PHYSICAL VACUUM AS CRYSTAL-LIKE PLANCK PLASMA

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The paper for the first time expresses the idea of physical plasma-like vacuum, possessing a crystal-like structure at Planck distances. On the basis it has been proposed a new mechanism to confine similarly charged particles in dust plasma. The arguments that by means of such an approach one may explain the nature of a "dark matter" are given. A new idea concerning a construction of a fusion reactor is stated as well.
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1. CURL MECHANISM OF THE CONFINEMENT OF CHARGED PARTICLES IN A DUST PLASMA

In [1], assuming a crystal-like structure of a physical vacuum at Planck distances, an accent has been put on a tight relation between physics of solid state and physics of elementary particles. Carrying on the study of physical vacuum structure as one of the main forms of the matter, it has been proposed in [2] a model of a crystal-like vacuum of NaCl type. In the frame of such a model we succeed, for example, in the explanation of the physical nature of electric charges, in the calculation of leptons mass spectrum, in the building of the Universe fractal model. Since energy knotted strings (masses) are the knots of such a crystal-like space in the model, which could be right- and left-hand n – foils and which correspond to positive and negative charges, one may draw a parallel between such physical vacuum and plasma. It means that, from one side, physical vacuum may be treated as a crystal-like Planck plasma, and from the other side, such a comparison becomes especially actual in terms of periodic plasma structures appearance (so-called dust plasma (see, for example, [3-7])), the nature of the forces holding negatively (positively) charged formations is not yet completely understood.

In the given work one try to explain these forces on a phenomenological level on the basis of dissipative-less curl structure appearance having toroidal symmetry, since a surface tore is Zeifert surface for such knotted strings (see [8]). Analogous to the calculations in [9] in the cases of non-stationary hydrodynamic curls displaying in various open systems, one may carry out analytic calculations also in the cases of crystal-like physical vacuum and dust plasma by means of Navier-Stokes equation and continuity equation for toroidal motion of viscous incompressible matter in a toroidal coordinates (r,ψ,ϕ), which are connected with the coordinates (x,y,z) as follows:

$$x = (d + r\cos\psi)\cos\phi,\ y = (d + r\cos\psi)\sin\phi,\ z = r\sin\psi\ . \quad (1)$$

Now accounting (1), let's write down Navier-Stokes equation in toroidal coordinates system taking into account, first, that in the basis of the task symmetry v velocity doesn't depend on ϕ angle and, second, taking into account the circulation of plasma ion flows on the fixed distance, $r = a$ (see Fig.1).

$$\frac{\partial v_r}{\partial t} + \frac{v_\psi}{a}\frac{\partial v_r}{\partial \psi} = \frac{\nu}{a^2}\left[\frac{\partial^2 v_r}{\partial \psi^2} - \mathrm{tg}\psi\,\frac{\partial v_r}{\partial \psi}\right], \quad (2)$$

$$\frac{\partial v_\psi}{\partial t} + \frac{v_\psi}{a}\frac{\partial v_\psi}{\partial \psi} = -\frac{1}{a\rho}\frac{\partial p}{\partial \psi} + \frac{\nu}{a^2}\left[\frac{\partial^2 v_\psi}{\partial \psi^2} - \mathrm{tg}\psi\,\frac{\partial v_\psi}{\partial \psi}\right], \quad (3)$$

$$\frac{\partial v_\phi}{\partial t} + \frac{v_\psi}{a}\frac{\partial v_\phi}{\partial \psi} = \frac{\nu}{a^2}\left[\frac{\partial^2 v_\phi}{\partial \psi^2} - \mathrm{tg}\psi\,\frac{\partial v_\phi}{\partial \psi}\right], \quad (4)$$

where v_r, v_ψ i v_ϕ are the components of ion flow velocity according along the orts e_r, e_ψ, e_ϕ of toroidal coordinates system, p, ρ - plasma pressure and density, ν - the coefficient of kinematics plasma viscosity. Here the pressure is only in the equation (3), since from the point of view of symmetry it is only the function of the angle ψ, and $\rho = \mathrm{const}$. As it is seen from (2) – (4), the additions that describe the viscosity effects disappear at the following means of velocities v_r, v_ψ, v_ϕ:

$$v_{r,\psi,\phi} = \frac{c_1}{2}\ln\left|\frac{1+\sin\psi}{1-\sin\psi}\right| + c_2, \quad (5)$$

where the constants $\tilde{n}_1$, $\tilde{n}_2$ are given by plasma parameters. The formula (5) shows that in the case of incompressible plasma the velocity profile of ion flow in a fixed distance $r = a$ from toroidal coordinates system centre is that all the components are similarly dependent on the angle ψ, i.e. their immediate meanings are equal to each other. Assume now that ion circulation takes place along a knot curve (n - foil), which parametric equations are got when substitute

$$\psi = (n + 1/2)\phi\ , \quad (6)$$

in (1), where $-2\pi \le \phi \le 2\pi$, n - a natural number. Substituting further (5) in (6) and making an averaging by the angle ϕ, we get $v_{r,\psi,\phi} = c_2$. Besides the equations (2), (4) and the continuity equation $\mathrm{div}\, v = 0$ are satisfied automatically and the equation (3) is the equation to find an immediate meaning of the pressure which must be averaged by the angle ϕ as well.

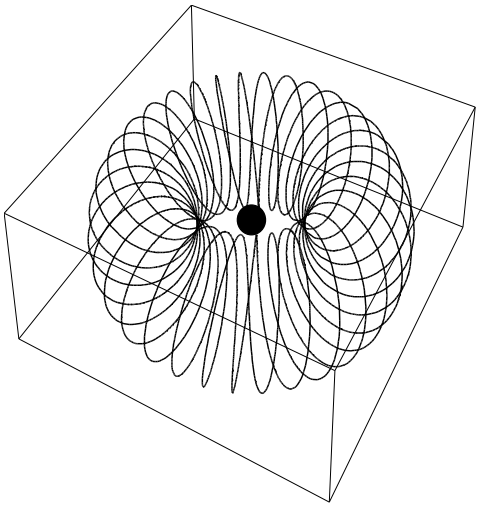

Fig. 1. Schematic representation of a curl ion flow around a charged particle in a crystal cell of a dust plasma

The result was expected for as the analogous situation appears in a crystal-like space-time as well. Really as it follows from Breit formula

$$\dot{x}_k = c\alpha_k , \qquad (7)$$

where $\tilde{n}$ - a light velocity, α_k - Dirac matrice, all the three components of a free electron velocity are equal to a light velocity in vacuum (see, for example, [10]). Thus, from one side, one can affirm that the matter circulation in Planck plasma of a space-time which causes an electron motion, is by knotted strings, and from the other side, we may be more confirmed to assume that the forces confining charged particles in dust plasma have curl nature.

2. ON A CURL NATURE OF A "DARK MATTER"

Note that by means of such a mechanism one may explain as well the existence of a dark matter as one of vacuum forms of the matter (see [2]). One may notice a tight relation between the nature of a dark matter and dust plasma nature generation, since both the first and the second systems discrete elements of the same type are confined at the expense of circular flows of energy (the flows of the similar knotted strings are oriented in such a way that they are one-side directed in the inter-knotted space). It has been illustrated in Fig. 2, where cubic crystallographic structures of two possible vacuum forms of the matter are shown schematically. Besides, crystallographic plane (100) of the "dark matter" vacuum is depicted in Fig. 2a, where similar grey color of the circles symbolizes inner structures model (for example, they may be n-foils) of discrete elements of this form of the matter and arrows show the orientation of circular flows of energy along these structure elements. It is evident that such an orientation of energy the circular flows in neighboring regions causes their junction that, means first, similar structure elements attraction, and, second, explains the existence of maximum possible Planck density of the "dark matter" mass

$$\rho_p = 3c^5/4\pi\hbar G^2 \approx 10^{93}\, g/cm^3 .$$

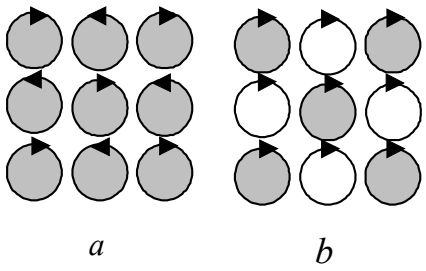

Fig.2. Schematic representation of crystal cells of two vacuum forms of the matter

It is necessary to notice that in the case of a usual physical vacuum of our space which may be represented as peculiar Planck plasma just the opposite situation takes place. Structural elements now are different but similarly circulating which leads to a complete compensation of the energy in neighboring regions (see Fig. 2b), i.e. mean density of a physical vacuum rigidly equals zero.

3. THE CONSTRUCTION OF A FUSION REACTOR BEING A KNOTTED TORUS

On the basis of above mentioned on the eristic level there appears the idea that charged ions flows will be in a stable regime if idea they move by knotted trajectories (for example by trefoils). Besides, magnetic power lines generated by these currents are knotted curves are also symmetric and at the same time link with current curves. Thus, one may propose, in author's opinion, new (unlike stellarators and tokamaks of various types) constructions of fusion reactors on the basis of links and knots geometry utilization. For example, torus knotted and linked as trefoil might be such a construction. In Fig. 3, for visual, current line is represented schematically in such a knotted torus.

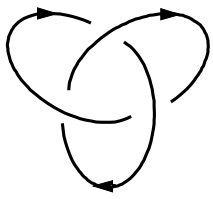

Fig. 3. Schematic representation of one of current lines in a knotted fusion reactor

It is necessary to notice that one might make some previous predictions concerning plasma behavior in such a knotted reactor, first, one may expect plasma polarization reduction, second, plasma oscillations may give less influence, and third, Lowson parameter could be easier achieved in such a symmetric system.

One may propose more exotic geometries of fusion reactors. For example, there may be two knotted and at the same time linked similar tubes This will lead to such a regime when plasma in one channel will influence plasma in another channel and vice versa. One may say that plasma confines plasma.

4. CONCLUSIONS

Thus, the assumption that physical vacuum of our space is a crystal-like Planck plasma allowed on the basis of some analogies and by means of simple calculations to explain the forces that confine charged dust particles in dust plasma.

The same assumption allows to make the hypothesis on the existence of so-called dust crystal-like "dark matter" with a non-compensated mass density on the background of a compensated plasma of physical vacuum.

And at last, the hypothesis about the existence of knotted flows of energy at Planck distances and the models built on the basis of curl ion flows in usual plasma lead to such constructions of fusion reactors where plasma has to move along knotted trajectories.

Thus the consideration of quite different phenomena under the same title became possible because all they are connected by toroidal symmetry of the matter knotted flows.

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ФИЗИЧЕСКИЙ ВАКУУМ КАК КРИСТАЛЛОПОДОБНАЯ ПЛАНКОВСКАЯ ПЛАЗМА

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Впервые высказывается идея, что физический вакуум можно считать плазмой, которая на планковских расстояниях имеет кристаллоподобную структуру. На основании этого предлагается новый механизм, который позволяет удерживать одноименно заряженные частицы в пылевой плазме. Приводятся аргументы, что с помощью такого подхода возможно объяснить природу "темной материи". Высказывается также новая идея относительно конструкции термоядерного реактора.

ФІЗИЧНИЙ ВАКУУМ ЯК КРИСТАЛОПОДІБНА ПЛАНКІВСЬКА ПЛАЗМА

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Вперше висловлюється ідея, що фізичний вакуум можна вважати плазмою, яка на планківських відстанях має кристалоподібну структуру. На основі цього пропонується новий механізм, що дозволяє утримувати однойменно заряджені частинки в запорошеній плазмі. Наводяться аргументи, що за допомогою такого підходу можливо пояснити природу "темної матерії". Висловлюється також нова ідея відносно конструкції термоядерного реактора.