# Project Details

**ROSES ID:** NNH14ZDA001N
**Selection Year:** 2014
**Program Element:** Focused Science Topic

**Topic:** Prediction of the Interplanetary Magnetic Field Vector Bz at 1AU

**Project Title:**
An investigation of solar energetic particles from poorly connected solar events by propagation through 3-dimensional interplanetary and coronal magnetic fields

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**Summary:**
We investigate SEP propagation in realistic 3d interplanetary and coronal magnetic fields. It is the first line of investigation for the determination of a connection between an observed SEP event to the timing and location of a source near the Sun. With this investigation, we can separate out the propagation effects from other aspects of the SEPs, such as particle acceleration process, magnetic structures of CME shock and solar flare. Our objectives are exactly the same as what the focus science team needs to achieve: (1) understand the longitudinal spread and timing of SEP enhancements, (2) understand the physics of particle transport in realistic coronal and interplanetary plasma and magnetic field structures, and (3) predict SEP hazards at any point in the inner heliosphere. We solve the 3d focused transport equation for particle propagation and acceleration that essentially includes all physical mechanisms of particle transport. To simulate any SEP event, we start with inputs of magnetic field and plasma configurations, properties of solar events, models of particle transport coefficients and possible calculations of SEP source distribution near the sun. Our product is a prediction of the time profile of SEP flux at any selected energies, pitch angles and locations. The results will be supplies to other team members for comparison with multi-spacecraft observations to determine their connection to SEP sources and to study the underlying physics producing the particles. In this way, we play a central role in the focused science team, because we bring to the team a proven capability of predicting particle intensity with 3d propagation effects included in all SEP data. We will continue our study using our successfully developed model of SEP propagation in the 3d interplanetary magnetic field with newer geometries or scenarios of SEP sources. We will also develop a new model of SEP propagation through the 3d coronal magnetic field from the low corona source sites to the solar wind source surface where our interplanetary propagation model starts. Special attention will be paid to assess the role and the magnitude of perpendicular diffusion and drift in the transport of SEPs in events with a wide longitudinal distribution and the role of lateral expansion of coronal magnetic field in spreading the particles. The model, software tools and gained knowledge from this investigation will eventually become valuable assets for space weather forecasting.

# Publication References:

**Summary:** no summary

**Reference:** Zhang, Ming; Qin, Gang; Rassoul, Hamid; (2009), Propagation of Solar Energetic Particles in Three-Dimensional Interplanetary Magnetic Fields, The Astrophysical Journal, Volume 692, Issue 1, pp. 109-132, doi: 10.1088/0004-637X/692/1/109

**Summary:** no summary

**Reference:** Qin, G.; Zhang, M.; Rassoul, H. K.; (2009), Prediction of the shock arrival time with SEP observations, Journal of Geophysical Research: Space Physics, Volume 114, Issue A9, CiteID A09104, doi: 10.1029/2009JA014332