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3D particle-in-cell simulation of a Thruster Anode Layer[1]
WILLCA VILLAFANA, CERFACS / Safran Aircraft Engines, FRANCOIS PECHEREAU, CERFACS - now ONERA, OLIVIER VERMOREL, BENEDICTE CUENOT, CERFACS — Hall thrusters are becoming increasingly popular for the propulsion of satellites. These devices efficiently take leverage of charged particles speed to reduce propellant use, and subsequently cutting costs dramatically. Although such systems have been extensively studied, the detailed physics of the magnetized plasma in these thrusters is very complex and several plasma processes that have direct influence on the thruster performances and lifetime are still poorly understood. Among remaining issues, the anomalous transport of electrons in the near exhaust region needs to be addressed. Particle-in-cell (PIC) models have the capability to describe this phenomenon but their use in 3D real geometries is very challenging. We present here the AVIP-PIC code coupled with a Poisson solver to model the plasma dynamics in industrial 3D geometries using unstructured grids and parallel computing. An AVIP-fluid version also exists which is presented in a separate contribution. In this pap er, a thruster anode layer (TAL), that can be viewed as a compact Hall thruster is studied in real dimensions and compared to experiment. After a presentation of the code and simulation setup, results about the TAL are analyzed to demonstrate the capabilities of the 3D AVIP-PIC solver.

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