

Scientific Hypothesis on the Origin of the Physical Universe

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God has created the nature that human beings search for understanding

Abstract

This paper represents the third essay of the "Trilogy on the Knowable Universe". Here a scientific hypothesis on the origin of the Universe is presented and that hypothesis is described through a succession of stages, in concordance with the Theory of Reference Frames. According to this interpretation the Universe isn't a closed and finite system, as it considered in present prevailing models. The Universe, here supposed, is an unlimited system whose origin is characterized by numerous nanobigbangs in the order of a series of subsequent stages rather than by an unique central explosive bigbang. Because the experimental science can give reliable answers to all questions unless the first question on the origin of the Universe and the last question on its final future, the interpretation of this essay on the origin of the Universe is only a scientific hypothesis that doesn't pretend to represent the truth on the origin of the Universe. Besides this hypothesis is in conflict neither with the religious narration of the Genesis nor with the philosophical speculation.

1. Introduction

I have felt always embarrassment to study in scientific terms the immense question regarding the birth and the end of the Universe, that is related strictly with the history of humanity. First of all because any theory that deals with these two themes cannot be considered a true scientific theory while it is possible for other themes. The scientificity of a theory can be valued as per a few inalienable points that are well described by the famous Galilean scientific method that consists in: 1. observation of experimental data, 2. formulation of an interpretative hypothesis, 3. mathematical "progress" that allows to pass from initial data to mathematically valid conclusions, 4. experimental verification of the mathematical conclusions. At present it would be suitable to add a fifth point that is necessary because of the strong ability of the human being to act and to change the environment: 5. respect of the nature and of humanity. Besides the correct and complete definition of the scientific method involves also experiments have to be reproducible in different places and in different times. It is manifest that the question regarding the birth and the end of the Universe is unable to respect the points 1 and 4 of the experimental scientific method.

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* The other two essays of the Trilogy are the references [1] and [7].

Laboratory simulations can have an interesting meaning in order to contributing to the process of the knowledge but they cannot replace real experiments. With these premises we have decided of formulating a theory on the origin of the Universe in the order of the Theory of Reference Frames. To this theory ourselves don't give meaning of scientific truth but only meaning of theory that is compatible with our reliable scientific knowledges.

In this paper the origin of the Universe is represented through the succession of the following stages:

- a. **Stage zero**
- b. **Initial stage**
- c. **Baryonic stage**
- d. **Leptonic stage**
- e. **Hydrogen stage**
- f. **Matter stage**
- g. **Evolution of the Universe.**

2. **Stage zero**

An **empty geometric space** existed in the beginning, i.e. an Euclidean space without matter ($M_0=0$) and without energy ($E_0=0$). It was representable by a tern of space coordinates (x,y,z) and it was a space without physical properties and consequently without the necessity of the existence of time. This non-physical space with regard to its geometric properties was infinite, infinitesimal and quantum or discrete with respect to the three space coordinates^[1].

It needs to suppose an unknowable instant of the stationary stage zero in which a physical event happened in the geometric Universe that determined the transition from the empty geometric space to the **empty physical space**. It defined too the beginning of an initial stage that determined the birth of physical time and the transition from the stage zero to the initial stage.

As per relativistic equations of transformations space -time^[1] we have already demonstrated the birth of the physical time is strictly connected with the birth of physical mass. Now we want only to specify this primordial and first physical process that has caused the subsequent and gradual development of the Universe till all the aspects that at present we know.

The empty physical space therefore became representable with four $(3+1)$ coordinates (x,y,z,t) because the new coordinate of time was additional to the three space coordinates generating the domain space-time $(3+1)D$.

From a scientific viewpoint we cannot know why that event happened just in that determinate and unknowable instant and not in another: in fact only the birth of time has allowed to fix a before and an after and to represent a time succession of events.

Therefore an inscrutable initial instant $t=0$ is existed in which a physical event happened allowing the transition from the geometric universe (stage zero) to the physical universe (initial stage).

The physical reason of that event is already present in the described condition, i.e. $E_0=0$ that represents the "**quantum zero**" of energy. This quantum isn't the "nothing" but it defines just a pre-physical state with zero energy. In the Non-Standard Model that quantum is a boson.

In the hypothesis that we are describing, the scientific history of the Universe started because, as we know, every quantum of energy fulfills Planck's relation $E=hf$, in which E is the quantum energy, $h=6,63 \times 10^{-34}$ [Joule \times second] is Planck's constant and f is the frequency of the quantum of electromagnetic energy.

The quantum zero of energy is characterized by a frequency zero ($f=0$), by an infinite period ($T=\infty$) and by an infinite wavelength ($\lambda=\infty$) because for all quanta of energy $\lambda f=c$. The quantum zero of energy filled therefore the whole static geometric Universe and the whole history of the Universe until the inscrutable initial instant in which an extraordinary cause has intervened in the history of the Universe for determining the birth of the initial stage through a physical process.

We know the entropy concept S is used for describing thermodynamic transformations of a complex physical system and besides we have defined this concept also in the event of elementary particles^[2].

In the event of complex thermodynamics systems entropy is defined by the relation

$$dS = \frac{dQ}{T} \quad (1)$$

in which dS represents the infinitesimal variation of entropy, dQ the infinitesimal quantity of heat that is absorbed or emitted by the physical system and T is the temperature of system.

For elementary particles the entropy has been defined considering the intrinsic energy E_i in place of heat^[2]:

$$dS = \frac{dE_i}{T} \quad (2)$$

For the Universe we can define the entropy

$$dS = \frac{dE}{T} \quad (3)$$

in which E is the energy of the Universe and dE is its variation.

In the stage zero of the Universe, in which energy is zero, we have $E_0=0$, $dE=0$ and $dS=0$. In the stage zero the temperature of the Universe is indeterminate, besides there isn't variation of entropy and therefore also the value of entropy is indeterminate and equal to a conventional value S_{i0} .

3. Initial stage

At the initial instant t_0 of the physical time, an extraordinary cause generated the primordial transformation and the quantum of zero energy converted into a real pair of baryonic particles (proton and antiproton)

$$E_0 \longrightarrow p^+ + p^- \quad (4)$$

This transformation determined the transition from the stage zero stage to the initial stage.

In order to be consistent from a physical viewpoint, the transformation (4) has to fulfil principles of conservation of physics:

- a. mass conservation
- b. charge conservation
- c. spin conservation
- d. energy conservation
- e. momentum conservation

a. mass conservation

Before the primordial transformation mass is zero ($M_o=0$), the principle of conservation involves also after the transformation total mass has to be zero, i.e.

$$M_o = 0 = 0 + 0 \tag{5}$$

It follows that the primordial transformation (4) involves baryonic particles (proton and antiproton) are generated at the critical speed $v_c = \sqrt{2} c$. In fact in the Theory of Reference Frames and in the Non-Standard Model^{[1][3][4][5]} electrodynamic mass of every massive elementary particle, whether leptonic or baryonic, at the critical speed is zero and consequently the relation (5) is respected. Mass conservation isn't an inalienable principle of Contemporary Physics because for instance the electrodynamic mass of massive elementary particles changes with the speed^[1] but in the order of the primordial transformation the mass conservation is respected.

b. charge conservation

The initial electric charge is $Q_o=0$, because proton has electric charge +1 and antiproton -1, the conservation of electric charge is respected because it is zero also after the transformation

$$Q_o = 0 = + 1 - 1 \tag{6}$$

c. spin conservation

In the NSM proton has spin $+\hbar/2$ and antiproton has spin $-\hbar/2$. Before the transformation, for the Theorem of Charge and Spin^[6], the quantum zero of energy has spin $s_o=0$ because of its zero primordial charge. It follows that also spin conservation is respected. In fact

$$s_o = 0 = +\frac{\hbar}{2} - \frac{\hbar}{2} \tag{7}$$

d. energy conservation

Before the primordial transformation total energy is zero ($E_o=0$) and therefore also after the transformation the total energy of the two particles generated has to be zero.

Because at the critical speed mass m_p of every baryonic particle is zero, it follows that also the intrinsic energy of every particle $E_i=m_p c^2$ is zero at that speed for which the principle of conservation of energy is respected before and after the transformation

$$E_o = 0 = E_i + E_i = 0 + 0 \quad (8)$$

Consequently also the Principle of Energy Conservation requires that the two baryonic particles must have necessarily the critical speed on the generation in the primordial transformation.

e. momentum conservation

Momentum \mathbf{p}_o before the transformation is zero, in fact because $E_o= hf=0$, momentum of the quantum zero is $\mathbf{p}_o=h/\lambda=0$ being $\lambda=\infty$.

After the transformation the two baryonic particles have momentum

$$\begin{aligned} \mathbf{p}^+ &= m_p \mathbf{v}_c^+ \\ \mathbf{p}^- &= m_p \mathbf{v}_c^- \end{aligned} \quad (9)$$

in which $\mathbf{v}_c^+ = \mathbf{v}_c^-$ is the critical velocity of the two particles. Because mass of both particles is zero on the generation, we have

$$\mathbf{p}^+ = \mathbf{p}^- = 0 \quad (10)$$

Consequently the principle of conservation of momentum is respected during the process of transformation being

$$\mathbf{p}_o = 0 = \mathbf{p}^+ + \mathbf{p}^- = 0 + 0 \quad (11)$$

Because for elementary particles entropy is also given by^[2]

$$S = S_{io} \left(1 + \ln \left| 1 - \frac{v^2}{2c^2} \right| \right) \quad (12)$$

it follows that at the initial stage ($v=v_c=\sqrt{2}c$) the entropy is infinite ($S= -\infty$). This value of entropy involves at the initial stage temperature Kelvin is $T=0K$ ^[2].

The transition from the stage zero to the initial stage is characterized by a decrease of entropy and consequently by a decrease of the disorder.

4. Baryonic stage

The primordial transformation of the quantum zero of energy generated two baryonic particles (1 proton and 1 antiproton) that on the generation have the critical speed $v_c=\sqrt{2} c$, electrodynamic mass zero, energy zero, electric charge respectively +1 and - 1, spin $+\hbar/2$ and $-\hbar/2$.

As we know by the theory^{[3][4][5][6]} of electrodynamic particles, these two particles at the critical speed are into an instability state, or better on the limit between the stability state and the instability state and therefore however unstable. Two particles consequently tend to pass to a stability state, as per the Principle of Decay^[4], according to two parallel processes of decay

$$\begin{aligned} p^+(v_c) &\longrightarrow p^+(0) + \delta \\ p^-(v_c) &\longrightarrow p^-(0) + \delta \end{aligned} \quad (13)$$

As per the (13), the two unstable primordial baryonic particles are transformed into two stable particles (proton and antiproton), practically at rest or at lowest speed, with emission of two quanta of energy δ . Because at rest the two baryonic particles have a mass $m_{p_0}=938,25\text{MeV}/c^2$ it is possible to calculate the frequency of the two quanta of energy

$$f = \frac{m_{p_0} c^2}{h} = 2,26 \times 10^{23} \text{Hz} \quad (14)$$

The two quanta of energy belong therefore to the band delta-Y^[5]. The decay process of the two baryonic particles involves a decrease of the speed and a variation of electrodynamic mass from the value zero to the resting value m_{p_0} where the speed is practically zero (fig.1).

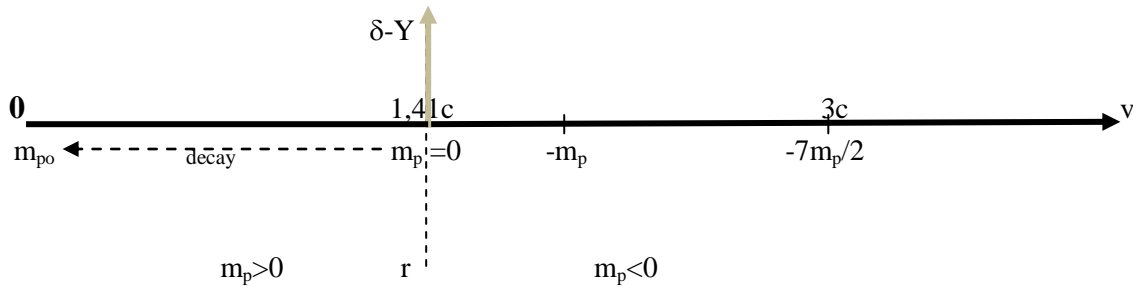


Fig.1 Graph relating to the behaviour of the proton at the critical speed. The r dotted line separates the stable behaviour of the proton (left) from the unstable behaviour (right). The quantum emitted during the decay belongs to the band delta-Y. The same behaviour is valid also for antiproton.

In this baryonic stage, immediately subsequent to the "initial stage", momentums of the two massive particles are zero or little different from zero. The conservation principle of momentum is in any case respected, in fact if speeds are zero the two momentums are zero and if speeds are smallest they are equal and opposite, so that the final total momentum is always zero (fig.2)

$$\begin{aligned} \mathbf{p}^+ &= m_{p_0} \mathbf{v}^+ \\ \mathbf{p}^- &= m_{p_0} \mathbf{v}^- \end{aligned} \quad (15)$$

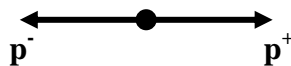


Fig.2 Because initial momentums of the two particles are zero because of zero masses, also after the transformation of decay the total momentum of the two particles must be equal to zero.

In this stage of the process of birth of the Universe, the physical space is filled by 1 proton, 1 antiproton both practically at rest, and by two quanta of energy, everyone with energy $E_p=0,938\text{GeV}$, that belong to the band $\delta\text{-Y}$.

In the baryonic stage, after the decay process, the two baryonic particles are characterized by smallest speed and in these conditions entropy of every baryonic particle is equal to S_{i0} . This value of entropy for every particle is derived from the relation (12) for $v=0$. Similarly the intrinsic entropy of every quantum of energy at the physical speed c of light is $0.3S_{i0}$ for which the total entropy of the Universe in the baryonic stage is $S_t=2.6S_{i0}$.

Every quantum of energy $\delta\text{-Y}$ doesn't have sufficient energy to generate, through a process of materialization, a pair proton-antiproton at low speed, but they have instead sufficient energy to generate a leptonic pair electron-positron.

5. Leptonic stage

At the end of the baryonic stage in the physical Universe, besides proton and antiproton, there are two quanta of energy $\delta\text{-Y}$, everybody with energy $E_p=0.938\text{GeV}$. For both quanta we can suppose a process of leptonic materialization (i.e. production of a pair of leptonic massive particles) because both quanta fulfil the physical condition^{[7][8]} that is necessary because it can happen

$$E_p \geq 1,02 \text{ MeV} \tag{16}$$

The process of materialization of every quantum is described by the following relation of leptonic transformation (fig.3)

$$E_p \longrightarrow e^- + e^+ + E_l \tag{17}$$

where E_l represents energy in excess with respect to the process of materialization.

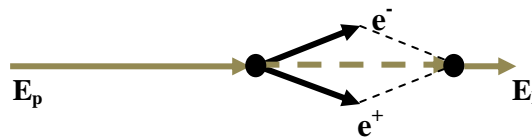


Fig.3 Feynman diagram of materialization of the $\delta\text{-Y}$ quantum into two leptonic particles

This process of leptonic transformation can happen also by intermediate phases, passing for instance through particles μ , but final products are always those that are described by the (17). Supposing that the two leptons are at low velocity, the quantum E_l has a content of energy

$$E_l = (938,25 - 1,02) \text{ MeV} = 937,23 \text{ MeV} \tag{18}$$

that is practically equal to E_p .

At the end of the leptonic stage the primordial Universe is composed of 1 proton, 1 antiproton, 2 electrons, 2 positrons and two quanta that belong still to the band δ -Y. The total entropy of the Universe in the leptonic stage is $S_t=6.6S_{i0}$. With respect to the baryonic stage the entropy and the disorder increase.

6. Hydrogen stage

The first process of formation of complex matter happened in the simplest shape: the hydrogen atom. The proton and 1 electron bind to constitute just one stable hydrogen atom H (fig.4).

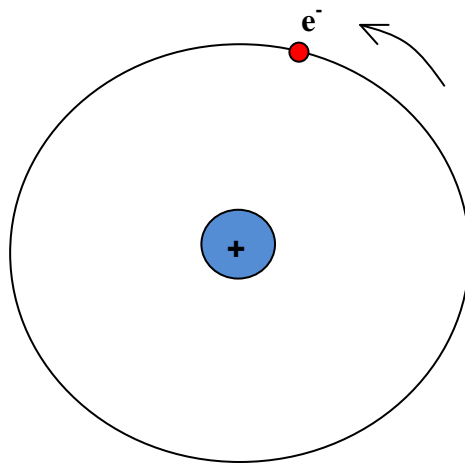
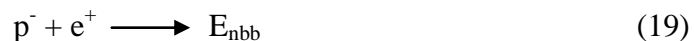


Fig.4 Formation of the first hydrogen atom H in the primordial Universe

Stability of the complex system constituted by hydrogen atom is caused by the exact balancing between the force of electrostatic attraction, due to electric fields generated by electric charges of proton and of electron, and the centrifugal force produced by electron motion around proton that represents the nucleus of system^[7].

Also the antiproton and one positron would tend to bind for constituting one antihydrogen atom AH of antimatter because of the force of electrostatic attraction between the two opposite charges. We have proved^[7] nevertheless this complex system is unstable and it causes the subsequent annihilation antiproton-positron that generates the first **nano-bigbang** of the history of the Universe. This process of collision with annihilation happens with the release of a great quantity of energy on microphysical scale



in which E_{nbb} is an energy quantum that embraces both, the resting energy of antiproton equal to 938,25MeV and the resting energy of the positron equal to 0,511MeV, but above all it contains also the greatest kinetic energy acquired by the two particles inside the attractive field.

We can suppose that the energy produced by the first nano-bigbang of the Universe is at least equal to 1.88GeV and therefore

$$E_{nbb} \geq 1.88 \text{ GeV} \quad (20)$$

In this stage the first atom of matter (hydrogen atom) forms while for the Principle of Asimmetry^[7] and for reasons of instability the first atom of antimatter (antihydrogen atom) annihilates and disappears from the primordial Universe generating a great quantity of energy on microphysical scale. This is the reason because in the present Universe at low energy there is matter but there isn't antimatter.

With regard to the entropy of the Universe in the hydrogen stage it decreases with respect to the entropy in the leptonic stage because the formation of the hydrogen atom involves a decrease of the disorder of the hydrogen atom with respect to the two free particles (i.e. proton and electron).

We can suppose that the entropy of the hydrogen atom is smaller than $2S_{i0}$. In the hydrogen stage the primordial Universe is composed of 1 hydrogen atom H, of 1 electron, of 1 positron and of three quanta of energy δ -Y. It follows that the total entropy of the Universe in the hydrogen stage is $S_t < 4.9S_{i0}$. In the hydrogen stage the total entropy is smaller than the total entropy into the leptonic stage because the Universe passing from the leptonic stage to the hydrogen stage is into a state of smaller disorder.

7. Matter stage

At this point of the evolution of the primordial Universe the following physical realities exist:

1 hydrogen atom H, 1 electron, 1 positron and 3 energy quanta belonging to the band δ -Y.

About the three energy quanta, 2 quanta E_1 have kinetic energy of about 938MeV and the third quantum E_{nbb} has a greater energy than 1.88GeV.

The third quantum is able to generate through a materialization process a pair proton-antiproton^{[5][7]}



while everybody of the two quanta E_1 generates a pair electron-positron



The process of birth of the physical Universe is sparked off and from then onwards fundamental processes of production of energy and matter recur, with similar modalities to those already described in the preceding stages, until the formation of the present Universe through the gradual formation of complex nuclei, of chemical elements, of the composed matter, of simple bodies, of stellar systems and of galaxies.

It needs to clarify again this process of birth and of evolution of the primordial Universe till to the present Universe, in the scientific hypothesis here represented, initiated from the primordial transformation, defined by the relation (4). This first physical process was generated by an inscrutable and extraordinary cause whose it is hardest, from a scientific viewpoint, to define the initial instant of time and the objective nature.

A graph representation of the birth of the Universe through the six stages, from the stage zero to the matter stage is given in fig.5.

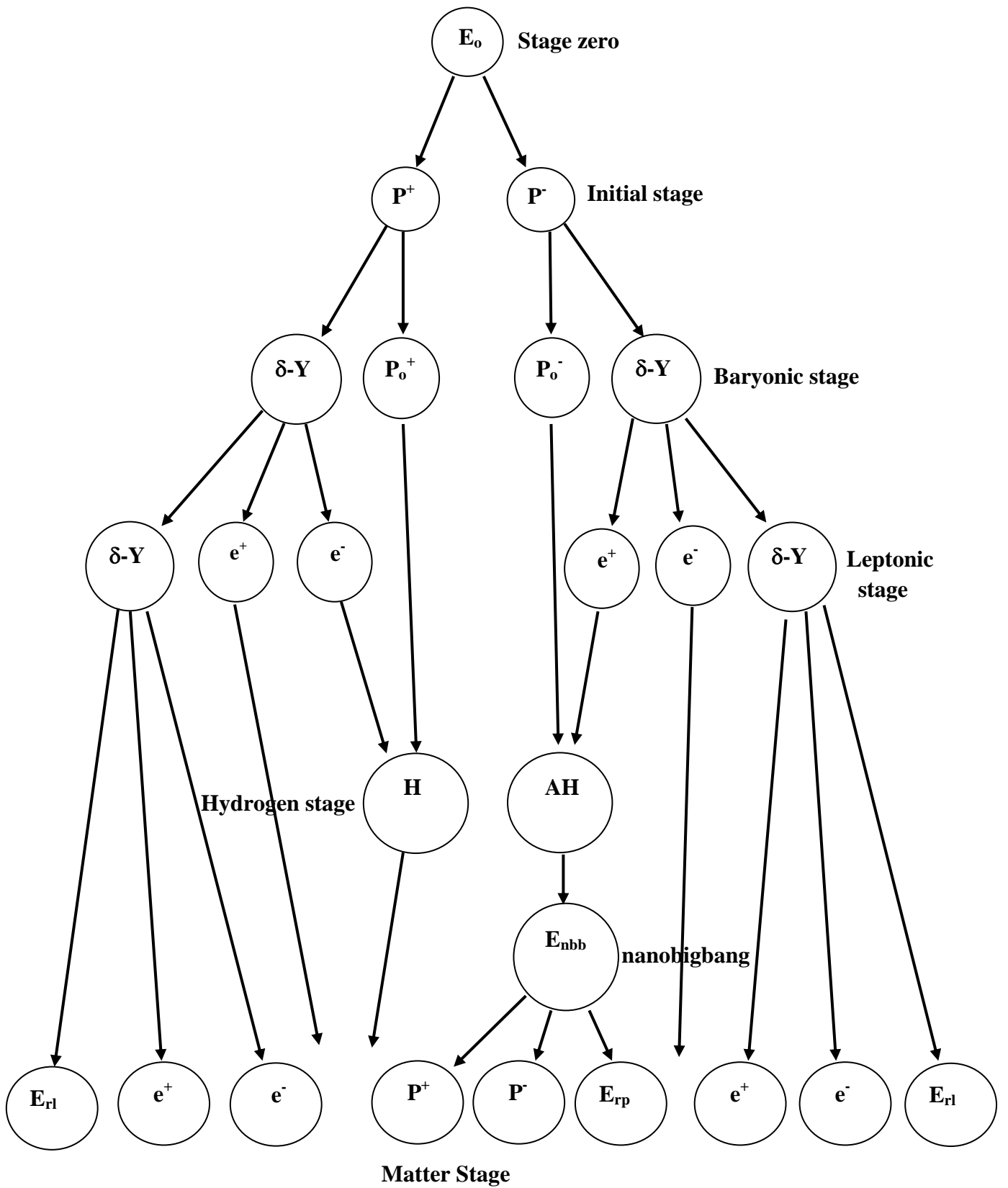


Fig.5 Graph representation of the history of the Universe from the stage zero to the matter stage

In concordance with "The scientific hypothesis on the origin of the physical Universe", here developed, the birth of the Universe didn't start from an unique sweeping big-bang in a singular point of the space-time but from subsequent nano big-bangs in so many different points of the space that still today continue and that are described by relations (19), (21) e (22).

All this happened in space and time and fundamental laws of physics became effective in parallel with the gradual origin of the universe without the possibility of occasional violations in specific points and in specific instants of the hystory of the Universe.

In the matter stage the primordial Universe is composed of 1 hydrogen atom H, 1 proton, 1 antiproton, 3 electrons, 3 positrons, 3 energy quanta δ -Y. It follows that the total entropy of the Universe in the matter stage is $4.9S_{io} < S_t < 10.9S_{io}$. In the matter stage the total entropy is greater than in the hydrogen state and therefore the disorder of the Universe began to increase again.

8. Stage of the evolution of the Universe

The passage from the primordial Universe to the present Universe is happened gradually stage by stage. The free proton and one of free electrons that are present in the matter stage are able to generate a second hydrogen atom. The antiproton and one positron can generate a new nano-bigbang through a process of annihilation according to the relation (19), with the production of a new quantum E_{nbb} . The two residual electrons and the two residual positrons can generate two similar processes of annihilation



The quanta δ -Y can generate pairs electron-positron according to the relations (17) and (22) and new pairs proton-antiproton according to the relation (21) when the quantum has a greater energy than 1.88GeV. The simultaneous presence of two protons and of one electron is able to generate the first ion of deuterium and hence the first neutron that is bound inside a deuteron^[6].

Like this the evolution of the Universe started according to the scientific hypothesis here developed that, as we have said time and time again, makes no pretence to represent the effective truth.

Anyway this scientific hypothesis is characterized by the unknowability of the cause that has determined the transition from the stage zero to the initial stage of the Universe in an unknowable instant of time. The evolution of the Universe is continued till the formation of the present Universe according to the described stages. In the Theory of Reference Frames the beginning of the physical time is concurring with the birth of mass. As per the hypothesis here developed, the birth of the physical time happened in the initial stage with the generation of the first pair of baryonic massive particles proton-antiproton, according to the relation (4).

Transformations space-time in the Theory of Reference Frames are represented by following relations^{[1][9]}

$$P[x,y,z,t] = P'[x',y',z,t'] + \int_0^t \mathbf{v} dt \quad (24)$$

$$dt = \frac{m}{m'} dt'$$

in which \mathbf{P}' represents a fixed point inside the moving reference frame $S'[O',x',y',z',t']$, that has vector velocity $\mathbf{v}[v_x, v_y, v_z]$ with respect to the reference frame supposed at rest $S[O,x,y,z,t]$. \mathbf{P} represents the same point with respect to S ; m and m' represent masses of a massive system with respect to S and S' respectively.

The second of (24) proves it is possible the existence of different times t and t' with respect to the two reference frames (and therefore a relativistic effect of time), but that effect is connected with a difference of mass between the two reference frames, and consequently with a particular and local physical phenomenon, and it isn't connected with a purely kinematic modification of space-time. We have demonstrated too it cannot happen for ordinary massive bodies and for electromagnetic radiations: consequently for mechanical, electromagnetic and optical phenomena it is always $t'=t$.

The question has significance instead in particle physics where electrodynamic massive particles have an electrodynamic mass that changes with the speed according to the following relation

$$m = m' \left(1 - \frac{v^2}{2c^2} \right) \quad (25)$$

and consequently for time, as per the second of (24) for constant speed v ,

$$t = t' \left(1 - \frac{v^2}{2c^2} \right) \quad (26)$$

in which t' is time with respect to S' and t is time with respect to S .

Our scientific hypothesis on the origin of the Universe proves the Universe didn't begin from an unique immense explosive mega-bigbang but from a succession of stages and from so many subsequent nano-bigbangs, in increasing number as that the evolution of the Universe proceeded^[10].

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