

3-Dimensional Ion Optics Simulations using an IFE-PIC code

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ABSTRACT

Ion optics modeling is becoming an ever more important element in ion propulsion research and development activities. The nature of plasma flow in ion optics has rendered computer particle simulation as the preferred modeling method. The major challenge in applying the particle simulation method as a design tool for electric propulsion is to build up a code that is sophisticated enough so the complex geometry associated with a device can be modeled properly and yet computationally efficient enough so large-scale 3-dimensional particle simulations can be performed routinely within a reasonable time period. Complex geometries are usually handled by tetrahedral cells or unstructured grids and finite-element based formulations. However, a tetrahedral cells based or unstructured grid based particle code can be computationally prohibitively expensive. This paper discusses a new particle simulation code for ion optics. The model adopts a recently developed immersed finite element (IFE) method to solve the electric field. This new field solver is independent of the type of the grid used. This approach allows a detailed description of the geometrical feature of ion optics. At the same time, the simulations may be performed almost as efficiently as in a standard particle code. Simulation results will be compared with ground test results obtained for the NSTAR ion thruster.