Mapping the high energy particle flux of Earth (LEO and HEO) and their associated drift shells

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- 08:00 - 12:20
    - Moscone South - Poster Hall

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Abstract

As a fully autonomous star tracker, the micro Advanced Stellar Compass has been operating successfully on numerous satellite missions ranging from Low Earth Orbiters (e.g. ESA's Swarm) to Deep Space missions (e.g. NASA's Juno), accurately providing absolute attitude observations.

Besides its primary function of attitude determination, the µASC is also capable of detecting particles with energies high enough to penetrate its camera shielding, where particles passing the focal plane CCD detector leave detectable ionization tracks. For electrons, and the typical shielding employed, the minimum energy required to penetrate is >10MeV whereas protons will require an energy in excess of 80MeV. The signature of passing particle will only persist in one frame time, but the signature differs between electrons and protons. To ensure full attitude performance operations even during the most intense CMEs, the signatures are removed before star tracking. By counting the signatures, and using a model for the flux transport through the shielding, an accurate measure of the instantaneous high energy particle flux is achieved at each update cycle (250ms). With this feature installed on both LEO (Swarm) and HEO (MMS) spacecraft, an hitherto unprecedented accurate mapping of the high energy particle population is achieved.

In this work, we present the global flux distribution of particles, the radial variation in their associated drift shells. We further present the highly variable flux, with detailed profiling of the direction, associated with injection processes and their relaxation time scales.

Plain Language Summary

As a fully autonomous star tracker, the micro Advanced Stellar Compass (µASC) besides its primary function of attitude determination, is also capable of detecting particles. By counting the signatures of detected particles, an accurate measure of the instantaneous high energy particle flux is achieved. With this feature installed on both LEO (Swarm) and HEO (MMS) spacecraft, an hitherto unprecedented accurate mapping of the high energy particle population is achieved.

In this work, we present the global flux distribution of particles, the radial variation in their associated drift shells. We further present the highly variable flux, with detailed profiling of the direction, associated with injection processes and their relaxation time scales.

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