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Aerosol in the laboratory analogue of ball lightning

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Ball lightning remains a virtually unstudied atmospheric phenomenon, which attracts the attention of many researchers seeking to understand its nature. In 2000, a special type of pulsed high-voltage electric discharge over a water surface was discovered in Gatchina [1]. During the discharge, a brightly glowing spherical object is formed (called a plasmoid in the literature). The lifetime of the glowing ball is quite long and can reach 0.6 s, with a typical galvanic contact time of the plasmoid with the electrodes of about 0.1 s.

Currently, this object is being studied in many laboratories around the world, for example, in the USA, China, Japan, Germany, Czechoslovakia and Russia. Many researchers consider this type of discharge as a laboratory or artificial analogue of natural ball lightning. Meanwhile, this object still remains insufficiently studied.

The paper discusses the results of studying this object in the laboratories in different countries, as well as the results of an experimental study carried out using a discharge setup assembled at the VICKC SB RAS.

An interesting fact was discovered that when a laser beam passes through a plasmoid, scattering of laser radiation on aerosol particles of different sizes is clearly observed. It was found that the inner part of the plasmoid is filled with water aerosol of medium-dispersed and submillimeter ranges [2]. The results of an experimental study are also presented to test the hypothesis about the mechanism of prolonged plasmoid glow due to reactions in the dispersed phase.

Observation of water aerosol at atmospheric pressure indicates that the temperature inside the brightly glowing object does not exceed 100 ℃. This contradicts the assumption about the plasma nature of the object under study at the stage of its autonomous existence.

1. G.D. Shabanov On the possibility of creating natural ball lightning by a new type of pulsed discharge in laboratory conditions // Uspekhi Fizicheskikh Nauk. 2019. No. 1. P. 95−111.

2. A. A. Cheremisin, V. P. Isakov, E. A. Shishkin, A. A. Onishchuk, and V. N. Parmon. Water Aerosol in an Artificial Analogue of Natural Ball Lightning// Herald of the Russian Academy of Sciences, 2023, DOI: 10.1134/S1019331623010094