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POSSIBILITY BALL LIGHTNING APPLICATION FOR NUCLEAR FUSION

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As is well known, to solve a problem of magnetic plasma isolation it is necessary to create it in the area of minimal magnetic field induction values $\vec{B}$. Follow F. Bacon – "All the best exists in Nature". As is shown in [1,2] minimum $\vec{B}$ plasma structures do exist in Nature. These structures are stars and ball lightnings. They include kernels of a surplus negative cha-rge and an external ringular layer of a surplus positive charge. Between a star kernel and an external ringular layer is a quasi-neutral, on the whole, intermediate layer. A ball lightning is a structural and electromagnetic analog of a radiating star. A considerable star and ball lightning lifetime is caused by the fact that the excess of one sign charges and the lack of opposite sign charges in star or ball lightning elements sharply decrease a recombination possibility. A second reason of long-time existence is that azimuth electron current in an external ringular layer generates a poloidal magnetic field, the lines of forces of which are localized in an inter-mediate layer. Therefore, the charged star and ball lightning kernel particles are in the area of minimum magnetic field induction. The force of Coulomb interaction between a kernel and an external ringular layer is balanced by a centripetal-acceleration-caused force and Lorentz force. If to employ, as an active reactor zone, a structure similar to that of a star or ball lightning, the conditions for a nuclear fusion reaction may be created that are present in the nearest star – the Sun. The most suitable type of reactor is a spheromak.

A method developed by the author allows to receive 25 cm diameter ball lightning under laboratory conditions with 7-10 kJ capacitor employed [3,4]. Application of a few mega-Joule ca-pacitors will allow to get ball lightnings a few meters in diameter. Long-lived this-size plas-ma formations being electrical sphere-shaped domains are of great interest for nuclear fusion. A spheromak, where a ball lightning-type structure is used as an active zone, needs a weak external field to stabilize an active zone of the reactor. However, certain doubts arise from a long-service possibility of a reactor wall at T=10^9 K in case of permanent operation mode. By NASA data the maximum temperature on the Sun is $1.5 \cdot 10^7$ K, i.e. two orders below a requi-red one to overcome the Coulomb potential barrier. The presence of radial electrical field between a kernel and a photosphere (external ringular layer) excludes a possibility of superheat ion existence. Fast ions (of energy sufficient to overcome Coulomb barrier) appear under plane domain generation in current-plasma channels that exist between a kernel and a photosphere [2]. As it was proven theoretically and experimentally [1], domain initiation was followed by transversal electromagnetic wave generation. Under the effect of electromagnetic wave the charged particles gather a substantial energy. The author's experiments on ball lightning generation a two-type discharge cell was used: coaxial and combined domaintrons. A principle of domaintron operation is based on energy inequality conversion effect in ion and electron plasma flows to microwave radiation [1, 5]. During coaxial domaintron tests in the zone of ball lightning generation (area approximately 2,5 m long) the charged particles gather energy that greatly exceeds the value matching the voltage applied to discharge cell electrodes. At 10kV voltage a longitudinal ion and electron energy component exceeded 100 keV. A ball lightning motion velocity in the vertical direction was $5 \cdot 10^8$ *cm/s*. An azimuth electron energy component in an external ringular layer was much higher than a longitudinal one and amounted to 350 keV [4]. A ball lightning obtained passes not only through a glass sheet 7 mm thick but also through an aluminium sheet 2 mm thick. The luminescence intensity of a ball lightning that passed through an absorber decreased by several-fold. A discharge was effected under atmospheric conditions (*p*=760 *mm Hg*). A combined domaintron was used to receive a long-lived ball lightning. During the experiments with the above domaintron applied a maximum time of ball lightning existence after energy supply phase was slightly less than one second. The image of the received ball lightning and its structure are given in Fig.1. It should be noted that a specific low energy output released, as a result of reaction in solar photosphere, was caused by

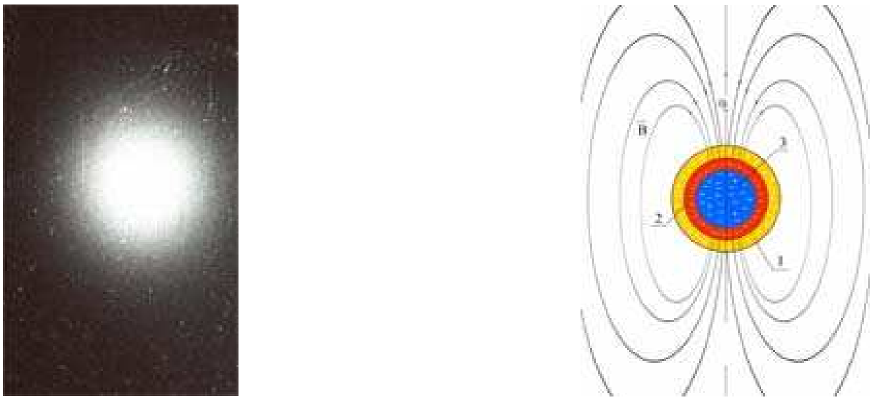

Fig.1 On the left - laboratory ball lightning image 25 cm in diameter at the distance of 2,5 m upwards from a discharge cell. Exposure – 20 ns. Storage capacity – 200 microfarad. On the right - ball lightning structure. Symbols: 1 – external ringular layer; 2 – intermediate layer; 3 – kernel; $\vec{B}$ – lines induction of magnetic field.

a low-frequency mode of electrical domain generation in current-plasma channels [2]. The data available give ground to believe that in photosphere a low-frequency mode with domain appearance delay is effected. To increase energy output high-frequency modes of domain generation should be used.

To carry out a fusion reaction there is no need to receive hot ions of T=10^9 K. Fast ions may be used, the energy of which is sufficient to come over Coulomb barrier. This method was first proposed and put to practice by E.Rutherford. In his experiments the protons accelerated by an electrical field interacted with an aluminium target. With lack of highly intensive ion sources present, E.Rutherford's method found no application. There are fast ions in plasma-focus discharges and radiating stars. They emerge due to a domain acceleration mechanism. The discharge cells – domaintrons designed by the author allow to receive intensive ion and electron flows. The availability of intensive ion flow exceeding 100 keV energy while passing through a ball lightning generation zone enables also to propose another method of nuclear fusion. A method offered shows a fast deuteron flow interacting with atomic deuterium present in the chamber. There are some estimates of possible energy output with reference to a laboratory installation "Prometeus" designed by the author. The storage capacity and the voltage applied at the latest tests were, accordingly, *C* = 100*mcF* and *U = 12 kV.* Charge Q = *CU = 1.2 Coulomb.* On the other hand, on single-charge ions *Q =Ne.* The number of particles in a discharge is $N = 6 \cdot 10^{18}$ particles. Assume that an impulse had only 1/10 part of fast deuterons accelerated and interacted with atomic-state deuterons, i.e. $6 \cdot 10^{17}$ particles per impulse. In d-d cycle the energy of 3.2 MeV releases for a single fusion act. Then the energy released during $6 \cdot 10^{17}$ particle fusion will be equal to $1.92 \cdot 10^{23}$ *eV* ≈30 *kJ* with energy stored in the capacitor $W = 7kJ$. The released energy ratio over a single cycle to expended energy is more than 4. A calculation was made for d-d cycle. If to apply d-t cycle or proton-aluminium cycle, the released energy/expended energy ratio will be much higher. A received value is of practical interest and it requires an evaluation test. A method of nuclear fusion offered has a number of important advantages.

These advantages are the following:

1. There is no need in expensive superconducting magnetic and high-vacuum systems, divertors, gyrotrons and liners;
2. Interaction cross-section of a "fast deuteron-atomic deuterium" system is higher than under interaction of two fast deuterons;
3. Ionization expenses are twice lower than in case of hot plasma application;
4. Compactness and mobility of power plants. They may be used on sea ships;
5. Minimum financial and time expenses;
6. Maintainability – after 10^7 cycles only discharge cell electrodes have to be replaced or displaced to keep a gap.

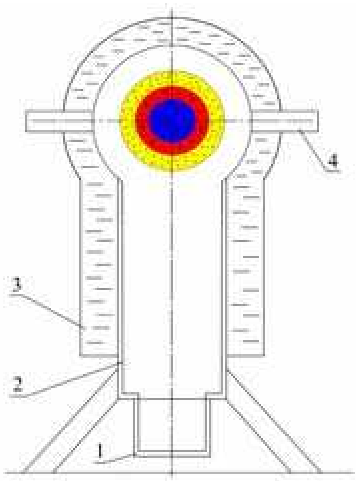

Fig.2. The sheme of reactor on base of ball lightning. Designations: 1-discharge cell; 2-chamber; 3- blanket; 4- devices for heating.

A method proposed to perform a nuclear fusion reaction is based on real data obtained by the author during the ball lightning generation experiments. The tests were carried out and financed by the author himself. The author is successfully experienced in ball lightning problem solution, the efforts to solve it have been made over the last 250 years. A method of nuclear fusion problem solution requires an evaluation test.

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