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Unified Hall Thruster Model for Studying Ground Facility Effects
LUBOS BRIEDA, Particle In Cell Consulting LLC, SAMUEL J. ARAKI, JUSTIN KOO, Air Force Research Lab - Edwards AFB — Hall thrusters are spacecraft propulsion devices that utilize a crossed electric and magnetic field configuration to ionize and accelerate propellant gas. The discharge chamber is open to the ambient environment, leading to the possibility that thruster behavior becomes affected by the downstream conditions. While this ground facility effect has been demonstrated repeatedly in the lab[1], numerical models of this influence are still lacking. The primary challenge is that Hall thrusters are generally modeled using a dual approach, in which one set of equations is used for the "device" region, while another set is used for the "plume". The coupling between the models is one directional, with the the device code feeding ions to the plume simulation. In this talk, we report on a recent effort to develop a unified Hall thruster model that captures both the device and the plume region. The model is based on an axisymmetric hybrid-PIC formulation, with particles used for the heavy neutrals and ions, and the fluid equations solved for the electrons[2]. The approach is demonstrated by simulating a generalized Hall thruster operating in a vacuum chamber. [1] Walker, M. Ph.D. Dissertation, U. Mich. 2005 [2] Geng, J., et. al, J. Ap. Phys, 114, 10, 2013

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