino has no <u>charge</u> (C), it is possible to change the <u>parity</u> (P) if it proceeds to <u>time</u> <u>reversal</u> (T); thus, all reactions may be changed in such a way that both neutrinos and antineutrinos should appear on the left hand side; so, they are converted in the agents causing the process:

n + ν_e ---> p + e^-

p + ν_e^* ---> n + e^+

π^- + ν_μ ---> μ^-

π^+ + ν_μ^* ---> μ^+

μ^- + ν_μ^* + ν_e ---> e^-

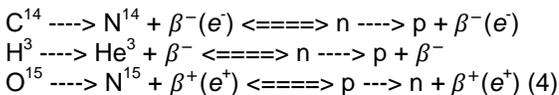μ^+ + ν_μ + ν_e^* ---> e^+

In this way, **neutrinos** remain in the "inner" space formed by the "charges" that configures the <u>isospin</u> and they cannot emerge to ordinary space, but <u>determines</u> the conditions of the producing leptons. **Beta decay** leads to a real "creation" of leptons, which <u>charges</u> may be explained by the formula Q = t_3+ Y/2 (1), where t_3, as a component of the isospin, will realize the "inner" charge of the neutrino and its antiparticle. Thus, for t_3 = +1/2 (antineutrino) and Y = -1, we get Q = ½ - ½ = 0, which corresponds to the antineutrino's charge that would emerges to the ordinary or real space. Also, for t_3 = -1/2 (neutrino) ==> Q = -1/2 – ½ = -1, which is the charge of the outgoing electron. That can be put in a simple form by the doublet (0, -1), which represents the charges (antineutrino, electron); this corresponds to the event or process n + ν_e ---> p + e^- (2), which it is more credible than n ---> p + e^- + v^*, since the left hand side of (2) describes the transformation that is is taking place in the "inner space". On the other hand, it is easy to verify the case of the doublet (positron, neutrino) (+1, 0), which will require

that t_3 = -1/2 (neutrino) must be changed to t_3 = +1/2 (antineutrino), which is used to form the positron that is shown in the correct "reaction": p + ν_e^* ---> n + e^+ (3).

The issue of Energy

Beta decay must be compatible with the so-called weak interaction, that occurs by the Gauge Particles (W⁻, W⁺, Zº), whose energy content is 80-90 GeV (1 GeV = 10^9 eV = 1000 MeV). This amount of energy is put into play in the union of protons and neutron to form the atomic nucleus; this process is interpreted as an "exchange" of **bosons,** according to Quantum Field Theory. The only way to accept such enormous energy is to confine it in the "inner" space, due to weak charges represented by coupling constants, g and g'; that energy may emerge to the ordinary or common space when an adecuated accelerator is acting, in order to convert the weak charges into true charges $(g \approx 2e)$, that together with the gauge potentials, A^1 or A^2 determine the energy contained, which can be detected thanks to its wavelike characteristic (frequency), as we have done in our paper: "*Matter In The Universe*" (International Journal of Mathematics and Physical Sciences Research. Vol 4, Issue 1, pp: (46-55). Available at www.researchpublish.com). The particles that can emerge to "exterior" space are **electrons** and **positrons**, when there is nuclear instability, so that beta decay occurs as nuclei transformation:

C^{14} ----> N^{14} + β^- (e^-) <====> n ----> p + β^- (e^-)
H^3 ----> He^3 + β^- <====> n ----> p + β^-
O^{15} ----> N^{15} + β^+ (e^+) <====> p ---> n + β^+ (e^+) (4)

(We must clarify that the equivalent expressions on the right must be understood in a formal way, as protons and neutrons do not act like free particles, but inmersed in the "inner space" of atomic nuclei) The energy topic was raised before the knowledge of the intricacies implied in the gauge particles. It was based on the graph corresponding to the energy spectrum of the electrons: the representation of the relative number of electrons (energy density) depending on its energy. One can appreciate a curve with a maximum that decreases gradually, until it became almost zero at an energy of about 1,2 MeV, that is considered the limit; it turns out relevant the resemblance with the blackbody radiation graph. But, first Pauli and later Fermi estimated that the shape and continuity of the curve turns out inexplicable unless a new particle was included, neutrino, as an energy carrier to compensate the supposedly "missing" energy; this must be so because was estimated that "all" electrons should acquire the limit energy 1,2 MeV, that is, the variation of energy between neutron and proton, $\Delta\square c^2$, so that the **mass difference,** Δm, must be regarded as a real or inertial mass subjected to Classical Mechanics. In this sense, it is argued: "... in beta decay should be possible to measure the momentum of neutrino observing the nuclear "recoil" due to the combined emission with the electron". (E.Segré: "*Nuclei and Particles*").

What is the meaning of this "recoil" when a new nucleus, ie, a new substance, is obtained, according to (4)?
How a particle, as neutrino, with neither charge nor mass and deprived of electromagnetic radiation, can transport energy and momentum?.

What is the matter with the mass?

The mass problema:

According to Relativity Theory, the velocity of the electrons is contained in the well known formula E = mc², where the mass, *m,* is the relativistic one, and the involved energy in the mass defect that is contained in the expressions $e\Delta V = \Delta mc^2 = h\nu$ (5); so, electrons o positrons are produced by the difference of mass, Δm, which have the properties of quantum particles, ie, wave $(h\nu)$-corpuscle ($e\Delta$V) Duality. Admitting the expression (5) on the **mass defect,** Δ m, and its relation with electromagnetic and wavelike parameters, we believe that the only way it makes sense is considering it **electromagnetic** and **virtual**, because it behave as a "money" (whose intrinsec value is null) between the electromagnetic and wave parameters. Thus, it is fully justified the choice of mass unit ie, electron-Volt (eV) by the identity contained in (5), ie, eV ≡ mc^2, under which the mass, *m*, may be considered as a derivative of the charge, e, which becomes the essential physical quantity. The arguments about the velocity, v, contained in the mass, *m*, and the mass-energy equivalence for m_o are "unnecessary", since c acts as a speed from a dimensional point of view. This is consistent with the mechanism that governs the process must be consistent with the charge equation Q = t^3+Y/2, where the isospin, t^3 indicates that proton or neutron are two aspects of the same particle: nucleon. So, both particles have identical "real" mass, as we tell below, but the difference of mass, due to the electric charge, is electromagnetic and "virtual". If we add the the phenomenon must be understood in a statistical way, it is not surprising the the energy graph of the emitted electrons has a similar shape to that of the blackbody radiation, where the number of particles with low and high energies are greatly reduced. Indeed, experimental data supplied values ranging from less than 0,1 MeV to the limit 1,2 MeV, adjusted to relativistic Energy, $E = m$c², where, *m* is **electromagnetic** and **virtual.** To support that, we must take into account the mass diference between neutron and proton, shall be considered as a maximun value, since those do not act as free particles but inside atomic nuclei, where Strong, Weak and Electromagnetic Interactions act. Besides, for doing the graph it must be used the momentum, **p** = m**v**, which must be equivalent to the moving charge, e**v,** ie, m**v** ≡ e**v;** otherwise, *how could be explained the so-called Lorentz equation*, **F** = e(**E** + **v**∧**B**) (6)**,** *through which the magnetic field may act?.* Actually, the data between 0,1 to 1,2 MeV turns out to be like a multiple method similar to that of Thompson to measure the electron's mass and the value of 0.51 MeV is acceptable, since it appears in the centre of the graph. The true achievement of Relativity is the **relativistic mass**, m, which, although "virtual", allows for getting the "real" **energy**, E = mc² and it turns out evident for its application to Quantum Theory, but not for Classical Mechanics, because in addition to the foregoing, the so-called rest or proper mass, m_o was introduced ad hoc, not measurable and taken away. With other words, in Relativity there is nothing "at rest" and the formula m = m_o/√1-v²/c²) (7) is merely a "definition", which do not allow consider v = 0, since in that case everything would turn down. This is consistent with the Oppenheimer's statement: "*Consider an electron in the ground state of the hydrogen atom; if you*

ask; 'is it moving?, the answer is, no; if you ask 'is it standing still?, the answer is no *and with that of Einstein: "I feel that it is a delusion to think of the electrons and the fields as two physically different, independent entities: Since neither can exist without the other, there is only* one *reality to be described, which happens to have two different aspects and the theory ought to recognize this from the start instead of doing things twice".* But, it was him!, who established the radical separation with the definition of rest or proper mass, m_o, not only for electrons, but for any other macroscopic particle; so, it should follow a relativistic mechanic (deterministic) in which the electromagnetic radiation should be excluded, since in this case must be m_o = 0. The **real or inertial mass** is originated in the most stable hadrons, ie, composite particles, as **protons** and **neutrons**, because in them is getting the condition of cohesion and structure, necessary for a particle to oppose to any change of its state for being at rest or at movement, ie, the **inertia**. This is due to Strong Interaction, which under the "interactive network" formed by the *gluons* and the special properties that involves "confinement", the *quarks* can not be separated. Also, such cohesion is completed by Weak Interaction, through wich protons and neutrons are putting together to form atomic nuclei, where its masses are equals, constante an **real**, according the laws of Chemistry and Classical Mechanis and they are expressed in atomic mass unit *(amu)* The confusion comes from using the mass units, either *eV* or *amu* indistinctly, when the latter is justified by the Avogadro Number, where electrons do not count. Nuclei masses, justified by mass espectrograh, differing from the mass number, are conventional and they are trying to investigate the forces (energies) that bind the nucleons (protons and neutrons), ie, with them it can probe the "inner space" that make up atomic nuclei, so they must be expressed in *eV* and not in *amu* units. Definitely, the **mass** (energy) involved in the electrons or positrons emitted, measured in electron-Volt (*eV*), come from the "inner" space that configure the nucleus and must be **electromagnetic** and **virtual**, according with the double expression (5), where we can appreciate that it behaves as "money" between the corpuscular and wave characteristics, so that obey the laws of Quantum Theory, but not to those of Classical Mechanics and Chemistry.

Spin and Parity:

They constitute the properties or characteristic, that together with the energy are used for the justification of the new particle, ie, neutrino. The total angular momentum of the proton and neutron together is 0 or 1, as a result of the sum of both **spin** (1/2), according with the quantum rules; orbital angular momentum does not affect, since the movement of one of them respect the other is indifferent. As the neutron spin is ½, it is required the introduction of another particle: neutrino. But, if we carried it out as we have shown earlier, i.e. inserting it with the neutron as it follows: n + v_e ---> p + e^-, the conservation of the total angular momentum will be accomplished and the antineutrino, v_e^*, does not have to appear to the right, that is, in the ordinary, real space. The issue of Parity can be easily explained, considering the emitted electron must be special in the sense it is produced from a true "creation" event, since is not initially in the neutron, but is formed

thanks to neutrino of the "inner" space that configures the isospin.

Let us discuss in detail the previous argument in a simple and heuristic way:

In general, electrons may be appearing into two states, according the spin components: +1/2 and – ½; these values can be discriminated by a magnetic field, **B,** that acts on a moving charge, thanks to the formula (6). To get the two components is necessary to change the velocity's direction, which is provided by the spin's rotation direction: so, when s = +1/2, the electron is right-handed. i.e. its spinning is the the same as a corkscrew going forward into space, implying a positive velocity; for s = -1/2, the spinning and velocity are opposed and the electron is left-handed. We can reach to the same result, by means of magnetic momentum of the electron and a magnetic field, as it happens in the Stern-Gerlach experiment. The probability for electrons to be in a state or another is the same, namely, 50%; this fact constitutes the Symmetry called **Parity**, since the existence of an electron and its mirror image are equally possible in the ordinary or "exterior space", which it has been shown through Stern-Gerlach experiment using the magnetic momentum in a non-homogeneous magnetic field. Applying that to "inner_space" that underlies the isospin and taking into account that a neutrino is associated with t_3 = -1/2, while for t_3 = +1/2 is always with an antineutrino, we see that **Parity** is not true for those particles; this means that a neutrino could not be seen itself in a mirror: instead it appears the antineutrino. So, neutrino *behave as a vampire particle!* The emerging electron get its charge under the formula Q = t_3 + Y/2, when t_3 = -1/2 and its spin should be determined for that value; finally, there will be a higher percentage of electrons left-handed. This fact have been revealed through the experiences carried out by Co[60], proving the **Parity violation** in **weak interactions.** Thus, both **spin** and **parity** can be explained without the necessity of filling the "exterior" space with those elusives particles: neutrino and antineutrino. If we take this as a fact and considering what have been stated about the nature of electron's mass, we are leaded to affirm that **charge**, for being quantize, is the essential parameter that governs the events ororprocesses of elementary particles and as such it is responsible for the indicated properties, while Strong, Weak and Electromagnetic interactions are for the construction of atoms, whose nuclei configure an "inner" space, represented by isospin, where it is possible to locate **neutrinos**.

Detection of neutrinos:

To prove the existence of neutrinos, several detection operations have been made and others are in action, which deserve a critical analysis:

1) The first one was carried out by F. Reynes and C. Cowan in 1956; they used antineutrinos! from a nuclear reactor to cause the reaction: v_e^* + p ---> n + e^+. It was obtained a frequency-rate of three events per hour; but that reaction is just the (3) one!, where we considered that antineutrino is immersed in the same nucleus containing the proton. In that case, our interpretation is that protons had been activated or excited producing positrons by the corresponding decay with a low

probability that may be perfectly the indicated before. If it is stated that neutrinos and antineutrinos practically are filling the "exterior" space, how is it that only three of them have the chance to interact with protons? and in which way the interaction might be taking place?.

2) <u>Super-kamoikande.</u> In this case a very high energy neutrinos that are coming from the Sun may collide with electrons in the water, providing it with a velocity greater than the light in the same water, originating the Cherenkov radiation. With photomultipliers you may get the "demonstration" of the existence of those neutrinos, that are a mix of muonic and electronic kinds, trying to prove that neutrinos have mass. Would it not be more reasonable that muons themself was the agents of the such high energy?. If we admit that all neutrinos may go through any obstacle, why cannot we admit that a few muons of very high energy are reaching to the target in spite of that obstacles?.

3) <u>Radiochemical methods</u>, such as Cl^{37} ---> Ar^{37} and Ga^{71} ---> Ge^{71}, based on the process $\nu_e + n$ ---> $p + e^-$, can prove nothing, since the neutrino is contained in the nuclei, either Cl^{37} or Ga^{71}, as we have shown above.

4) <u>South Pole neutrino detector.</u> "In more than a year of operating with the <u>icecube</u> detector, there has been seen nothing", said the Physicist N.Whitethorn of Wisconsin University. Madison; although lately it seems to have being detected some "particles" from the far galaxies.

Conclusion:

This paper is led by the perplexity that produces the fact that an "elementary particle" may exist in spite of being chargeless, massless and no electromagnetic energy and becomes a greater accuracy of our previous paper: "Elementary Particles: A New Aproach" (International Journal of Scientific & Technology Research. Volume 4, issue O7, July 2015). Now, we think we have proved the electromagnetic nature of the electron's mass by analyzing its energy spectrum of beta decay. **Mass** of electrons or any other elementary particle is coming to be **derivative** of its **charge**, which is becoming the only essential parameter; that is the reason for considering **virtual** such masses, but this virtuality is important, since it serves to determines the **real** energy. Notwithstanding, the subject might be under discussion, since there is a particle as Z boson in the weak interaction that it is usually related with neutrino; but that boson, as the carrier of neutral current contributes together with photon to the coupling constants, g and g', which are necessaries for determining the energies involved is keeping in the "inner space" The alleged reactions with neutrinos as they appear at Feynman diagram have the same meaning that the process or event indicated earlier, i.e. those particles remain in the so-called "inner space" like the gauge particles, without the possibility of emerging to the "outer space".

References:

[1]   Kaplan: "Nuclear Physics". Addison-Wesley (1962).

[2]   E.T Jaynes: "Probability in Quantum Theory" (1996).

[3]   E.T.Jaynes: "Scattering of light by free electrons" (1996).

[4]   Alonso-Finn: "Quantum and Statistical Physics". Addison-Wesley (1968)

[5]   Michio Kaku: "Quantum Field Theory". Oxford University Press (1993).

[6]   G. Wick: "Elementary Particles" . Geoffrey Chapman (1972)

[7]   H.Muirhead: "Elementary Particles Physics". Pergamon Press (1971).

[8]   Ta-Pey Cheng: "Gauge Theory Elementary Particles". Oxford (1984).

[9]   S. Glashow: "El encanto de la Física". Tusquets Edit. (1995).

[10]   R.N.Mohapatra: "Unification and Supersymmetry". Springer (2003).

[11]   E.Segré: "Núcleos y Partículas". Editorial Reverté (1972).

[12]   ChrisQuig: "Spontaneous Symm.Breaking as a basis of Part.Mass" (2007).

[13]   Franck Wilszek: "Origin of mass" (2012).

[14]   M.Gabella: "Non abelian gauge theories and Higgs Mechanism" (2006).

[15]   W.A.Tiller: "Underst.Internal Symmetry: Gauge Symmetry" (2002).

[16]   R. Feynman: "The Feynman Lectures". Addison-Wesley (1969).

[17]   Landau y Lifshitz: "Teoría Clásica de los Campos". Ed. Reverté (1966).

[18]   P. Roman: "Advanced Quantum Theory". Addison-Wesley (1965).

[19]   Kittel: "Elementary Statistical Physics". J.Wiley (1967)

[20]   J.Bourjally: "Non-abelian Gauge Inveriance". Notes. (2004).

[21]   F.Mandl: "Introduction Quantum Field Theory". Int-Science (1959).

[22]   D.Hestenes: "Misteries and insights of Dirac theory". (2002).

[23]   P.Davies: "Espacio y tiempo en el Universo". Fondo Cult.Econ. (1977).

[24]   Panofsky: "Classical Electricity and Mangnetism". Add.Wesley (1964).

[25]   M.A.Pomerantz: "Cosmic Rays". Van Nostrand Reinholt Co. (1971).

[26]   H.Goldstein: "Mecánica Clásica". Aguilar (1963).

[27]   Ander-Sonnessa: "Principles of Chemistry". The Macmillan Company (1965).

[28]   M.Born: "Einstein's Theory of Relativity". Dover (1965).

[29]   A. Einstein: "The Principle of Relativity". Dover (1952).

[30]   O.Frisch,..: "Panorama de la física contemporanea". Alianza Editorial (1975).

[31]   J.G.Stark: "Modern Chemistry". Penguin Books (1970).