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The Dynamical Inner Heliosphere and the Space Radiation Environment

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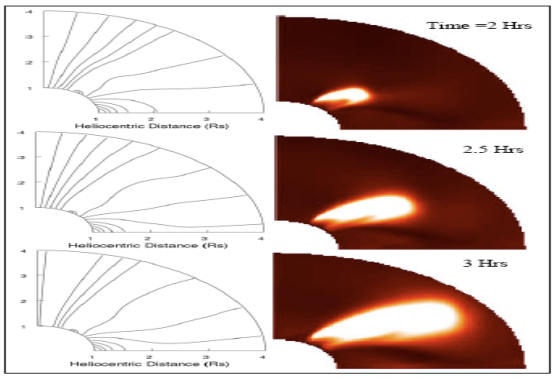

The evolution of magnetic field topology and transition of x-ray jet to CME (Zhang & Wu, 2009).

Research: By combining the collective expertise of the University of Alabama in Huntsville (UAH), NASA Marshal Space Center (MSFC), Alabama A&M University (AAMU), and an industrial partner EXPI, all located in Huntsville, AL, we propose to initiate the development of a physics based predictive model to describe the interplanetary radiation environment throughout the inner heliosphere, including at the Earth. To forecast and nowcast the radiation environment throughout the inner heliosphere, from the solar corona to ~10 AU, requires the fusing of three components: 1) the need to provide probabilities for incipient solar activity (both all clear forecasts and the when, where, and how strong for outbursts); 2) the ability to use these probabilities and daily solar coronal and solar wind observations to continuously model the 3D time-dependent heliosphere, including magnetic field structure, within 10 AU; and 3) the ability to model the acceleration and transport of energetic protons, electrons, heavy ions, and neutrals based on current heliospheric conditions. By developing a physics based radiation model, we will be in a position to transition it to an operational forecast and nowcast tool, positioning us to support 1) NASA's human health radiation research program, which is critical to reduce uncertainties in radiation effects and to better define radiation limits on future space flight; 2) The NOAA Space Weather Prediction Center (SWPC), which monitors and forecasts the space weather environment and works closely with the JSC Space Radiation Analysis Group (SRAG) and other operational NASA missions; 3) the NASA JSC SRAG which provides and coordinates operational support to human space flight; 4) Robotic missions, where the focus is on designing spacecraft to survive the space radiation environment, and for which operational support varies widely from project to project, and finally 5) ongoing defense needs. A successful outcome to this project will therefore significantly increase future research opportunities by opening up a large and varied potential customer base, both in research and in applications to government/federal, defense, and aerospace industrial needs.

Potential Impact: Four key elements make this proposal possible. The first is the enormous commitment to computational space physics made by the UAH, in hiring Science PI Zank and 6 new 50% faculty lines. The second is that the physics department at AAMU, an historically black university, has been building a space science program since 2001, hiring two junior space science professors in 2006, both of whom are integral parts of this proposal. Third, the immediate proximity (same building and shared office space) of the science PI and his research group with the NASA MSFC solar and space physicists is allowing us to develop important collaborative efforts in understanding the variable inner heliosphere and its radiation environment. The integral role of NASA MSFC personnel in developing solar coronal forecast tools and relating radiation models to space weather prediction are key elements of this proposal. Finally, Exploration Physics International Inc. (EXPI), a local Huntsville company classified as an Alabama Service Disabled Veteran-Owned small business (disadvantaged classification), has developed the first and only solar wind forecast models based on real-time space weather events, which will be used in this project.