Project Title:
Spectral Characterization of the Hot Plasma Population at Geosynchronous Orbit Over an Entire Solar Cycle

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Project Information:
The geosynchronous orbital slot is heavily populated with commercial, military, and other governmental satellites. Unfortunately, the space environment at geosynchronous orbit is highly variable and often far from benign. One major environmental hazard in this region of the magnetosphere is surface charging, which occurs when satellites are immersed in the hot plasma originating in the tail plasma sheet. Recent work shows the importance of the shape of the ambient ion and electron energy distributions for determining the occurrence and amount of surface charging. Mitigating the effects of such charging (through design or through operational action plans) requires a good understanding of the extent of the hazard, i.e., a statistical characterization of the charging environment that captures the spectral properties that are directly related to surface charging. We propose to use the comprehensive and unique database of plasma measurements obtained over the last 12 years by Los Alamos Magnetospheric Plasma Analyzers on several geosynchronous satellites to perform such a statistical characterization. Guided by recent detailed charging analyses based on MPA data, we will perform multiple-population functional fits to MPA observations, and we will compute charging-relevant parameters based on actual distributions. The spectral properties and charging parameters will be analyzed statistically, as a function of orbital position, magnetospheric activity, phase of the solar cycle, etc. This will provide a statistical characterization that should be directly useful for the design of more reliable spacecraft systems. Identification of the multiple populations will enable a statistical assessment of the role of the different source/delivery processes that ultimately produce the charging environment. Finally, we will explore the use of novel feature-identification techniques to characterize the energy-time-domain signatures at multiple satellites to obtain statistical information about the delivery and acceleration of the plasma into the near-earth region.

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