Abstract Submitted
for the DPP14 Meeting of
The American Physical Society

Gradient Drift Instabilities in Two Dimensional Hybrid Hall Thruster Simulations[1] JACOB ALEY, CALEB DOWDY, EDUARDO FERNANDEZ, Eckerd College — Instabilities triggered by a variety of mechanisms have been theoretically predicted for Hall thruster plasmas. Experimentally, fluctuations spanning a wide range of frequencies and wave numbers have been observed. Perhaps more importantly, fluctuations have been postulated to play a role in regulating cross-field electron transport in Hall thrusters. However, a clear understanding of what instabilities are responsible for such transport is presently lacking. In this work we focus on analysis of long wavelength gradient drift instability in the Hall thruster via two dimensional hybrid fluid-PIC simulations that resolve azimuthal dynamics. Recent theoretical analysis by Frias[2] et al. shows that previous stability criteria for drift instabilities are modified due to compressibility of the electron flow. In our simulations, we test this improved criterion by examining the transient waves that emerge in the simulation from a smooth initial condition. The simulations give good agreement with the theory, both in the frequency/growth rate characteristics of the waves as well as the region of the thruster where such disturbances are predicted to emerge. These results suggest that gradient drift instabilities play a significant role in Hall thruster plasmas.

[1]Jacob Aley, Caleb Dowdy, and Eduardo Fernandez are supported by a grant from the II-VI Foundation.
[2]Winston Frias, Andrei I. Smolyakov, Igor D. Kaganovich, and Yevgeny Raitses, "Long wavelength gradient drift instability in Hall plasma devices. I Fluid Theory," Physics of Plasmas 20, 072112 (2012).

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Date submitted: 08 Jul 2014 Electronic form version 1.4