Ion-Energy Diagnostics in the Plasma Exhaust Plume of a Hall Thruster

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Of primary concern with the integration of Hall thrusters on conventional satellite designs is the possible damaging effect of high-energy exhaust ions impinging upon spacecraft surfaces. This paper reports on measurements of plasma ion-energy distributions within the plume of an SPT-100Hall thruster using a custom-designed molecular beam mass spectrometer. With this instrument ion energy was measured over a complete 360-deg circumference about the thruster at a radius of 0.5m from the exit plane and over a total inclusive arc of 260 deg at 1.0-mradius. These data uncovered the existence of high-energy ions departing the thruster at angles exceeding 90 deg from the thrust vector and continuing well into the backflow region of the plume. Through an analysis of the energy structure, the evidence of charge-exchange collisions occurring between plume ions and background neutrals was documented; such collisions produced anomalous distributions of ions having voltages greater than that applied to the thruster discharge.