Global modes of gradient drift instability in Hall plasma thruster

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Plasma in coaxial Hall thrusters is subject to a lot of instabilities driven by azimuthal $\mathbf{E} \times \mathbf{B}$ electron flow [1, 2]. Such instabilities directly affect the operational capabilities of plasma thrusters due to their impact on anomalous electron mobility across the external magnetic field [1, 3, 4]. In this paper the instability analysis of global electrostatic modes in inhomogeneous partially magnetized plasmas (unmagnetized ions and magnetized electrons) is performed in the framework of two fluid model. The eigenvalue equation, including the effects of electron inertia, gradients of plasma density and magnetic field, along with the shear of equilibrium electron flow, is derived and numerically solved for the Hall thrusters specific values and axial profiles of external magnetic field and plasma parameters [5]. The obtained solutions are compared with the results of local stability analysis, predicting the existence of the long-wavelength instability in the near-anode region of thruster channel [6]. It is shown that the characteristics and the structure of unstable eigenmodes strongly depend on the geometry of the thruster. For some ratios of the acceleration channel length to its radius the instability can be fully stabilized.

References

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