NEUTRINO IS a NEUTRAL ELECTRON

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A B S T R A C T
As known the brilliant idea of a new particle came to Pauli (fully shared by Fermi) to compensate the *energy-mass gap* that emerged from the disintegration of the neutron, or *negative β decay* (βd^-): $N \rightarrow P + e^-$. The basic requirements originally requested by Pauli and Fermi for the new particle, or 3rd particle (called *neutrino*), are essentially three: it is electrically neutral and it must have the same mass and spin of an electron. Therefore, if the mass of the *neutrino* (ν) corresponded to that assumed by Pauli and Fermi, the mass gap problem of the βd^- would be brilliantly solved. However, the current upper limits of the mass of the ν are <2eV.
Here we show that a clear incongruity comes out: the mass attributed to the ν will never be able to solve the energy gap problem of the βd^-; it takes ≥ 250˙000 ν to compensate the energy-mass gap. Unless we consider, instead of ν, another particle, probably still unknown, as the 3rd particle of βd^-. To find a solution, we hypothesized the existence of an electron with no electric charge: a neutral electron (e°).

1. INTRODUCTION
As we all know, the brilliant idea of a new particle, electrically neutral, came to Pauli[1] to compensate the *mas gap* that emerged from the *neutron decay*:

$$N \rightarrow P + e^- \qquad (1),$$

where N is the neutron, P is the proton and e^- is the electron with a negative electrical charge.

1.1 MASS GAP PROBLEM of the NEUTRON DECAY(βd^-)
It clearly appears that the sum of the masses of the proton and the electron is less than the mass of the neutron. In fact, let's evaluate the masses of the particles represented in equation(1). The neutron weighs $1.67492728 \cdot 10^{-24}$[g], while the proton weighs $1.67262171 \cdot 10^{-24}$[g]; on its turn the electron weighs $9.1093826 \cdot 10^{-28}$[g]. The mass difference(Δ_M) between neutron and proton corresponds to

0.00230557·10^{-24}[g], that is Δ_M=2.30557·10^{-27}[g]. According to the mass-energy conversion factors, if we consider that "1 MeV is about 1.782 ·10^{-27}[g]" [2], and follow the *cgs* metric system, we have:

$$\frac{2.30557}{1.782} \cdot 10^{-27}[\text{g}] = 1.29381 \text{ MeV/c}^2 \qquad (2).$$

This is the mass-energy value that in the *neutron decay*, or *negative* β *decay*(βd^-), must be carried away by the electron and a 3rd particle, in order to safeguard the mass-energy balance in this process. In fact, in the βd^- many Conservation Laws were not respected, among which immediately stood out the violation of the Law of Conservation of Mass and Energy. At this regard, when Marie Curie observed for the first time this type of decay, she only associated it to the emission of an electron. Even Bohr thought that it was necessary to accept this deficiency: it seemed to him it was inevitable to resign to the violation of those conservation laws.

For some years it was not possible to find a solution, until there was a *master strike*. Pauli, in fact, did not give up. Therefore, after much hesitation, on 04/12/1930 Pauli sent his famous letter to the participants of the Congress of Physics in Tubingen. From that letter we can read: "I have hit upon a desperate remedy to save the 'exchange theorem' of statistics and the law of conservation of energy. Namely, the possibility that in the nuclei there could exist electrically neutral particles, which I will call neutrons, that have spin 1/2 and obey to the exclusion principle and that further differ from light quanta in that they do not travel with the velocity of light. The mass of the neutrons must be of the same order of magnitude as the electron mass and in any event not larger than 0.01 proton mass"[1]. Pauli called this new particle *neutron*. The neutron as such was discovered by Chadwick only two years later[3], thus *Pauli neutron* was called *neutrino* (ν) as suggested by Amaldi to Fermi.

To this purpose, Fermi asserted: "We still have the problem of knowing the laws of forces acting between the particles making up the nucleus. It has indeed, in the continuous spectrum of β rays, some clues that, according to Bohr, suggest that perhaps in these new unknown laws even the Principle of Conservation of Energy is not valid any more; unless we admit – together with Pauli – the existence of the so-called *neutrino*, that is a hypothetical electrically neutral particle having a mass of the order of magnitude of the electron mass. This, for its enormous penetrating power, escapes any current detection method, and its kinetic energy helps to restore the energy balance in the β disintegrations"[4].

In this respect Fermi elaborated one of his masterpieces, the Theory of β Disintegration, according to which whenever in a radioactive nucleus there is the spontaneous disintegration of a neutron, it follows the emission of a proton, a β ray and a 3rd particle, the ν, which with its mass, together with its high kinetic energy (E_{kin}), compensates for the amount of energy and mass that cannot be entirely taken by the β ray[4]. Namely: 1) Proton and Neutron are two different states of the same fundamental object or Nucleon. 2) The electron ejected, or β ray, does not exist within the nucleus, but it is created, together with this 3rd particle during the process of the neutron transformation into proton(in what Fermi deviates from Pauli). 3) The process of radioactive decay of the nucleon is governed by a new Fundamental Force introduced by Fermi, now known as Weak Nuclear Interaction(WI) or *Fermi's interaction*. In fact, the explanation of the nuclear β decay(βd) Fermi gave in 1933[4] was the prototype of the WI. He, taking as a model the description of the electron-proton diffusion (provided by Quantum Electro-Dynamics), proposes also for the βd a type of interaction based on the fields theory. Fermi uses the mathematical formalism of the operators of creation and destruction of particles introduced to the Electro-Dynamics by Dirac, Jordan and Klein, called *second quantization*[5][6]. In this case, however, the interaction is punctiform and called '4 fermions interaction'. It constitutes a *contact interaction* between the 4 particles involved: the neutron(which constitutes the initial state) plus the proton, the electron and this 3rd particle, or ν. These concepts were represented by Fermi through the mathematical formalism of the βd^{-}:

$$N \rightarrow \ P + e^{-} + \bar{\upsilon} \qquad (3),$$

where $\bar{\upsilon}$ is the anti-neutrino.

Now we know that in the spontaneous decay of a nuclear neutron(N), or βd^{-}, it is a down quark (dQ) of the N to be transformed, by the WI, in an up quark (uQ) through the emission of a W^{-} boson. In fact, the WI is the only force capable of changing the *flavour* of a particle, that is to transform it into another. Such a *flavour* exchange between Qs involves the transformation of N into a P. The W^{-} particle immediately decays into an electron(e^{-}) and an electronic antineutrino($\bar{\upsilon}_e$):

$$\text{udd}(N) \rightarrow \text{udu}(P) + W^{-} \rightarrow \text{udu}(P) + e^{-} + \bar{\upsilon}_e \qquad (4).$$

2. DISCUSSION

Therefore, let's consider the value of the *minimum energy* of an electron, i.e. the so-called Z*ero Point Energ*y(ZPE)[7][8]: it is equal to 0.511 MeV.

Now, if we subtract this value from the energy value expressed by Eq.(2), we obtain the value of the energy that could be covered by the 3rd particle of the βd, denoted by Δ_E:

$$\Delta_E = 0.78281 \text{ MeV} \qquad (5).$$

This value exceeds the 53.192 % the energy of an electron *at rest*. But it is worth pointing out that this is the maximum value the 3rd particle can reach (considering that at the same time the electron is emitted too). This does not mean that it always has so much energy, rather the contrary.

In fact in the value expressed by Eq.(2) we must also consider the *kinetic energy*(E_{Kin}) of the β-ray(i.e. the electron), whose energy spectrum, as Fermi had reported [4][9][10], may also coincide with the entire energy value described by Eq.(2).

2.1 βd^{-} MASS GAP: UNSOLVED PROBLEM

From the analysis of the βd^{-}, we seem to catch two important results:

1) The total energy of the emitted charged electron can fluctuate *randomly* (depending on the intensity of acceleration) in a precise range between 1.29381MeV and 0.511MeV.
2) The energy the 3rd particle can acquire, should fluctuate, still *randomly* distributed, between 0.78281 and 0.511MeV.

Therefore, these are the energy values which must obligatorily be attributed to the 3rd particle emitted with βd^{-}, represented as $\bar{\upsilon}_e$ in the Eqs.(3) and (4), in order to *balance* and make congruent this equation. But reality is different.

Regardless the Standard Model, according to which ν was massless, the mass still attributed to ν is well 5 orders of magnitude less than the electron mass!

This limitation, in fact, was inferred from the observations of Supernova 1987A, for which it had been assumed that the mass of the ν_e was <5.8eV[11]. Why this limit? Because the neutrinos of this supernova arrived on Earth a few hours before the visible light; so they "must have traveled at a speed very close to that of light. Since lighter particles travel faster than heavier ones, scientists have concluded that the mass of ν is very small"[12]. Maiani adds: "The current upper limits of the mass of the neutrinos(m_ν) emitted with the *β-decay* are m_ν<2eV"[13], a value corresponding to <1/250˙000 of the electronic mass.

2.2 NEUTRINO REQUIREMENTS

On the contrary, the basic requirements originally requested by Pauli and Fermi for the ν, i.e. for the 3rd particle or missing particle in the βd^-, defined by several authors as a *ghost particle*, are essentially three: 1) it is electrically neutral; 2) it has the same mass of an electron; 3) it has the same spin of the electron[1][4].

Well, why not to think immediately to a neutral electron (e°)? All requests would be satisfied. It seems the most logical answer, and physically more than adequate to meet the demands of Pauli and Fermi. It could be said that the same results reached by a e° are obtained similarly even with a ν. And then: e° does not exist, this is an invention! The only known electrons are those carrying an electric charge: e^- and e^+. Yet even the ν, when suggested by Pauli, was an invention. Moreover the ν was a particle totally unknown, invented from scratch. Indeed, it was forced to introduce in

Physics, *compulsorily*, a new family of particles, with their own characteristics, and with presumed properties quite different from the other elementary particles known at the time.

The e°, instead, refers to one of the fundamental particles more widespread in nature, even if only those electrically charged are known. In addition, a not negligible result, with the e° it is not necessary to invent a new category of particles to be added to the *Standard Model*(SM), maintaining the symmetry of the SM and further simplifying it (according to the *reductionist* approach preferably adopted in Physics[14]).

2.3 NEUTRINO *PSEUDO*-DETECTION

As is well-known, in announcing the possible existence of a 3rd particle in the βd^-, both Pauli and Fermi scrupulously specified that it would be very difficult to detect such a particle. To this purpose, Pauli says: “This particle would have the same or perhaps a 10 times larger ability to get through [material] than a γ ray”[1]. Fermi points out: “This particle, for its enormous penetrating power, escapes any current detection method, and its *kinetic energy* helps to restore the energy balance in the β disintegrations"[4].

Bethe and Peierls, i.e., after several calculations, wrote that it would be impossible to detect a ν, since this would pass, without interacting, through a lead wall of over 3500 light years[15]. It must be added that the very small cross section(σ) of such a particle causes it can more easily pass through the matter without interacting with it. In fact, the σ of ν was found to have a value as small as 10^{-44} [cm^2][15]. It is really a very small cross section. This same value was confirmed in 1959 by Reines and Cowan [16], who revealed that the σ of the ν_e was equal to:

$$\sigma = (11 \pm 2.6)10^{-44}[\mathrm{cm}^2] \qquad (6).$$

At this regard Rasetti (the founder, together with Fermi of the School of Physics of *via Panisperna*) adds: “The ν is the smallest object human beings have ever met. It can cross the matter very easily, that’s why it has very little propensity to interact with matter, not only because it is very small, but also because it travels at very high speeds for which it remains near to atomic nuclei – with which it could possibly interact - for a time which is too short to allow a reaction. In order to have any effect, the neutrinos in their movement should fully center the nucleus of an atom, however it is such a rare event that it is estimated that these strange creatures would be able to cross a wall of a few light years thickness without finding any obstacle" [17].

2.3.1 RADIOCHEMICAL METHODS

Leafing through the vast literature about it, it is immediately obvious that all the different techniques of detection of the 3rd particle of *βd*, or *ν*, have always only showed the effects (on the particles involved in the reaction) determined by a particle freed in radioactive decays: to be exact an invisible particle , believed to be the *ν* (but those detected may well be indirect effects induced by another particle). In fact, It took 25 years to come to a detection, always *indirect*, of the $\bar{\upsilon}$, and then the *ν*. In this respect, the apparatus designed by Reines and Cowan[18] (complying with Pontecorvo suggestions[19]) was made of a target of about 1000 litres of aqueous solution of cadmium chloride contained in two containers alternating with three other containers filled with a liquid scintillator acting as a detector. Thus, installing this system near nuclear reactors, in which constantly occur countless *β-decays*, it could happen that the alleged $\bar{\upsilon}$ issued, bombing water protons, created a reverse process, i.e. a *positive β-decay*(*βd*$^+$), transforming the proton in neutron, moreover the emission of a positron (e^+) and a *ν*.

Since it was known that the 3rd particle emitted in this process could never be detected, identified directly, Reines and Cowan pointed the research on two the other particles: neutron and positron.

The race of the neutron emitted is slowed, "moderated", by the collisions with water (as it had first been shown by Fermi and his *boys of Via Panisperna*) thus, in about 10^{-5} seconds, the neutron is captured by cadmium, with immediate emission of γ rays of a particular frequency and energy (~6MeV). The positron, in its turn, annihilating with an electron of the water, generates a pair of γ photons of a defined frequency, able to produce light in the scintillators placed along the walls surrounding water. Such light, or *Cherenkov Light* (*CL*)[20], is detected by photomultipliers. The characteristic time is ~10^{-9} seconds, and the coincidence between two scintillators represents the time (t_o) of the measure. Therefore, in the same pair of scintillators it occurs a delayed coincidence, compared to t_o [18]. Yet, in order to better analyse with accuracy and without bias the findings from this experiment, we can divide it into two phases: 1) The 1st stage takes into account any *βd*$^-$ which occurred in the nuclear reactor, resulting in the emission of a 3rd particle, believed to be a $\bar{\upsilon}$. 2) The 2nd stage considers the effects produced by the clash between this $\bar{\upsilon}$ with a proton of the water contained in the tanks: what occurs is a *βd*$^+$ with emission of a *ν* (which, just as the $\bar{\upsilon}$ will never be disclosed) and with the emission of a positron which, annihilating with an electron of that same water, produces the pair of γ photons detected by the photomultiplier. That's all. That is, the strategy of *data taking* by the experimenters essentially consists in recording time, which separate the events sought, and the energy value registered by the photomultipliers. In this regard, we read: "The mark that distinguishes events sought is therefore a double coincidence in a pair of scintillators, separated by a time of a few microseconds"[21]. "If instruments had revealed γ rays exactly of two energies provided, separated by suitable intervals, the investigators would have caught the $\bar{\upsilon}$ " [22].

Thus, this was enough to believe to have found, specifically and unequivocally the effects of the elusive $\bar{\upsilon}$. With good conscience, this statement seems to us a *stretch* in the interpretation of the findings. That statement, in our view, requires a preconceived, a *dogma*: that the 3rd particle emitted with *βd*$^-$ must be only and unquestionably an $\bar{\upsilon}$, no other type of particle.

2.3.2 SNO and SUPER KAMIOKANDE

We can still quote two more neutrino detectors: the Subdury Neutrino Observatory (SNO) and the famous Super-Kamiokande. They are both made of huge pools of water, whose walls are covered with an infinity of 'light detectors', or photomultipliers. Both experiments use the procedure characterizing the detection of Reines and Cowan, for which the alleged $\bar{\upsilon}$ (or 3rd particle of βd^-) strikes a proton of a water molecule, triggering a βd^+: the electrons freed at relativistic speeds, traveling faster than light (in the same medium), emit the typical *CL* which is captured by photomultipliers. It is believed that it is the ν to trigger the series of reactions leading to the production of the *CL*. Yet, even in these experiments (SNO and Super Kamiokande) the ν remains elusive: it is only possible to detect the effects of the invisible particle (*ghost particle*) issued in *βd*. Nevertheless, in such surveys the production of *CL* is considered as the evidence of the existence of ν and $\bar{\upsilon}$. This interpretation of the experimental data seems to us *forcing*: 1) Because, since the precise identikit of the 3rd particle emitted with *βd* is not known, we cannot say with scientific certainty that the effects it produces are attributable specifically and exclusively to a ν. 2°) Because we know, with certainty, that the *CL*[20] is a typical natural phenomenon generated by electrons highly accelerated which, as we know, are released also in *β-decays*. 3) The fact that it is known and proven that the *CL* is produced specifically by extremely accelerated electrons, makes clear, fair, compatible, and even more likely the hypothesis that in *β-decays* are emitted e° too (or its antiparticle) instead of ν [23].

2.3.3 CHERENKOV PHENOMENA

At this regard, it should be remembered that when charged particles such as electrons, present in a medium such as air pollution, are accelerated at speeds exceeding the light in the same medium[24] [25], emit light under a characteristic angle: the above mentioned *C*herenkov Light(*CL*). The reason of such issue can be traced to the effects of polarization and depolarization of the medium, associated to the passage of the charge. These motions charge around each point touched by the moving charge generate a series of spherical waves (which in a non-dispersive medium travel with the group velocity $v_g = c/n$, where $n > 1$ is the refractive index) whose envelope constitutes a coherent conical wave front, propagating at a greater speed than the solar light in that medium, and in order to create a coherent wave front, characterized by an angle (θ), known as *Cherenkov angle*:

$$\cos\ \theta = \frac{1}{n} \cdot \beta \qquad (7),$$

where $\beta = v/c$ is the ratio between the speed of the particle and the speed of light in the vacuum, whereby β corresponds to 1, for particles traveling at relativistic speed, while $n=c/c_{medium}$ is the refractive index of the considered medium (as known the speed of light in the air corresponds to 224000 km/sec).

The *Cherenkov Effect* (*CE*) is comparable to the formation of a wake generated from a boat traveling with a speed greater than that of the waves on the water surface. It can be considered also as the *optical equivalent* of the sonic boom generated by the breaking of the wall sound barrier.

It must be considered that, apart from the alleged ν, what is known for certain is that the *CL* is produced firstly (and probably only) by extremely accelerated electrons.

Therefore, our model to consider e° instead of ν is in the fullest and perfect accord with the mechanism underlying the *CE*, i.e. with Nature, without the necessity to *invent* entirely new particles. We wish to repeat: the only known particles able to emit *CL* (as occurs constantly in our atmosphere) are electrons accelerated at high speed, after the impact with cosmic rays in the upper atmosphere.

Then, it was considered that the alleged ν were able to issue *CL* (however with no direct evidence that this radiation was produced precisely by neutrinos(ν_s). In contrast, without similar forcing, it may

appear far more natural that, instead of the supposed ν it is the e° which, accelerated at high speed in the *β-decays*, is able to emit the *CL*, like the (electrically charged) electrons of atmospheric molecules, in turn accelerated by the violent shock suffered by cosmic rays.
It really seems more appropriate, compatible and consistent with the findings of course *naturally* supplied by the *CE* in the upper atmosphere, and therefore *without having to force Nature herself*.
In short, the findings reported in these various detection techniques of the ν are nothing but the effects attributable to an invisible particle, *transparent* to matter: really a *ghost particle* (*GP*). Instead of ν we prefer to call it *GP*, or 3rd particle of the *βd*, since we only know its indirect effects: it has never been seen or detected directly, to date (even the experiment of Reines and Cowan gives an *indirect* evidence).

2.3.4 LOW INTEROPE of NEUTRINO WITH MATTER

Let's try to understand why the third particle emitted by the *βd* does not interact at all with the matter, so it has never been seen directly: **1)** Being a leptonic particle, whether it matches the ν, or it is represented by e°, it follows that it is insensitive to the Strong Interaction (SI). **2)** Being neutral particles (one of the primary requirements dictated by Pauli and Fermi), they are insenitive to Electro-Magnetic Interaction too. **3)** Its very small mass makes it very weakly subject to Gravity Interaction (GI), although it is sensitive to such interaction. In this regard Feynman reminds us: "The gravitational activation between two objects is extremely weak: the GI between two electrons is less than the electrical strength of a 10^{-40} factor (or maybe 10^{-41})" [2]. Furthermore, considering that the GI action in itself is extremely weak, and considering that the particle in question travels at very high speed, hence it proves insensitive to the GI. **4)** In addition, the 3rd particle emitted with βd^- is right-handed, just as the hypothetical $\bar{\upsilon}$ (or the possible $\bar{e}°$), so it is even more elusive, since it is also insensitive to Weak Interaction(WI). But even considering the respective particles, which are left-handed, and therefore potentially sensitive to WI, they are essentially unaffected. First of all because the very high acceleration with which the 3rd particle is issued (both in βd_s and in the process of nuclear fusion) makes this particle travel undoubtedly with relativistic speed, reducing in this way the time the WI - and the GI- can exercise their action. Moreover the WI action is notoriously weak, and quite *slow* compared to the GI and SI, thus it is even more difficult that it may prevail on the *kinetic energy* the 3rd particles travels. The WI acts only on a short distance, which restricts even more the possibilities of such a particle to interact since, as it can be seen from our calculations, the maximum distance WI bosons can travel corresponds to $1.543 \cdot 10^{-15}$ [cm] for W^+ and W^- particles, and $1.36 \cdot 10^{-15}$[cm] for Z° particles[26][27]. So, even e°, despite being sensitive to the WI (since it is left-handed), should be able to cross every *weak field* undisturbed.

3. CONCLUSIONS

In short, a basic point might be that every time it was considered that ν had been detected, they were always *indirect detection* thanks to traces left by a *ghost particle* never detected *de visu*. It is the detection of the impacts' effects, such as the Cherenkov Effect (*CE*), to prove the existence of ν, although it might be another particle to induce the *CE*. In Nature the *CE* is only elicited by electrons. The electrons of the atmospheric molecules, hit by cosmic rays at high altitude, are accelerated at very high speed, so emitting those photons that give consistency to the so-called *Cherenkov Light*[20]. One thing we can be certain about the results of all *indirect detection* of the ν: they only show the *traces* left by a *ghost particle*, that is, the 3rd particle released with the βd_s , a particle never directly identified. In favor of our hypothesis, that in βd what is released is a e° instead of a ν (more precisely an ē° in βd^- and an e° in the βd^+), is the fact that the main detection techniques of ν all use the *CE*: a phenomenon *naturally* induced by electrons. So it's no wonder if it is still an electron, this time without electric charge, to induce the various *CEs* highlighted during the *surveys* carried out by Reines and Cowan[18], or at the Superkamiokande, or the Subdury Neutrino Observatory (SNO), or elsewhere.

Yet, one might object: why the *e°* has never been detected, even accidentally? Electron decay products emerge continuously in the *colliders*! But it is clear: the crucial difference lies in the fact that we are talking about electrons without electricity charge, they do not interact with matter for all the same reasons ν_s do not interfere . In addition, the 3rd particle emitted with βd^- is right-handed, just as the hypothetical $\bar{\upsilon}$ (or the possible $\bar{e}°$), so it is even more elusive, since it is also insensitive to WI. At this regard the Randall writes: "Though neutrinos(ν_s) are very light and, consequently, largely to the energetic reach of colliders, it is not possible to detect them directly in the LHC (Large Hadron Collider), since they don't have an electric charge: their interaction in detectors is extremely weak. The interaction of ν is so weak that even if every second $50{\cdot}10^{12}$ ν_s come down from the sun, we had no idea before physical books told us. It remains to be resolved the issue of how ν can be experimentally identify. Since they don't have any electric charge and interact so weakly, the ν escape the detectors without leaving any trace. Then how is it possible to affirm their presence in an experiment conducted at the LHC? The principle of conservation of *momentum*, such as energy, has never been experimentally refuted. Thus, if the *momentum* of the particles produced at the end of a certain event, measured in the detector of particles, is less than the *momentum* at the beginning of the event, this means that there has been another particle, or particles, that have escaped detection and have taken away the *momentum* missing in the assessment of the event. We still have the question of how to know exactly which particle it is, among the number of potential particles that could leave no trace in the detector. Reflecting on the possibility that new discoveries come out at the LHC, it is important to keep in mind this way of relating to the problem. What has been said about ν is also applicable to other possible new uncharged particles or having such a weak charge to be not directly detectable. In these cases to understand what the underlying reality is we can only combine theoretical considerations with experimental evaluations on the missing energy. This is the reason why the *airtightness* of the detectors, with the consequent recognition, though the most accurate, of all the collision *momenta* is so important "[14].

In short, even the LHC detectors, considered among the most reliable and sophisticated in the world, are not able to discern the dilemma of secure identity of the 3rd particle emitted in the process of βd. We repeat: since we have never identified the hypothetical ν, but only through the *effects* it produced, we cannot say with certainty that it exists. This seems the crucial point: since this 3rd particle issued with βd has never been identified, directly, concretely, but always and only indirectly, the same effect as that ν could also, with equal possibilities, be attributed to e° or another particle compatible with the βd (unless it is proved that the existence of a 3rd type of electron, e°, is incongruous with the reality of our Universe and incompatible with the known physical laws).

3.1 ALTERNATIVE βd^- MODEL

To sum up, the minimal mass attributed to the $\bar{\upsilon}_e$ will never be able to solve the *mass gap problem*

of the *N decay*: it takes between 100˙000-250˙000 neutrinos to balance the mass gap!
An anti-neutral electron (ē°), instead, would have all requirements to represent the 3rd particle of the *βd*⁻[28]. Only in this way, in our opinion, the energy balance in the *β* disintegration is restored, thus safeguarding the Laws of Conservation of Mass and Energy and at the same time safeguarding the Law of Conservation of Electric Charge and Angular Momentum.
That is, Pauli's opinion, this 3rd particle should be a fermion and "must be of the same order of magnitude as the electron mass"[1], but without carrying electric charge: you could really think of an electron without electric charge, a neutral electron (e°).
Well, all Pauli-Fermi requests would be satisfied.
So, if the existence of the e° should be real, the Eq.(3) describing the βd^-, should be rewritten as follows:

$$N \rightarrow P + e^- + \bar{e}^\circ \quad (8),$$

where ē° indicates the anti-neutral electron.

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