

Review of dissertation for the degree of Doctoral Thesis of Mr. Kurban M. Rabadanov entitled «Investigation of kinetic processes in nonlocal gas-discharge plasma» submitted for defense of the degree of candidate of physical and mathematical sciences, specialization 01.04.08 – Plasma Physics.

The present dissertation is devoted to the study of the nonlocal electron kinetics and the development of methods for solving the nonlocal kinetic Boltzmann equation in software packages, and to the study of the effect of the ambipolar field on the plasma characteristics in the positive column.

The work consider the positive column of a glow discharge of low and medium pressure in argon in the local and nonlocal approximation. The kinetics of electrons in argon is systematically studied, where the Boltzmann kinetic equation is first solved without taking into account electron-electron collisions and superelastic collisions, and then this equation is solved taking into account the effect of these collisions on the electron kinetics both in local and nonlocal approximation.

The dissertation consists of an introduction, five chapters, a conclusion and a list of references.

Chapter 1:

The first chapter provides a detailed review of the literature on the topic of the dissertation. The history of the development and research of gas-discharge plasma with the dates and names of researchers and scientists is given. Theories of the positive column of a glow discharge are described. It is also written in detail about the Boltzmann kinetic equation and the local and nonlocal approximation.

Chapter 2:

The second chapter is devoted to the study of the influence of the ambipolar field on the formation of the electron distribution function of the EDF and other plasma characteristics of the positive column. The conclusions of all equations are described in detail and accurately. The research results are presented which are presented in the form of drawings and graphs. Also, according to the results of the study, the conditions for the applicability of the local approximation are specified.

Chapter 3:

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The third chapter provides a solution to the Boltzmann kinetic equation according by the so-called author of the Holstein-Tsendin method. The results of studies using this method are presented, as well as a comparison of these results with the results of studies by other authors.

Chapter 4:

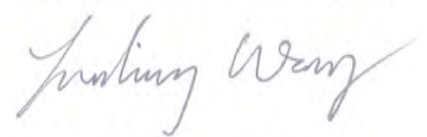
In the fourth chapter, the Boltzmann equation is solved taking into account the effect of electron-electron collisions on the kinetics of electrons in both local and nonlocal modes. The results of studies in the form of figures are presented. The influence of electron - electron collisions on the formation of a nonlocal EDF and other characteristics of a positive column plasma in argon is analyzed. It is shown that at high degrees of ionization, it is necessary to take into account the contribution of electron - electron collisions to the formation of both local and nonlocal EDF.

Chapter 5:

Finally, in the fifth chapter Boltzmann equation is solved taking into account the effect of superelastic collisions on the kinetics of electrons in both local and nonlocal regimes. As in the previous chapters, research results are presented in the form of graphs and figures. The influence of superelastic collisions of metastable atoms with electrons on the formation of a nonlocal EDF and other characteristics of a positive column plasma in argon is analyzed. It is also shown that at high degree of excitation, it is necessary to take into account the contribution of superelastic collisions of metastable atoms with electrons to the formation of local and nonlocal EDF. An interesting phenomenon is described in the case of taking into account the influence of metastable atoms on the formation of a nonlocal EDF, the so-called phenomenon of "copying" EDF.

The following remarks can be made from the text of the work:

1. In the text, even within the same paragraph there are synonyms, for example, such as "nonequilibrium" and "equilibrium", "radial field" and "ambipolar field", etc. Also in some places the word "nonlocal" is written without a hyphen, and in some places it is written with hyphen "non-local".
2. There are Russian letters on page 165 in figure 1.2, and the description of figure 2.7 is not translated into English.
3. In the work describes the averaging method, which the author calls the Holstein-Tsendin method. Why is the author calling this method so? Earlier



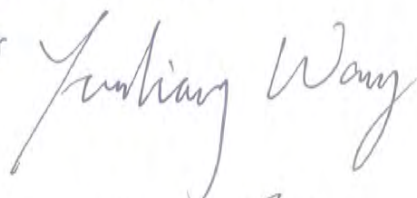
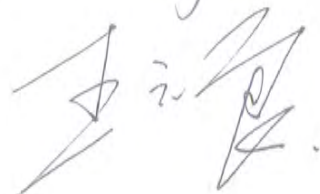
in the literature I have not met this term. I think the term was most likely introduced by the author.

Despite the above mentioned remarks which do not spoil the general positive impression made by this research, the thesis deserves to be positively evaluated.

The thesis of K. M. Rabadanov «Investigation of kinetic processes in nonlocal gas-discharge plasma» completely fulfills the requirements established by the Decree № 6821/1 dated September 01, 2016 "On order of Granting Degrees in St. Petersburg State University", and Kurban Rabadanov deserves to be granted with a degree of Candidate of Physical and Mathematical Sciences, specialization 01.04.08 - Plasma Physics.

Dissertation board member

Professor

Date: 11.09.2019

