Investigation of the spark channel microstructure in the nanosecond time scale in various approximations [[1]](#footnote-1)\*)

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The Maxwell equations for the problem of the propagation of monochromatic radiation in an optically inhomogeneous medium goes into the wave equation, and then to the Helmholtz equation. A further solution of the Helmholtz equation is generally performed for a scalar field. This does not allow to take into account the polarization during wave scattering. However, the problem is formulated sufficiently fully to take into account the effects of diffraction and interference of light beams.

The Helmholtz equation is unsolvable in general terms, and various approximations are used to solve it, using information about the size of the inhomogeneity compared to the wavelength of the probe radiation, the value of the deviation from the average of the dielectric constant, and the spatial scales of its variation.

In our work we study the constraints that arise during transitions from the Maxwell equations to the Helmholtz equation, that are classical for plasma physics, and also study various approximations (geometric optics method, parabolic equation method, smooth perturbation method) in which the Helmholtz equation can be solved for conditions, usual for nanosecond plasma formations in air with characteristic sizes up to 100 microns. A numerical comparison of the accuracy of the methods is presented.

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1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVII/Lt/ru/ER-Khir'yanova.docx) [↑](#footnote-ref-1)