

# Statistical features of surface charging plasma environment in the medium earth orbit

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The spacecraft surface charging sometimes causes spacecraft anomalies due to electrostatic discharging (ESD). We study the surface charging environment in the medium earth orbit (MEO) using the Helium Oxygen Proton Electron (HOPE) data of the Van Allen Probes from 2012 to 2019. The severe charging (< -1 kV) events are only observed in the eclipse region because of the lack of the photoelectron emission mitigating charging and are induced by enhancement of hot (> ~10 keV) electron flux above 4 Re. These events show good correlations with geomagnetic activity indicated by the Kp and AE indices. The results show that the severe charging is induced by the hot plasma injection into the MEO at substorm. Before the severe charging events start, the integral flux of the low temperature (0.1 - 2 keV) electrons gradually increase tens of minutes before the enhancement of the hot electron flux and, after a while, the integral flux of the middle temperature (2-10 keV) electrons also gradually increase on the orbit. After the severe charging is induced, the ambient low temperature electrons are distracted by the spacecraft potential and their observed flux decreases. These suggest the plasma environmental features form the growth phase to onset of magnetospheric substorm for the severe charging events on the MEO.

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