Charged particles transport in the Hall effect thruster

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Plasma transport phenomena in the SPT and TAL Hall effect thrusters was a subject of many studies [1-2]. Despite this fact, the origin of a so-called anomalous transport is not understood to this date. As a result, in the theoretical and numerical models [3] researches assume ad-hoc cross-field diffusion coefficients, which may differ by several times from the classical Bohm result.

To study the transport phenomenon we develop several models. The first model is 2-dimensional in space (for axial and azimuthal directions), but 3-dimensional in velocity. A similar geometry was adopted in references [4-5], but we try to push the simulation to the realistic scale (several centimeters), while keeping the minimum spatial resolution on the order of the Debye length.

The next model is 3D in space. Because of numerical limitation the geometry of the thruster is idealized. However, we will account for the radial inhomogeneity, including important wall effects like self-consistent sheath structure, etc. To overcome the limiting restrictions of the particles-in-cell method on spatial/temporal scales [6], we'll try applying the implicit method [7] to the 3D simulations, to make simulations relevant to the Hall thruster plasma conditions.

It is hoped that the numerical results will provide a better understanding of the anomalous transport in Hall thrusters due to the collective modes, shed light on the nature of the observed high-frequency oscillations, and give an incentive on how to suppress them.

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