

**Second Report of LWS TR&T Focus Science Team (Inner Heliosphere)
Submitted by O. C. St. Cyr
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This is the second progress report for the Living With a Star (LWS) Targeted Research and Technology (TR&T) Focus Science Team (FST) titled “Use Inner Heliospheric Observations to Better Constrain Coronal Mass Ejection (CME) and Solar Energetic Particle (SEP) Event Models” (short title: Inner Heliosphere). Proposals to this FST were submitted in October 2008, and the full text of the ROSES solicitation is provided in Appendix A of this report.

A successful second team meeting for this FST was held at HAO in Boulder, CO, on August 18-19, 2010. This report provides an overview of that meeting, including brief descriptions of the collaborative research topics that were identified in the initial 2009 team meeting. The report satisfies the requirements to inform NASA HQ annually of progress within the team. (St. Cyr’s funding commenced October 1, 2009, so Annual Progress Reports will be scheduled to coincide with that milestone.)

The second team meeting was scheduled to follow the Workshop on Advanced Computational Capabilities for Exploration in Heliophysical Science (ACCEHS), also held in Boulder at the NCAR Mesa Lab. Several of the team members also attended parts of ACCEHS.

Four of the six PI’s attended the meeting, as well as several collaborators and Co-Is. Dr. M. Guhathakurta from NASA HQ also attended. Members of this FST and the titles of their proposed investigations are shown in the table below.

Name	Attended 2^d Team Meeting?	Role	Proposal Title
O. C. St. Cyr	Yes	FST Leader, PI	Understanding Interplanetary Shock Dynamics in the Inner Heliosphere with New Observations and Modeling Techniques
H. Xie	Yes	Co-I	
N. Gopalswamy	Yes	Co-I	
H. Cremades	No	Collaborator	
D. Odstrcil	Yes	Collaborator	
L. Mays	Yes	Collaborator	

C. Ng	Yes	PI	Shock Acceleration and Transport of Solar Energetic Particles from the Corona to > 1 AU
T. von Rosenvinge	No	Co-I	
C. de Koning	Yes	PI	Single- and Multi-View 3D Localization and Analysis of Coronal Mass Ejections
V. Pizzo	Yes	Collaborator	
N. Sheeley	No	PI	Tracking CMEs Through the Inner Heliosphere
A. Vourlidas	Yes	Co-I	
A. Roulliard	Yes	Collaborator	
J. le Roux	No	PI	Modeling The Radial Dependence Of The Shock Acceleration Of Solar Energetic Particles From The Corona To Earth With A Time-Dependent Focused Transport Model
W. Manchester	Yes	PI	Simulating CME-Driven Shocks and SEP Acceleration
A. Vourlidas	Yes	Co-I	

The Agenda for the kick-off meeting is included in Appendix B. Each PI presented a progress report on their own proposed work in an informal workshop setting to foster discussion and understanding among team members. Some of the potential collaborations between FST members that had been identified and discussed at the first team meeting were presented as part of the individual presentations. For completeness, all those topics are documented in the table below, as well as new topics that arose during this meeting. At this stage, a grand unified problem enlisting full team participation has still not been identified. However, the team views the collaborative projects listed below as a significant start toward extending their own proposed research topics.

Short Title	Participants	Notes/Comments
Shock Pathways on Alfven Carrington Maps	Vourlidas, Ng, Manchester	April/August 2002 SEP events; Superpose Alfven speed on LASCO/STEREO CR density maps.
"Push" Streamers	Sheeley, Ng	Characterize "push streamers" (deflections) into the inner heliosphere (streamers vs pseudo) and SEP events; check in situ signatures; shocks crossing streamers vs pseudo-streamers? <i>Some progress reported by Roulliard at August 2010 team meeting.</i>
Shock vs CME Arrival Time	de Koning, Mays	Can the STEREO SECCHI full-resolution science data be used with the de Koning technique to show empirically the difference between the shock vs CME arrival time?
Field line random walk in the corona	Sheeley, le Roux	Does this phenomenon explain pseudo-streamers?
Ng (1994)	Roulliard, Ng	Is there any recent data inside 1 AU to examine the Ng et al. (1994) model that shows that observed SEP intensity saturates and SEP production reaches a plateau?; Helios/Messenger/Venus Express SEP instrumentation? <i>Investigated, but no satisfactory spacecraft data from the inner heliosphere was identified for studying SEP saturation events.</i>
J-maps	Sheeley, de Koning, Mays	Can the NRL J-maps (and the associated software tools) be used on STEREO beacon data to improve the prediction of CME arrival time? [Compared to deKoning's methods] <i>Some progress reported by de Koning working with RAL at August 2010 team meeting.</i>
NOAA STEREO	de Koning,	Compare the CME arrival time predictions for

beacon events I	Xie, Odstrcil	the NOAA STEREO beacon events with the ENLIL+cone+FluxRope model Some progress reported by de Koning at the August 2010 team meeting.
NOAA STEREO beacon events II	de Koning, Manchester	Compare the CME arrival time predictions for the NOAA STEREO beacon events with the UMichigan model
SEP Seed population	Ng, Xie, Gopalswamy	Are there relevant observations to guide modelers in choosing an SEP seed population?; e.g., repetition from same active region?; Interacting CMEs in the inner heliosphere?; Focus on the SOHO period (1997-1998?)
NEW TOPICS	DISCUSSED	AT AUGUST 2010 Team meeting
ENLIL Plasma Frequency Maps	Odstrcil	As a result of discussions within St. Cyr's team, this enhancement is being made to ENLIL
SWPC using STEREO beacon	de Koning	Transitioning the STEREO beacon CME localization techniques into SWPC
Synoptic maps	Vourlidas, Roulliard, and de Koning	Can the use of white light synoptic maps enhance the localization techniques?
New Solarsoft tool	Roulliard and Sheeley	Brief demo of a novel interactive tool combining remote sensing and <i>in situ</i> measurements as a f(t)

Team members agreed to provide a progress report on their own proposed work as well as on these collaborative topics at the next FST meeting. The third team meeting is tentatively scheduled for Winter/Spring 2011, location to be determined. A proposal was made by St. Cyr at the first team meeting to rotate through the PI's home institutions, and there was general agreement to this idea. The FST agreed to discuss at the next team meeting the possibility of a joint meeting with a related team (e.g., the 2006 SEP-related team led by Glenn Mason) at some point in the future.

Appendix A: ROSES Target Description

Target Description: The inner heliosphere remains a frontier that has been minimally explored. Thus far, only the Helios mission and Pioneer Venus Orbiter (PVO) have probed this region in any depth. Yet it is key to understanding what happens to Interplanetary CMEs (ICMEs) and their SEP-accelerating shocks in transit from the Sun to the Earth. Now Messenger and Venus Express are providing some new observations. In conjunction with the Solar TERrestrial RELations Observatory (STEREO), the Wind satellite, the Advanced Composition Explorer (ACE), and SOHO, these make a changing constellation of space weather measurements useful for investigating both the widths and the radial evolution of heliospheric space weather phenomena. Planning is also underway for Solar Orbiter/Sentinels and a Solar Probe mission will finally explore this inner frontier in more detail. These upcoming mission opportunities are best exploited if available measurements are used together with our increased understanding to obtain new insights.

Goals and Measures of Success: The goal is to provide observational validation for inner heliosphere models, as well as updated information for new mission instrumentation and observational strategies. Measures of success for this Focused Science Topic include the ability to predict the evolution of shocks in the inner heliosphere that are inferred from remote sensing close to the Sun and in-situ measurements at Mercury's orbit and beyond. This will require the characterization of coronal and solar wind properties into ~ 5 -10 Rs where ICME shocks are inferred to form. Observational and theoretical tests that resolve contested issues such as the importance of scattering in energetic particle transport, the mode(s) of acceleration at the shock, and the nature and origin of the heavy ion contributions to energetic particle populations are desirable consequences. Improved diagnostics of the physics of CME ejecta evolution and their solar wind interaction as they travel into the heliosphere, accelerating or decelerating and undergoing distortions as they travel, will aid future forecasting efforts and provide Sun-to-Earth event model constraints.

Types of investigations:

- Retrospective analyses with modern tools and models of solar wind properties, CME/ICMEs and their SEP events observed during the Helios mission;
- Multispacecraft analyses of events detected at Messenger and Venus Express that use Sun-to-Earth event models; and
- Analyses of 0.3-1.0 AU suprathermal ions from a SEP event seed particle perspective.

Appendix B: Agenda for Second Team Meeting (August 18-19, 2010)

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Wednesday, August 18, 2010 (HAO, Boulder)

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13:30 (St. Cyr) Welcome, introductions, HQ welcome, logistics, objectives

14:00 (Vourlidas/Roulliard) Proposed work and progress-to-date

15:00 (de Koning) Proposed work and progress-to-date

16:00 Break

16:15 (St. Cyr/Gopalswamy/Xie/Mays/Odstrcil) Proposed work and progress-to-date

17:30 Adjourn

19:00 Team dinner (Colterra Restaurant in nearby Niwot)

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Thursday, August 19, 2010 (HAO, Boulder)

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09:00 (Ng) Proposed work and progress-to-date

10:00 (Manchester/Vourlidas) Proposed work and progress-to-date

11:00 Discussion of collaborations, synergies, short-term goals, plans for future meetings

12:30 Adjourn