

Instrument Design and Analysis for Diagnosis of a Hall Thruster Plume for the ETEEV Shuttle Experiment

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The Electric Thruster Environmental Effects Verification (ETEEV) experiment consists of in-space diagnostics of a hall thruster plume. The ETEEV experiment will be mounted on a Hitchhiker-pallet on board the shuttle. The purpose of ETEEV is to provide recommendations with respect to the effluent-spacecraft interactions and provide design parameters for future missions. The objective of this project is to design and test instruments at the MIT Space Propulsion Laboratory to obtain plume measurements for the ETEEV experiment. The designed diagnostic instruments include a faraday cup, an emissive probe, and a Langmuir probe. Performance measurements of the 200-Watt Busek Hall thruster will be presented. Furthermore, the design of the diagnostic instruments will be described and the results of the in-laboratory testing will be shown. Measurements of current density using a faraday cup will be presented. The existence of various faraday cup designs causes variability of current density measurements for a given hall thruster plume. Therefore, a faraday cup will be designed such that the current density measurements will be comparable to the computer simulation results developed at MIT. Thus, this will ensure the validation of the ETEEV experiment. Also, measurements plasma potential using a floating emissive probe will be presented. The floating emissive probe will be used to map the plasma potential of the plume by increasing the heating current and measuring the floating potential. In addition, measurements of electron density and electron temperature using a single-Langmuir probe will be presented. Finally, contamination and erosion studies will be performed using Quartz Crystal Microbalances (QCM) and the results will be shown.