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DISCHARGE INSTABILITY IN APPLIED FIELD MAGNETOPLASMADYNAMIC THRUSTERS

Abstract

The discharge instability related to the "onset" phenomenon is a key factor restricting the propulsion performance of the magnetoplasmadynamic thruster (MPDT). In the past few decades, although a lot of experimental and theoretical researches on the instability have been carried out, so far, no clear physical explanation of this instability has been reached. In order to reveal the physical nature of the discharge instability of the applied field MPDT, a particle simulation method is used to establish a tangential-radially simplified discharge model in the cross section of the thruster. And characteristic parameters such as electric field disturbance and momentum change describing the plasma instability are obtained. By analyzing the evolution of the electron and ion momentum components, it is considered that the instability will reduce the rotational energy of plasma, and then hinder the conversion efficiency from electrical energy to kinetic energy. The results show that there are three different oscillation frequencies, including plasma electron frequency, electron cyclotron frequency and electron cyclotron drift frequency. Due to the drift motion of the plasma in the EB cross-field, an electrostatic drift wave is generated in the plasma of the applied field MPDT, which ultimately results in the electron cyclotron drift instability.