Numerical STUDY OF FAST IONIZATION WAVES IN EXTENDED CAPILLARIES NON-UNIFORMLY FILLED WITH GAS [[1]](#footnote-1)\*)

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A distinctive feature of DC glow discharges in extended tubes is their unique glow pattern, characterized by alternating dark and light areas [1]. Among them, a positive column, cathode and anode layers, as well as near-cathode plasma regions, such as negative glow and Faraday dark space, are usually distinguished. The properties of the near-cathode regions are largely determined by nonlocal ionization produced by fast electrons coming from the cathode layer, which is independent of the local plasma parameters – the particle density and temperature of slow electrons or the strength of the electric field [2]. For this reason, obtaining the complete structure of a dc glow discharge in the course of a self-consistent simulation inevitably requires accounting for the nonlocal ionization in some way. Initially, the problem was solved using a hybrid approach that combines the hydrodynamic description of ions and slow electrons with the Monte Carlo procedure for calculating the rate of non-local ionization [3]. The fundamental disadvantage of this approach, which remains relevant to this day, is its significant complexity both in the numerical implementation of the model and in performing actual calculations. A promising alternative in this sense is the use of an analytical formulation for the source of nonlocal ionization within the framework of the fluid approach. Numerical implementation of this approach made it possible to obtain reliable quantitative estimates of the electrical and plasma parameters of a short (without a positive column) glow discharge [4]

In this work, we show that the combininig terms for local and non-local ioniztation within the framework of one model makes it possible to reproduce quickly and efficiently the complete structure of a DC glow discharge with all its main regions, as well as to obtain reliable quantitative estimates of its parameters along the entire length of the discharge tube. Comparison of the thus obtained structure of the discharge with the experimental one, by analogy with the current-voltage characteristics, allows one to obtain additional information about a number of parameters, the direct measurement of which in the experiment is fraught with significant technical difficulties. The possibility of using the analytical formulation of the nonlocal ionization source to construct a fully analytical model of the discharge is discussed as well.

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