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Magnetic Nozzle Simulation Studies for Electric Propulsion ALFONSO TARDITI, NASA Johnson Space Center - ESCG — Electric Propulsion has recently re-gained interest as one of the key technologies to enable NASA's long-range space missions. Options are being considered also in the field of aneutronic fusion propulsion for high-power electric thrusters. To support these goals the study of the exhaust jet in a plasma thruster acquires a critical importance because the need of high-efficiency generation of thrust. A model of the plasma exhaust has been developed with the 3D magneto-fluid NIMROD code [1] to study the physics of the plasma detachment in correlation with experimentally relevant configurations. The simulations show the role of the plasma diamagnetism and of the magnetic reconnection process in the formation of a detached plasma. Furthermore, in direct fusion-propulsion concepts high-energy (MeV range) fusion products have to be efficiently converted into a slower and denser plasma jet (with specific impulse down to few 1000's seconds, for realistic missions in the Solar System). For this purpose, a two-stage conversion process is being modeled where high-energy ions are non-adiabatically injected and confined into a magnetic duct leading to the magnetic nozzle, transferring most of their energy into their gyro-motion and drifting at slower speed along with the plasma propellant. The propellant acquires then thermal energy that gets converted into the direction of thrust by the magnetic nozzle. [1] C. R. Sovinec et al., J. Comput. Phys. 195, 355 (2004).

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