
Cross-field anomalous chaotic transport of electrons by ExB electron drift instability

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Abstract

Many plasma devices involve perpendicular, static, electric and magnetic fields. In Hall thrusters, electrons are magnetized while ions are unmagnetized, and the ExB electron drift instability generates low frequency electrostatic waves.

A model calculation is presented to characterize the cross-field transport of electrons. In presence of these low frequency electrostatic waves, the electron dynamics becomes chaotic and generates stochastic webs, in which the transport is of anomalous sub-diffusive type.

Electrons gain energy from these background waves, leading to a significant increase in their temperature along the perpendicular direction (up to 4 times the parallel temperature) and an enhanced cross-field electron transport along the thruster axial direction. It is shown that the wave-particle interaction induces a mean velocity of the electrons along the axial direction, which is of the same order of magnitude as seen in experimental observations.

1. D. Mandal, Y. Elskens, N. Lemoine and F. Doveil, Phys. Plasmas 27 (2020), DOI: 10.1063/1.5134148, arXiv : 1911.03556.
2. D. Mandal, Y. Elskens, X. Leoncini, N. Lemoine and F. Doveil, to be published.

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