A possible explanation for the results of some experiments with LENR

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I. INTRODUCTION

Experimental results directly confirmed by spectral methods [1], have revealed the presence of transmutation of chemical elements with the release of additional heat without detection of conventional products of nuclear fusion (tritium, helium-3 and helium-4, thermal neutrons, gamma rays). The results of transmutation can be very good explained in the proposal of formation of cold neutrons in the conditions of these experiments [2]. This indicates the existence of non-conventional mechanism of occurring of low energy nuclear reactions (LENR).

One possible explanation of processes occurring in the experiments [1,2] is offered in the given paper. It is based on the ether theory of elementary particles, developed in the company «New Inflow». The mathematical model of ether was proposed by the author in [3-9] in the form of dense nonviscous compressible medium in three-dimensional Euclidean space with coordinates $\vec{r} = (x, y, z)^T$, having at each time t the density $\rho(\vec{r},t)$ and the velocity vector $\vec{u}(\vec{r},t) = (u_1(\vec{r},t), u_2(\vec{r},t), u_3(\vec{r},t))^T$ of propagation of small perturbations of the density. It was proposed to describe the dynamics of the ether by two nonlinear equations

$$\frac{\partial \rho}{\partial t} + div(\rho \vec{u}) = 0, \; \frac{d(\rho \vec{u})}{dt} = \frac{\partial(\rho \vec{u})}{\partial t} + (\vec{u} \cdot \nabla)(\rho \vec{u}) = 0, \qquad (1)$$

where the first equation is the continuity equation, and the second - the momentum conservation law of ether. These equations follow from the classical mechanics of Newton and are invariant under Galilean transformations.

In [3-6] the equations of Maxwell and Dirac, the laws of Coulomb and Biot-Savart-Laplace were derived from the system of equations (1). The correction of Ampere's law was found, which is valid not only for parallel, but also for perpendicular currents. The basic formulas of quantum mechanics, the formulas for magnetic induction and for intensities of electric and magnetic fields of an element of the current were obtained, the appearance of an electromotive force in the conductor, the forces of Ampere and Lorentz were explained from the standpoint of classical mechanics. There were found not only the well known values of the energy levels of the excited states of the hydrogen atom, which coincide with the experimental values, but also new stable nonradiative hydrinos states of the hydrogen atom, that can not be described by the Schrödinger equation [7]. In [8] it was shown that the dimensions of all physical quantities determined from the system of ether equations (1) coincide with the dimensions of these quantities in the CGS system. In [9] the mathematical models of electron and proton were constructed in the form of wave solutions of the nonlinear system of ether equations (1). The definitions and formulas for calculating of their charge, energy, mass and magnetic moments were given. Numerical values of the magnetic moments were almost exactly the same as the experimental so-called "anomalous" values.

II. PROTON, ELECTRON AND NEUTRON STRUCTURES

As follows from [9], the electron and proton are spherical wave solutions of nonlinear ether equations having Compton radius. That is they are the balls of radius r_0, within which along each parallel (circle of radius $r \sin\theta$, $r \le r_0$) as a result of small radial oscillations of the ether density the waves propagate around the axis z along the angle φ with constant angular velocity (frequency) $\omega = c/r_0$. These wave solutions $\vec{u} = (V_r, V_\theta, V_\varphi) = (V, 0, W)$ of the system of ether equations (1) have a kind in the stationary spherical system of coordinates

$$V(r,\theta,\varphi,t) \approx \frac{V(\theta)\cos((\omega t - \varphi)/2)}{r}, \qquad \frac{d\varphi}{dt} = \omega, \quad W = \omega r \sin\theta. \qquad (2)$$

Functions $V_e(\theta)$ and $V_p(\theta)$ for an electron (positron) and proton (antiproton) in the formulas (2) have a series expansions on the angle θ:

$$V_e(\theta) = V_0(a + \sin\theta + b\sin 2\theta + c_e \sin 3\theta),$$
$$V_p(\theta) = V_0(a + \sin\theta - b\sin 2\theta + c_p \sin 3\theta),$$

where the constants a, b, c_p, c_e were defined in the paper [9]. Charge density half-waves for proton and electron carrying only positive or only negative charges were defined in [9] as

$$\delta_p(r,\theta,\xi) = \frac{\rho_0\omega_p}{8\pi r^2} V_p(\theta)\sin\xi/2, \qquad 0 \le \xi < 2\pi,$$

$$\delta_e(r,\theta,\xi) = \frac{\rho_0\omega_e}{8\pi r^2} V_e(\theta)\sin\xi/2, \qquad -2\pi \le \xi < 0,$$

The next results were obtain in [9] for charges q, magnetic moments p_m and internal energies ε of electron and proton:

$$|q_e| = |q_p| = \frac{\rho_0 c}{2\pi} V_0 \int_0^\pi (a\sin\theta + \sin^2\theta) d\theta = \frac{\rho_0 c V_q}{2\pi} = \frac{\rho_0 c V_0}{4}(1 + \frac{4a}{\pi}) = q,$$

$$p_{me} = -\frac{4\pi V_{me}}{3V_q}\frac{qc\, r_e}{2} = \beta_e \mu_B, \qquad p_{mp} = \frac{4\pi V_{mp}}{3V_q}\frac{qc\, r_p}{2} = \beta_p \mu_N, \tag{3}$$

$$\varepsilon_e = \pi^2\rho_0^2 c V_\varepsilon \omega_e / 4 = \hbar\omega_e, \quad \varepsilon_p = \pi^2\rho_0^2 c V_\varepsilon \omega_p / 4 = \hbar\omega_p, \quad V_\varepsilon = \int_0^\pi V_{e,p}^2(\theta)\sin^3\theta\, d\theta,$$

where μ_B and μ_N are the Bohr magneton and the nuclear magneton, $\hbar$ is the Planck constant,

$$V_{me,p} = V_0 \int_0^\pi (a + \sin\theta \pm b\sin 2\theta + c_{e,p}\sin 3\theta)\sin^3\theta\, d\theta = V_0(\frac{4}{3}a + \frac{3\pi}{8} - \frac{\pi}{8}c_{e,p}) = \frac{\pi}{8}(\frac{32a}{3\pi} + 3 - c_{e,p})V_0,$$

and

$$V_\varepsilon = \int_0^\pi V_0^2(a + \sin\theta \pm b\sin 2\theta + c_{e,p}\sin 3\theta)^2 \sin^3\theta\, d\theta = V_0^2(\frac{4a^2}{3} + \frac{3a\pi}{4} + \frac{16}{15} + \frac{64}{105}b^2 - (\frac{32}{35} + \frac{a\pi}{4})c_{e,p} + \frac{208}{315}c_{e,p}^{\ 2}) = V_0^2 d.$$

Consequently,

$$\beta_e = -\pi(\frac{32a}{9\pi} + 1 - c_e/3)/(\frac{4a}{\pi} + 1); \qquad \beta_p = \pi(\frac{32a}{9\pi} + 1 - c_p/3)/(\frac{4a}{\pi} + 1). \tag{4}$$

There are two natural combinations of the interaction of waves of perturbations of ether density inside the proton and the electron: the combination with opposite spins and the combination with the same spins. As shown earlier by the author in [7], the interaction (superposition) of the waves of electron and proton with opposite spins is a hydrogen atom, having a radius of its ground state is much larger than the radius of the electron. We will now show that the another interaction (superposition) of the waves of the electron and proton with the same spins is a neutron, having a radius of its ground state approximately equal to the radius of the proton.

If electron is sitting on the proton under the influence of an electric field of proton, so that their centers coincide, and they have the same spins, then the angular velocities of propagation of perturbations of the ether density inside the electron and proton should be increased, and their radiuses should be decreased. Structure, resulting in such superposition of waves of perturbations of ether density inside the electron and the proton should be like that shown in Figure 1. At this figure $\omega'_p > \omega_p$ is the angular velocity of propagation of perturbations of ether density inside the compressed proton, which is a positively charged ball with a radius $r'_p < r_p$. And $\omega'_e = \omega_n >> \omega_e$ is the angular velocity of propagation of perturbations of ether density inside the compressed electron, which is a negatively charged ball with a radius $r'_e = r_n << r_e$. Inside the ball of compressed proton ether is slightly compressed, and inside the ball of compressed electron ether is a slightly sparse. Radius of compressed electron r'_e will be a radius of the thus obtained structure, i.e. radius of the neutron r_n. And $\omega_n r_n = \omega'_p r'_p = c$. Thus, the neutron has a central part (core) with the radius r'_p, which is a superposition of waves of positive and negative charges, and the peripheral part (coat) with radius $r'_e = r_n$, charged as well as the electron (negatively). And, as the degree of compression of an ether is inversely proportional to the frequency of a wave (see [9])

$$\rho = \rho_0 + g(r,\theta,\varphi,t), \qquad g(r,\theta,\varphi,t) \approx -\frac{V(\theta)\varphi\cos((\omega t - \varphi)/2)}{r^2\omega},$$

then the compression of ether inside the compressed proton smaller than the depression of ether inside the compressed electron. Consequently, the ether inside the core of neutron is also sparse as ether inside its coat. This is the meaning and purpose of neutrons in an atom - to remove the excess compression of ether produced by protons.

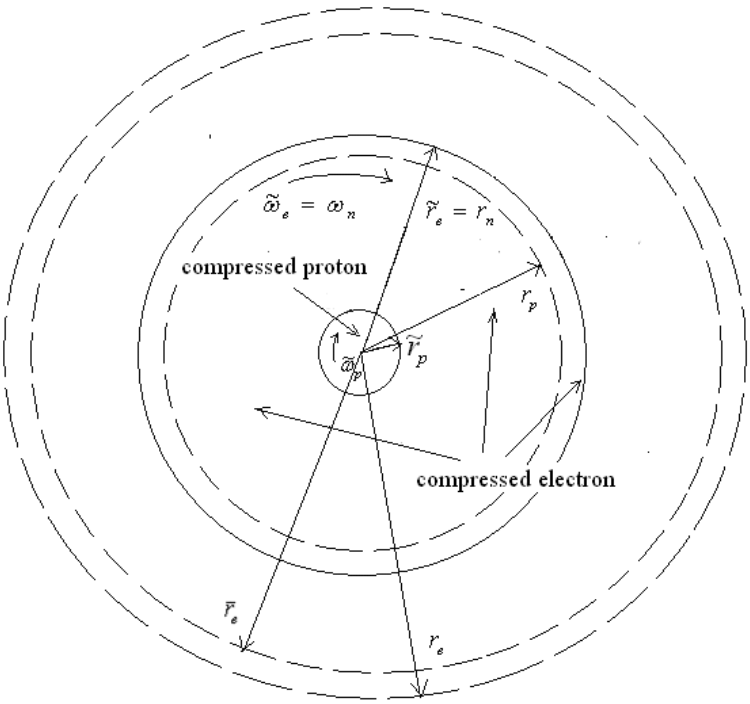

Fig.1. Scheme of formation of a neutron from the compressed proton and electron (top view).

As energy of proton is expended for compression of electron, then the frequency of a wave of perturbations of ether density in an electron at its compression by proton should be in a resonant ratio with the frequency of a wave of perturbations of ether density in a proton. That is, to begin the process of compression of an electron by proton, an electron must first be compressed in δ times up to a radius $\overline{r}_e$ corresponding to the resonant frequency $\overline{\omega}_e = c/\overline{r}_e = \omega_p / l$ of proton due to some external energy source, and after this its radius should decrease in an integer of times $m = \omega_n / \overline{\omega}_e = \overline{r}_e / r_n$, in such a manner that its initial radius should decrease also in an integer of times $n = \delta\, m$. Such external energy source providing preliminary compression of electron, can be an electronic antineutrino, that is perturbations of ether density, having a half-wave of density of a charge in a kind

$$\delta_{-}(r,\theta,\xi) = \frac{\rho_0 \omega_e}{8\pi\, r^2} V_0 \widetilde{b} \sin(2\theta) \sin \xi_e / 2, \qquad -2\pi \le \xi_e = \omega_e - \varphi < 0.$$

A particle, having such negative half-wave of distribution of the charge density, has energy, but has no charge, magnetic moment and mass, because corresponding integrals of the charge, magnetic moment and the change of the average density of ether inside a particle are equal to zero. Particle having an additional positive half-wave of distribution of the charge density we call neutrino.

Since at the interaction with the electron energy of antineutrino is expended to increase the frequency of the electron up to $\overline{\omega}_e = \delta\omega_e$, then the internal energy of electron compressed by the antineutrino is equal to

$$\overline{\varepsilon}_n = \pi^2 \rho_0^2 c \omega_e (V_{\varepsilon e} + \widetilde{V}_\varepsilon)/4 = \pi^2 \rho_0^2 c\, \overline{\omega}_e V_{\varepsilon e}/4 = \delta\varepsilon_e, \quad \widetilde{V}_e = V_0^2 \frac{64}{105} \widetilde{b}^2 .$$

After the establishment of the resonance frequencies of electron and proton a formation of neutron is beginning in the process of compression of electron and proton. It is natural to assume that the parts of radial components of velocities of change of the ether density, which depend on the angle θ, are identical in both parts of the neutron and equal to the average value (half-sum) of these components inside the electron and the proton, i.e.

$$V_n(\theta) = V_0(a + \sin\theta + (c_e/2 + c_p/2)\sin 3\theta).$$

This assumption means that the proton energy is expended for compression of the electron up to coincidence their radial components of velocities which depend on the angle θ . The frequencies of the waves of perturbations of the ether density in both parts of the neutron must also be in the ratio of the resonance, i.e. their attitude must be an integer $k=\tilde{\omega}_p/\omega_n=r_n/\tilde{r}_p$. Now we can express all the characteristics of the neutron through yet unknown integer constants l,m,k,n .

III. CHARGE AND MAGNETIC MOMENT OF NEUTRON

Charge of the neutron q_n, as the sum of the charges of compressed proton and electron, is obviously equal to zero, since

$$q_n=\int_0^{\pi}\int_0^{2\pi}\int_0^{\tilde{r}_p}\frac{\rho_0\tilde{\omega}_p}{8\pi r^2}V_n(\theta)\sin(\xi_p/2)r^2\sin\theta\, dr d\xi_p\, d\theta-\int_0^{\pi}\int_0^{2\pi}\int_0^{r_n}\frac{\rho_0\omega_n}{8\pi r^2}V_n(\theta)\sin(\xi_n/2)r^2\sin\theta dr d\xi_n\, d\theta=\frac{\rho_0 c V_q}{2\pi}-\frac{\rho_0 c V_q}{2\pi}=0.$$

We now calculate the neutron magnetic moment $\vec{p}_m$ as the sum of the magnetic moments of the compressed proton and electron, using the well-known formula

$$\vec{p}_m=\frac{1}{2}\int_{\Omega}\Delta\left[\vec{W}\cdot\vec{r}\right]d\Omega,$$

where electric charges with density distribution Δ are moved within the volume Ω at a linear rate $\vec{W}$. Then

$$p_{mn}=\frac{1}{2}\int_0^{\pi}\int_0^{2\pi}\int_0^{\tilde{r}_p}\frac{\rho_0\tilde{\omega}_p}{2r^2}V_n(\theta)\sin(\xi_p/2)\tilde{\omega}_p r\sin\theta\, r\sin\theta\, r^2\sin\theta\ dr d\,\xi_p\, d\theta-$$

$$-\frac{1}{2}\int_0^{\pi}\int_0^{2\pi}\int_0^{r_n}\frac{\rho_0\omega_n}{2r^2}V_n(\theta)\sin(\,\xi_n/2)\omega_n r\sin\,\theta\, r\sin\,\theta\, r^2\sin\,\theta\, dr\, d\xi_n\, d\theta\,=$$

$$\frac{\rho_0\tilde{\omega}_p^2\,\tilde{r}_p^3}{3}V_{mn}-\frac{\rho_0\omega_n^2\,r_n^3}{3}V_{mn}=\frac{\rho_0 c^2}{3}V_{mn}(\tilde{r}_p-r_n),\ \ V_{mn}=\int_0^{\pi}V_n(\theta)\sin^3\theta\, d\theta.$$

Since $\tilde{\omega}_p/\omega_n=r_n/\tilde{r}_p=k$, the magnetic moment of neutron can be written as

$$p_{mn}=-\frac{\rho_0 c^2 r_n V_{mn}}{3}(1-\frac{1}{k})=-\frac{2\rho_0 c^2 r_n}{3}(1-\frac{1}{k})\frac{\pi}{8}(\frac{32a}{3\pi}+3-\frac{(c_e+c_p)}{2})V_0,$$

or in terms of the nuclear magneton (see [9])

$$p_{mn}=-\frac{qcr_p}{2}\left[\pi\frac{r_n}{r_p}(1-\frac{1}{k})(\frac{32a}{9\pi}+1-\frac{(c_e+c_p)}{6})\right]/(\frac{4a}{\pi}+1).$$

And, since $r_n/r_p=\omega_p/\omega_n=(\omega_p/\overline{\omega}_e)/(\omega_n/\overline{\omega}_e)=l/m$, then the value of the neutron magnetic moment in the units of nuclear magneton is equal to

$$\beta_n=-\left[\frac{\pi\, l}{m}(1-\frac{1}{k})(\frac{32a}{9\pi}+1-\frac{(c_e+c_p)}{6})\right]/(\frac{4a}{\pi}+1). \tag{5}$$

IV. ENERGY AND MASS OF NEUTRON

We calculate the internal energy of neutron as the sum of the internal energies of compressed proton and electron. First, we calculate the work done by the fields of internal forces of compressed proton and electron over the charges moving in them (see details in [9]):

$$A_e(t)=\frac{1}{8}\int_0^{\pi}\int_0^{2\pi}\int_0^{r_n}\rho_0^2\omega_n^2V_n^2(\theta)\frac{\partial}{\partial\varphi}(\varphi\sin((\omega_n\, t-\varphi)/2))^2\sin^3\theta\, dr d\,\varphi\, d\theta=\ \frac{1}{2}\pi^2\rho_0^2\omega_n^2 r_n\sin^2(\omega_n\, t/2)V_{\varepsilon n}.$$

$$A_p(t)=\frac{1}{8}\int_0^{\pi}\int_0^{2\pi}\int_0^{\tilde{r}_p}\rho_0^2\tilde{\omega}_p^2V_n^2(\theta)\frac{\partial}{\partial\varphi}(\varphi\sin((\tilde{\omega}_p\, t-\varphi)/2))^2\sin^3\theta\, dr d\,\varphi\, d\theta=\ \frac{1}{2}\pi^2\rho_0^2\tilde{\omega}_p^2\tilde{r}_p V_{\varepsilon n}\sin^2(\tilde{\omega}_p\, t/2),$$

$$V_{\varepsilon n}=\int_0^{\pi}V_n^2(\theta)\sin^3\theta\, d\theta.$$

Averaging the resulting expressions over the period of time, we find the energy ε_n and mass m_n of the neutron

$$\varepsilon_n = \pi^2\rho_0^2 c(\tilde{\omega}_p + \omega_n)V_{\varepsilon n}/4 = \pi^2\rho_0^2 c\,(k+1)V_{\varepsilon n}\omega_n/4, \quad m_n = \varepsilon_n/c^2,$$

where

$$V_{\varepsilon n} = V_0^2\left[\frac{4a^2}{3} + \frac{3a\pi}{4} + \frac{16}{15} - (\frac{32}{35} + \frac{a\pi}{4})\frac{(c_e + c_p)}{2} + \frac{208}{315}(\frac{c_e + c_p}{2})^2\right] = V_0^2 d_n. \qquad (6)$$

V. COMPARISON WITH EXPERIMENTAL DATA

It was shown in [9] that $c_p = 1/3$. It follows from the equality $Q_p=0$ for quadruple moment Q_p of proton. Then, as it follows from (4), the value of the magnetic moment of proton is $\beta_p = 2.79253$. This value is different from the experimentally determined values $\beta_p \approx 2.7928$ less than on 0.01%.

The numerical value for c_e is defined in [9] from the condition that c_p and c_e are the roots of the same quadratic equation

$$\frac{4a^2}{3} + \frac{3a\pi}{4} + \frac{16}{15} + \frac{64}{105}b^2 - (\frac{32}{35} + \frac{a\pi}{4})c + \frac{208}{315}c^2 - d = 0 \Rightarrow c_e + c_p = \frac{18}{13} + \frac{315}{208}\frac{a\pi}{4}.$$

Then for $a = \pi/20$ and $\gamma = 4a/\pi = 0.2$, the value of the magnetic moment of electron is $\beta_e = -2.00295$ that is different from its experimentally determined value $\beta_e \approx -2.0023$ ([10], c.126) less than on 0.04%.

Further, as the energy (mass) of neutron is equal to the sum of energies (masses) of proton and precompressed by antineutrino in δ times electron, then

$$\pi^2\rho_0^2 c\,(k+1)V_{\varepsilon n}\omega_n/4 = \pi^2\rho_0^2 c(k+1)V_{\varepsilon n} m\overline{\omega}_e/4 = \varepsilon_p + \overline{\varepsilon}_e = \pi^2\rho_0^2 c(l+1)V_\varepsilon\overline{\omega}_e/4,$$

and so $(k+1)md_n = (l+1)d$. From the last equation and formula (6) for the energy of the neutron we find that for $\gamma = 0.2$

$$(k+1)m(0.678406\gamma^2 + 1.4235\gamma + 0.750182) = 1.06202(k+1)m = (l+1)d.$$

Let's accept now $k = 4,\ m = 684,\ l = 726,\ m\delta = n = 1730$. Then

$$\delta = n/m = 1730/684 \approx 2.52924, \qquad d = 1.06202(k+1)m/(l+1) = 4.99602,$$

$$m_p = l\delta\, m_e \approx 1836.23 m_e,\ m_n = (l+1)\delta\, m_e \approx 1838.76 m_e,\ \ m_n - m_p = \delta\, m_e \approx 2.52924 m_e.$$

Thus, the values of masses of proton and neutron which are obtained from the formulas of the ether theory are different from their experimentally determined values $m_p \approx 183616 m_e,\ \ m_n \approx 1838.68 m_e$ less than on 0.01%. Now we can determine the fine structure constant from (3)

$$\alpha = \frac{q^2}{\hbar c} = \frac{(\rho_0 c V_0)^2}{16}\frac{(1+\gamma)^2}{(\pi^2\rho_0^2 c V_0^2 d)c/4} = \frac{(1+\gamma)^2}{4\pi^2 d} = 0.0073009\,.$$

The value of the fine structure constant which is obtained from the formulas of the ether theory is different from its experimentally determined value $\alpha \approx 0.00729735$ less than on 0.05%. And the value of magnetic moment of neutron calculated on the formula (5)

$$\beta_n = -\frac{\pi}{(1+\gamma)}\frac{l}{m}(1 - \frac{1}{k})(\frac{8\gamma}{9} + 1 - (\frac{3}{13} + \frac{105}{208}\frac{\pi^2}{32}\gamma)) = -1.909$$

is different from its experimentally determined value $\beta_n \approx -1.913$ less than on 0.2%. The electron is compressed in neutron in 1730 times and the proton - approximately in 3.76 times.

IV. ETHEREAL EXPLANATION OF LENR RESULTS

In the considered experiments ([1]), at the beginning hydrogen atoms are released by electrolysis from water molecules, then plasma is generated by discharge with the dissociation of the hydrogen atoms into protons and electrons. But as it follows from the ether theory (see [7]) a hydrogen atom is an interaction (superposition) of the waves of electron and proton with opposite spins (with opposite directions of rotation of waves around one axis). After dissociation of the hydrogen atoms into protons and electrons a revolution of spins of electrons or protons and formation of new superpositions of their waves with the same spins occurs in plasma. In this case, as it described in the given paper, protons can compress electrons up to cold neutrons or neutron-like objects which sizes are approximately equal to the sizes of protons. Such compression of electrons with formation the new cold neutrons occurs under the influence of electric fields of protons in the needle nanostructures of the metal powder. These nanostructures create conditions for precompression of electrons up to resonant frequencies with protons. These conditions can be created by antineutrinos, geometric shapes of needle nanostructures or by other external sources of energy. The given birth cold neutrons can easily penetrate into metal atoms, giving rise to new chemical elements, in beta decay of which additional energy is released that is fixed in experiments (see [2]).

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