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DUAL SATELLITE SYSTEM AND MISSION ARCHITECTURE DESIGN AND VALIDATION FOR OPERATIONAL STUDIES OF EARTH'S VAN ALLEN BELTS

Abstract

Our Earth has always been a safe haven for us in our hostile universe. Sun being the second-generation star for our solar system, solar storms bring in energetic particle ejections at velocities exceeding 600 miles per second, interacting with Earth's magnetic sphere. This interaction with the coronal mass ejections protects the atmosphere of Earth. However, it would be quite feeble-minded of us to assume that there will be no effects of a phenomenon so powerful.

This project proposes a design of a dual satellite constellation mission to observe the charged particles in the belt qualitatively as well as their effects on the Earth. This system will provide real-time data of the Van Allen belts which have multiple future applications and will also provide a theoretical model for validation and further study with the help of the Salammbô Model.

Satellite 1, able to cover both inner and outer belts, further payloads with respective experiments is loaded into Satellite 2 concentrating on the widest topics of the third Van Allen Belt and the charge transition at the poles. Satellite 2 aims to contribute to the detailed study of anomalies in magnetic fields and particle transitions at the magnetic poles of Earth where the magnetic field lines appear to open out

into space as the curve tends to an infinite distance.

All the subsystems and payloads have been modeled through iterative trade studies, literature reviews, case studies, and analyzed using simulations and numerical methods. The entire mission is designed in a pattern to compute the data needed to perform different experiments using the carried payloads. The satellite models, multi-layer insulation systems, and orbits have been tested and simulated using software like GMAT, COMSOL Multiphysics, and Taitus Software- SaVoir. The expected outcomes of our experiment include resolving how extant high-energy charged particles within Earth's radiation belts are developed, their reaction towards the geomagnetic storms, a mathematical 3-D model of the belt, and evolution in reaching periods.