The cosmological consequences for the hypothesis of the birth from vacuum of the complexes of particles possessing positive and negative masses

Ya.P. Terletsky

Dept. Theor. Phys.
Peoples' Friendship University, Moscow 117302

The most popular cosmological model of the Universe, the Big Bang model, contains an irremovable singularity, which means the existence of the absolute origin of the Universe in time, when it had been entirely consentrated in one point. In other words, the moment of "creation" is admitted, while the idea of its everlasting existence is rejected [1]. The alternative models of the stationary Universe (F. Hoyle, H. Bondi, T. Gold and others) permitting its unlimited existence in time, proceed from the conception of the continuous spontaneous birth of substance, i.e. from "creation of matter". The model of the everlasting, expanding Universe is supported by the hypothesis of the spontaneous birth of atomic nuclei and electrons from vacuum.

Though the model of the ever existing and expanding Universe is rather attractive from the common philosophical point of view, its idea of the "matter creation", i.e. nonconservation of mass, gives rise to the same negative attitude as the presence of the "creation" moment of the Universe in the Big Bang model.

It is easy to see that the hypothesis of the existence of substance with negative mass together with the ordinary substance of positive mass [2,3] can replace the hypothesis of "matter creation". If the particles of negative mass (negatons) are admitted, then jointly with the ordinary particles of the positive mass (positons), the reactions of birth from the pure vacuum (i.e. from nothing) of the groups of four particles ("quadrigs") containing a pair of positons and a pair of negatons are also permitted. If, for instance, in initially empty space the positon proton-electron pairs and the corresponding negaton pairs are being born spontaneously, then the arising hydrogen will be gathering into the accumulations (stars, galaxes and so on), while the combinations formed by the negaton pairs will be pushing away, homogeneously filling space (the negatons, according to Newton's law, attract each other, but at the same time they accelerate in the opposite direction, so that they practically repulse). Therefore, the continuous birth of the (positon) substance is possible together with the dispersed negaton substance of negative mass, the total mass of the Universe always being equal to zero, in contradiction with the previous models of stationary Universe.

The process of the birth of two pairs of positons and negatons from the pure vacuum without energy and momentum is kineticly possible because the pair of positons moving apart in the opposite directions and possessing total zero momentum, can have energy which is compensated by the negative energy of the pair of negatons moving apart from the same point. The creation of a greater number of positon and negaton pairs is also kineticly permitted ; at the same time the creation of a pair consisting of a positon and a negaton moving apart is impossible, because in this case momentum appears (i.e. the vacuum must possess nonzero momentum).

The possible existence of negatons is contained in the nonlinear field theory of elementary particles [2], which treats elementary particles as the particle-like (regular, solitonic) solutions of the nonlinear equations of the complex of fields [4,5 and others]. If one considers the most general form of the equations of any fields to be their spinor (Dirac-like)form [6], then any field (including the electromagnetic one) is split into two symmetrical components, one with the positive energy density (the plus-field), and the other with the negative (the minus-field) [2]. Due to the entire symmetry of the plus –and minus– fields, the particle-like solutions will also be symmetrical over main parameters with positive and negative mass (the plus-particles or positons, and minus-particles or negatons).

Thus, we shall consider that there exist either positons, or symmetrical to them, negatons. For example, besides the protons ${}_{+1}\hat{P}^{+}$ and electrons $\hat{e}^{-}$ one has the corresponding negatons, i.e., ${}_{-1}\check{P}_{-}$ and $\check{e}_{+}$. Here we assume the following notation : for a particle, denoted by the symbol A, the signs of the mass M, charges e (for the plus-field) and ε (for the minus-field) and the baryon number B are given according to the scheme

$$ {}_{B}\overset{M}{A}{}^{e}_{\varepsilon} \qquad (1) $$

where the electric charge $e = +, -$; the charge creating the minus-electromagnetic field $\varepsilon = +, -$; the baryon number $B = +1, -1$ the sign of the mass $M = \wedge, \vee,$, i.e. the positive mass is given by the symbol $\wedge$, and the negative by $\vee$. The lepton number is not introduced here.

In a given notation the reaction of birth from vacuum of a positon pair, a proton and an electron, and a negative pair, a minus-proton and a minus-electron, may be written as

$$0 = {}_{+1}\hat{P}^{+} + \hat{e}^{-} + {}_{-1}\check{P}_{-} + \check{e}_{+} \tag{2}$$

and, correspondingly, the reaction of birth of an antiproton and a positron with a respective negaton pair will have the form

$$0 = {}_{-1}\hat{P}^{-} + \hat{e}^{+} + {}_{+1}\check{P}_{+} + \check{e}_{-} \tag{3}$$

It should be specially mentioned that the particles and antiparticles, possessing the opposite baryon and lepton numbers, are born in the reactions independently from each other. Therefore, the absence of antiparticles in the surrounding Universe may be explained by a fortuitous difference in probability of the original running of reactions (2) and (3). With this, there is no need to consider the initial state of vacuum to have some total positive baryon number, as it is considered inevitable in the model of Big Bang.

Certain objections against the possibility of the existence of negatons (see, e.g. [3], p.102) consisting in the fact that the probability of birth from the vacuum of a complex of greater number of particles exceeds the probability of the birth of the lesser number of particles [7], can be overcome if one gives up an idea of the absolute orientation of time (in the reactions (2) and (3) from the left to the right) which is obviously used for the derivation of the above mentioned conclusion [7]. If both directions of time are considered to be equal, i.e. the direction of time is not absolute, but is conditioned by the entropy increase law, then the reactions of disappearance of the complexes of positons and negatons of the type

$${}_{+1}\hat{P}^{+} + \hat{e}^{-} + {}_{-1}\check{P}_{-} + \check{e}_{+} = 0 \tag{4}$$

should be considered as probable as the birth reactions (2). Here the above mentioned objection does not work because the probability of the reaction (2) can be calculated as for the process

$${}_{+1}\hat{P}_{+} + \hat{e}_{-} = {}_{+1}\hat{P}^{+} + \hat{e}^{-} \tag{5}$$

i.e. one can move the negatons to the left-hand side replacing them by the corresponding positons (i.e. changing all the signs of charges and numbers into opposite ones). Then the probability of the colliding positons of the left-hand side can be estimated from the average density of negatons on the right-hand side of (2). In other words, the time arrow for negatons must be considered as directed opposite to the time arrow for positons. The objections do not arise if the Universe is considered symmetrical with respect to the direction of time. And such a symmetry in time is natural for a Universe which does not have any absolute time origin (singularity).

Therefore, a model of an initially empty Universe is possible with a null average energy, null total mass, without any total charge, or baryon and lepton numbers, in which at certain period the positon and negaton pairs appear according, for example, to the reaction (2). The hydrogen atoms, emerging from protons and electrons, under the gravitational attraction form all the visual astronomical objects. The simultaneously created negaton atoms fill the whole space homogeneously in average (with an average density of substance in the Universe). Nevertheless, the large accumulations of positons (stars, galaxies) will attract the dispersed negatons (according to Newton's law, the negatons pull away from the accumulations of positons, but, having a negative inertial mass, they accelerate in the opposite direction, i.e. practically attracted). Thus, the negatons will shield the attraction of large astronomical objects. If one considers a negative temperature of negatons, at which they are in equilibrium, to be equal $-3°K$, then, according to [3,8,9], the gravitational shield must take place (similar to the Debye one in electrolytes) with a radius of the order $10^{22}cm$, which easily explains the structural peculiarities of the spiral and interacting galaxies [8,9].

Therefore, we have substantiated the process of the continuous replenishment of the Universe with the positons and negatons, leading to a scenario similar to that of the continuous creation of matter, without the hypothesis of the breaking of energy and momentum conservation. There remains to understand why until now the negatons have not been discovered. The reasons for that are the following : 1) there are vey few free negatons in the surrounding space, their concentration being of the order of the average concentration of positon matter in the Universe ; 2) the process of the formation of negatons is spontaneous and uncontrollable ; and 3) the discovery of negatons according to an ordinary scheme of detecting elementary particles, i.e. their absorption with the release of energy, is impossible, since the negatons carry a negative energy, so that their absorption means that energy is being taken away from the detector and not given to it.

Let us mention lastly, that according to the proposed scenario of the formation of the visual Universe, it looks rather similar to a real gas near the critical state, when large inhomogeneities of a fluctuational nature appear. We already noticed such an analogy in the work of 1963 [10], in which, however, the negatons were not introduced, and where it was considered a priori that Newton's gravitational law should be replaced by Ukawa's law equivalent to the presence of the gravitational shield.

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