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Space Weather Prediction and Protection of Space Missions from Its Effects (3)

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MICRO-SATELLITE NETWORK TO MEASURE THE INTERPLANETARY RADIATION ENVIRONMENT (IRENE)

Abstract

With the rise of a new period of solar activity, interest is growing on the development of accurate forecasting of space weather and its effects. In order to accurately predict particle fluences at Earth or in other parts of the Heliosphere, in situ concurrent measurements of particle density, energy and direction are required at a number of locations. Recent modelling activities into the propagation of high energy particle populations at the University of Surrey and elsewhere have encountered problems with the quantity and quality of data available at locations away from 1AU due to the sparse coverage provided by the few spacecraft travelling on interplanetary trajectories in terms of energy, time and location. As such, these models must rely on extensive physical modelling to attempt to describe propagation mechanisms, however there remains very little data available to validate these results. In this paper, we present an overview of recent particle propagation modelling activities and highlight the issue of limited data availability. We propose a low cost, multi spacecraft micro-satellite mission to investigate the propagation of energetic protons and electrons originating from Solar flares and Coronal Mass Ejections (CMEs). The proposed mission would make use of a number of well instrumented small spacecraft in the 10-100kg mass range in elliptical heliocentric orbits in the ecliptic plane between 0.7-3AU. A number of mission variants are presented, including the use of orbital resonances in order to routinely locate spacecraft along Interplanetary Magnetic Field (IMF) lines in order to measure particles along these. A mission trade off analysis is presented for various mission parameters, including launch configuration, cost, power, data rate, etc. We also describe some high capability, low mass, low power radiation sensing instrumentation under development at the University of Surrey and elsewhere which could be used on this mission, and some possible secondary payloads which would make use of an extensive interplanetary monitoring network.