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PASSAGE OF PULSE RADIATION THROUGH A DUSTY ATMOSPHERE UNDER CONDITIONS OF DEVELOPMENT OF BREAKDOWN ON THE PARTICLES

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The problem of propagation of a nondiverging pulsed laser radiation through an atmosphere containing aerosol particles with a size distribution $n=f_0(R_0)$ is considered. If the radiation intensity I is sufficient to permit breakdown to develop on particles of size R_0, plasma regions are produced in the atmosphere, absorb the incident radiation, and increase in size at a rate $\dot{R}$.

The paper considers the case when the development of the plasma region proceeds in the optical-detonation regime and the produced plasma region can be regarded as absolutely opaque. In this case $\dot{R} \sim I^{1/3}$ and does not depend on R.

The problem was solved numerically assuming a Jung distribution of the particles by size with parameters $\beta = 3$ and $\tilde{R} = 10^{-5}$ cm, a distribution typical of the atmosphere next to the earth. The dependence of the breakdown threshold intensity on the aerosol particle size was specified in accordance with the available published data. The figure shows the results of one of the variants of the calculation of the change of the shape of a neodymium

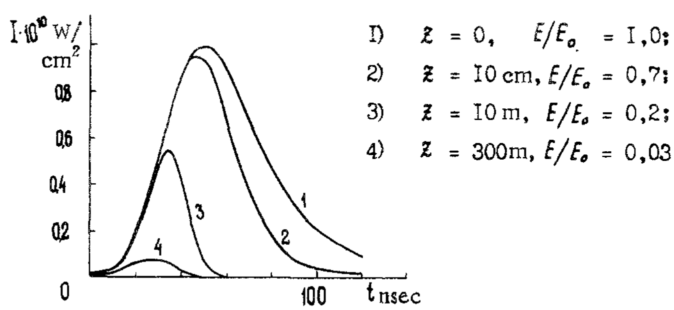

Fig. 1

Translated from II Vsesoyuznoe Soveshchanie po Rasprostraneniyu Lazernogo Izlucheniya v Dispersnoi Srede. Tezisy Dokladov (Second All-Union Conference on Propagation of Laser Radiation in a Disperse Medium. Summary of Proceedings), Part II, pp. 106-107, 1982.

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laser pulse ($I^{peak} = 10^{10}$ W/cm², $t_p^{0.5} = 5.10^{8}$ sec) at various distances from the start of the path at a value of the attenuation coefficient of the medium $\alpha_0 = 2.10^{-6}$ cm⁻¹. This value of α corresponds to a meteorological visibility $S_M \approx 20$ km, which is typical of the overwhelming majority of atmospheric situations.

AIR BREAKDOWN MINIMIZED BY BREAKDOWN IN AQUEOUS AEROSOL DROPS ACTED UPON BY RADIATION WITH $\lambda = 1.06$ μm

V. K. Mamonov

The lowering of the breakdown threshold of air upon interaction of $\lambda = 1.06$ μm radiation with aerosol that absorbs this radiation weakly was first observed in [1]. However, since that experiment was purely qualitative, this fact was not satisfactorily explained. In later studies it was shown that the process proceeds in two stages: breakdown develops first inside the drops, after which the breakdown of the surrounding air is initiated [2]. The length that determines in this case the conditions needed for the development of air breakdown is the primary breakdown inside the aerosol drops. The investigations performed have led to two viewpoints concerning the cause of its development. First, the regular spherical shape of the drops leads to formation within them of a complicated distribution of the field with "hot" zones, where the field intensity can exceed considerably (by up to 30 times) the mean values. It was therefore proposed that breakdown of the drop material is possible in these "hot" zones when the incident radiation is insufficient for breakdown [3, 4]. Second, the breakdown can be produced on microcontamination particles inside the drop as is the case with breakdown in water which is not specially purified [2, 5].

1. The investigation of the initial stage of development of the breakdown nucleation site in microcontaminations of water was performed on stagnant distilled water placed in a cell. This made it possible to avoid the characteristic field inhomogeneity inside the drop and to obtain reliable results on the breakdown threshold intensities.

The results of the measurements of the threshold intensity on natural ($r \sim 10^{-5}$ cm) impurities and those artificially introduced into the water (particles of Al_2O_3 with average dimension $\sim 5.10^{-4}$ cm and 2.10^{-3} cm) are shown in Fig. 1. The figure indicates the maximum spread of the experimental values. It also shows for comparison data on breakdown at Al_2O_3 particles in air (light circles), obtained by us in [6] with apparatus similar to that used in the present study. It can be seen from the comparison that at equal energy in the pulse the breakdown by corundum particles in water takes place at an intensity smaller by almost an order of magnitude than breakdown in air. It is perfectly possible that this is due to the substantial decrease of the loss in the breakdown region, since the process takes place in a medium of strongly compressed vapor of the particle material and of water.

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