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Far-field CFD simulations of a magnetic nozzle on a field-aligned mesh THOMAS MARKS, BENJAMIN JORNS, IAIN BOYD, University of Michigan — Magnetic nozzles are space propulsion devices in which a plasma expands along diverging magnetic field lines, accelerating to produce thrust. Unless it at some point detaches, the plasma would follow the closed field lines of the nozzle, returning to the thruster and nullifying thrust. While it experimentally appears that detachment occurs in real devices, parts of this process remain poorly understood. For example, while it has been established that the heavier ions detach convergently (inward from the field lines), models predict the lighter electrons should detach divergently. This creates a current ambipolarity (CA) violation as electron and ions move in opposite directions. To explore if and how downstream current closure occurs and how it impacts thrust, there is a need to develop models with a larger experimental domain. The open-source CFD code SU2 was altered to model a magnetic nozzle, with all species treated as collisionless. A Jameson-Schmidt-Turkel scheme was employed for the fluxes, with a Runge-Kutta explicit scheme to advance time to steady state. The model confirms the presence of the downstream CA violation and shows that the resulting electric field pulls the ions outward and the electrons inward, increasing beam spread and decreasing thrust.

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