A DOUBLE HEMISPHRECIAL PROBE (DHP) FOR IMPROVING SPACE PLASMA MEASUREMENTS.

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Over the past 50 years Langmuir probes have been the most frequently used instruments for in-situ measuring of space plasmas. Langmuir probes work by inserting a conducting electrode (sphere, cylinder, or plane) that is swept with bias voltages to collect currents, yielding a current-voltage (I-V) curve. Such an I-V curve yields the potential, temperature, and density of the plasma. However, even after decades of use, there are still challenges in the analysis and interpretation of Langmuir probe measurements. Due to ambient plasma interactions with the spacecraft (SC) and probes themselves, a localized plasma environment is often created around the probes that is different from the true ambient plasma. As a result, errors can be introduced in the derived plasma parameters.

We advance this technology with a Double Hemispherical Probe (DHP) to improve space plasma measurements in the following scenarios: i) low-density plasmas; ii) high surface-emission environments; iii) flowing plasmas; and iv) dust-rich plasma environments.

The DHP consists of two identical hemispheres that are swept with same bias voltages simultaneously. The current differences between the two hemispheres are used to characterize locally generated plasma around the probe, which effects on probe measurements are then removed or minimized. In this paper, probe in the SC sheath due to low-density plasmas is addressed. Low-density plasmas create large Debye sheaths around the SC that may engulf the Langmuir probe mounted at the end of a boom, causing mischaracterization of the ambient plasma.

Measurements of a lab DHP model at different locations in sheaths have been taken with various plasma conditions. Our results show that the ratio of the electron saturation currents of two hemispheres, as the probe is moved deeper into the sheath, can be correlated with the potential difference between the probe location and ambient plasma, divided by the Debye length, yielding a linear relationship that determines how deep the probe is in the sheath. Preliminary analyses show similar trends in the measured plasma parameters as a function of the sheath depth. These relationships will be established and used to derive true ambient plasma parameters from measured plasma characteristics in the sheath.