Kinetic Simulation of a Magnetized Plasma in an ECR Thruster

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Abstract:

Onera is currently developing a new concept of plasma thruster called ECRA for Electron Cyclotron Resonance Accelerator. It has the potential to overcome several limitations of the current generation of electric thrusters since it does not require grids or neutralizer. In the ECRA concept, the quasi-neutral plasma is heated up using microwaves thanks to the cyclotron resonance phenomenon and accelerated using a magnetic nozzle.

An advanced numerical code is under development at Onera to model the physical behavior of the thruster and improve our understanding of its design. It is an electromagnetic Particle-In-Cell (PIC) code coupled to a Monte-Carlo Collision module (MCC) and adapted to massively parallel architectures. The code dimensionality can be 1D, 2D or 3D, and it can be run with a pure MPI or a hybrid MPI/OpenMP parallelization. Among the key issues to understand in this research project we can found the heating and the non-local transport of magnetized electrons (electron mean free path greater than the source radius), and the effect of the coaxial chamber walls and the microwave coupling strategy in the thruster performance.

Keywords:

Particle-In-Cell; Magnetized plasma; Cyclotron resonance; Electric propulsion

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