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MAGNETOPLASMADYNAMIC ELECTRIC PROPULSION THRUSTER BEHAVIOR AT THE 27 MEGAWATT LEVEL – ISRO SPONSORED PROJECT

Abstract

Characteristic measurements were made of a hundred megawatt modified helium inverse pinch switch and compared against numerical modeling and theoretically expected behavior. Thruster voltage was measured for currents between three and three hundred kilo amps and for mass flow rates between 0.96 and 40 grams per second. From that, characteristic voltage, power, and resistance curves were generated. Electron temperature measurements made inside the plasma flow were found to be between three and thirty electron volts. General expected behavior, such as decreasing resistance with increasing mass flow rate, were confirmed. The quasi steady assumption was studied between 1.5 and 1.7 milliseconds and found to be appropriate. A theoretical model, based on normal MPD thrust behavior, was used to estimate fall voltages and pumping coefficients. An empirical model for thruster voltage was then created to estimate the behavior of voltage as a function of the similarity parameter. The two models were then put together and found to be self consistent with the experimental data. Total temperatures, specific impulses, and efficiencies for assumed isentropic nozzle expansion were then calculated.