Project Details

ROSES ID: NNH21ZDA001N-LWSSC
Selection Year: 2021
Program Element: Strategic Capability

Topic: A model of CME evolution and impact on the inner heliosphere

Project Title:
A Capability for Community Modeling of Solar Eruption Propagation and Particle Radiation

PI Name: Spiro Antiochos
PI Email: atn@g.ucla.edu
Affiliation: University of Michigan
Project Member(s):
- van der Holst, Bart;Co-I;University Of Michigan, Ann Arbor
- Sachdeva, Nishtha;Co-I;University Of Michigan, Ann Arbor
- Leka, KD;Co-I/Institutional PI;NorthWest Research Associates, Inc
- Arge, Charles N;Co-I;NASA Goddard Space Flight Center
- Lario, David;Co-I;NASA Goddard Space Flight Center
- Dahlin, Joel Timothy;Co-I;NASA Goddard Space Flight Center
- Barnes, Graham;Co-I;NorthWest Research Associates, Inc
- Gombosi, Tamas I;Co-I;University Of Michigan, Ann Arbor
- Sokolov, Igor;Co-I;University Of Michigan, Ann Arbor
- Tenishev, Valeriy;Co-I;University Of Michigan, Ann Arbor
- Manchester, Ward Beecher;Co-I;University Of Michigan, Ann Arbor
- Zhao, Lulu;Co-I;University Of Michigan, Ann Arbor
- Karpen, Judy;Co-I/Institutional PI;NASA Goddard Space Flight Center

Summary:
The University of Michigan in close partnership with NASA/GSFC and NWRA proposes to build and deliver to the CCMC the Strategic Capability SCEPTER (Solar Coronal Eruption Propagation to Earth with particle Radiation). SCEPTER will be built on four cornerstone models that the proposing team has developed and delivered to the CCMC over the past two decades: AWSoM a model for the background corona and heliosphere, EEGGL a model for solar eruption (CME/flare) onset and evolution, M-FLAMPA a toolkit for calculating energetic particle acceleration and transport along dynamic field lines, and AMPS a complete modeling suite for calculating either single particle or particle distribution evolution in time-varying E-M fields. SCEPTER will also be built on the unmatched record of success by the proposing team in delivering on schedule and as promised Capabilities to the CCMC, in full partnership with CCMC staff, and in making the models available to the community both through the CCMC and via a non-commercial open-source license for the source code on GitHub.

SCEPTER will meld these foundational models into one powerful capability with a single set of interfaces so that the user can select an eruptive event and study its complete life cycle including impact at Earth. To achieve this ambitious goal, we will make major upgrades to both the background and eruption models. We will add to AWSoM an innovative method that we have developed for aligning the magnetic field line and the fluid flow in the wind, so that the connectivity from the heliosphere to the Sun can be determined, thereby, enabling rigorous calculation of SEP fluxes along those lines. We will add to EEGGL options for initiating the eruption: by a TD fluxrope and by shearing flows and/or helicity condensation. The most dramatic upgrade for SCEPTER is that we will couple our widely-used model for flux emergence/cancellation with EEGGL. With this new model, EEG-2, SCEPTER will be truly transformational. It will allow the general community to study, for the first time, the pre-eruption energy buildup as determined by the physically self-consistent interaction of the photosphere/convection region with the corona. This new capability is also very timely, because the increased computational resources needed by the inclusion of emergence/cancellation match up well with the new dedicated allocations that the CCMC has received on NASA HEC architectures. In partnership with the CCMC we will develop interfaces and user manuals for running SCEPTER both at the CCMC's in-house resources and at the HEC Centers. To validate user results and achieve closure with NASA mission observations, SCEPTER will provide the tools to output from the simulations, synthetic data for all the relevant missions in NASA's Heliophysics System Observatory, including SOHO, STEREO, SDO, WIND, and ACE, as well as for PSP and SO when that mission data becomes accessible to the external community. To schedule and focus the model development we have selected four science investigations that we will perform and that will define the timing of the milestones and model delivery to the CCMC.

The SCEPTER program is clearly bold and ambitious, but the proposing team has all the science expertise and development experience for successfully carrying out this program. The PI Antiochos and Co-PI Gombosi have decades of proven leadership in both science and modeling advances. The Institutional PIs Karpen and Leka are leaders in observations and simulations of solar eruptions. SCEPTER build on the long-standing partnership between the three participating institutions and the CCMC in delivering major capability advances to NASA and the Heliophysics community.

Publication References:

no references