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Inner Radiation Belt Simulation during the Geomagnetic Storm Event of February 2022

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Abstract

In this work, we simulate the inner proton belt dynamics during the geomagnetic storm event of 3-5 February 2022, known as the "SpaceX" storm. The reason for the occurrence of this geomagnetic storm is the eruption of an M1.1 flare on January 29, which ended up as a shock-driving magnetic cloud (MC).

We developed a relativistic three-dimensional test particle simulation code to calculate the particle trajectories in the inner magnetosphere. We have implemented the guiding center Tao-Chan-Brizard model. The background electromagnetic field consists of a time-varying magnetic field generated by IGRF-13 and Tsyganenko Model TS05, with the associated inductive electric field computed by the Biot-Savart Law.

The numerical results elaborate on the inner proton belt variation during the three phases of the geomagnetic storm as well as the variation of the proton flux in the South Atlantic Magnetic Anomaly (SAMA).

Investigating the inner radiation belt dynamics during this magnetic storm event is essential to understand the consequent impacts on satellites.

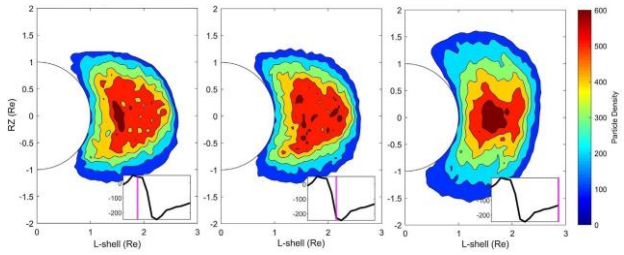

Figure 1: Inner proton belt simulation during the magnetic storm event of 15 May 2005 [Girgis et al., JSWSC (2021)]

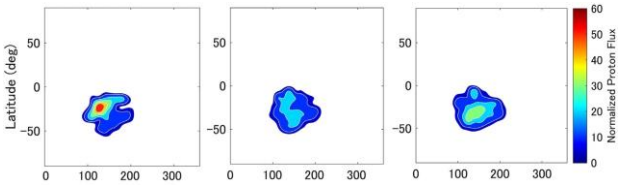

Figure 2: The corresponding proton flux in the South Atlantic Magnetic Anomaly (SAMA) region during the three magnetic storm phases [Girgis et al., JSWSC (2021)]

References

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