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Ion Acceleration Modes in a Miniature Helicon Thruster TIMOTHY A. COLLARD, FRANS H. EBERSOHN, J.P. SHEEHAN, University of Michigan — Operation and characterization of the CubeSat Ambipolar Thruster (CAT), a miniature helicon electric propulsion device, is presented. Its small plasma volume ($\sim$ 10 cm^3) and low power requirements (<100 W) make it ideal for propelling nanosatellites (<10 kg). Permanent magnets generated a magnetic nozzle with a maximum field strength of 800 G. This field decreased to 0.5 G, the strength of earth's magnetic field, within 50 cm allowing the entire exhaust plume to develop in the vacuum chamber without being affected by the chamber walls. A parametric study of the thruster operational parameters was performed to determine its capabilities as both a thruster and as a plasma source for magnetic nozzle experiments. Operating with xenon and argon, separately, the plasma density, electron temperature, and plasma potential in the plume were measured with Langmuir probes, double probes, and emissive probes. Two modes of operation were observed. At low flow rates ($\sim$ 5 sccm) the plasma was well collimated along the magnetic nozzle and produced beam ions in excess of 50 eV. At high flow rates ($\sim$ 25 sccm) charge exchange collisions disrupted the magnetic nozzle and no ion beam was observed.

J. P. Sheehan
University of Michigan

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