SPACECRAFT CHARGING AND SPACE ENVIRONMENT MONITORING SYSTEM USING DISTRIBUTED LANGMUIR PROBES AROUOND THE DEEP SPACE GATEWAY.

Aroh. Barjatya. (Embry-Riddle Aeronautical University, Physical Sciences Department, 600 S. Clyde Morris Blvd, Daytona Beach, FL 32114 (Other authors will likely be included if the abstract is chosen for presentation)

Abstract: One of the critical elements of any space habitat, in low earth orbit or deep space, is a monitoring system for spacecraft floating potential as well as space environment in the vicinity of the spacecraft. Spacecraft floating potential (i.e. spacecraft charging) is critical on manned missions that involve extra-vehicular activity for astronaut safety. Floating Potential Measurement Unit (FPMU) aboard the International Space Station is a suite of Langmuir probe instruments that not only monitors the varying levels of spacecraft charging as the ISS enters and exits eclipse [1], but it is also an important long term tool to measure environmental parameters such as plasma density and temperature (see figure below)

Any deep space habitat needs to have a spacecraft potential measurement tool akin to FPMU on the ISS. A Langmuir probe type instrument installed on the deep space habitat would not only perform 'space science' by continuously measuring plasma density and temperature around the Moon as it orbits Earth, but also 'spacecraft science' by monitoring spacecraft charging as the habitat enters and exits the eclipse behind the moon. A critical understanding of varying floating potential of manned spacecrafts is necessary as future deep space manned missions leave the relatively safe confines of Earth's plasmasphere and magnetosphere. Additionally, unlike FPMU which is located at a single location on ISS, this tool should likely have 3 - 4 copies installed around the spacecraft to study wake effects and differential charging. In tenuous plasmas, such as what one may encounter in deep space missions, density in the wake might likely exceed densities in the ram direction [2, and references therein]. Langmuir probes have been miniaturized to fly aboard satellites as small as CubeSats [3]. Thus, operating 3-4 of these low power devices (less than 1 W each) distributed around the deep space habitat is a low cost way to monitor one of the vital parameters of spacecraft health: spacecraft charging. And plasma parameters (density and temperature) as observed by such a suite of instruments on the deep space habitat will be an important measurement of the cislunar environment, which is pertinent to heliophysics.

References:

[1] Barjatya A., C. M. Swenson, D. C. Thompson, and K. H. Wright, Jr., *Data Analysis of the Floating Potential Measurement Unit aboard the International Space Station*, Invited paper, Journal Cover, Review of Scientific Instruments., April 2009, DOI:10.1063/1.3116085.

[2] Albarran II, R. and A. Barjatya, *Plasma wakes for CubeSats in the Earth's Ionosphere* Journal of Spacecraft and Rockets, Vol. 53, No. 3 (2016), pp. 393-400

[3] Fish, C.S., C.M. Swenson, G. Crowley, A. Barjatya, T. Neilsen, et al, *Design, Development, Implementation, and On Orbit Performance of the Dynamic Ionosphere CubeSat Experiment Mission*, Space Science Reviews May 2014, Volume 181, Issue 1-4, pp 61-120

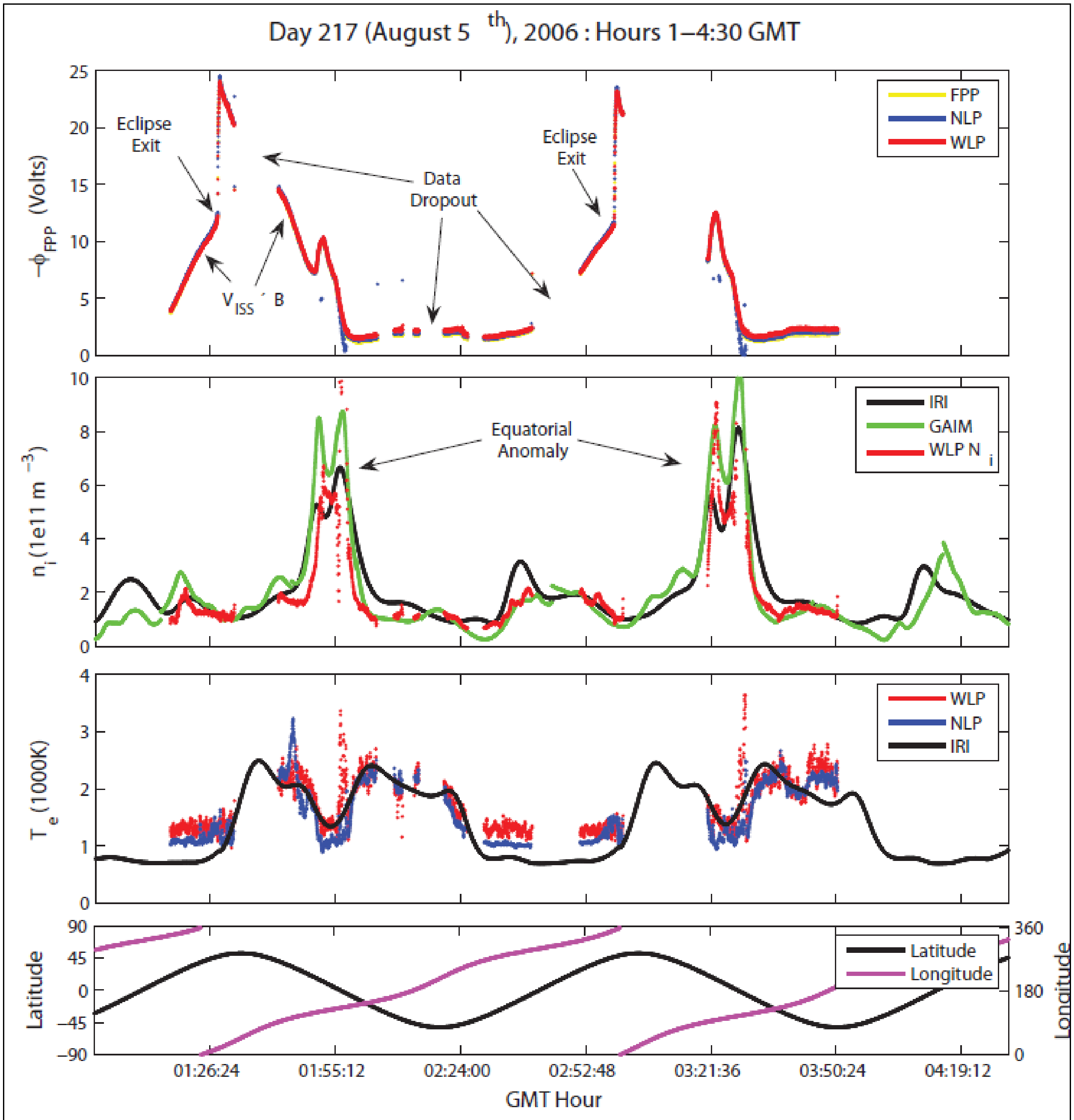

Fig. A two orbit dataset showing the floating potential of the International Space Station as observed by the FPMU suite of instruments: Wide Langmuir Probe (WLP), Narrow Langmuir Probe (NLP), and the Floating Potential Probe (FPP). The plasma density and temperature as observed by the WLP and compared with IRI and assimilative model such as GAIM is shown in rows 2 and 3. The last row shows the latitude and longitude of the orbital location. As can be clearly seen, the ISS floating potential changes by an order of magnitude, all while the ISS is inside the relatively safe confines of the Earth's plasmasphere. [from Barjatya et al 2009]