Paper ID: 41232
student

24th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Small Space Science Missions (2)

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A CUBESAT SENSOR PLATFORM FOR ATMOSPHERIC ENTRY AEROTHERMODYNAMICS

Abstract

Thermal protection systems on spacecraft for atmospheric entry are currently designed with significant margins due to uncertainties in chemical reaction rates for transitional and continuum flight regimes. These margins substantially increase cost and mass for missions. Ground based testing of these regimes is currently extremely difficult, due to the high-enthalpy, low density nature of the flows. As a result, the most effective method for obtaining this flow data is through flight testing. While past missions have attempted to obtain this information, none have successfully provided data for a non-ablative vehicle traveling at orbital velocities in the upper atmosphere. This work describes the Purdue Sensor Payload (PSP) for the Student Aerothermal Spectrometer Satellite of Illinois and Indiana ($SASSI^2$). This undergraduate designed 3U CubeSat will specifically target Nitrogen and Oxygen dissociation and Nitric-Oxide production rates during reentry. The CubeSat includes three spectrometers, five heat flux sensors, and three pressure sensors. The PSP, comprised of the heat flux and pressure sensors, will determine bulk flow properties. When coupled with the spectral intensities provided by the spectrometers, the chemical reaction rates in the flow can be determined. This information will enable the design of more efficient thermal protection systems on spacecraft.