High-Voltage Auroral-Zone Charging of Large Dielectric Spacecraft: A Wake-Induced-Barrier-Effect Mechanism

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ABSTRACT

The Shuttle Orbiter is likely to enter the auroral plasma during high-inclination missions such as the proposed WISP/OMV mission. The usual mechanism for high-voltage spacecraft charging involves the overcoming of secondary electron emission from spacecraft surfaces by an ambient electron distribution which contains mostly energies well above the secondary yield maximum. We discuss a different mechanism, which involves suppression of emitted-electron escape by a potential barrier downstream of the spacecraft, produced by unbalanced electron space charge in its wake. We obtain a tentative prediction that this mechanism can produce potentials roughly 100 V negative with respect to space, on downstream-facing Orbiter surfaces. Predicted potentials become more negative as spacecraft size increases. Shuttle tiles and spacesuit outer fabric have low enough photoelectron yields that daylight auroral-zone high-voltage charging appears possible for these materials. Essentially the entire content of this paper is contained in: J.G. Laframboise and J. Luo, High-Voltage Polar-Orbit and Beam-Induced Charging of a Dielectric Spacecraft: A Wake-induced Barrier Effect Mechanism, J. Geophys. Res. 94, 9033 (1989).

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