

BALL LIGHTNING INVESTIGATIONS ON “PROMETHEUS-2”

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A ball lightning phenomenon has attracted attention of researchers for a quarter of millennium. A great number of papers are dedicated to this phenomenon. Many efforts had been made to give a theoretical explanation of causes of its generation, structure and essential lifetime. A common feature for all models is the fact that ball lightnings generate in electrical discharges in the atmosphere. A ball lightning as a plasma system with magnetic field induction minimum in center of it represents exclusive interest for nuclear fusion. In a ball lightning origin area the intensive flows of fast ions can be obtained, the energy of which is sufficient for overcoming of Coulomb's potential barrier [1].

The prior experiments, which were made at “Prometheus” installation, showed that a ball lightning created at the initial pulse stage [2]. To increase energy transfer efficiency from capacity storage to a ball lightning a “Prometheus-2” installation was built. The parameters of a new installation are: charge in storage - 0.4 Coulomb, charge voltage – 50 kV, stored energy – 10 kJ. The current in a discharge cell was equal 140 kA and a pulse's duration was about 100 microseconds. In the course of experiments the following parameters were measured: voltage and current in a discharge cell, ball lightning potential by means of a probe with a divider, the collector current at ball lightning collapse. Microwave radiation in a discharge and

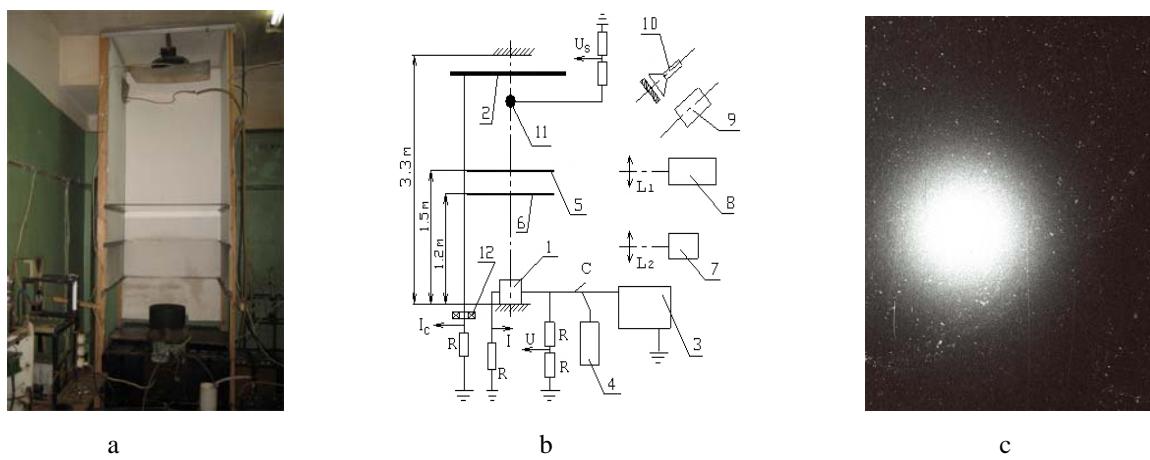


Fig.1. General view of field for experiments on generation of ball lightnings on “Prometheus-2” installation – a; the scheme of experiments – b and image of ball lightning under the ceiling – c. Designations: 1- domaintron (discharge cell); 2- collector; 3-main storage; 4-start unit; 5-absorber from an aluminum; 6-absorber from a glass; 7- electronic optical converter; 8- electronic optical camera; 9- X-rays detector; 10- detector of microwave radiation (with teflon absorber); 11-potential probe; 12- Rogowski loop; L-lense.

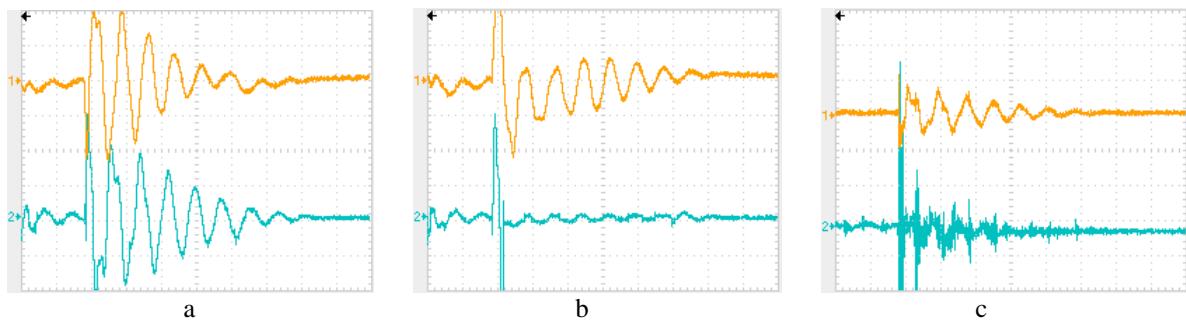


Fig.2. A typical wave fronts: of applied voltage to a discharge cell (upper trace) and current in discharge (bottom trace) - a; ball lightning potential from a probe (upper trace) and collector current (bottom trace) – b and microwave radiation (upper trace) and bremsstrahlung from absorber in a discharge (bottom trace) - c.

bremsstrahlung generated were registered while a ball lightning was passing through absorbers. Ball lightning luminescence was registered optically by means of opto-electronic converters. In experiments it has been revealed that a ball lightning is quasi-neutral system in a whole. General view of field for experiments and scheme of experiments and image of a ball lightning are given in Fig.1. A typical wave fronts of applied voltage to a discharge cell, current in discharge cell, ball lightning potential from the probe, current from the collector, microwave radiation and bremsstrahlung from absorber are given in Fig.2. At measuring of the voltage, applied to electrodes of a discharge cell, it has been revealed, that measured value of a voltage approximately four times exceeds value of a voltage to which the basic store of installation ($U_{ap}=50$ kV) was charged. This effect can be explained only presence of a ball lightning of the strong electric field in the area of its origin. This field existence is related with separation of charges during which time ball lightning's elements are shaped: a kernel with a surplus negative charge and a ringular external layer with a surplus positive charge. The own electric field of a ball lightning has radial and ambipolar components.

Experiments by definition of presence of a redundant charge which as some researchers suppose, the ball lightning has carried out also. In these experiments on the distance 40 cm from centre of a ball lightning's origin area the metal plate which had the shape of a quadrate with the leg equal 50 cm was installed. The plate obviously overlapped the area of the ball lightning's passage which diameter was equal 25 cm. The plate has been joined by means of cable to the plug of the condenser which was previously charged to a voltage +38 kV concerning the earth's potential. The voltage on the condenser was being registered by kilovoltmeter S1-95. In case of contact of a ball lightning which has not compensated redundant charge with a plate, kilovoltmeter indications should be change. However, during experiments it was revealed, that a ball lightning transits through a plate and kilovoltmeter indications don't

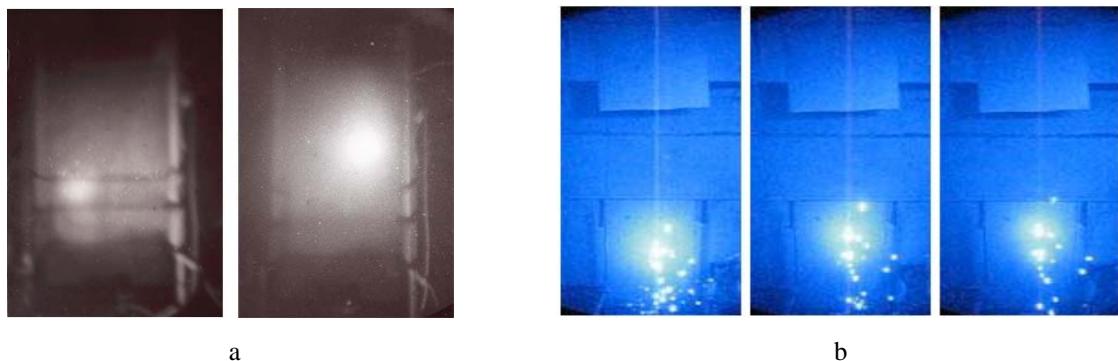


Fig.3. Images of ball lightnings on "Prometheus-2" for two moments of time – a and video of clusters in discharge and their passing through absorber from a glass on "Prometheus"- b.

change. This fact gives the warrants to consider, that the ball lightning is quasi-neutral as a whole, i.e. the redundant positive charge of a ringular external layer is equal to a redundant negative charge of a kernel. Images of ball lightnings on "Prometheus-2" for two moments of time are given in Fig.3 (a).

Works on perfection of a discharge cell's constructions and method of ball lightning's generation were spent. In experiments the auxiliary storage with capacity 60 mF. and with energy store equal 18.75 kJ was used. The storage was charged to a voltage 25 kV. The summary energy in the discharge was approximately 30 kJ. By means of the auxiliary storage in the area of a ball lightning's generation plasma was previously created, and then the basic discharge was carried out. This method allows to gain intensive flows of charged particles with a high energy. The executed experiments on installations of type "Prometheus" have shown, that efficiency of energy transmissions from the storage to a ball lightning are very low. For increasing of energy transmission's efficiency it is necessary, that the pulse duration of a voltage applied to a discharge cell for several times exceeded Maxwellian a relaxation time of a spatial charge. The voltage impulse should be unipolar and have the "hand bell" shape. Such impulse can be gained in case of use as the storage Marx generator.

In a discharge on "Prometheus" at later stage – after ball lightning generation and escape – brightly luminous large clusters-Fig.3 (b) are seen. Some of them pass through a thick absorber from a glass.

In the course of experiments with thicker absorbers a visually seen aura over the absorber disappears. A dark spherical field was discovered quite by chance with a very thick absorber (polyethylene 60 mm thick or carbon steel 4 mm thick) in the area under the ceiling. The diameter of this area was about a ball lightning's diameter. The time of appearance of a dark area equal to the time of ball lightning's appearance in the same place in the absorber absence,

i.e. a dark area's motion velocity from an absorber upwards to a place of its observation equal to a ball lightning's motion velocity in the absorber absence. Existing above, under the lab's ceiling for a very short time, a dark spherical area doesn't emit radiation. With application of aluminum foils 0.05 mm thick in the absence of a thick absorber across the ball lightning passageway there are imprints on thin foils that appear as a result of ball lightning collapse. With the presence of a thick absorber across the ball lightning passageway – under interaction of a dark spherical area with thin foils imprints on foils are absent. To give an explanation of the dark spherical area presence from classical physics positions is impossible. Dark area existence gives reason to believe that under interaction of ball lightning with a thick absorber there takes place a process of particle release with high penetrating ability. As is known, an exclusively high penetrating ability is characteristic for neutrino. The processes of electrical charge generation may be connected with existence in the Universe of particle flows that have mass and energy and also possess high penetrating ability. The idea of such particle existence was first stated by Lessage. By means of such particles depending on conditions or effect level available a gravitational, electromagnetic or weak interaction is realized. Those particles may be called type-eight neutrinos or lessagens. In the process of matter charging, typical for some kind of dielectrics, there is electron generation as a result of friction. If to suppose that in the process of dielectric charging the electron generation takes place with participation of flows of high-penetrating ability particles, then in the process of interaction of ball lightning with a thick absorber under the presence of poloidal magnetic field takes place the process of electron energy dissipation, their destruction and particles appearance that took part in the process of electric charge generation. Therefore, under interaction of electron with metal in a magnetic field a process of electron collapse takes place. A process of electron collapse accompany attenuation of it's wave constituent and release type-eight neutrino (lessagens) as particle. Then the electron has electron nucleus or "nucleolus". Probably, that particles from which the dark spherical area consists, are base fundamental particles from which the substance in the Universe consists.

References

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