Abstract Submitted
for the GEC16 Meeting of
The American Physical Society

Theory for the anomalous electron transport in Hall-effect thrusters[1] TREVOR LAFLEUR, LPP Ecole Polytechnique, and Centre National d'Etudes Spatiale (CNES), SCOTT BAALRUD, Department of Physics and Astronomy, University of Iowa, PASCAL CHABERT, LPP Ecole Polytechnique — Using insights from particle-in-cell (PIC) simulations, we develop a kinetic theory to explain the anomalous cross-field electron transport in Hall-effect thrusters (HETs). The large axial electric field in the acceleration region of HETs, together with the radially applied magnetic field, causes electrons to drift in the azimuthal direction with a very high velocity. This drives an electron cyclotron instability that produces large amplitude oscillations in the plasma density and azimuthal electric field, and which is convected downstream due to the large axial ion drift velocity. The frequency and wavelength of the instability are of the order of 5 MHz and 1 mm respectively, while the electric field amplitude can be of a similar magnitude to axial electric field itself. The instability leads to enhanced electron scattering many orders of magnitude higher than that from standard electron-neutral or electron-ion Coulomb collisions, and gives electron mobilities in good agreement with experiment. Since the instability is a strong function of almost all plasma properties, the mobility cannot in general be fitted with simple $1/B$ or $1/B^2$ scaling laws, and changes to the secondary electron emission coefficient of the HET channel walls are expected to play a role in the evolution of the instability.

[1]This work received financial support from a CNES postdoctoral research award.

Trevor Lafleur
LPP Ecole Polytechnique, and Centre National d'Etudes Spatiale (CNES)

Date submitted: 27 Apr 2016 Electronic form version 1.4