Project Details

ROSES ID: NRA-NNH04ZSS001N
Selection Year: 2005
Program Element: Focused Science Topic

Topic: To relate solar-energetic particles to their origin at the sun and inner heliosphere.

Project Title:
NUMERICAL STUDIES OF THE SOLAR ENERGETIC PARTICLE ACCELERATION USING A DYNAMICAL FIELD-LINE-ADVECTION MODEL COUPLED WITH A REALISTIC CME MODEL

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Summary:
Solar Energetic Particle (SEP) acceleration and transport is an issue of really vital importance, because SEPs produce radiation hazards. The manifold increase in the SEP fluxes after a Coronal Mass Ejection (CME) endangers human life and can destroy electronic devices on board manned or unmanned spacecraft that are not shielded by Earth s magnetic field. Despite some uncertainties, the available models for CME dynamics can reproduce some particular features in the CME observations, as well as the models for SEP acceleration can qualitatively explain some features in the SEP fluxes. Nevertheless, to construct a quantitative model which could explain and predict the fluxes observed in the Earth s proximity, a realistic model for CME dynamics, and a model for SEP acceleration, should be coupled together and combined with the model for dynamic interplanetary magnetic field and the solar wind to account for SEP transport from the Sun to the Earth. This project seeks funds to develop a global framework, including the MHD models of the Sun-heliosphere system, coupled with the realistic models for CME events, as well as the model describing the SEP acceleration and transport in a realistic magnetic field from the Sun to the Earth. Observational data from present (SOHO, ACE) and future (STEREO, SDO) NASA missions will be used to drive the models and to validate them accordingly. These data-driven models will then be used as the framework to investigate the physical processes that are responsible for the SEP fluxes observed at 1 AU from the Sun. These studies will provide an improved understanding of the physical coupling between the Sun, heliosphere, magnetic field topology, CME dynamics, and SEP acceleration processes. They will also be important for the development of advanced prediction tools for Space Weather. To accomplish our scientific goals, we will use the state-of-the-art computational technology developed at the University of Michigan, namely the three-dimensional global MHD code BATS-R-US, as well as the FLAMPA code modeling SEP transport and acceleration. Both codes are integral parts of the Space Weather Modeling Framework (SWMF). These tools are the most suitable for our purposes because their inclusiveness, robustness, and adaptive grid capability will allow us to explore the physical coupling of the Sun-heliosphere system over a wide range of length scales, the SEP acceleration up to relativistic energies, and transport from the Sun to the Earth. The proposing team consists of six scientists from the University of Michigan, University of Arizona and the Naval Research Laboratory that have the necessary computational, analytical, and observational expertise needed for the success of the proposed studies. This project is expected to improve our scientific understanding of the basic physical processes of importance for Space Weather. Thus, we expect the outcome of the proposed investigations to be valuable to NASA, the Sun-Earth Connection Program in particular, and to have an impact on the solar, heliospheric, and SEP communities. This project is relevant to LWS TR&T Program Objective T3d and we will coordinate with the Focused Team to target this objective. The proposed studies address the following OSS Themes, Science Objectives and RFAs: Goal I, Sun-Earth connection, RFA 1(a); and Goal II, Sun-Earth connection, RFA 1(a), 2(a), 2(b).

Publication References:

no references