On structure and formation of stars in a Giant Electric Discharge

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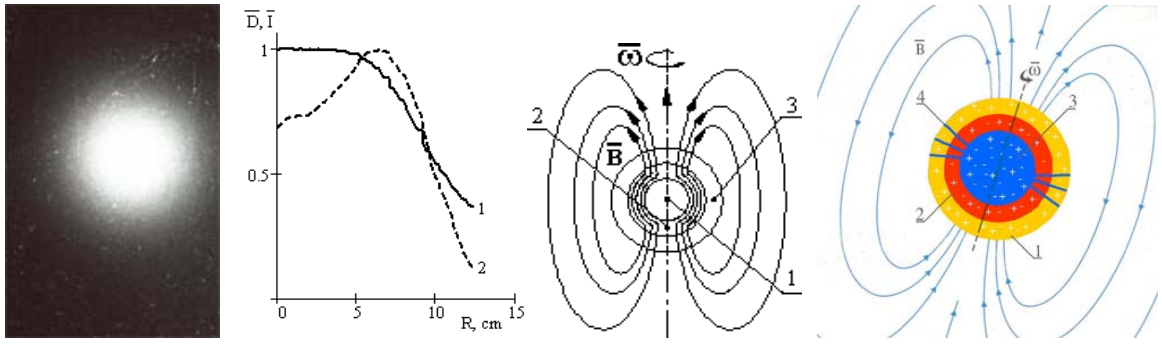
It is considered that star formation occurs as a result of gravitational compression of gas-dust mixture. It is also assumed that a process of star formation in the gravitational force between the particles is balanced by the force due to gas-kinetic pressure. At a certain stage the gas-dust mixture turns into a hot plasma in which the fusion reaction takes place. A well-known model completely lacks correct explanation of the process essence of turning the gas-dust mixture into hot plasma. It should also be noted that the strength of the Coulomb repulsion between like-charged particles is 10^{42} times greater than the force of gravitational interaction. The star is considered to be a high-temperature plasma clot. The essential argument against a plasma model is the ability of star almost instantaneous recombination and its collapse. If we assume that a star consists of a quasi-neutral plasma, it must collapse during the time which exceeds several fold the characteristic time of electron-ion recombination. Existing models of star formation also fail to explain both the presence of high star temperature and its rotation and generation of its electric and magnetic field. Considerable doubt in astrophysics is also the concept of a Big Bang. With help of an explosion any object can only be destroyed. A number of factors noted above testify that the known models of structure and existing processes do not correspond to real structure and processes in the objects. With astrophysics problems of obtaining experimental data available it is necessary to use research results obtained in experiments with laboratory plasma. In experimental physics there is a number of results relating to the registration of electric domains in gas-discharge, solid-body and electrolytic plasma. They provide a reasonable basis to believe that the same physical processes occur in different plasma systems.

R.Cartes created a model, in accordance with which all celestial bodies were formed as a result of vortex motions occurring in uniform matter. Experimental results on ball lightning obtaining in the laboratory [1-4] give the basis to consider that their generation occurs in the plasma vortex created in the discharge. The optical image analysis of ball lightnings obtained by means of electron-optical converter, allows to have information about its internal structure. The analysis shows the luminosity intensity of the peripheral part exceeds the luminosity intensity in the central part. The same distribution of luminosity intensity is also a characteristic of micro-ball lightnings obtained earlier by the author in the experiments on

the breakdown near the dielectric surface. A radial distribution of the luminosity intensity and blackening density of the film normalized to their maximal values are given in Fig.1(b). The radial distribution of the intensity was obtained by means of the Abel inversion. The luminosity intensity in the peripheral part is higher than in the central one because the peripheral part contains more ions than electrons. The central part or the kernel of the ball lightning has more electrons than ions. Consequently, the ball lightning consists of a kernel with surplus negative charge and the external spherical layer with surplus positive charge. The ball lightning is an electric domain of a spherical shape. The scheme of a ball lightning structure is shown in Fig.1(c) and the scheme of a star is given in Fig.1(d).



a b c d

Fig.1. An image of a ball lightning 25 cm in diameter at distance of 2,5 m up from a discharge device – (a); radial profiles of the film blackening density - 1 and luminosity intensity – 2, both normalized to its maximal values – (b); scheme of a ball lightning structure – (c) and scheme of radiating star structure- (d). Designations in (c): 1 – kernel; 2 – intermediate layer; 3 – external spherical layer; B – induction lines of poloidal magnetic field. Designations in (d): 1- external spherical layer (photosphere); 2 – intermediate layer; 3 – kernel; 4 – current-plasma channels with sunspots on photosphere surface.

The analysis shows that the star and ball lightnings have not only the same ideal shape but also the structure and general conditions of stability and long-term existence. A star also has a structure of an electric domain of a spherical shape and consists of a kernel with surplus negative charge, an external spherical layer with surplus positive charge and intermediate quasineutral plasma layer. A quasineutral layer is located between the kernel and the external spherical layer. Presence of excess charges in the kernel and the external layer generates a radial electric field - $\vec{E}_{rad}$. The distribution of the electric field intensity in the star is given by the Poisson equation

$$\nabla\left(\varepsilon\vec{E}_{rad}\right) = 4\pi e(n_i - n_e), \qquad (1)$$

where ε is permittivity and density of components are redundant. The star obtains a rotational, electric and magnetic moments during its origin in a plasmic vortex. There is a

strong radial electric field between the kernel and external spherical layer - $\vec{E}_{rad}$. As known the star rotates relatively to its axis with an angular velocity $\vec{\omega}$. There is also an ambipolar electric field between the kernel and the external spherical layer - $\vec{E}_{amb}$. Existence of the ambipolar field relates to the fact that rotating external spherical layer causes rotation of kernel as a result of the electrostatic interaction. A system of charges rotates round the axis with big speed and represents a circular current that creates a poloidal magnetic field in space. The existence of such field follows from Maxwell equation

$$rot\vec{B}_\theta = \frac{4\pi}{c}\vec{J}_\varphi \ , \qquad (2)$$

where $\vec{B}_\theta$ is an induction of poloidal magnetic field and $\vec{J}_\varphi$ is an azimuth current. The resultant electric field intensity is equal to the vector sum of the radial and the ambipolar component of the intensity. A lines of a strong magnetic field pass inside the intermediate layer of a star. Increasing in a radial direction in the intermediate layer (except poles) a magnetic field prevents diffusion of the charged particles across of the field. The existence of a radial electric field between the elements of the Sun is confirmed by the presence of sunspots in equatorial plane. Between the elements of the star in the equatorial plane due to the presence of excess charges and radial electric field the current is set and realized in the form of radially directed current-plasma channels (CPC). The channel shape of current passage is due to the fact that the same current density cannot flow from the center to the periphery of a sphere or a disk as the current always generates an azimuthal magnetic field. CPC serve as a direct electrical pathway in the circuit "kernel-external spherical layer". Since the intensity of electron luminosity is much less than the intensity of ion luminosity, the CPC exit areas on the surface of the solar photosphere were called sunspots. Current spreading over the surface of the photosphere leads to the appearance of "electrical islands" with different surplus charges and electrical breakdown between them. In the star there is also a reverse current (from the periphery to the center, outside the CPC) under the action of the Lorentz force. Continuous existence of the star takes place at presence and realization of the following conditions:

1. The star kernel is located in the area with minimum of induction of the poloidal magnetic field. Charged particles of the kernel cannot move in the direction in which the increasing values of the magnetic field induction take place;

2. The excess of charges of one sort and the lack of charges of another sort in the kernel

or an external spherical layer significantly reduces the possibility of the electron capture by the nearest ion, therefore the recombination processes in a star become difficult;

3. The inequality of positive and negative charges in the elements of a star also significantly reduces the losses of charged plasma on bremsstrahlung;

4. The resultant of all forces, including the force of electrostatic interaction between the elements of a star, a force of gas-kinetic pressure and force caused by the centripetal acceleration should be equal to zero in the equatorial plane of a star;

5. A reaction of nuclear fusion takes place due to the strong field in the star in the presence of deuterium.

It is possible that the generation of a plasma vortex due to the fact that the spiral arms of Galaxies have excess charges of opposite sign. Electrical breakdown in the center between the spiral arms creates a plasma vortex in which the star is born. In the plasma vortex under the action of forces the large-scale charge separation and star element formation occur. The methods developed allow to carry out astrophysical experiments in the laboratory. Figure 2 shows the images of ball lightning formation in a plasma vortex on Prometheus-M installation. Thus there are enough reasons to believe that generation of stars and Galaxies in the Universe took place in a Giant Electric Discharge. An approach based on the electric domains also allows us to explain the existence of coronal holes and the flows of fast particles.

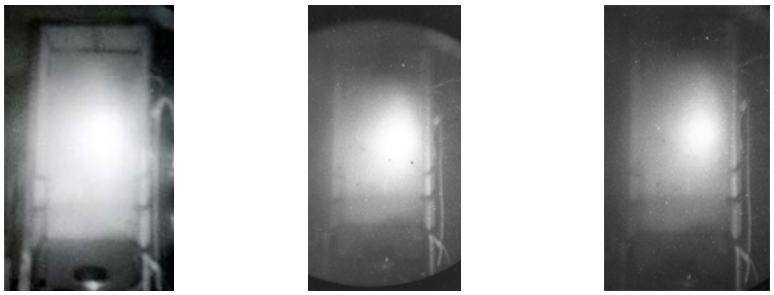


Fig.2. An images of formation of ball lightning in в three consistent startups

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