SIMULATION OF MINI-MAGNETOSPHERIC PLASMA PROPULSION (M2P2) INTERACTING WITH AN EXTERNAL PLASMA WIND

R. M. Winglee[1*], P. Euripides[1†], T. Ziemba[2‡], J. Slough[2*], and L. Giersch[2‡]

[1] Department of Earth and Space Sciences
University of Washington
Seattle, WA 98195-1650
winglee@ess.washington.edu

[2] Department of Aeronautics and Astronautics
University of Washington
Seattle, WA 98195-2400

ABSTRACT

Substantial progress has been made over the last year in the development of the laboratory Mini-Magnetospheric Plasma Propulsion (M2P2) prototype. The laboratory testing has shown that that the plasma can be produced at high neutral gas efficiency, at high temperatures (a few tens of eV) with excellent confinement up to the point where chamber wall interactions dominate the physics. This paper investigates the performance of the prototype as it is opposed by an external plasma acting as a surrogate for the solar wind. The experiments were performed in 5ft diameter by 6ft long vacuum chamber at the University of Washington. The solar wind source comprised of a 33 kWe arc jet attached to a 200 kWe inductively generated plasma source. The dual plasma sources allow the interaction to be studied for different power levels, shot duration and production method. It is shown that plasma from the solar wind source (SWS) is able to penetrate the field of the M2P2 magnetic when no plasma is present. With operation of the M2P2 plasma source at only 1.5 kWe, the penetration of the SWS even at the highest power of operation at 200 kWe is stopped. This deflection is shown to be greatly enhanced over that produced by the magnet alone. In addition it is shown that with the presence of the SWS, M2P2 is able to produce enhanced magnetized plasma production out to at least 10 magnet radii where the field strength is only marginally greater than the terrestrial field. The results are consistent with the initial predictions that kWe M2P2 systems would be able to deflect several hundred kWe plasma winds to produce enhanced propulsion for a spacecraft.