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Integrity of the Plasma Magnetic Nozzle CRAIG WILLIAMS, NASA GRC, RICHARD GERWIN, Los Alamos National Laboratory, MICHAEL LAPOINTE, NASA MSFC — The efficient conversion of plasma thermal energy into directed thrust using a magnetic nozzle is an oft-stated assumption in high power interplanetary mission concepts. This paper analyzes certain aspects of plasma flow through a magnetic nozzle, in particular the integrity of the plasma-magnetic field interface for various operational parameters. An expression is derived for the initial thickness of the plasma-field interface. A comparison is made between classical resistivity and gradient-driven anomalous resistivity, from which interface thickening is derived as function of time. An expression for the plasma temperature, density, and velocity dependencies is derived and found to agree with classical resistivity at local plasma temperatures of around 200-eV. Macroscopic flute instabilities within the interface in regions of adverse magnetic curvature are discussed, and a growth rate formula for magnetic nozzle design is derived. Preliminary analysis indicates that only one to two e-foldings of the most unstable Rayleigh-Taylor mode will occur; a more complete treatment of the Rayleigh-Taylor effect will include the Hall effect and ion magnetoviscosity. The Hall effect is incorporated into Ohm's law, and a critical nozzle length expression is derived below which the interface thickness is limited to approximately one ion gyroradius.

Michael LaPointe
NASA MSFC

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