Why there is no symmetry in physical vacuum between the overall number of particles and twin antiparticles

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Physical vacuum can be seen as a turbulent ideal fluid. Particles of matter originate from primordial inclusion in the fluid of the empty space. The proton is modeled by a hollow bubble stabilized due to positive perturbation of the averaged turbulence energy and accompanying drop of the pressure on the wall of the cavity.

The antiproton can be created only in the pair with the proton: extracting from the medium a ball V of the fluid and inserting it into another place of the medium. The intrusion into the medium of the redundant void thus performed is concerned with a huge amount of the energy p_0V needed in order to expand the fluid by the volume V against the background pressure p_0. Still, because of the free energy of the system tendency to decrease, the redundant void will be shortly canceled to the continuum.

Creation of the electron−positron pair requires a relatively small energy $\sim p_0\Delta V$, where $\Delta V \ll V$, which is the work of the elastic deformation of the turbulent medium. The resulting radial stress arising in the turbulent fluid corresponds to the electric field of the elementary charge. The system can be stabilized merging the small cavity ΔV of the positron with the large bubble V of a neutron.

Thus, the total number of protons turns out to be equal to total number of electrons, where, being a void, the proton should be classified as particle, and, being an islet of the fluid, the electron should be classified as antiparticle.

Keywords: physical vacuum, turbulent fluid, cavities, particles, antiparticles

Recently Troshkin has shown [1] that small perturbations of the averaged turbulence of the ideal fluid obey to the chain of linear equations which, with a reasonable closure, appear to be isomorphic to Maxwell's equations. This finding enabled me to construct a mesoscopic mechanical model of elementary particles [2]. The model assumes physical vacuum to be a turbulent ideal fluid and particles of matter concerned with voids intrinsic in the aether.

1. PHYSICAL VACUUM AS A TURBULENT IDEAL FLUID

Mesoscopically, a turbulent ideal fluid is described in terms of the averaged over a short time interval pressure $\langle p\rangle$, fluid velocity $\langle \mathbf{u}\rangle$ and cross moments of their fluctuations $\mathbf{u}'$ and p', where $\mathbf{u} = \langle \mathbf{u}\rangle + \mathbf{u}'$ and $p = \langle p\rangle + p'$. We suppose here that for stationary perturbations of the homogeneous turbulence other moments except $\langle u_i'u_k'\rangle$ are vanishing or insignificant. The background turbulence is characterized by the values $\langle p\rangle_0 = p_0$, $\langle \mathbf{u}\rangle_0 = 0$ and $\langle u_i'u_k'\rangle_0 = c^2\delta_{ik}$ which do not depend on space and time coordinates. From relative magnitudes of experimental masses of the electron and proton we may conclude that physical vacuum is a low pressure and high turbulence energy medium:

$$p_0 \ll \varrho c^2 \tag{1}$$

where $\varrho = \texttt{const}$ is the density of the incompressible fluid (see (B8) in Appendices).

A turbulent ideal fluid behaves on the average as an elastic medium. Linear waves spread in it with the velocity c and perturb only nondiagonal terms of the Reynolds stress tensor $\varrho\langle u_i'u_k'\rangle$ [2]. The following correspondence between the perturbations of the background and electromagnetic fields takes place:

$$\mathbf{A} = \kappa c\langle \mathbf{u}\rangle, \tag{2}$$
$$\varrho\varphi = \kappa(\langle p\rangle - \langle p\rangle_0), \tag{3}$$
$$E_i = \kappa\partial_k\langle u_i'u_k'\rangle \tag{4}$$

where κ is a dimensional constant, $\partial_k = \partial/\partial x_k,\ i,k = 1,2,3$. Here and further on summation over recurrent index is implied throughout.

So, the turbulent ideal fluid may be taken as a substratum for electrodynamics, and we will take it as a substratum for physics on the whole.

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2. PARTICLES AS VOIDS IN AETHER

Perturbations of diagonal elements of the Reynolds stress tensor $\varrho \langle u_i' u_k' \rangle$ may arise because of the compulsory boundary condition on the walls of the inclusion into the medium of the empty space. The pressure on the wall of a hollow bubble must be vanishing. The drop of the pressure entails a respective positive perturbation of the turbulence energy density $3/2\varrho \langle u_i' u_i' \rangle$, in the stationary case according to the one-dimensional relation

$$\varrho \langle u_1' u_1' \rangle + \langle p \rangle = \varrho c^2 + p_0 \tag{5}$$

which is the analog for the turbulence of the Bernoulli equation. The stabilized due to positive perturbation of the turbulence energy hollow bubble models the proton (see Fig.1).

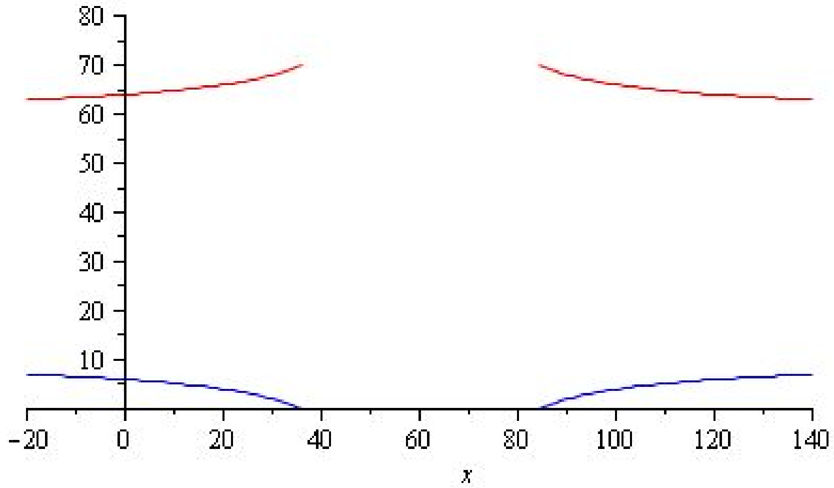

Figure 1: The proton: the equilibrium cavity of the large radius R. The blue line (below) depicts the dependence of the averaged pressure $\langle p \rangle$ on the distance from the center of the cavity, and red line (above) $-$ that of 2/3 of the averaged turbulence energy density, $\varrho \langle u_1' u_1' \rangle$, as it is prescribed by the equation (5). In conventional units $p_0 = 10$ and $\varsigma \langle u_1' u_1' \rangle_0 = \varsigma c^2 = 60$, $R = 24$.

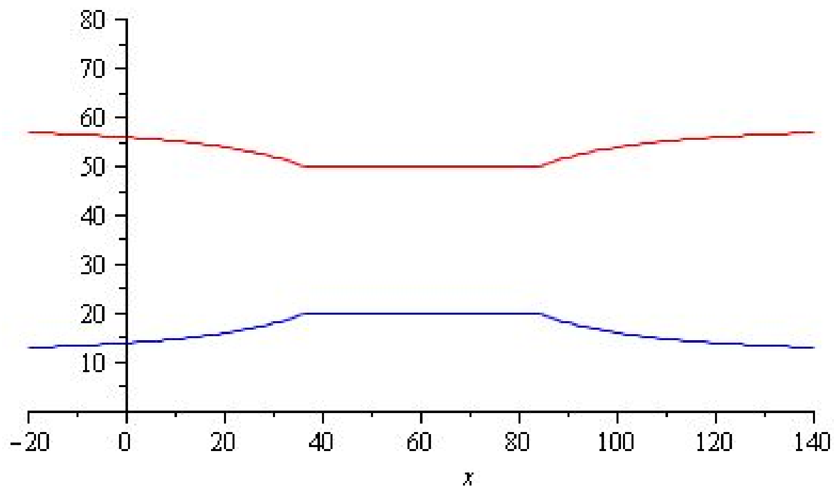

Figure 2: The antiproton: the large isle of the radius R of the turbulent fluid. The blue line (below) depicts the dependence of the averaged pressure $\langle p \rangle$ on the distance from the center of the cavity, and red line (above) $-$ that of 2/3 of the averaged turbulence energy density, $\varrho \langle u_1' u_1' \rangle$, according to relation (5). In conventional units $p_0 = 10$ and $\varsigma \langle u_1' u_1' \rangle_0 = \varsigma c^2 = 60$, $R = 24$.

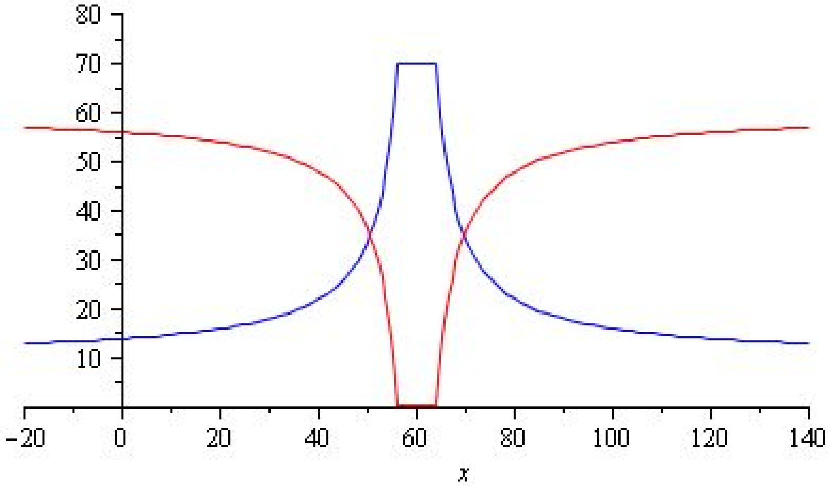

Figure 3: The electron: an islet of quiescent fluid of the radius $r_e \ll R$. The blue line (below) depicts the dependence of the averaged pressure $\langle p \rangle$ on the distance from the center of the cavity, and red line (above) − that of 2/3 of the averaged turbulence energy density, $\varrho \langle u'_1 u'_1 \rangle$, according to relation (5). In conventional units $p_0 = 10$ and $\varsigma \langle u'_1 u'_1 \rangle_0 = \varsigma c^2 = 60$, $r_e = 4$.

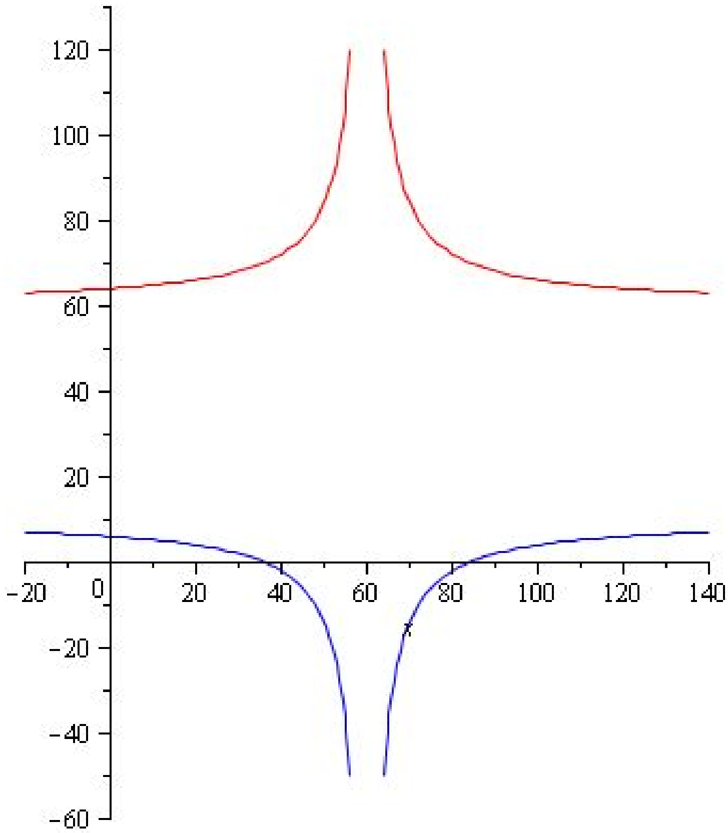

Figure 4: The positron: a hollow cavity of small radius $r_e \ll R$ with negative pressure on the wall. The blue line (below) depicts the dependence of averaged pressure $\langle p \rangle$ on distance from the center of the cavity, and red line (above) − that of 2/3 of averaged turbulence energy density, $\varrho \langle u'_1 u'_1 \rangle$, according to (5). In conventional units $p_0 = 10$ and $\varsigma \langle u'_1 u'_1 \rangle_0 = \varsigma c^2 = 60$, $r_e = 4$.

3. PARTICLES AND ANTIPARTICLES

Let us extract out of the medium a ball of the volume V and insert it into another place of the medium. The cavity thus obtained models the neutron, and the ball intruded models the antineutrion. The cavity can get into equilibrium with the turbulent fluid filling it with the gas formed from the fluid.

The proton (Fig.1) is formed from the neutron condensing the gas in the cavity and perturbing the turbulence energy so that the pressure on the wall drops down to zero, in accord with the relation (5). In order to compensate exactly the positive deviation of the turbulence energy due to boundary condition on the wall of the cavity we must increase the pressure on the surface of the ball intruded (Fig.2). Thus the model of the antiproton will be obtained. As we see, the field perturbations due to the antiproton are opposite to those of the proton, and there is the fluid in the core instead of the empty space.

Because of the tendency to decrease the free energy of the system, the structures shown in Fig.1 and Fig.2 in a direct contact cancel each other into continuum. This process is known as the annihilation of antiparticles.

In reality physical vacuum contains primordial, or inherent inclusions of the empty space, that correspond to neutrons and protons not counterparted by respective antiparticles. The gas bubble modeling the neutron turns after a while into the proton (Fig.1). The resulting positive perturbation of the turbulence energy is compensated, but not exactly, by negative perturbation in the electron (see Fig.3). The excess of the turbulence energy is emitted in the form of the antineutrino [4] according to the equation

$$n = p^+ + e^- + \tilde{\nu}. \tag{6}$$

In the result we obtain the asymmetrical pair proton−electron, where, by this scheme, the electron is an antiparticle, but not the antiparticle of the proton.

The symmetrical pair positron−electron can be obtained in the following imaginable process. Let us extract out the medium a small ball of the volume $\Delta V \ll V$ and insert it into another place of the medium. The pair, small gas bubble plus the small fluid ball intruded, should be properly named as static neutrino and antineutrino, respectively. This system turns into the following pair: a small empty cavity with negative pressure on the wall (Fig.4), which models the positron, and an islet of quiescent fluid (Fig.3), which models the electron. The pair positron−electron annihilates similar to the pair proton−antiproton. However, the system can be stabilized merging the positron with a large cavity of volume V. Thus we will obtain the above indicated hydrogen atom p^+e^-.

4. WHY ANTIPROTONS ARE SO RARE

The mesoscopic model of physical vacuum does not know why the volumes V and ΔV are fixed and unique. Basing on the experimental interrelation $m_e \ll M$ between the mass M of the neutron and mass m_e of the electron, we may conclude only that $\Delta V \ll V$ (see (B6) and (B7) in Appendices).

The creation of the pair proton−antiproton demands a huge energy $p_0 V$ needed in order to expand the cavernous fluid against the background pressure. Creation of the pair positron−electron requires a relatively small energy which has the order of $p_0 \Delta V$. This is the energy of deformation of the elastic medium. In both processes the redundant empty space is formed. But in case of the positron it is small, and the system is stabilized merging the small cavity ΔV of the positron with the large bubble V of a neutron at hand.

In these transformations physical vacuum should be viewed properly as an elastic-plastic medium, so that it may experience two regimes of behavior. When creating electrical charges, the system expands remaining in the elastic domain. In order to produce the neutron−antineutron pair we must overcome the threshold of fluidity in expansion, after which the medium yields to the plastic flow. The process of creating the proton-antiproton pair belongs to both regimes of medium's behavior, as they manifest themselves in the expansion.

5. CONCLUSION

Nucleons exist and persist because they are formed from primordial inclusions of empty space in the physical vacuum. Creation of antinucleons is concerned with intrusion into the medium of redundant or superfluous voids. The surplus voids tend to be filled with the material of the medium returning it to the original state. The redundancy of the empty space associated with particles formed in pair with antiparticles may be the cause why there are no gatherings of antimatter in the universe.

The electron as antiparticle to positron persists because, being a small void, the positron merges with the large bubble of a neutron, thus stabilizing the system.

Appendix A: THE MASS AND THE ENERGY

The neutron is modeled by the equilibrium gas bubble. Its self-energy is given by

$$\mathcal{E} = p_0 V \tag{A1}$$

which is the work needed in order to create in the fluid the inclusion of the volume V. The cavity can be stabilized filling it with the gas of the mass M which has the pressure

$$p = p_0 \tag{A2}$$

and energy

$$K = \frac{3}{2} M \langle u_i' u_i' \rangle = \frac{3}{2} M c^2. \tag{A3}$$

Supposing the gas to be ideal we have for the state equation

$$pV = \frac{2}{3} K. \tag{A4}$$

Combining equations (A1)-(A4) the relation can be obtain between the self-energy of the cavity and the mass of the equilibrium ideal gas in it

$$\mathcal{E} = M c^2. \tag{A5}$$

This will be the energy-mass relation for mechanical model of the neutron.

Appendix B: HIGH PRESSURE LOW TURBULENCE ENERGY VACUUM

The perturbation of the energy density was shown [3] to depend on the distance from the center as $\sim 1/r$. According to Fig.1 we have for the pressure field of the proton

$$\langle p \rangle = p_0 - \frac{p_0 R}{|\mathbf{x} - \mathbf{x}'|} \tag{B1}$$

where R is the radius of the hollow bubble, and, according to Fig.3, for the turbulence energy density of the electron:

$$\langle u_1' u_1' \rangle = c^2 - \frac{c^2 r_\mathsf{e}}{|\mathbf{x} - \mathbf{x}'|} \tag{B2}$$

where r_e is the radius of the islet of quiescent fluid and $\mathbf{x}'$ the center of the particle's core. The integral of $1/r$ over the space diverges. So that the infinite positive deviation of the turbulence energy should be compensated by its respective negative deviation in other place of the medium. Equating (B1) and (B2) with the account of (5) yields

$$\frac{r_\mathsf{e}}{R} = \frac{p_0}{\varsigma c^2}. \tag{B3}$$

The mass m_e of the electron can be modeled by the mass of the islet of quiescent fluid

$$m_\mathsf{e} = \varsigma \Delta V. \tag{B4}$$

From (A2)-(A4) we have $p_0 V = M c^2$. Using the latter and (B4) in (B3):

$$\frac{r_\mathsf{e}}{R} = \frac{M \Delta V}{m_\mathsf{e} V} \tag{B5}$$

where M is the mass of the neutron. Taking in (B5)

$$V \approx \frac{4}{3}\pi R^3, \quad \Delta V = \frac{4}{3}\pi r_\mathsf{e}^3 \tag{B6}$$

gives

$$\frac{r_\mathsf{e}}{R} \approx \sqrt{\frac{m_\mathsf{e}}{M}}. \tag{B7}$$

From the experimental relation $m_\mathsf{e} \ll M$ and (B7) with (B3) we come to the high energy low pressure vacuum (1)

$$p_0 \ll \varrho c^2. \tag{B8}$$

Appendix C: THE ELECTRIC CHARGE

The work $\mathcal{E}$ done against an external perturbation field $\langle p\rangle - p_0$, when expanding, $\Delta V > 0$, or contracting, $\Delta V < 0$, the cavernous medium, is given by

$$\mathcal{E} = (\langle p\rangle - p_0)\Delta V. \tag{C1}$$

This means that the islet of quiescent fluid, ΔV, will repulse, $\mathcal{E} > 0$, other islet of quiescent fluid, $\langle p\rangle - p_0 > 0$ (Fig.3). And it will attract, $\mathcal{E} < 0$, the stabilized empty cavity, $\langle p\rangle - p_0 < 0$ (Fig.1 or Fig.4).

Using in (C1) the definition (3) of the scalar potential φ gives

$$\mathcal{E} = \varphi\frac{\varsigma\Delta V}{\kappa}. \tag{C2}$$

Comparing (C2) with the expression of the electrostatic energy φq we obtain for the electric charge

$$q = \frac{\varsigma\Delta V}{\kappa} \tag{C3}$$

where $\kappa < 0$. Using in (C3) the definition of the mass m_{e} of the electron (B4) gives for the charge e of the electron

$$e = \frac{m_{\mathsf{e}}}{\kappa}. \tag{C4}$$

The particle definition (C3) of the electric charge must agree with its field definition. By (B2) with the account of (4), the field definition of the electric charge for the electron reads

$$e = \kappa c^2 r_{\mathsf{e}}. \tag{C5}$$

Excluding the dimensional coefficient κ from the particle (C4) and field (C5) definitions of the charge of the electron we obtain a relation between the charge and mass and the size of the electron

$$e^2 = r_{\mathsf{e}} m_{\mathsf{e}} c^2. \tag{C6}$$

Appendix D: THE SELF-ENERGY OF THE ELECTRON

The self-energy of the electron consists of two parts, the electric energy and the elastic energy. Using (C6) we find for the electromagnetic part of the self-energy

$$\mathcal{E}_{\mathtt{electr}} = \frac{1}{2}\frac{e^2}{r_{\mathsf{e}}} = \frac{1}{2}m_{\mathsf{e}}c^2. \tag{D1}$$

Take notice that here electromagnetic energy is not some extraneous entity but a mechanical integral of motion [3]. It will be shown elsewhere that this integral can be considered on equal footing with the elastic energy of the discontinuity. The elastic energy is given by (see Fig.3)

$$\mathcal{E}_{\mathsf{elast}} = \frac{1}{2}(p_{\mathsf{max}} - p_0)\Delta V = \frac{1}{2}\varsigma c^2\Delta V = \frac{1}{2}m_{\mathsf{e}}c^2 \tag{D2}$$

where (B4) was used. Summing (D1) and (D2) yields the whole self-energy of the electron

$$\mathcal{E}_{\mathsf{e}} = \mathcal{E}_{\mathsf{electr}} + \mathcal{E}_{\mathsf{elast}} = m_{\mathsf{e}}c^2. \tag{D3}$$

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