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Updates on the development of a Double Hemispherical Probe (DHP) for improving space plasma measurements

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Langmuir probes are an important instrument used for measuring space plasmas. However, due to interactions between ambient plasmas and the spacecraft as well as the probe itself, the local plasma conditions around a probe could be very different from the true ambient plasmas. These local plasma conditions are often anisotropic and/or inhomogeneous. A new type of directional Langmuir probe, the Double Hemispherical Probe (DHP), is currently under development to improve plasma measurements in the following scenarios: low-density plasmas; high surface-emission (photo and/or secondary electron emission) environments; flowing plasmas; and dust-rich plasma environments. The DHP consists of two identical hemispheres that are electrically isolated and swept with the same potential biases simultaneously. The differences between the current-voltage (I-V) curves of two hemispheres are used to identify and characterize the anisotropic/inhomogeneous plasma conditions created around the probe, which will be then removed or minimized to improve the data interpretation. A lab DHP model 4 mm in diameter has been built and tested in simulated spacecraft sheaths with various parameters. The results for deriving the true plasma conditions will be presented. A prototype DHP 5 cm in diameter has been built and tested in uniform plasmas, showing good results as expected. We will also show the results of a new coating material Iridium that minimizes the probe surface oxidation effects on the current collection in oxygen-rich plasma environments such as planetary ionospheres.