The Principle of Asymmetry in the Elementary Universe

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Not always symmetry is a principle of nature

Abstract

In this paper we consider a few important questions concerning the microuniverse of elementary physical systems. We know leptonic matter is characterized by negative electric charge and leptonic antimatter by positive electric charge. Conversely baryonic matter is characterized by positive electric charge and baryonic antimatter by negative electric charge. In the Non-Standard Model both, matter and antimatter, can have negative values of mass (antimass) for greater speeds than the critical speed. We will demonstrate, always in the order of the Non-Standard Model, there is a full symmetry for elementary particles in regard to the behavior of matter, antimatter and antimass whether when they are in the leptonic state or in the baryonic state.
The physical reality of nature shows neverheless in the Elementary Universe a Principle of Asymmetry is in force. In fact if this Principle doesn't exist then in the Universe and in Nature we would have to observe a comparable quantity of matter and antimatter. It is known instead that the practically exclusive presence of matter, above all at low energy, is proved. Our object now is to discover that principle of Asymmetry, that in our physico-mathematical model represents a surmounting of the concept of spontaneous breaking of the symmetry, that is assumed in the Standard Model. We will demonstrate the Principle of Asymmetry is based upon a criterion of stability that identifies the actual asymmetry of the Elementary Universe with the instability state of some microphysical structures.
This paper represents the second essay of the "Trilogy on the knowable Universe".

1. Introduction

The standard distinction between matter and antimatter is altogether conventional and it is due to the fact that particles, like electrons and protons, were discovered first and consequenty they represented the elementary matter. Positrons and antiprotons were discovered only successively and they conventionally represented the elementary antimatter. From physical viewpont that distinction has no importance or meaning and therefore we could consider also a different distinction. For instance we could assume that matter is composed of all elementary particles with positive electric charge and antimatter is composed of elementary particles with negative electric charge: like this, for instance, a hydrogen atom would be composed at the same time of matter (proton) and antimatter (electron).

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Similarly an antihydrogen atom would be composed of antimatter (antiproton) and matter (positron). Like this whether matter or antimatter would be in the Universe and the question would be why this asymmetry is in force in the Universe for which only hydrogen and not also antihydrogen exists in nature.
We nevertheless will make use of the standard definition and will search for explaining in the order of the Non-Standard Model (NSM) why in the Universe in the elementary state there is only matter and there isn't antimatter: this question is independent of the definition that is assumed for matter and antimatter and certainly it involves the existence of a Principle of Asymmetry.
The Non-Standard Model of Particle Physics is based upon two innovative concepts: the new definition of spin, based on the "Theorem of Charge and Spin"[1][2], that relates the spin to the electric charge, and the "Decay Principle"[3] that allows to define a new classification[2] of elementary particles as per processes of decay of unstable particles. The Principle of Asymmetry, together with the previous two concepts, completes the group of fundamental ideas that are at heart of the Non-Standard Model. Besides the NSM together with the Physico-Mathematical Theory of Reference Frames[4][5] (TR) and with the Deterministic Quantum Physics[6] (DQP) represents the essential structure of the new **"contemporary physics"**.
Charged massive elementary particles, whether leptonic or baryonic, are characterized by the relativistic electrodynamic mass[7] . It is a physical property of both, elementary matter and antimatter, that changes with the speed. When the speed is smaller than the critical speed, the electrodynamic mass is positive; when the particle speed is greater than the critical speed the electrodynamic mass is negative and in that case it represents the "antimass" that has opposite physical properties with regard to the positive mass. Besides the electrodynamic mass is null when the speed is critical: it doesn' t mean the particle has disappeared but only it has changed[1].

2. Leptonic matter and antimatter

Leptonic matter is composed of electrons and of unstable particles with negative electric charge (leptonic n-matter[2]). Leptonic antimatter is composed instead of positrons and of unstable particles with positive electric charge (leptonic p-antimatter).
Electron is the parent of the leptonic n-matter and positron is the parent of the leptonic p-antimatter. Positronium is instead the parent of the neutral and boson leptonic subfamily[2][3].
in previous papers[1][7] we have described the behavior of accelerated electron whose electrodynamic mass m_e^- changes with the speed according to the known relationship

$$m_e^- = m_e \left(1 - \frac{1}{2}\,\frac{v^2}{c^2}\right) \qquad (1)$$

where m_e is the resting electron mass and v is its speed.
We have showed also this behavior can be represented through the Feynman diagram[1][3][8][9] , like in fig.1.

The accelerated electron emits two quanta of energy belonging to the gamma band, respectively at the physical speed c of light and at the critical speed v_c=1,41c.
At the critical speed the electrodynamic mass is zero, when the speed increases further mass becomes negative and the electron absorbs energy in the shape of negative electrodynamic mass. For smaller speeds than the critical speed electrodynamic mass is positive and the accelerated electron is stable, while for greater speeds than the critical speed accelerated electron generates all unstable particles of the leptonic n-matter, that in the free state decay to electron[3][8].

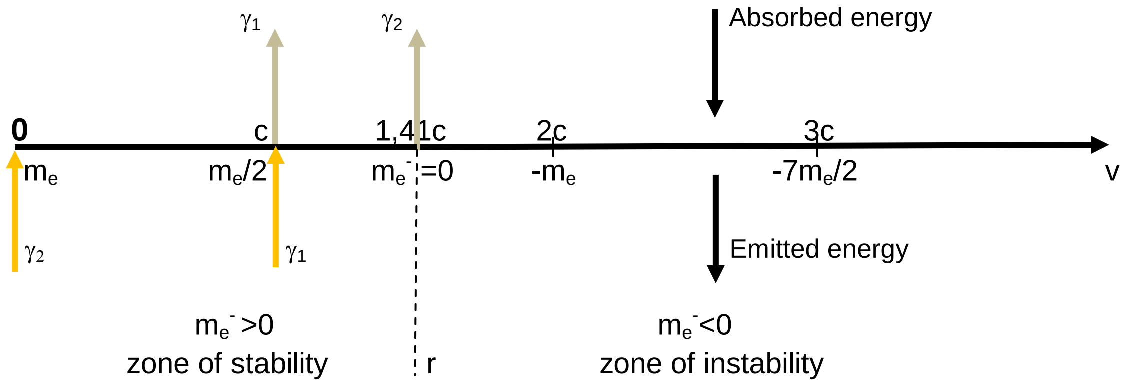

Fig.1 Feynman's dynamic diagram relative to the behavior of the accelerated electron (leptonic n-matter) and to the behavior of the decelerated electron.

During the forced deceleration (that isn't a spontaneous decay) electron behaves in dual way with respect to the acceleration phase with emission of radiant energy for greater speeds than the critical speed and with absorption of two energy quanta for smaller speeds, respectively at the physical speed of light and at the resting state.
In the process of spontaneous decay that happens when particle is free, it emits one delta quantum of energy when it goes back to the resting state or to the state of minimal energy starting from speeds $v \geq c$ and it emits one X quantum of energy for $v<c$[4].
Let us want now to study the behavior of leptonic p-antimatter at changing of speed with particular reference to positron. The resting positron has the same electrodynamic mass m_e of the resting electron and the same intrinsic energy $E_{io}=m_e c^2$. At the speed v the positron has an equivalent kinetic energy $E_c=m_e v^2/2$ and an intrinsic energy $E_i=m_e^+ c^2$, where m_e^+ is the positron mass at the speed v.
Applying the Conservation Law of Energy we have

$$E_{io} - E_c = E_i \tag{2}$$

from which we deduce the mathematical model that defines the variation of electrodynamic mass of positron with the speed

$$m_e^+ = m_e \left(1 - \frac{1}{2} \frac{v^2}{c^2} \right) \tag{3}$$

The (3) shows the accelerated and decelerated positron behaves like the electron and also the graphic representation is similar (fig.2).

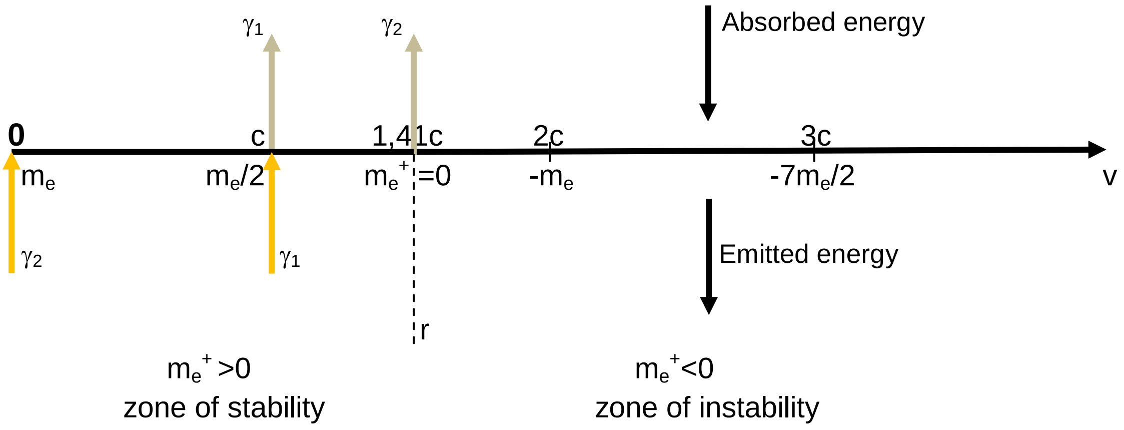

Fig.2 Feynman's dynamic diagram relative to the behavior of the accelerated positron (leptonic p-antimatter) and to the behavior of the decelerated positron.

We deduce therefore the dynamic behavior of both the leptonic matter, whose parent is the electron, and the leptonic antimatter, whose parent is the positron, are characterized by perfect physical symmetry.

3. Baryonic matter and antimatter

Baryonic matter[10] is composed of protons and of unstable baryonic particles with positive electric charge (baryonic p-matter). Baryonic antimatter is composed of antiprotons and of unstable baryonic particles with negative electric charge (baryonic n-antimatter).
The proton is the parent of the baryonic p-matter and the antiproton is the parent of the baryonic n-antimatter. The neutron instead is the parent of the subfamily of the baryonic neutral matter.
We demonstrated[10] mass m_p^+ of the accelerated proton at the speed v is given by the following relationship

$$m_p^+ = m_p\left(1 - \frac{1}{2}\frac{v^2}{c^2}\right) \qquad (4)$$

At the physical speed c the mass of the accelerated proton becomes half ($m_p/2$) and the remaining half is emitted in the shape of energy quantum belonging to the δ-Y band. At the critical speed v_c=1,41c the proton emits a second quantum of energy that is equal to the first and itself belonging to the δ-Y band ($f \geq 1.13 \times 10^{23}$Hz) .
The baryonic mass of proton decreases when the speed increases, it becomes zero at the critical speed and for greater speeds than the critical speed becomes negative (baryonic antimass) with the simultaneous beginning of a physical state of instability for the particle.
Therefore we can deduce baryonic matter has the same behavior as the leptonic matter.
It can be represented in diagram as in fig.3.

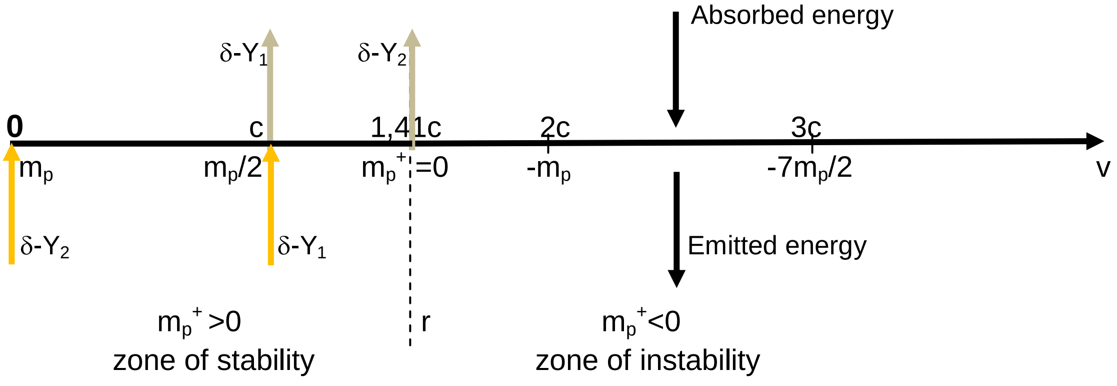

Fig.3 Feynman's dynamic diagram relative to the behavior of the accelerated proton (baryonic p-matter) and to the decelerated proton.

Let us consider now the behavior with changing of the speed of the baryonic n-antimatter with particular reference to the antiproton. It has the same resting mass m_p of the resting proton and therefore the same resting intrinsic energy $E_{io}=m_pc^2$. At the speed v it has an equivalent kinetic energy $E_c=m_pv^2/2$ and an intrinsic energy $E_i=m_p^- c^2$.
Applying the Conservation Law of Energy we have

$$E_{io} - E_c = E_i \tag{5}$$

from which we derive the mathematical model that gives the change of the electrodynamic mass of the antiproton with the speed

$$m_p^- = m_p \left(1 - \frac{1}{2}\frac{v^2}{c^2}\right) \tag{6}$$

The (6) proves the accelerated antiproton behaves like the accelerated proton and consequently also the graphic representation is the same (fig.4).

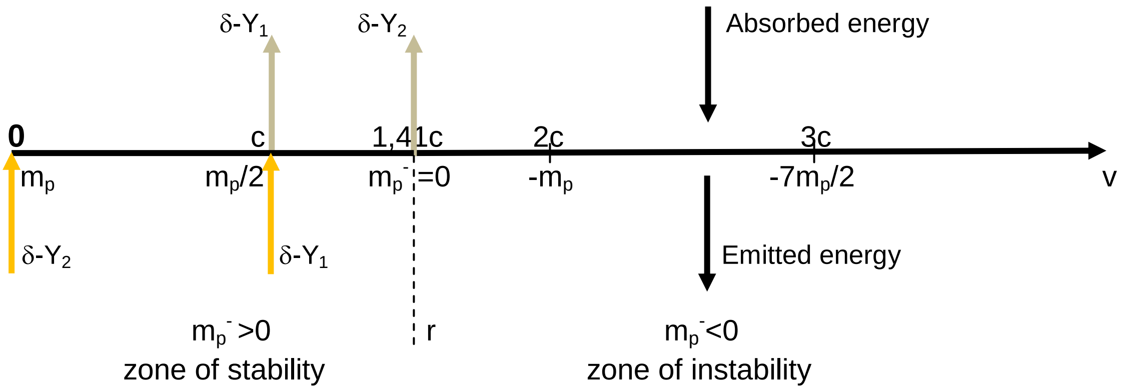

Fig.4 Feynman's dynamic diagram relative to the behavior of the accelerated antiproton (baryonic n-antimatter) and to the decelerated antiproton.

We deduce therefore baryonic matter and baryonic antimatter have a symmetric physical behavior likewise leptonic matter and antimatter.

4. Materialization of the electron-positron leptonic pair from a quantum of gamma energy

We considered[1] already, in the order of the Theory of Reference Frames, the process of materialization (or production) of the electron-positron pair (photon materialization).
Now we want to specify a few aspects of the process. It is known that the production of an electron-positron pair from an energy quantum happens, in concordance with the standard theory, with quanta of gamma energy that have values $E(\gamma)=hf \geq 1{,}02$ MeV. The standard theory requires also the presence of a nucleus.
The value $E(\gamma)=1{,}02$ MeV represents the least threshold of materialization and in that case the process is described in fig.5.

$$\gamma \longrightarrow e^- + e^+ \qquad (7)$$

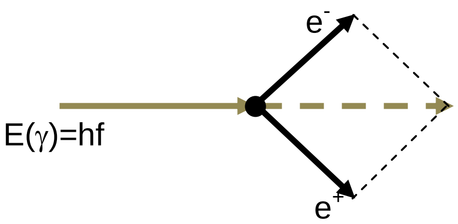

Fig.5 Feynman's diagram describing the materialization of a gamma quantum that has the least threshold of materialization.

The analysis of the materialization process in the order of the Theory of Reference Frames involves that process can happen also in the absence of a nucleus. We can draw in one only graph (fig.6) the behavior with the changing of the speed of both, the leptonic n-matter and the leptonic p-antimatter.

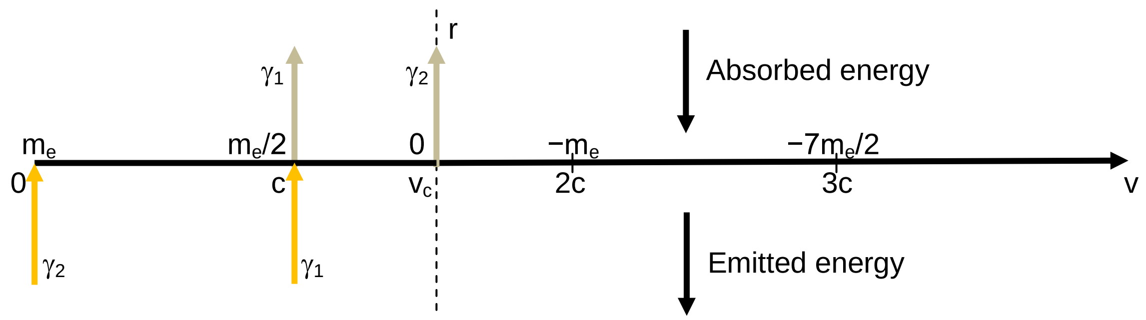

Fig.6 Feynman's dynamic diagram relative to the symmetric behavior of both, the accelerated (or decelerated) electron and the accelerated (or decelerated) positron. Acceleration happens in the positive direction of v.

The analysis of the symmetric behavior of the two particles with the changing of the speed allows the following important deductions in the case of the materialization process:

a. The Conservation Law of Momentum involves the speed v of both, the electron and the positron, in the absence of nucleus, is greater than the speed of light[1]

$$v \geq c \qquad (8)$$

b. The Conservation Law of Mass in the considered physical process involves then it can happen only at the critical speed

$$v_c=1,41c \qquad (9)$$

At this speed electrodynamic masses of both, electron and positron, are null like the real mass is null before the materialization process.

c. The Conservation Law of Energy involves then the initial energy quantum has to have the value

$$hf \geq 1.02MeV \qquad (10)$$

This value of energy corresponds with energy quanta belonging to the gamma band and it subdivides equally between the two particles that are generated in the process with at least 0.51MeV for every particle. It is easy to verify that the deviation angle of both, electron and positron, with respect to the direction of the gamma quantum is 45° in the event of least threshold.
Whether electron or positron, at the free state and at the critical speed, are in a physical state of slight instability (or marginal stability); consequently they decay spontaneously into the two resting particles, with respect to the reference frame supposed at rest, with the transformation of the energy into resting electrodynamic mass.
It is suitable to underline that the process of spontaneous decay is physically different from the deceleration process of non-unstable particle from the critical speed to the null speed that happens instead with absorption of two energy quanta, respectively at the physical speed of light and at the resting state, because of the action of the external force and at the expense of the electric field.
The three conditions (a, b, c) are compatible and consequently they don't generate problems of physical realizability in regard to the materialization process.
Those three conditions involve the presence of a nucleus is superfluous.
With respect to the three physical conditions that are necessary for the materialization of the gamma quantum of energy and for the production of a electron-positron pair the most restrictive condition is certainly the second condition (b) that therefore determines, together with the third condition (c), the physical realizability of the process in the absence of nucleus.
If the initial energy quantum is greater than the least threshold ($E(\gamma)>1,02MeV$), it is manifest that in that event the energy difference, in concordance with the Conservation Law of Energy and the Conservation Law of Momentum, is in the shape of a third energy quantum ε :

$$E(\gamma) = \frac{hf}{2} + \frac{hf}{2} + \varepsilon \qquad (11)$$

$$\mathbf{p} = \mathbf{p_{e^-}} + \mathbf{p_{e^+}} + \mathbf{p_\varepsilon} \qquad (12)$$

5. *Materialization of the proton-antiproton baryonic pair from a quantum of delta-Y energy*

Let us ask now if the materialization process is valid also for baryonic matter. Scientific evidences on this physical process are uncertain and therefore we have to reason in theoretical and previsional terms.
Let us assume this materialization process is possible in nature and it happens with the same modalities of the process of electron-positron production.
It is manifest that in that case the energy quantum E=hf must have the property to allow this materialization process. Because resting masses of proton and antiproton are both equal to $m_p=1831{,}6m_e=0{,}938GeV/c^2$, consequently the energy quantum has to fulfil the relationship

$$E = hf \geq 1{,}876\ GeV \qquad (13)$$

The least value of energy (materialization threshold =1.876 GeV) is characterized by a frequency $f=4{,}53{\times}10^{23}$Hz that belongs to the δ-Y band of frequencies. Therefore the materialization process proton-antiproton can happen only by delta-Y quanta of energy E(δ-Y) that fulfil the (13), and in the event of least threshold we have (fig.7)

$$\delta\text{-}Y \longrightarrow p^+ + p^- \qquad (14)$$

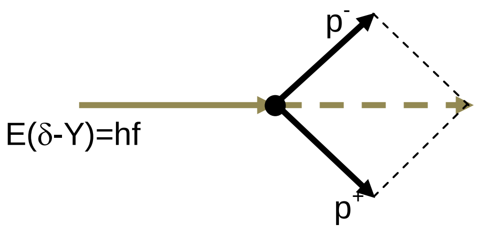

Fig.7 Feynman's diagram of materialization of one delta-Y quantum with least threshod of materialization.

The same process can be described also through the graph of fig.8 where the behavior at the changing of the speed is represented whether for the baryonic p-matter or the baryonic n-antimatter.

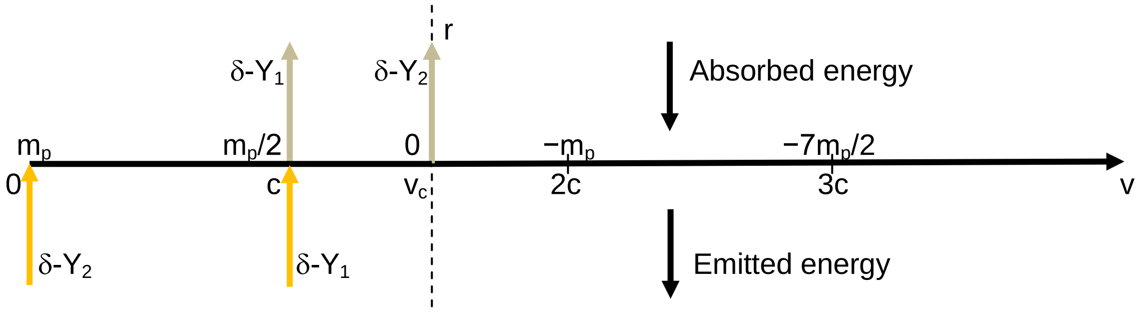

Fig.8 Feynman's dynamic diagram relative to the symmetric behaviour of both, the accelerated (or decelerated) proton and the accelerated (or decelerated) antiproton

The process represented by the relation (14), like the process of electron-positron materialization, has to fulfil the Conservation Laws:

a. The Conservation Law of Charge is respected, in fact before and after the materialization is

$$0 = +1 - 1 \tag{15}$$

b. The Conservation Law of Spin is respected, in fact

$$0 = +\hbar/2 - \hbar/2 \tag{16}$$

c. The Conservation Law of Mass is respected, in fact at the critical speed we have

$$0 = 0 + 0 \tag{17}$$

Consequently this Law involves that also the materialization of the proton-antiproton pair must happen at the critical speed.

d. The Conservation Law of Energy, in the general case $E(\delta\text{-Y}) \geq 1{,}876\text{GeV}$, requires

$$E(\delta\text{-Y}) = hf/2 + hf/2 + \varepsilon_b \tag{18}$$

In that case we have also

$$2m_pc^2 \leq hf \tag{19}$$

If $\varepsilon_b=0$, $E(\delta\text{-Y})=1{,}876\text{GeV}$ (least threshold) and $2m_pc^2=hf$.

e. With regard to the Conservation Law of Momentum, in the general case for $E(\delta\text{-Y}) \geq 1{,}876\text{GeV}$, the process can be represented like in fig.9.

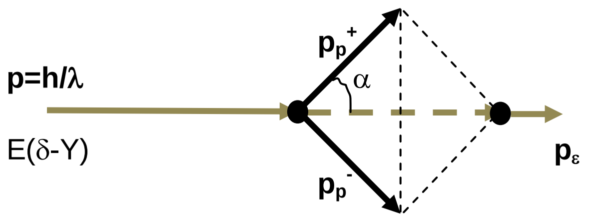

Fig.9 Feynman's diagram of materialization of the δ-Y quantum in the general case $E(\delta) \geq 1{,}876\text{GeV}$

Suppose that $\mathbf{p}=\mathbf{h}/\lambda$ is the momentum of the energy quantum delta-Y, $\mathbf{p_p^+}$ and $\mathbf{p_p^-}$ are the momentums of proton and antiproton, and $\mathbf{p_\varepsilon}$ is the momentum of the residual quantum of energy in the general case. The Conservation Law of Momentum involves that

$$\mathbf{p} = \mathbf{p_p^+} + \mathbf{p_p^-} + \mathbf{p_\varepsilon} \tag{20}$$

In the event of least threshold we have $p_\varepsilon=0$. Because $p_p^+=p_p^- =m_p v$ and $p=h/\lambda=hf/c$, we obtain then

$$2p_p \cos\alpha = \frac{hf}{c} \qquad (21)$$

Because in the general case, i.e. non-least threshold, for the (19) is $hf/c \geq 2m_p c$, we have also

$$v \geq \frac{c}{\cos\alpha} \qquad (22)$$

in which the equality is valid in the case of least threshold.
From the (22) we derive that also the two baryons (proton and antiproton), produced by the materialization of the δ-Y quantum of energy, have necessarily a greater speed than c. The Conservation Law of Mass involves then this materialization happens just at the critical speed $v_c=\sqrt{2}\,c$ and therefore from the (22) we derive, like in the case of the leptonic materialization, that $\alpha=45°$.
This study proves there is a perfect theoretical symmetry in the behavior of both, leptonic matter and antimatter, and, baryonic matter and antimatter. The Principle of Asymmetry, that we are pursuing, must therefore lie in a level of matter with greater complexity, i.e. in the level in which elementary particles group together for constituting the atomic complex matter. The most simple and elementary physical system of complex matter is the hydrogen atom.

6. Physico-mathematical model of hydrogen atom

Hydrogen atom has the same physical components of neutron, i.e. one proton and one electron, but the two systems have a completely different physical behavior. In fact neutron at the free state is unstable and in a time of about 900s decays spontaneously into its components (one proton and one electron) more one electron neutrino that belongs to the gamma band[8][11]. Hydrogen atom instead, at the free and insulated state, is a basically stable system[6] and for breaking the proton-electron bond it needs to supply a small quantity of energy equal to 13.6eV (ionization potential) or it needs that hydrogen atom interacts with other atoms, particularly metals.
It is also known that two hydrogen atoms, that are bound in order to compose a hydrogen molecule, have a greater degree of stability than the single hydrogen atom.
Let us want to examine now a few important physical properties of atom hydrogen.
Let us consider to that end an atom (fig.10) composed of one proton, pole supposed at rest, with electric charge Q=+e, and of one orbital electron with speed v and with electric charge q= -e. Atom is considered with respect to the inertial reference frame, supposed at rest, that has the origin in the centre of the nucleus (system with central symmetry[4][5][6][7]).
The proton generates an electric field

$$\mathbf{E} = \frac{e}{4\pi\varepsilon_o r^2}\,\mathbf{r} \qquad (23)$$

and the Coulomb attractive force **F** on the electron is given by

$$\mathbf{F} = \frac{-e^2}{4\pi\varepsilon_o r^2}\,\mathbf{r} \qquad (24)$$

where **r** is the versor of the axis r (versor=vector with unitary module) and r represents the distance of the electron from the pole.

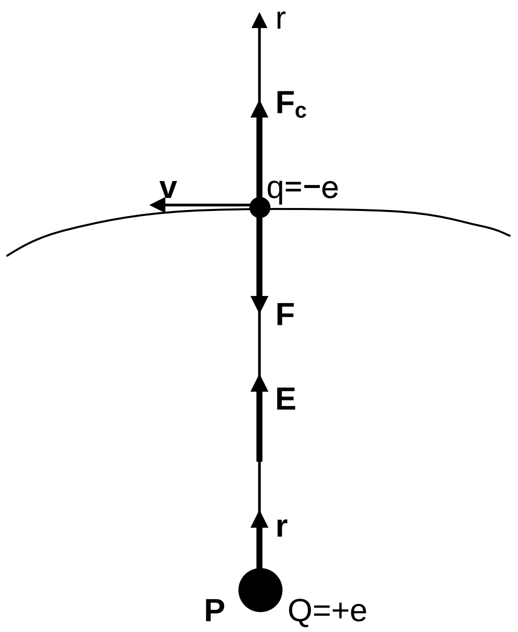

Fig.10 Hydrogen atom

The electron has into the electric field a potential energy $E_p = -\,eV$ where the electric potential V(r) is given by the relation

$$\mathbf{E} = -\frac{dV}{dr}\,\mathbf{r} \qquad (25)$$

In the scalar shape the field $E = -\,dV/dr$ and according to the (23) we have

$$V(r) = \frac{-e}{4\pi\varepsilon_o}\int_{\infty}^{r}\frac{dr}{r^2}$$

$$V(r) = \frac{e}{4\pi\varepsilon_o r} \qquad (26)$$

Consequently the potential energy of the electron is given by

$$E_p(r) = -\frac{e^2}{4\pi\varepsilon_o r} \qquad (27)$$

In the orbital motion the Coulomb attractive force (that acts also as centripetal force) is balanced by the centrifugal force

$$\mathbf{F_c} = m_e \frac{v^2}{r} \mathbf{r} \qquad (28)$$

where m_e is the electrodynamic mass of the electron. From the scalar equality $F=F_c$ we derive the equivalent kinetic energy

$$E_c(r) = \frac{e^2}{8\pi\varepsilon_o r} \qquad (29)$$

for which the total energy E_t of the electron (fig.11) is given by

$$E_t(r) = E_p + E_c = -\frac{e^2}{8\pi\varepsilon_o r} \qquad (30)$$

From the fig.11 we derive the hydrogen atom is a stable system.

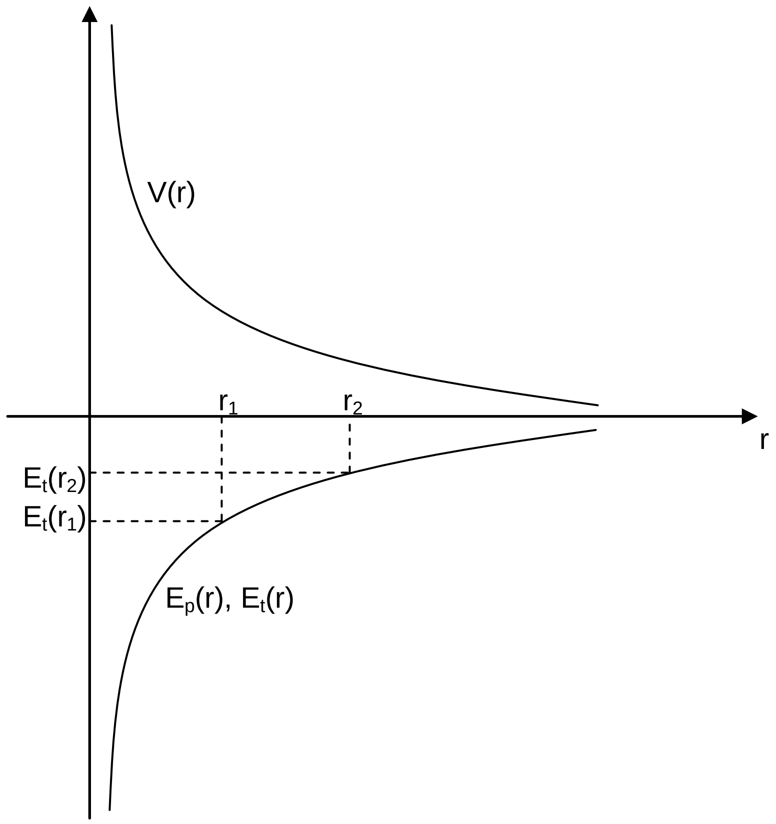

Fig.11 Qualitative graph of the electric potential V(r), of the potential energy $E_p(r)$ and of the total energy $E_t(r)$ relative to the orbital electron in hydrogen atom.

In fact supposing that the electron is for example in the fundamental stable quantum state ($n=1$, $r=r_1$), if it acquires an excess energy in the shape of energy quantum $\Delta E_t=E_t(r_2)-E_t(r_1)>0$, it jumps for instance into the succeeding quantum state characterized by ($n=2$, $r=r_2$), moving away from the nucleus being $r_2>r_1$. This state is unstable relative to the only electron of hydrogen atom because it is characterized by a total energy in excess with respect to the fundamental stable state. On this account, as per the principle of least energy, the electron spontaneously tends to go back to the fundamental stable state expelling the energy absorbed quantum.
This behavior is typical for stable systems that, being at that particular moment into an unstable state, tend to go back to the initial state of stability when the cause of instability ends. Consequently in the considered physico-mathematical model hydrogen atom into the fundamental state is stable in confirmation of what is already known.
Besides the positive work that it is necessary for extracting the electron from hydrogen atom[7] is given by

$$W = \frac{e^2}{4\pi\varepsilon_o r} \qquad (31)$$

where r is the initial distance of the electron from the pole charge.
We have also demonstrated the quantized orbital radius[6] of the electron in hydrogen atom is

$$r = \frac{\varepsilon_o h^2 n^2}{\pi m e^2} \qquad (32)$$

where m is the electrodynamic mass of the electron into the quantum state n.
Combining the (31) and the (32) we have

$$W = \frac{m e^4}{4\varepsilon_o^2 h^2 n^2} \qquad (33)$$

Because the ionization potential of the electron that is into the fundamental quantum state ($n=1$) is equal to 13.6eV, we derive this value is obtained in the (33) only for $m=m_e/2$.
We know electrodynamic mass of moving electron becomes half when its speed is equal to the physical speed of light ($v=c$), consequently we have obtained the important result that the orbital electron, when it is into the fundamental quantum state of hydrogen atom, has the physical speed of light.
If electron moves in radial manner towards the nucleus (fig.12), the speed at the critical distance[7]

$$r_c = \frac{e^2}{4\pi\varepsilon_o m_e c^2} = 2.8 \text{ fm} \qquad (34)$$

is equal to the critical speed $v_c=1{,}41c$ ($1\text{fm}=10^{-15}\text{m}$) .
The distance r_c represents also the radial dimension of nucleus.

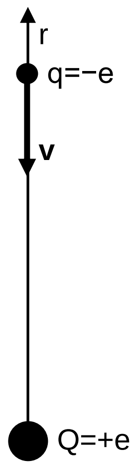

Fig.12 Electron with radial speed into the electrostatic field of proton

5. Physico-mathematical model of antihydrogen atom

Like already we knew, the analysis of the hydrogen atom has shown that into the fundamental quantum state it represents a stable physical system.
Let us want now to consider the antihydrogen atom (fig.13) that is composed of one antiproton $\mathbf{P}^-$, supposed at rest, with negative charge $Q = -e$ and of one orbital positron with positive charge $q=+e$.

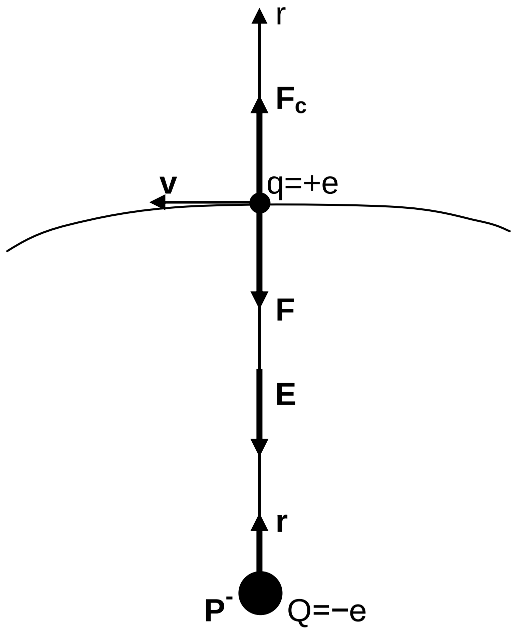

Fig.13 Antihydrogen atom

In that event the Coulomb attractive force **F** on the positron is the same as on the electron into hydrogen atom

$$\mathbf{F} = \frac{-e^2}{4\pi\varepsilon_o r^2}\,\mathbf{r} \qquad (35)$$

The electric field has the same intensity as in hydrogen atom

$$E = \frac{e}{4\pi\varepsilon_o r^2} \qquad (36)$$

but it has opposite direction

$$\mathbf{E} = \frac{-e}{4\pi\varepsilon_o r^2}\,\mathbf{r} \qquad (37)$$

The electric potential V(r) is related to the electric field through the relationship

$$\mathbf{E} = -\frac{dV}{dr}\,\mathbf{r} \qquad (38)$$

Making calculations we derive the electric potential V(r) has the same expression as in hydrogen atom

$$V(r) = \frac{e}{4\pi\varepsilon_o r} \qquad (39)$$

while the potential energy of the positron, given by E_p=eV, is now positive

$$E_p(r) = \frac{e^2}{4\pi\varepsilon_o r} \qquad (40)$$

Therefore in the antihydrogen atom the electric potential is the same as in the hydrogen atom while the potential energy is opposite. Because the kinetic energy is equal in both cases $E_c(r)=e^2/8\pi\varepsilon_o r$, we have for the total energy of the positron in the antihydrogen atom the following expression

$$E_t(r) = E_p + E_c = +\frac{3e^2}{8\pi\varepsilon_o r} \qquad (41)$$

We have derived the total energy $E_t(r)$ in the antihydrogen atom is positive while the same energy is negative in the hydrogen atom.
In fig.14 qualitative graphs of V(r), $E_p(r)$ and $E_t(r)$, are charted.

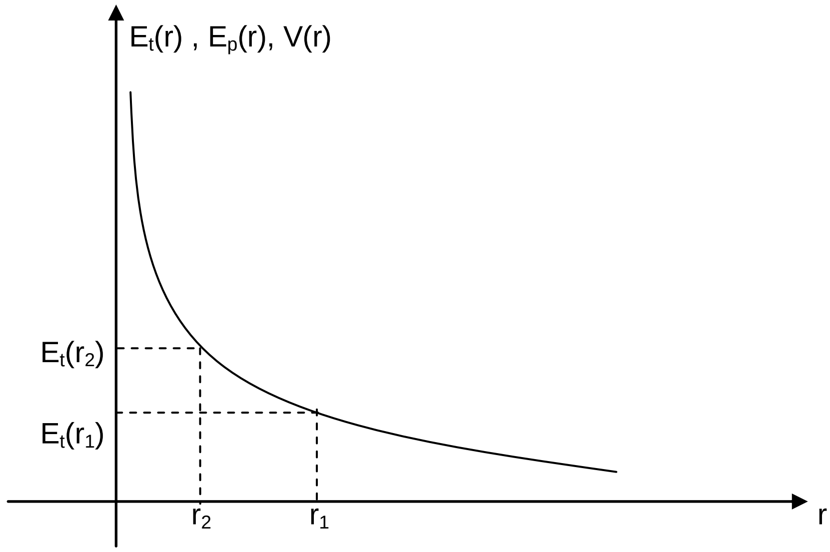

Fig.14 Qualitative graph of the electric potential V(r), of the potential energy $E_p(r)$ and of the total energy $E_t(r)$ relative to the orbital positron in the antihydrogen atom.

We observe antihydrogen atom is greatly unstable because its physical behavior is asymmetrical with respect to hydrogen atom. In fact if the positron, that is for instance into the fundamental quantum state ($n=1$, $r=r_1$), virtually stable, acquires an energy excess in the shape of energy quantum $\Delta E_t = E_t(r_2) - E_t(r_1) > 0$, it tends to near the nucleus (being $r_2 < r_1$), unlike hydrogen atom in which the electron in the same conditions tends instead to go away from the nucleus. That approach to the nucleus involves the positron fall towards itself nucleus, because the positron was for the sake of argument into the quantum fundamental state at least energy. It generates an annihilation of the positron with the antiproton that causes the collapse of the antihydrogen atom, of its components and of the same antimatter with production of energy in the shape of quantum.
The process is described by the annihilation relation

$$P^- + e^+ \longrightarrow E(hf) \qquad (42)$$

in which E(hf) represents the energy quantum that has been produced by the process.
Because the positron mass is smallest with respect to the antiproton mass we can write in first approximation

$$E(hf) \approx m_p\, c^2 = 0{,}938 \text{ GeV} \qquad (43)$$

from wich we derive quantum frequency $f = 2{,}27 \times 10^{23}$Hz belongs to the band of delta-Y frequency of the spectrum of electromagnetic elementary particles[2].
The analysis of the physical behavior of the two dual systems clarifies no doubt the hydrogen atom and consequently matter is stable.
In the antihydrogen atom on the contrary, because of a different behavior of both, the potential energy and the total energy, a strong instability is present in the system that causes both, the collapse of atom by annihilation and instability of antimatter.

This different behavior is the basis of the asymmetry that is present in nature. Antihydrogen atom therefore could be stable only in physical conditions of complete insulation with respect to interactions with matter and energy. It explains why in CERN recent experiments (ALPHA, ATRAP) antihydrogen atoms have been attained with a greater lifetime than with respect to preceding experiments (about 960s, little more than the lifetime of a free neutron): it has been achieved bringing those atoms to low temperature and in the absence of reactive matter. The more the insulation degree is great and the more the temperature is low, the more the instability degree is small.
Through this analysis we have underlined a great difference and a complete asymmetry in the physical behavior of both, hydrogen atom and antihydrogen atom, and therefore in general a complete asymmetry between matter and antimatter that causes the early dissolution of antimatter and an universe composed only of matter at level of non-elementary structures that are at low energy. At high energy instead elementary particles of matter and antimatter tend to remain into the elementary state without generating atom complex structures and therefore they exist practically in the same amount independently of collisions.

6. Principle of Asymmetry

Preceding analyses have underlined a substantial difference relative to the physical behavior of both, hydrogen atom and antihydrogen atom, that explains why in the Universe there is matter and not antimatter. Accordingly a fundamental asymmetry exists in nature at level of atom physical systems.
We have demonstrated this different behavior is due to asymmetrical effects caused by fundamental laws that govern interactions of elementary matter and more precisely the different behavior happens at level of atom structure at low energy. It is due to an asymmetry in the two physical situations with regard to the performance of both, potential energies and total energies, caused by the field force because of the different electric charge of nucleus, even though electric potentials are equal in the two considered cases.
As per these considerations we are able to formulate the following

Principle of Asymmetry:

" Laws of physics show a relation of asymmetry exists with regard to the elementary structure at low energy of the Universe relative to the atom physical state of both, matter and antimatter, and this asymmetry state is determined by a stability criterion".

The asymmetry state in the elementary structure of both, matter and antimatter, therefore isn't present at level of elementary particles, but it is present at a more complex level of matter at low energy where it tends to constitute the atom structure.

As per it we are able now to formulate the following

Criterion of Stability of the Elementary Universe:

" At elementary level at low energy atom matter is stable while atom antimatter is unstable into the force field generated by the nucleus charge. It is due to a different performance, relative to potential energies and total energies, of electrons (in the event of atom matter) and of positrons (in the event of atom antimatter)".

This criterion claims substantially the asymmetry in nature between matter and antimatter fundamentally is due to fields of electric force inside atoms and to different performances of energies with a consequent state of stability for atom matter and a consequent instability state for atom antimatter that causes a collapse of antihydrogen atom.
It justifies completely the predominant presence of matter at low energy in nature and the simultaneous absence of antimatter. In fact if the Principle of Asymmetry wasn't valid, hydrogen atoms and antihydrogen atoms would be present in equal quantity and they would cause a continuous process of annihilation with the total collapse of matter and antimatter. The Principle of Asymmetry is therefore the principle of nature that safeguards the existence of the Universe in the shape of organized matter.
It involves antimatter can exist in nature only in the shape of elementary particles at high energy where matter and antimatter aren't in physical conditions for organizing in the atom complex shape. Because of the Principle of Asymmetry antimatter isn't able to generate in normal physical conditions at low energy stable antimatter like matter. It is confirmed by recent experiments of the ISS (International Space Station) that has noted at high energy antimatter in the elementary state of particles in superior quantity to waitings.

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