The electron cyclotron drift instability: thruster studies and physical interpretations

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The electron cyclotron drift instability (ECDI) has been studied in various contexts since the 1970s, including collisional shocks and θ-pinch devices[1, 2, 3]. In recent years, its role as a likely contributor to anomalous electron current in Hall thrusters was made evident in PIC (particle-in-cell) numerical simulations performed by Adam, Héron and Laval[4]. This work was the first to establish a clear link between the presence of a particular thruster instability and the anomalous electron current. PIC simulation efforts were also later pursued by Coche and Garrigues[5].

The existence of the instability in the Hall thruster plasma was confirmed in recent years by special coherent Thomson diagnostic measurements[6]. Combined experimental and theoretical studies[7,8] on the mode have provided detailed insights regarding its features. Subsequent PIC studies[9] have also provided an improved understanding of subtle effects, including the interaction between the instability and electron wall emission.

This talk discusses experimentally-determined insights into the ECDI and the relationship between such results and numerical studies in axial-azimuthal and radial-azimuthal geometries. The broader challenges associated with determining the level of electron current attributable to this instability, in the light of recent results, are discussed.

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