An overview of instabilities capable of inducing cross-field transport in low -temperature, partially magnetized discharges

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An overview is presented of select plasma instabilities capable of inducing cross-field electron transport in two types of plasma devices, the Hall effect thruster and the Penning discharge. In most cases, the cross-field electron current in these devices---the current in the direction of the applied electric field---is orders of magnitude higher than what can be explained by classical effects such as interspecies collisions. This suggests that there are other, non-classical mechanisms that dominate this process. A fluid-formalism is presented that demonstrates how propagating modes with a wavevector component in the Hall direction can induce enhanced cross-field electron current. A summary is then presented of plasma instabilities that both satisfy this criterion and have been experimentally-observed in these low-temperature devices. These instabilities are examined in the context of their dispersion relations, stability criteria, numerical simulations, and experimental observations. Where applicable, data is also presented on the magnitude of current that these instabilities can conduct in the cross-field devices. Special attention is paid to two of the most popular modes currently being examined in the Hall thruster community: large-scale spoke-like oscillations and short length scale turbulence.