

charge state composition of these events will be discussed. Two classes of magnetospheric outflow have been identified, both occurring mainly under southward IMF conditions. First, in high speed solar wind streams, series of short bursts of magnetospheric ions can typically be observed on the time scale of Alfvénic fluctuations. Second, magnetic clouds of ICMs are linked to highly structured flux tubes of magnetospheric ions. Analysis of one of these events has revealed non-gyrotropic ion outflow from the magnetosphere along a reconnected field line during the main recovery phase of the Earth's ring current.

## SH51B-12 1150h

## Rapid Movements of the Earth's Bow Shock

Adam Szabo<sup>1</sup> (3012865726; Adam.Szabo@gscf.nasa.gov)

Jan Merka<sup>1</sup> (Jan.Merka@gscf.nasa.gov)

Thomas W Narock<sup>1</sup> (Tom.Narock@gscf.nasa.gov)

Joseph H King<sup>2</sup> (Joe.King@gscf.nasa.gov)

John D Richardson<sup>3</sup> (jdr@space.mit.edu)

<sup>1</sup>Laboratory for Extraterrestrial Physics NASA Goddard Space Flight Center, Code 696, Greenbelt, MD 20771, United States

<sup>2</sup>National Space Science Data Center NASA Goddard Spec Flight Center, Code 633, Greenbelt, MD 20771, United States

<sup>3</sup>Center for Space Research, MIT, Cambridge, MA 02139, United States

28 years of Earth bow shock crossings observed by the IMP 8 spacecraft between 1973 and 2000 have been compiled into a reference database. Each individual shock crossing is tabulated separately, rather than averaged together, allowing the systematic study of the location and motions of the bow shock over more than two solar cycles. The nearly circular IMP 8 orbit kept the observations near the same flank locations on both the dawn and dusk sides allowing meaningful comparisons over the years. The results of our systematic study will be presented showing the variability of the bow shock location as a function of the upstream solar wind parameters and their standard deviations. Moreover, dawn-dusk asymmetries largely due to the average orientation of the interplanetary magnetic field will be demonstrated. Also, wave analysis shows that for the cases when the bow shock was encountered many tens of times, a simple damped traveling wave does not fit the observations suggesting that the bow shock is continuously driven. These results suggest that the bow shock is very rarely in its steady state position, hence discrepancies with steady state model predictions are expected and the development of dynamic models becomes necessary. The upstream particle populations are also expected to be strongly influenced by the moving and accelerating bow shock.

## SH52A MCC: Hall D Friday 1330h

## Solar and Coronal Physics Posters

**Presiding:** S E Gibson, National Center for Atmospheric Research, High Altitude Observatory

## SH52A-0436 1330h POSTER

## Active regions as sources of the heliospheric field

Carolus J. Schrijver<sup>1</sup> (650 424 2907; schrijver@lmsal.com)

Marc L. DeRosa<sup>1</sup> (derosa@lmsal.com)

Alan M. Title<sup>1</sup> (title@lmsal.com)

<sup>1</sup>Lockheed Martin Advanced Technology Center, L9-41/252, 3251 Hanover Street, Palo Alto, CA 94304, United States

The magnetic field in the heliosphere originates from a variety of sources on the surface of the Sun, including mature, decaying, and decayed active regions, as well as sunspots. The emergence of new active regions together with the dispersal of flux from older active regions causes the coronal magnetic field topology to continually evolve, allowing previously closed-field regions to open into the heliosphere and previously open-field regions to close. Such evolution of the coronal field, together with the rotation of the Sun, drive space weather through the continually changing conditions of the solar wind and the magnetic field embedded within it. We combine observations and numerical simulations by assimilating SOHO/MDI magnetograms into a surface flux transport model, in order

to investigate the origins of the heliospheric field on the solar surface through the rising phase of the current activity cycle. We find that around cycle maximum, the interplanetary magnetic field (IMF) is typically rooted in a dozen disjoint regions on the solar surface. Whereas active regions are sometimes ignored as a source for the IMF, the fraction of the IMF that connects directly to magnetic plage is found to reach up to 30-50% at cycle maximum, with even direct connections between sunspots and the heliosphere. We further compare this data assimilation model with a pure simulation model, in which the properties of the emergent active regions were chosen at random from parent distribution functions measured for the sun. The two models show remarkable agreement in the temporal behavior of the sector structure of the IMF, in the magnitude and time-behavior of the heliospheric field, and even in such global properties as the tilt angle of the Sun's large scale dipole. We thus conclude that no additional flux-emergence patterns or field-dispersal properties are required of the solar dynamo beyond those that are included in the model in order to understand the large-scale solar and heliospheric fields.

## SH52A-0437 1330h POSTER

## A naturally driven reconnection mechanism for the solar corona

Giovanni Lapenta<sup>1</sup> (lapenta@lanl.gov)

Dana Knoll<sup>1</sup> (nol@lanl.gov)

<sup>1</sup>Los Alamos National Laboratory, MS: K717, Los Alamos, NM 87544, United States

Reconnection in the solar corona is believed to be important for a series of processes from flares and CMEs to coronal heating. However, theoretical understanding of the reconnection process still remains elusive. The reconnection rate predicted by the Sweet-Parker model is determined by resistivity and is very many orders of magnitude too small to explain the observations.

A possible mechanism that can provide fast reconnection rate is driven reconnection. When external flows drive field lines together, the rate of reconnection is determined by the driving mechanism and is independent of resistivity. In related works applied to the Earth's magnetopause [1], it has been shown that a Kelvin-Helmholtz instability (KHI) can cause local compressive motions that push field lines together and drive reconnection.

We propose here that the same mechanism could conceivably be at work in the solar corona. We propose that photospheric motions cause torsional Alfvén waves that propagate in the chromosphere and are amplified in the transition regions, emerging as sizable velocity shears in the solar corona. Simulation works have proposed that such shear can be amplified to a good fraction (e.g. 0.3) of the Alfvén speed [2]. The velocity shear injected in the corona can cause magnetic loops previously stressed by photospheric motions [3] to reconnect.

We have conducted a series of simulation to prove this scenario and to observe the properties of the reconnection process. We have shown that indeed reconnection can be achieved through local compression driven by the KHI and that the reconnection rate in that case is not sensitive to resistivity.

[1] Brackbill, J.U., Knoll, D.A., Phys. Rev. Lett., 86, 2329 (2001) [2] Kudoh, T., Shibata K., Ap. J., 514, 493 (1999) [3] Mikic, Z., Barnes, D.C., Schnack, D.D., Ap. J., 328, 830 (1988)

## SH52A-0438 1330h POSTER

## Chromospheric Waves Observed in HeI (1083 nm)- a Closer Look

Holly R. Gilbert<sup>1</sup> (303-497-1510; iggy@ucar.edu)

Thomas E. Holzer<sup>1</sup> (303-497-1567; holzer@ucar.edu)

<sup>1</sup>High Altitude Observatory/NCAR, P.O. Box 3000, Boulder, CO 80307-3000, United States

Although "Moreton" waves have historically been observed in H-alpha data, more recently waves have also been observed in chromospheric He I (1083 nm) images. In a previous study, we found that chromospheric waves observed in He I data (from the Mauna Loa Solar Observatory) in two events are co-spatial with the corresponding coronal waves observed by EIT (Fe XII 19.5 nm). In an effort to better understand the nature of chromospheric waves, we focus on these two wave events observed in He I in which two interesting phenomena occur: the waves are visible in the He I velocity data, and multiple waves are observed for each event. We suggest the velocity signal is a result of slow-mode wave compression followed by a slow-mode wave rarefaction in the chromosphere. We also suggest the observed multiple waves indicate more than one driving mechanism may be involved.

## SH52A-0439 1330h POSTER

## Correlations on Arcsecond Scales Between Chromospheric and Transition Region Structures in Active Regions

Bart De Pontieu<sup>1</sup> (1-650-424-3094; bdp@lmsal.com)

Ted Tarbell<sup>1</sup> (1-650-424-4033; tarbell@lmsal.com)

<sup>1</sup>Lockheed Martin Solar Astrophysics Lab, 3251 Hanover Street, O/L9-41, Bldg. 252, Palo Alto, CA 94304, United States

The discovery of active region moss, i.e. dynamic and bright upper transition region emission at chromospheric heights above active region (AR) plage, provides a powerful diagnostic to probe the structure, dynamics, energetics and coupling of the magnetized solar chromosphere and transition region (TR). Here we present an observational study of the interaction of the chromosphere with the TR moss, by studying correlations (or lack thereof) between emission at varying temperatures (or lack thereof) between the low chromosphere (Ca II K-line), to the middle and upper chromosphere (wings of H $\alpha$ ), to the low transition region (C IV 1550 Å at 0.1 MK), and the upper transition region (Fe IX/X 171 Å at 1 MK and Fe XII 195 Å at 1.5 MK). We use several datasets at high cadence (24 to 42 seconds) obtained with the Swedish Vacuum Solar Telescope (SVST, La Palma) and the Transition Region and Coronal Explorer (TRACE).

This correlation analysis from low chromosphere to upper TR in AR plage quantifies and considerably expands on previous studies. Our results elucidate various issues, such as: 1. how the heating mechanisms of the chromosphere and lower and upper transition region are related (if at all), 2. how important heating of spicular jets is for the energy balance of the lower TR, 3. the occurrence of significant periodic activity at all levels of the transition region and its coherence over a wide range of temperatures, 4. which time scales dominate the dynamic behavior of the AR transition region, and, 5. whether the spatial and temporal variability of moss can be used as a diagnostic for coronal heating.

## SH52A-0440 1330h POSTER

## Solar Cycle Variations of the F Corona Brightness Resulting from the Interaction of Dust Grains with CMEs

Brigitte Ragot<sup>1</sup> (bragot@astro.as.utexas.edu)

Stephen Kahler<sup>2</sup> (stephen.kahler@hanscom.af.mil)

<sup>1</sup>Astronomy Department, University of Texas, 2511 Speedway, Austin, TX 78712, United States

<sup>2</sup>Air Force Research Laboratory, Space Vehicles Directorate, 29 Randolph Rd., Hanscom AFB, MA 01731, United States

The density of interplanetary dust increases sunward to reach its maximum in the F corona, where its scattered white-light intensity dominates that of the electron K corona above about 4 Rs. We consider the effects of interactions between the dust and the particles and fields of coronal mass ejections (CMEs). The dominant forces, with and without CMEs, acting on the dust close to the Sun are calculated for dust grain radii ranging from 0.01 to 100 microns. Dust grain orbits are then computed to compare the drift rates from assumed grain injections at 5 Rs to lower orbits for periods of minimum and maximum solar activity, where a simple CME model is adopted to distinguish the two periods. The CMEs result in significantly shorter drift times of the large (> 3 microns) dust grains, hence faster depletion rates and lower dust grain densities, at solar maxima. This would explain a relatively strong (> 30%) solar cycle variation of the near infrared brightness close to the dust plane of symmetry. While trapping the smallest of the grains, the CMEs also help scatter in latitude the grains of intermediate size (0.1 to 3 microns). The consequences for the optical brightness should be a time variation correlated to the solar cycle, not to exceed 10% at high latitude with a better isotropy reached at solar maxima. Limits on the dust size spectra are set from the basic features of the optical and infrared brightness distributions and variations.

## SH52A-0441 1330h POSTER

## 3-DIMENSIONAL EVOLUTION OF A MAGNETIC FLUX TUBE EMERGING INTO THE SOLAR ATMOSPHERE

Tetsuya Magara<sup>1</sup> ((406) 994-7810; magara@solar.physics.montana.edu)

Dana W Longcope<sup>1</sup> ((406)994-7851; dana@physics.montana.edu)

<sup>1</sup>Montana State University, Dept. of Physics, EPS264, Montana State University, Bozeman, MT 59717, United States

We present results on the emergence of a magnetic flux tube into the solar atmosphere, obtained by 3-dimensional MHD numerical simulation. The simulation shows that emerging field lines can be classified as either expanding field lines or undulating field lines according to their evolution. Field lines that emerge with a large aspect ratio (the ratio of height to footpoint distance) simply continue to expand into the outer atmosphere, while field lines emerging with a small aspect ratio show an undulating behavior in the lower atmosphere. Those undulating field lines subsequently either expand into the outer atmosphere or sink toward the photosphere; in the latter case a dipped structure develops in the middle of field lines. For the field lines composing a twisted magnetic flux tube, the outer field lines are expanding field lines and the inner field lines are undulating field lines.

We analyze the injection of magnetic energy and magnetic helicity into the atmosphere during the simulated flux emergence. Each of the injection rates can be divided into contributions from horizontal shearing flows and vertical emergence flows at the base of the atmosphere. We find that the emergence contributions are the dominant ones at the early phase of flux emergence and that later that role is played by the shearing contributions. The emergence starts with a simple dipole structure formed in the photosphere, which is subsequently deformed and fragmented, leading to a quadrupole structure.

URL: [http://solar.physics.montana.edu/magara/Research/Research\\_info\\_3def.html](http://solar.physics.montana.edu/magara/Research/Research_info_3def.html)

#### SH52A-0442 1330h POSTER

##### The Sulfur Isotopic Composition of the Sun

Robert F. Wimmer-Schweingruber<sup>1</sup>  
([wimmer@physik.uni-kiel.de](mailto:wimmer@physik.uni-kiel.de))

George Gloeckler<sup>2</sup>

Peter Bochsler<sup>3</sup>

Thomas H. Zurbuchen<sup>4</sup>

<sup>1</sup>IEAP/Extraterrestriek, University of Kiel, Leibnizstrasse 11, Kiel 24118, Germany

<sup>2</sup>University of Maryland, College Park, College Park, MD 20742, United States

<sup>3</sup>Physikalisches Institut, University of Bern, Sidlerstrasse 5, Bern 3012, Switzerland

<sup>4</sup>University of Michigan, 2455 Hayward Street, Ann Arbor, MI 48109, United States

The Solar Wind Ion Mass Spectrometer (SWIMS) on the Advanced Composition Explorer (ACE) has successfully measured the isotopic composition of sulfur in the solar wind. Preliminary analysis yields  $^{34}\text{S}/^{32}\text{S} \approx (4.3 \pm 0.6)\%$  which is in good agreement with the meteoritic value of  $^{34}\text{S}/^{32}\text{S} = 4.43\%$ . As opposed to elemental composition which can be very accurately measured spectroscopically, the isotopic composition of sulfur on the Sun cannot be directly measured. Solar wind measurements are thus the only means of determining solar isotopic abundances. For refractory elements the meteoritic isotopic composition is thought to represent the solar composition very well. This has been verified with measurements of Mg and Si in the solar wind. In contrast to Mg and Si, sulfur is a volatile element, and as such is especially susceptible to processes that alter its isotopic composition, be it during the formation of the solar system, or during the history of the sample being studied. Thus the determination of its isotopic composition in the Sun can yield valuable information on the original sulfur isotopic composition in the protosolar nebula and on possible fractionation mechanisms active during the formation of the early solar system. We will compare the solar values of  $^{33}\text{S}/^{32}\text{S}$  and  $^{34}\text{S}/^{32}\text{S}$  with values derived from meteoritic samples, for the GCR, the interstellar medium, and from SEPs.

#### SH52A-0443 1330h POSTER

##### Particle Acceleration Associated with Three-Dimensional Fan Magnetic Reconnection

Yuri Litvinenko ([yuri.litvinenko@unh.edu](mailto:yuri.litvinenko@unh.edu))

University of NH, UNH Space Science Center, Durham, NH 03824, United States

Particle acceleration associated with three-dimensional magnetic reconnection is discussed. Orbits of charged particles in the current sheet located in the fan of a magnetic null point are described analytically in both nonrelativistic and ultrarelativistic limits. An orbit instability effect is identified, which limits the acceleration times and kinetic energy gains in the reconnection-related electric field. The results are discussed using exact MHD solutions for fan reconnection, discovered by I.J.D. Craig and co-workers. The use of an analytical self-consistent MHD solution to derive the magnetic field configuration near the

null point allows one to constrain local parameters in the magnetic reconnection region. As a consequence, simple conditions can be identified for effective particle acceleration in realistic reconnecting geometries. Applications to acceleration processes in solar flares are discussed.

#### SH52A-0444 1330h POSTER

##### Solar Radar

William A Coles (858 534 2703; [bcoles@ucsd.edu](mailto:bcoles@ucsd.edu))

University of California at San Diego, Electrical and Computer Engineering, MC 0407, La Jolla, CA 92093-0407, United States

Radar echoes from the Sun were first detected in 1959 at 25 MHz and an extensive set of measurements was made at 38 MHz between 1960 and 1969. The results were unexpected and could not be explained at the time. Interest in the technique waned and radar astronomy evolved to the use of higher frequencies so it became impossible to repeat the measurements. The early observations can be explained in the light of our present understanding of the corona. New radar observations, with correlative optical, UV, and soft X-ray observations, would be very useful in probing the corona near the origin of the solar wind.

Radar measures the range to the reflection point and the plasma velocity at the reflection point. Reflection occurs where the dielectric constant goes to zero, which is polarization dependent. Thus dual polarization observations provide estimates of the electron density, magnetic field, and velocity at the reflection point. Solar echoes can be observed at frequencies between 18 MHz and 100 MHz, corresponding to reflection heights between (roughly) 1.8 Rs and 1.15 Rs. It may be possible to operate up to 200 MHz and probe to the edge of the transition region.

Here we will review the early observations; explain their basic features; outline existing and potential opportunities for new observations; and speculate on the future development of the technique.

#### SH52A-0445 1330h POSTER

##### An Improved Calibration for Obtaining Intensity and Line-of-Sight Velocity Using MLSO/CHIP He I 1083 nm Observations.

J. A. Darnell<sup>1</sup> ((303)497-1541; [tdarnell@ucar.edu](mailto:tdarnell@ucar.edu));

A. L. Stanger<sup>1</sup> ([stanger@ucar.edu](mailto:stanger@ucar.edu)); T. E. Holzer<sup>1</sup>

([holzer@ucar.edu](mailto:holzer@ucar.edu)); D. F. Elmore<sup>1</sup>

([elmore@ucar.edu](mailto:elmore@ucar.edu)); H. R. Gilbert<sup>1</sup>

([igg@ucar.edu](mailto:igg@ucar.edu)); G. Detoma<sup>1</sup> ([detoma@ucar.edu](mailto:detoma@ucar.edu));

J. T. Burkepile<sup>1</sup> ([iguana@ucar.edu](mailto:iguana@ucar.edu))

<sup>1</sup>High Altitude Observatory/NCAR, P.O. Box 3000, 3450 Mitchell Lane, Boulder, CO 80307-3000, United States

A calibration technique has been developed utilizing normalized intensities measured at seven different He I filter positions which are used to infer the line-of-sight velocity of structures observed with the MLSO CHIP He I filter. To obtain He I intensity, the output from each of the seven filter positions are normalized to reflect only the photospheric continuum radiation and the He I 1083 nm absorption or emission line. Velocity is inferred from an application of these normalized intensities to an algorithm derived from an empirical analysis of synthetic spectra. Both the normalization technique and the application of the algorithm are presented as well as some example events.

URL: <http://mlso.hao.ucar.edu>

#### SH52A-0446 1330h POSTER

##### Indications and implications of twisted magnetic flux in the corona

Sarah E Gibson<sup>1</sup> (303 497 1587; [sgibson@hao.ucar.edu](mailto:sgibson@hao.ucar.edu))

Yuhong Fan<sup>1</sup> (303 497 1575; [yfan@hao.ucar.edu](mailto:yfan@hao.ucar.edu))

Rekha Jain<sup>2</sup> (0161 200 8771;

[rjain@suraj.phy.umist.ac.uk](mailto:rjain@suraj.phy.umist.ac.uk))

Boon Chye Low<sup>1</sup> (303 497 1553; [low@hao.ucar.edu](mailto:low@hao.ucar.edu))

<sup>1</sup>NCAR/HAO, 3450 Mitchell Lane, Boulder, CO 80307, United States

<sup>2</sup>Dept. of Physics, UMIST, Sackville St, Manchester M60 1QD, United Kingdom

The question of whether magnetic flux ropes are fundamental to CMEs and their precursors will be addressed using a combination of analytic and numerical models, along with coronal observations. We have developed computational tools for evaluating observable properties of modeled magnetic flux ropes suspended in

the corona, such as separatrix surfaces and dipped magnetic fields. We have also developed numerical models to demonstrate how a flux rope emerging into an overlying coronal magnetic arcade will relax to a force-free configuration, with associated formation of current sheets. Using the results of these two parallel studies, we will directly compare separatrix surfaces determined from an analytic (non-force-free) equilibrium model to the current sheets formed during numerical force-free relaxation of the same initial field configuration. We will then consider these in the context of observed X-ray sigmoid structures. We have also developed mathematical methods for determining the magnetic free energy in analytic models of both magnetic flux ropes, as well as sheared field configurations that contain no rope. We will compare the free energies thus determined for both sheared and twisted fields, as functions of spatial size, magnetic field strength, and degree of shear or twist. We will consider the implications of these results for the energetics of coronal mass ejections.

#### SH52A-0447 1330h POSTER

##### The properties of small magnetic regions on the solar surface and the implications for the solar dynamo(s)

Mandy Hagenaar<sup>1</sup> (650 354 5313; [hagenaar@lmsal.com](mailto:hagenaar@lmsal.com))

Carolus J Schrijver<sup>1</sup> ([schryver@lmsal.com](mailto:schryver@lmsal.com))

Alan M Title<sup>1</sup> ([title@lmsal.com](mailto:title@lmsal.com))

<sup>1</sup>Lockheed Martin, Org. L9-41, Bldg 252 3251 Hanover Street, Palo Alto, CA 94304, United States

We study a combination of previously published work on active regions and large ephemeral regions, complemented with an analysis of the photospheric magnetic field outside active regions, as observed in SOHO/MDI full-disk magnetograms taken from the most recent sunspot minimum in 1996 to about a year after sunspot maximum in 2001. We find that bipolar active regions that emerge onto the Sun's surface are part of a smoothly decreasing frequency distribution that spans almost 4 orders of magnitude in flux and 8 orders of magnitude in frequency. Distributions of emergence latitude and dipole orientation narrow from nearly uniform for the smallest observed ephemeral regions ( $\sim 5 \times 10^{18}$  Mx) up to narrowly distributed about the mean for the largest active regions (close to  $10^{22}$  Mx), while the emergence frequency increases smoothly and rapidly with decreasing flux. At the low end of the flux spectrum, the cycle variation in emergence frequency is at most a factor of 1.5, in *anti*phase with the cycle variation of close to an order of magnitude for the large active regions. We discuss a scenario in which the ephemeral regions with fluxes below  $\sim 30 \times 10^{18}$  Mx have their origin in a turbulent dynamo, largely independent of the global sunspot cycle. We confirm that the ephemeral regions are an important source of flux for the quiet magnetic network, in particular for the smallest scales; the larger scale patterns are dominated by flux dispersing from decaying active regions. A comparison of the flux-emergence rate with the network flux implies an overall mean replacement time for flux in quiet Sun of 8 – 19 hrs.

#### SH52A-0448 1330h POSTER

##### 3-Dimensional Density Model of the Solar Corona

David Foster<sup>1</sup> (303 497 1514; [dafoster@hao.ucar.edu](mailto:dafoster@hao.ucar.edu))

Sarah E Gibson<sup>1</sup> (303 497 1587; [sgibson@hao.ucar.edu](mailto:sgibson@hao.ucar.edu))

Tom Holzer<sup>1</sup> (303 497 1567; [holzer@hao.ucar.edu](mailto:holzer@hao.ucar.edu))

Madhulika Guhathakurta<sup>2</sup> (202 358 1992; [mguhatha@hq.gsfc.nasa.gov](mailto:mguhatha@hq.gsfc.nasa.gov))

<sup>1</sup>NCAR/HAO, 3450 Mitchell Lane, Boulder, CO 80307-3000, United States

<sup>2</sup>NASA Headquarters, 300 E Street SW, Washington DC 20546-0001, United States

We present a 3-D density model of the solar corona, determined from synoptic maps of Carrington Rotations 1942-3 (22 Oct. 1998 - 18 Nov. - 15 Dec. 1998). The rotations we have chosen include the time period of the SPARTAN 201-05 flight (Nov. 1-3, 1998), which had unprecedented spatial and temporal coverage of the white light corona. These rotations are also useful because they occur at a point in the solar cycle (ascending phase) that is complex enough to exhibit interesting 3-D structure, yet not so dynamic that a meaningful density model cannot be constructed using the rotation of the sun to provide the 3-D information. Along with SPARTAN data, we consider observations made by the Mark IV instrument in the Mauna Loa Observatory, and also SOHO/LASCO and EIT observations. Our analytic model, an extension of the axisymmetric model of Guhathakurta et al (1996), allows for multiple

streamers varying in both latitude and longitude, and explicitly treats nonradial streamers. Our 3-D model will be useful for testing analysis techniques for the upcoming STEREO mission. We will also compare its structure to magnetic field extrapolation models, coronal hole boundaries, and magnetic neutral lines.

#### SH52A-0449 1330h POSTER

##### Initial Results from the Cassini Solar Conjunction Faraday Rotation Experiment

Elizabeth A Jensen<sup>1</sup> (310-206-1208; firerock@alum.mit.edu); Mike K Bird<sup>2</sup> ((49) 228 / 73-3651; mbird@astro.uni-bonn.de); Martin Paetzold<sup>3</sup> (49 - 221 - 470 - 3385; paetzold@geo.uni-koeln.de); Sami W Asmar<sup>4</sup> (818-393-0662; sami.w.asmar@jpl.nasa.gov); John D Anderson<sup>4</sup> (818 354-3956; john.d.anderson@jpl.nasa.gov); Luciano Iess<sup>5</sup> ((39) 6-4458-5336; iess@hp.ifi.fra.cnr.it); Christopher T Russell<sup>1</sup> (310-825-3188; ctrussell@igpp.ucla.edu)

<sup>1</sup>UCLA, Dept of ESS 595 Charles E. Young Dr., E., Los Angeles, CA 90095, United States

<sup>2</sup>Uni. Bonn, Radioastronomisches Institut Auf dem Hgel 71, Bonn D-53121, Germany

<sup>3</sup>Uni. Koeln, Institut fr Geophysik und Meteorologie Albertus-Magnus-Platz, Koeln D-50923, Germany

<sup>4</sup>JPL, 4800 Oak Grove Dr., Pasadena, CA 91109, United States

<sup>5</sup>Uni. Roma "La Sapienza", Dipartimento Aerospaziale via Eudossiana 18, Roma 00184, Italy

On June 21, 2002 Cassini was in solar conjunction with the line of sight passing just below the south pole of the sun within 1 solar radii of the solar surface. Since Cassini carries both coherent X-band (8GHz) and Ka-band (32GHz) transponders, this conjunction can provide Faraday rotation measurements of the line of sight magnetic field close to the sun. Measurements of the left and right circular polarizations were carried out at Goldstone, California over an 11-day period centered on conjunction. Using a model of the coronal electron density we calculate the spatially averaged magnetic field from the Faraday rotation data with special attention to times of transient behavior. SOHO observations show several CME's crossing the Earth-Cassini line of sight during this interval.

#### SH52A-0450 1330h POSTER

##### Two wave morphologies in SOHO/EIT - EIT waves and Moreton waves

Douglas A Biesecker<sup>1</sup> (doug@sungrazer.nascom.nasa.gov)

Barbara J Thompson<sup>2</sup>

Hugh S Hudson<sup>3</sup>

Alexander Warmuth<sup>4</sup>

Stephen White<sup>5</sup>

<sup>1</sup>NOAA/SEC/RD r/sec, 325 Broadway, Boulder, CO 80305

<sup>2</sup>NASA/GSFC, Mail Code 682.0, Greenbelt, MD 20771

<sup>3</sup>UC Berkeley, Space Science Laboratory, Berkeley, CA 94720

<sup>4</sup>Astrophysikalisches Institut Potsdam, An der Sternwarte 16, Potsdam D-14482, Germany

<sup>5</sup>University of Maryland, Astronomy Program, College Park, MD 20742

EIT waves are global waves observed to propagate across quiet coronal field regions in the SOHO/EIT data. The waves are initiated in association with other transient activity. The literature now contains many references to EIT waves and observers have published observations of associated waves at a variety of wavelengths. We show in this poster that there is confusion in the literature as to what an EIT wave is. We use YOHKOH SXT, Nobeyama Radioheliograph and He I 10830A observations to show that the EIT instrument observes waves with two distinct properties and morphologies. These two morphologies correspond to the classical Moreton wave and to what we call the EIT wave. The Moreton waves in EIT appear as a sharp, bright feature, travelling at super-Alfvénic velocities. The EIT waves instead appear as a diffuse, faint feature, moving at relatively slower velocities. The EIT waves appear much more frequently than the Moreton waves and Moreton waves are usually seen in tandem with EIT waves. Both types of waves have been modelled by various researchers as MHD waves.

#### SH52A-0451 1330h POSTER

##### UVCS/SOHO Observations of Large Coronal Holes During Solar Cycle 23

Mari Paz Miralles<sup>1</sup> (617-496-7925; mmiralles@cfa.harvard.edu)

Steven R. Cranmer<sup>1</sup> (617-495-7271; scanmer@cfa.harvard.edu)

John L. Kohl<sup>1</sup> (617-495-7377; jkohl@cfa.harvard.edu)

<sup>1</sup>Harvard-Smithsonian Center for Astrophysics, 60 Garden St., MS-50, Cambridge, MA 02138, United States

The Ultraviolet Coronagraph Spectrometer (UVCS) aboard SOHO has been collecting spectroscopic data from numerous coronal holes as part of an ongoing campaign to determine the plasma properties of the solar wind acceleration region throughout the current solar cycle. The UVCS observations show marked variations of ion properties (in the acceleration region of the high-speed solar wind) in different types of coronal holes. We present empirical models for the physical properties of large coronal holes and the acceleration of the associated high-speed solar wind derived from ultraviolet coronagraphic spectroscopy. We discuss the role of solar cycle trends and the variation of ambient coronal-hole properties (e.g., magnetic field, geometry, density). We use these observations to test phenomenological models of coronal heating and solar wind acceleration.

This work is supported by NASA under Grant NAG5-11420 to the Smithsonian Astrophysical Observatory, by the Italian Space Agency and by PRODEX (Swiss contribution).

#### SH52A-0452 1330h POSTER

##### Mapping RHESSI footpoints with potential-field models

Lyndsay Fletcher<sup>1</sup> (lyndsay@astro.gla.ac.uk)

Hugh S Hudson<sup>2</sup> (510-643-0333; hhudson@ssl.berkeley.edu)

Thomas R Metcalf<sup>3</sup> (metcalf@lmsal.com)

<sup>1</sup>Department of Physics and Astronomy, University of Glasgow, Glasgow G128QQ, United Kingdom

<sup>2</sup>SSL, University of California, Berkeley, CA 94720, United States

<sup>3</sup>LMSAL, Lockheed Martin Solar and Astrophysics Laboratory, Palo Alto, CA 94304, United States

RHESSI hard X-ray observations help us to identify the locations of magnetically conjugate footpoints, and to study their apparent motions during the evolution of the impulsive phase of a flare. We put this information into the context of an M-class flare that occurred 2002 March 14 01:50 UT (GOES peak time) at S12, E23 (NOAA region 9866) by making potential-field mappings of the coronal magnetic structure. In principle the hard X-ray sources (plus the mapping) constrain the site of magnetic energy release, and the maps reveal the location of the stored energy. The RHESSI source centroids can be determined to better than 1'' (rms) for an M-class flare. This analysis is an exploration of the feasibility of such an approach, since full success would require understanding the magnetic restructuring in detail. If suitable X-class RHESSI flares occur we will be able to present data with better precision.

#### SH52A-0453 1330h POSTER

##### Five years of Yohkoh science nuggets

Hugh S Hudson<sup>1</sup> (510-643-0333; hhudson@ssl.berkeley.edu)

David E McKenzie<sup>2</sup> (mckenzie@solar.physics.montana.edu)

Nariaki V Nitta<sup>3</sup> (nitta@lmsal.com)

<sup>1</sup>Space Sciences Laboratory, University of California, Berkeley, CA 94720, United States

<sup>2</sup>MSU, Montana State University, Bozeman, MT 59717, United States

<sup>3</sup>LMSAL, Lockheed Martin Solar and Astrophysics Laboratory, Palo Alto, CA 94304, United States

The Yohkoh "science nuggets", weekly Web-based reports emphasizing current Yohkoh observations, began October 24, 1997. Many writers (the SXT "chief observers" in particular) contributed, and over the years a characteristic style developed: these were educational pieces rather than public-relations puffs, and they each attempted to describe a particular item for a technically savvy non-specialist. In this poster we summarize the nugget philosophy and point out some of our favorites, such as the remarkable "triple jet." This and many other interesting observations have not yet otherwise been published. Since December 2001 we have gradually broadened our science basis to include

SOHO, TRACE, and now RHESSI input. The topic index lists more than 60 categories, and there is a general search facility. We present this poster partly to encourage discussion of the future development of the series. URL: <http://solar.physics.montana.edu/nuggets/>

#### SH52A-0454 1330h POSTER

##### RHESSI Observations of the Motion of Coronal Hard X-Ray Source in 9 July 2002 Flare

Sharad R Kane<sup>1</sup> (925-648-7317; kkane@vsn.net)

Gordon J Hurford<sup>1</sup> (510-643-9653; ghurford@ssl.berkeley.edu)

<sup>1</sup>University of California, Berkeley, Space Sciences Laboratory, University of California, Berkeley, CA 94720, United States

The high energy spectroscopic imager aboard the RHESSI spacecraft images the Sun at photon energies from 3 keV to 15 MeV with high temporal, spectral and spatial resolution, and so is well suited to study the properties of energetic electrons in flares through the observations of the hard X-ray sources. Multi-spacecraft observations during the last solar cycle showed that flare-associated hard X-ray sources exist in the corona. Images of these sources were, however, not available. An opportunity to image a coronal source was provided by the 9 July 2002 (0905 UT) flare which apparently occurred in the Active region NOAA 0026 after it rotated off the west limb of the Sun. It is inferred that the flare was located about 12 degrees behind the west limb. Images of the 6-12 keV and 12-25 keV X-ray sources obtained by RHESSI during the early decay of the X-ray flare indicate that the height of the X-ray source above the photosphere increased from about 18500 km to 27000 km within a period of 10 minutes corresponding to an average speed of about 14 km/sec. Relationship of this motion to the overall flare process will be discussed.

#### SH52A-0455 1330h POSTER

##### Magnetic Helicity Injection by Horizontal Flows in the Quiet Sun: II. Self Helicity Flux

Brian T Welsch<sup>1</sup> (510 - 642 - 9650; welsch@ssl.berkeley.edu)

Dana W Longcope<sup>2</sup> (406 - 994 - 7851; dana@hale.physics.montana.edu)

<sup>1</sup>Space Sciences Lab, UC - Berkeley, Centennial Dr. at Grizzly Peak Blvd., Berkeley, CA 94720

<sup>2</sup>Dept. of Physics, MSU - Bozeman, EPS Bldg., Rm. 260 PO BOX 3840, Bozeman, MT 59717-3840

The helicity flux from winding motions in isolated, quiet-sun magnetic flux elements can be expressed as a sum of mutual-helicity flux (from the braiding of field lines from distinct elements), and a self-helicity flux (from the braiding of field lines in individual elements).

In a previous paper, we used a tracking algorithm applied to five sequences of high-cadence, high-resolution SOHO MDI magnetograms (each eight hours or longer) to quantify the quiet-sun mutual-helicity flux.

Here, we use the same data sets and tracking routines to quantify the quiet-sun self-helicity flux, from the time evolution of the quadrupole moments of individual magnetic flux elements.

No systematic injection of self-helicity from the quiet sun is obvious in our results, leading us to conclude that there is essentially no mean self-helicity flux from winding motions in quiet sun fields.

#### SH52A-0456 1330h POSTER

##### Comparison of the Coronal Magnetic Field Derived from PFSS and MHD Models

S. A. Ledvina<sup>1</sup> (510-643-1352; ledvina@ssl.berkeley.edu)

J. G. Luhmann<sup>1</sup>

Y. Li<sup>1</sup>

W. P. Abbett<sup>1</sup>

<sup>1</sup>Space Sciences Lab, University of California, Berkeley, CA 94720, United States

The coronal magnetic field determines many properties of the solar corona such as the location of the heliospheric current sheet and regions of high and low speed solar wind. Thus understanding the structure of the coronal magnetic field is crucial to the understanding of space weather. Several models use a synoptic map to derive the structure of the coronal field out to several solar radii. One such model is the potential

field source surface model (PFSS). This model neglects electric currents between the photosphere and a "source surface" (typically 2.5 Rs). At the source surface the field lines are forced to be radial in order to mimic the effects of the solar wind. In contrast MHD models try to self-consistently derive the coronal field and the plasma properties of the corona. We compare the coronal magnetic field structures derived by the PFSS and MHD models in order to understand what role dynamical effects may have on the field structure.

## SH52A-0457 1330h POSTER

## Flare Observations With the NOAA GOES-12 Solar X-ray Imager

Christopher C Balch<sup>1</sup> (303-497-5693; christopher.balch@noaa.gov)

Steven M Hill<sup>1</sup> (303-497-3283; shill@sec.noaa.gov)

Victor J Pizzo<sup>1</sup> (303-497-6608; vpizzo@sec.noaa.gov)

<sup>1</sup>NOAA Space Environment Center, 325 Broadway r/e/se, Boulder, CO 80305, United States

A new Solar X-ray Imager (SXI) was launched into geosynchronous orbit aboard the NOAA GOES-12 spacecraft on 23 July 2001. During the post-launch checkout period from late August through mid December 2001, an extensive set of flare observations was made by SXI. In this study we compare the SXI observations with the widely used GOES X-Ray Sensor (XRS) light curves to help us interpret GOES XRS data. In particular, we examine the location, brightness, and area of flares observed by SXI, and we investigate the statistical properties of these parameters, their time evolution, and their interrelationships with other flare parameters. We also consider the relationship of SXI flare parameters to other types of associated activity, such as coronal mass ejections.

## SH52A-0458 1330h POSTER

## Correction of Offset in the MDI/SOHO Magnetograms

Yang Liu<sup>1</sup> (1-650-724-5605; yliu@quake.stanford.edu)

Xuepu Zhao<sup>1</sup>

J. Todd Hoeksema<sup>2</sup>

<sup>1</sup>HEPL, Stanford University, 455 Via Palou, Stanford, CA 94305-4085, United States

<sup>2</sup>NASA, Code SR NASA Headquarters, Washington, DC 20546, United States

Shutter noise induces a shift of zero point in the full disk magnetograms taken by the Michelson Doppler Imager (MDI) onboard SOHO. In this paper, we suggest a method to remove this offset by using Gaussian function to fit distribution of strength of magnetic field. We also find a systematic error in 5-minute magnetogram that is sum of 5 individual magnetograms computed onboard; and this error can be corrected, too. Mean field and synoptic frame from corrected magnetograms show significant improvement. Synoptic chart is expected to be improved from systematic error in the individual data and/or from decrease of noise. This indicates that this correction is effective and necessary.

## SH52A-0459 1330h POSTER

## Active Region and Coronal Holes Sources of Solar Wind at Solar Activity Maximum

Paulett C Liewer<sup>1</sup> (818-354-6538; paulett.liewer@jpl.nasa.gov)

Marcia Neugebauer<sup>2</sup>

(marcia.neugebauer@jpl.nasa.gov)

Janet G Luhmann<sup>3</sup> (jgluhman@ssl.berkeley.edu)

Thomas Zurbuchen<sup>4</sup> (thomasz@umich.edu)

<sup>1</sup>Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109, United States

<sup>2</sup>Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ 85721, United States

<sup>3</sup>Space Sciences Laboratory, University of California, Berkeley, CA 94720, United States

<sup>4</sup>University of Michigan, Space Physics Research Laboratory, Ann Arbor, MI 48105, United States

Previous studies of the photospheric source regions of solar wind near solar maximum showed that solar wind comes from open flux in active regions as well as from the familiar coronal hole sources. To understand the relationship between solar wind sources and coronal magnetic structure, we compare the coronal hole and active regions solar wind sources as imaged in various wavelengths: He 10830 Å (the traditional coronal hole

diagnostic), EUV (SOHO EIT lines) and soft X-rays (Yohkoh). The various wavelengths presumably show closed loops of different temperatures and/or heights and we will compare the images with the coronal magnetic structure predicted by potential source surface models. The determination of the solar wind source regions were made using a two-step magnetic mapping of solar wind sampled at ACE and Ulysses to the photosphere (1). A solar wind source was labeled an active region source when there was no corresponding coronal hole in the He 10830 Å synoptic maps. Using ACE data, we also found that the solar wind from these active region sources generally has a higher Oxygen charge state than wind from the Helium-10830 coronal hole sources, indicating a hotter source region, consistent with the active region source interpretation. Further investigation of active region sources in the four Carrington rotations analyzed showed that, although no coronal hole is identified in the 10830 Å synoptic maps, often a dark lane or hole is seen in SOHO EIT or YOHKOH SXT images near the location of the active region source. We address the question of which wavelength synoptic maps are the best indicator of solar wind source regions.

(1) Neugebauer, M. et al. "Sources of the Solar Wind at Solar Activity Maximum," (JGR, in press, 2002)

URL: [http://online.itp.ucsb.edu/online/solar\\_c02/p\\_liewer/](http://online.itp.ucsb.edu/online/solar_c02/p_liewer/)

## SH52A-0460 1330h POSTER

## Inferring Subphotospheric Supergranular Flows by Time-Distance Helioseismology

Junwei Zhao<sup>1</sup> ((650)725-9549; junwei@quake.stanford.edu)

Alexander G Kosovichev<sup>1</sup> (sasha@quake.stanford.edu)

<sup>1</sup>Hansen Experimental Physics Laboratory, 455 via Palou, Stanford University, Stanford, CA 94305-4085, United States

Time-distance helioseismology has provided us a tool to investigate the interior structures and flow fields of the Sun. Combining the measurements from surface and deep-focusing schemes, we have attempted to derive the flow maps of supergranules by using the LSQR algorithm. The divergent horizontal flow fields are obtained near the surface, and there is evidence of converging flows below 12 megameters or so. The main difficulty is in inferring the vertical component of the flow field because of strong cross-talk between the horizontal divergence and the vertical velocity in the travel-time data. A Multi-Channel Deconvolution technique was also employed to derive the velocity fields, and the results agree well with those from LSQR inversion. We discuss the systematic and random errors of the measurements, and implications of the initial results for understanding the supergranular convection.

## SH52A-0461 1330h POSTER

## RHESSI Gamma-Ray Line Spectroscopy of the X-class Flare of July 23, 2002

David M Smith<sup>1</sup> (510-643-1585;

dsmith@ssl.berkeley.edu); Richard A Schwartz<sup>2,3</sup>;

Robert P Lin<sup>1,4</sup>; Gerald H Share<sup>5</sup>; Ronald J

Murphy<sup>5</sup>; Gordon Hurford<sup>1</sup>; Sam Krucker<sup>1</sup>;

Martin Fivian<sup>4</sup>; Lewis Hyatt<sup>4</sup>; Brian R Dennis<sup>2</sup>;

Nicole Vilmer<sup>6</sup>

<sup>1</sup>Space Sciences Laboratory, University of California, Berkeley, Berkeley, CA 94720, United States

<sup>2</sup>NASA Goddard Space Flight Center, Code 682, Greenbelt, MD 20771, United States

<sup>3</sup>SSAI, c/o NASA GSFC Code 682, Greenbelt, MD 20771, United States

<sup>4</sup>Department of Physics, University of California, Berkeley, Berkeley, CA 94720, United States

<sup>5</sup>E. O. Hulburt Center for Space Research, Naval Research Laboratory, Washington, DC 20375, United States

<sup>6</sup>Observatoire de Paris, 5 Place J. Janssen, Meudon 92195, France

The Reuven Ramaty High Energy Solar Spectroscopic Imager (RHESSI) is the first spacecraft with high-spectral-resolution germanium gamma-ray detectors to be dedicated to solar flare studies. We will report on RHESSI's first observation of a major gamma-ray line flare, the X4.8 limb flare of July 23, 2002. RHESSI observed nuclear de-excitation lines of Mg, Si, Ne, O, and C from this flare, plus the neutron-capture line at 2.223 MeV. There is evidence for redshifts and Doppler broadening of the de-excitation lines, as well as temporal variations of the line spectrum. We will discuss the implications of these observations for the spectrum, time variation, angular distribution, and composition of the accelerated ions and for the composition of the interaction region.

## SH52A-0462 1330h POSTER

## Gamma-ray Imaging of the 2002 July 23 Solar Flare

G. J. Hurford<sup>1</sup> (1-510-643-9653; ghurford@ssl.berkeley.edu)

R. A. Schwartz<sup>2</sup>

S. Krucker<sup>1</sup>

R. P. Lin<sup>3</sup>

D. M. Smith<sup>1</sup>

<sup>1</sup>Space Sciences Lab, University of California, Berkeley, CA 94720

<sup>2</sup>NASA-GSFC / SSAI, GSFC Code 680, Greenbelt, MD 20771

<sup>3</sup>Space Sciences Lab, Dept of Physics, University of California, Berkeley, CA 94720

Gamma-ray spectroscopy of nuclear line emission has provided the primary observational tool for the study of accelerated nuclei near the Sun. The Reuven Ramaty High Energy Solar Spectroscopic Imager (RHESSI), launched in February 2002, is an imaging-spectrometer which not only does high-resolution spectroscopy from 3 keV to 17 MeV, but also images gamma-rays with angular resolution as high as 35 arcseconds. This enables the emission sites of the 2.2 MeV capture line (from thermalized neutrons), of the Doppler-broadened, prompt gamma-ray continuum and of the hard x-ray continuum (from accelerated electrons) to be located within the flaring active region. Comparison of these locations can provide a new perspective on acceleration and transport processes.

The X4.8 limb flare of 23 July 2002 provided the first opportunity to observe solar gamma-ray lines with RHESSI. This paper presents the first solar gamma-ray images of the 2.2 MeV line and of the 4 to 7 MeV gamma-ray range which is dominated by excitation lines of C and O. The locations of these gamma-ray sources will be compared to those of the hard x-ray sources.

## SH52A-0463 1330h POSTER

## The Advanced Spectroscopic and Coronagraphic Explorer (ASCE) Mission Concept Study

John Kohl<sup>1</sup> (617 495 7377; jkohl@cfa.harvard.edu);

Russell Howard<sup>2</sup> (howard@louis14.nrl.navy.mil);

Joseph Davila<sup>3</sup> (joseph.davila@gssc.nasa.gov);

Giancarlo Noci<sup>4</sup> (noci@arcetri.astro.it); Larry

Gardner<sup>1</sup> (lgardner@cfa.harvard.edu); Dennis

Socket<sup>2</sup> (dennis.socket@nrl.navy.mil); Marco

Romoli<sup>4</sup> (romoli@arcetri.astro.it); Leonard

Strachan<sup>1</sup> (lstrachan@cfa.harvard.edu); Linton

Floyd<sup>2</sup> (floyd@susim.nrl.navy.mil); Steven

Cranmer<sup>1</sup> (scanmer@cfa.harvard.edu); John

Raymond<sup>1</sup> (jraymond@cfa.harvard.edu); Adriaan

van Ballegoijen<sup>1</sup>

(avanballegoijen@cfa.harvard.edu)

<sup>1</sup>Harvard Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138, United States

<sup>2</sup>Solar Physics Branch, Naval Research Laboratory, Washington, DC 20375, United States

<sup>3</sup>NASA Goddard Space Flight Center, Code 682, Greenbelt, MD 20771, United States

<sup>4</sup>University of Florence, Largo Fermi 5, Florence 50125, Italy

The ASCE Mission is currently in a Phase A feasibility study as a candidate for the upcoming MIDEX selection. The ASCE science payload provides next generation spectroscopic and polarimetric instrumentation aimed at identifying the physical processes governing solar wind generation and coronal mass ejections (CMEs). During the current phase, engineering design and analyses have demonstrated the feasibility of accomplishing the original mission objectives within the MIDEX mission constraints. The launch is planned for early 2007 and the operations and analyses are expected to continue for 5 years. ASCE data along with data analysis software and calibration data will be unrestricted and available to the scientific community via an automated web site. A Guest Investigator program is planned with an average of 15 grants running concurrently during 2008 to 2012. Grants would be awarded in response to proposals submitted during the first and subsequent years of the mission.

URL: <http://cfa-www.harvard.edu/asec/>

## SH52A-0464 1330h POSTER

## Vector Magnetic Field Measurement Capability of the Helioseismic and Magnetic Imager on SDO

Rock Bush<sup>1</sup> (650.723.8162; rbush@solar.stanford.edu); Philip Scherrer<sup>1</sup> (pscherrer@solar.stanford.edu); Jesper Schou<sup>1</sup> (jschou@solar.stanford.edu); Yang Liu<sup>1</sup> (yliu@solar.stanford.edu); Steven Tomczyk<sup>2</sup> (stomczyk@solar.stanford.edu); Jonathan Graham<sup>2</sup> (jgraham@solar.stanford.edu); Aimee Norton<sup>2</sup> (anorton@solar.stanford.edu)

<sup>1</sup>Stanford University, HEPL Annex B212, Stanford, CA 94305-4085, United States

<sup>2</sup>High Altitude Observatory, National Center for Atmospheric Research P.O. Box 3000, Boulder, CO 80307-3000, United States

The Helioseismic and Magnetic Imager (HMI) instrument has been selected as part of the payload complement of the Solar Dynamics Observatory Spacecraft. In this poster we describe the observing technique for measuring solar vector magnetic fields. The expected performance of the HMI instrument will be discussed including results of modeling the observing lines and instrument.

## SH52A-0465 1330h POSTER

## Correlation of RHESSI and TRACE Observations of the Rise Phase of the 21 April 2002 X1.5 Flare

Amir Caspi<sup>1,2</sup> (510-642-1397; cepheid@ssl.berkeley.edu)

Sam Krucker<sup>1</sup> (510-643-3101; krucker@ssl.berkeley.edu)

Robert P Lin<sup>1,2</sup> (510-642-1149; rlin@ssl.berkeley.edu)

<sup>1</sup>Space Sciences Laboratory, University of California, Berkeley, CA 94720-7450, United States

<sup>2</sup>Department of Physics, University of California, Berkeley, CA 94720-7300, United States

The X1.5 flare of 21 April 2002 was observed simultaneously by RHESSI and TRACE, and thus provides a great opportunity to correlate RHESSI findings with independent observations from another instrument. We begin by analyzing the thermal and non-thermal parts of the flare spectrum observed by RHESSI. We then use the temperature and volume emission measure obtained from fitting to predict the TRACE instrument response. We correlate these predictions with the observed TRACE flux at the flare site. Gallagher et al. (2002) state that TRACE showed EUV (195 Å) brightening some 4 minutes after RHESSI, but preliminary results indicate a small initial brightening in the 195 Å passband around 00:40 UT, at the same time as RHESSI, with the primary flux increase occurring around 00:44 UT. This roughly matches predictions of TRACE response based on RHESSI spectral data.

URL: <http://sprg.ssl.berkeley.edu/~cepheid/agu2002/>

## SH52A-0466 1330h POSTER

## Current Helicity of Emerging Active Regions

Alexei Pevtsov<sup>1</sup> (apevtsov@nso.edu)

Vasily Maleev (vasya@astro.spbu.ru)

<sup>1</sup>National Solar Observatory, PO Box 62, Sunspot, NM 88349

We employ the SOHO MDI magnetograms and EIT images to study evolution of current helicity of solar active regions during early stages of their emergence. Using longitudinal magnetograms we compute linear force-free fields  $\nabla \times \mathbf{B} = \alpha \mathbf{B}$  and compare extrapolated field lines with bright coronal structures to constrain the value of  $\alpha$ . At the beginning of emergence all studied regions have small  $\alpha \approx 0$ . As active region grows,  $\alpha$  gradually increases and reaches a "plateau" within approximately one day of emergence. Using change in separation between negative and positive fluxes, we divide regions on "slow" and "rapid" emergence. Three regions show "slow" (> 1 day) emergence. For these regions  $\alpha$  increases faster than the separation. In two "rapid" (< 1 day) emerging regions  $\alpha$  grows slower than the separation. This observed evolution of current helicity is in agreement with Longcope & Welsch (2000) model of emergence of subphotospheric twisted flux rope into the corona.

V. Maleev is NSO 2002 Summer Research Assistant from St. Petersburg State University, Russia

## SH52A-0467 1330h POSTER

## TRACE, SOHO/EIT, and SOHO/MDI Observations of AR0030, Including Rotating Sunspots and the July 15, 2002 X3.0 Flare in Ultraviolet and Extreme Ultraviolet

Richard W. Nightingale<sup>1</sup> (1-650-424-3293; nightingale@lmsal.com); Richard A. Shine<sup>1</sup>; David Alexander<sup>1</sup>; Samuel L. Freeland<sup>1</sup>; Zoe A. Frank<sup>1</sup>; Daniel S. Brown<sup>2</sup>

<sup>1</sup>Lockheed Martin Solar & Astrophysical Laboratory, Dept. L9-41, Bldg. 252, 3251 Hanover Street, Palo Alto, CA 94304, United States

<sup>2</sup>University of St. Andrews, School of Mathematics, St. Andrews KY16 9SS, United Kingdom

On July 15, 2002 TRACE and several SOHO instruments observed an X3.0 flare in AR0030 near 2000 UT. During this period TRACE was primarily observing in its 1600Å ultraviolet (UV) channel (most sensitive to temperatures around 100,000 K in the flare). The 195Å extreme ultraviolet (EUV) channel of SOHO/EIT (which is most sensitive to about 1.6 MK) will be utilized in this poster, in addition to the magnetic field measurements of SOHO/MDI during this event period. TRACE followed the active region for over 10 days, starting about 4 days before the flare. Broadband white light TRACE images of the photosphere indicate that one or more of the sunspots were rotating, a possible precursor to the flare. Images and movies of AR0030 in the various wavelengths will be shown. The flare region was so intense in the TRACE UV that it is very difficult to show both the quiescent and flaring regions, so the UV movie will focus on the flaring plasma with its 2 eruptions. In the EIT EUV, more coronal structure away from the flare can be seen. Analysis of the rotational rates of the sunspots will be given along with their possible coupling to the flare.

This work was supported by NASA under contract NAS5-38099.

## SH52A-0468 1330h POSTER

## Predicting the Structure of the Solar Corona During the December 4, 2002 Total Solar Eclipse

Zoran Mikic<sup>1</sup> (858-826-6934; zoran.mikic@saic.com)

Jon A Linker<sup>1</sup> (858-826-7820; jon.a.linker@saic.com)

Roberto Lionello<sup>1</sup> (858-826-6771; roberto.lionello@saic.com)

Pete Riley<sup>1</sup> (858-826-9550; peter.riley@saic.com)

<sup>1</sup>SAIC, 10260 Campus Point Drive, San Diego, CA 92121, United States

We describe the application of a three-dimensional magnetohydrodynamic (MHD) model to the prediction of the structure of the corona during the total solar eclipse that is expected to occur on 4 December 2002. The calculation uses the observed photospheric radial magnetic field as a boundary condition. This model makes it possible to determine the large-scale structure of the magnetic field in the corona, as well as the distribution of the solar wind velocity, plasma density, and temperature. We will use magnetic fields observed on the solar disk prior to eclipse day to predict what the corona will look like during the eclipse. The estimated coronal density and temperature will be used to predict the plane-of-sky polarization brightness and emission of UV radiation prior to the eclipse. The prediction will be posted on our web site (<http://haven.saic.com>) prior to the eclipse.

## SH52A-0469 1330h POSTER

## Multi-wavelength Structure of an Active Region Filament

K S Balasubramaniam<sup>1</sup> (505-434-7134; bala@nso.edu)

Therese A. Kucera<sup>2</sup> (301-286-0829; Terry.Kucera@gsofc.nasa.gov)

Alan H. McAllister<sup>3</sup> (303-545-5562; ahm@dimensional.com)

<sup>1</sup>NASA/GSFC, National Solar Observatory, Sunspot, NM 88349, United States

<sup>2</sup>NASA/GSFC, G1 Building 26, SOHO EAF NASA/GSFC, Code 682.3 G1 Building 26, SOHO EAF, Greenbelt, MD 20771, United States

<sup>3</sup>Helio Research, 1665 Lombardy Dr., Boulder, CO 80304, United States

In this work we will compare the structure of active region filaments near a sunspot, in a number of wavelengths. The data were obtained from three sources on

June 20, 2001 between 14:00 and 16:00 NSO/SP, photospheric and chromospheric observations of intensities (G-Band), and spectroscopy (H $\alpha$ , MgI 5172 Å, and CaI 8500 Å) to determine velocities, and magnetic fields; TRACE observations at 1600Å continuum, and coronal measurements in 171 Å; SOHO/EIT coronal observations in Fe XII 195Å, SOHO/CDS spectroscopic observations in spectral lines – SiXII 520.66 Å, OIV 554.52 Å, NeVI 562.80 Å, HeI 584.33 Å, OIII 599.59 Å, HeII 303.78 Å, MgIX 368.07 Å, MgX 624.94 Å, OV 629.73 Å, SiXII 520.66 Å, OIV 554.52 Å, NeVI 562.80 Å, HeI 584.33 Å, OIII 599.59 Å, HeII 303.78 Å, MgIX 368.07 Å, MgX 624.94 Å, OV 629.73 Å; and SOHO/MDI magnetic and intensity images.

The common FOV covers about 100 arcseconds. We will present the evolutionary nature of the photospheric magnetic field, the corresponding chromospheric velocities and the coronal variations of this filament region. During the initial period of the observations, this active region filament system is disrupted by an adjoining solar flare. The structure and dynamics of the filament system during this eruption will be traced.

## SH52A-0470 1330h POSTER

## High Speed Reconnection in the Low Corona

Alan M Title<sup>1</sup> (650-424-4034; title@lmsal.com)

Richard A Shine<sup>1</sup> (shine@shimmer.lmsal.com)

Carolus J Schrijver<sup>1</sup> (schryver@lmsal.com)

<sup>1</sup>Lockheed Martin Advanced Technology Center, 3251 Hanover Street, Palo Alto, CA 94304, United States

High cadence observations taken with the Transition Region and Corona Explorer (TRACE) instrument in the 1600Å band (with  $\approx 2$  second cadence) and in the Fe IX/X 171Å band ( $\approx 8$  seconds cadence) reveal fast reconnection events of several types. The most common is a newly emerging magnetic loop that reconnects with an overlying fan of loops. As the loops intersect, material is injected into the overlying loops. A newly formed small bright condensation travels in a helical path with a pitch angle of about 45 degrees and a speed of 700 to 1000 km/s. Movies of example events in both spectral bands will be shown.

This work was supported by NASA contract NAS5-38099.

## SH52A-0471 1330h POSTER

## Estimating the Effects of JPEG Compression and Radiation on the Accuracy of Vector Magnetic Fields Measurements for Solar-B

Bruce Lites<sup>1</sup> (lites@hao.ucar.edu)

Richard A Shine<sup>2</sup> (650-424-4045; shine@shimmer.lmsal.com)

A Lopez Ariste<sup>1</sup> (ariste@hao.ucar.edu)

Theodore D Tarbell<sup>2</sup> (tarbell@lmsal.com)

<sup>1</sup>High Altitude Observatory, National Center for Atmospheric Research, Boulder, CO 80307, United States

<sup>2</sup>Lockheed Martin Advanced Technology Center, 3251 Hanover Street, Palo Alto, CA 94304, United States

The Japanese Solar-B satellite, currently scheduled for launch in September 2005, includes a spectropolarimeter (SP) to precisely measure the full Stokes polarization vector (I, Q, U, V) in the Fe I lines at 6302Å. These will be processed to produce vector magnetograms of the solar surface using algorithms based on those for the Advanced Stokes Polarimeter (ASP) as described in Skumanich, et al, 1997, ApJ Suppl 110. Accumulations of the raw images into time averaged I, Q, U, V images will be done on board and the results will be 12 bit JPEG compressed to make the best use of the available telemetry. Hence a single radiation hit in a raw image affects the entire time average at that point. Also, radiation spikes affect JPEG compression performance. Because of concerns about these effects, we simulated them separately and in combination using ASP data and radiation level measurements from the TRACE satellite. Like TRACE, Solar-B will fly in a high inclination, sun synchronous orbit and be exposed to radiation from the polar radiation belts as well as the SAA. Since the SP detector will be better shielded than that on TRACE, we hope that these will be an over estimate of the effects.

The results from the simulations are very encouraging. We find that for active region magnetic fields we can use JPEG to compress the data volume by more than a factor of 10 without compromising the accuracy of the inferred magnetic field vector. The radiation in the polar regions has little effect and even the much stronger SAA radiation causes average perturbations that are less than the formal errors for sunspot fields and about twice the formal errors for plage fields. However, very weak field measurements will benefit from

less lossy compression and periods of low radiation. Of course, the very strong radiation hits always produce artifacts. Compression performance is affected only slightly so it will not be necessary to avoid observations in the SAA because of excessive telemetry usage.

This work was supported by NASA contract NASS-01002.

## SH52A-0472 1330h POSTER

### Temperature and Abundance Variations of an Active Region in Three Solar Rotations

Yuan-Kuen Ko<sup>1</sup> (1-301-286-4091; yko@cfa.harvard.edu)

Andrzej Fludra<sup>2</sup>

John C. Raymond<sup>1</sup> (1-617-495-7416)

<sup>1</sup>Harvard-Smithsonian Center for Astrophysics, 60 Garden St., MS-50, Cambridge, MA 02138, United States

<sup>2</sup>Rutherford Appleton Laboratory, Chilton, Didcot, Oxfordshire OX0000, United Kingdom

Active region 9718 (AR 9718) appeared at the east limb on November 26, 2001 which was newly formed when it was at the backside of the Sun. It survives through three solar rotations – AR 9755 and AR 9798 for subsequent rotations. AR 9798 decayed to no visible sunspot before it reached the west limb. SOHO/UVCS observed this region four times, as part of SOHO JOP 151, when it was at the limbs (AR 9718 at the west limb, AR 9755 at both the east and west limbs, and AR 9798 at the west limb). SOHO/CDS made observations when AR 9718 and AR 9755 were at the west limb. We investigate the temperature and abundance variations of this active region during its lifetime, and look for possible correlations between these physical parameters and its magnetic characteristics.

## SH52A-0473 1330h POSTER

### Hard X-ray and Microwave Imaging Observations of the 18-July-2002 Flare

Satoshi Masuda<sup>1</sup> (81-533-89-5194; masuda@stelab.nagoya-u.ac.jp); Tetsuya

Yamamoto<sup>2</sup>; Kunihiko Yoshida<sup>2</sup>; Syun-ichi

Tanuma<sup>3</sup>; Shinzo Enome; Takaaki Yokoyama<sup>4</sup>;

Masumi Shimojo<sup>4</sup>

<sup>1</sup>STEL, Nagoya University, Honohara 3-13, Toyokawa 442-8507, Japan

<sup>2</sup>School of Science, University of Tokyo, Hongo 7-3-1, Bunkyo 113-0033, Japan

<sup>3</sup>Kwasan Observatory, Kyoto University, ohmine, Kita-kasan, Yamashina, Kyoto 607-8471, Japan

<sup>4</sup>Nobeyama Solar Radio Observatory, NAOJ, Nobeyama, Minami-maki 384-1305, Japan

On 18 July 2002, an M-class flare was observed with RHESSI and the Nobeyama Radio Heliograph (NoRH). We compared the hard X-ray (HXR) images in the energy range above 30 keV and 17 GHz radio maps taken during the impulsive phase. Two HXR sources were observed and they were located at the two ends of a long (~ 20000 km) loop structure, which was observed with TRACE in the later phase. The stronger HXR source was located at the northern end of the loop and the weaker one was at the southern end. On the other hand, a single radio source was observed in 17 Hz and it was located at the site of the southern (or weaker) HXR source. In EUV images, a few small (< 5000 km) loops were observed near the northern (stronger) HXR source. These observations suggest that the electron acceleration occurred at the interaction site between the long loop and the small loops, and then they precipitated along the two loops. Such flares have been often observed with Yokoh/HXT and NoRH in these ten years. Usually two radio emission sources and one HXR source have been observed. The main radio source is located at the same location as the HXR source and the remote radio source is located at the other end of the long loop where there is no HXR source. It is believed the main radio source and the HXR source include the emission from two footpoints of the small loop and a footpoint of the long loop due to the poor spatial resolutions of HXT and NoRH. In the case of the 18-July-2002 flare, most of observational facts are consistent to this scenario. However, the lack of radio emission at the northern region is much different from the characteristics of the same type of events which have been observed with HXT and NoRH. We focus our attention on this difference and confirm whether this flare can be explained by the simple loop-loop interaction model or not.

## SH52A-0474 1330h POSTER

### The Dynamic Evolution of Twisted Omega-loops in a 3-D Convecting Flow

William P. Abbott<sup>1</sup> (abbett@ssl.berkeley.edu)

Yuhong Fan<sup>2</sup> (yfan@hao.ucar.edu)

George H. Fisher<sup>1</sup> (fisher@ssl.berkeley.edu)

<sup>1</sup>Space Sciences Laboratory, University of California, Berkeley, CA 94720-7450, United States

<sup>2</sup>HAO, National Center for Atmospheric Research, P.O. Box 3000, Boulder, CO 80307, United States

We present the latest results from 3D MHD simulations (in the anelastic approximation) of buoyant magnetic flux tubes interacting with turbulent convection in the solar interior. We focus our study on active region scale flux ropes and Omega-loops, and perform a large parameter space study of the effects of not only initial field strength, but twist and loop geometry on the morphology and dynamics of sub-surface magnetic structures. We also investigate the effects of different numerical treatments of viscosity, and quantify the amount of magnetic field in each simulation that succumbs to the effects of turbulent pumping.

## SH52A-0475 1330h POSTER

### Development of the SANMHD Code

David J. Bercik<sup>1</sup> (1-510-643-4118; bercik@ssl.berkeley.edu)

George H. Fisher<sup>1</sup> (1-510-642-8896; fisher@ssl.berkeley.edu)

<sup>1</sup>Space Sciences Laboratory, University of California, Berkeley, CA 94720-7450, United States

The connection between the generation of magnetic field by dynamo processes in stellar interiors and the signatures of magnetic activity observed in stellar atmospheres is not well understood. This is especially true in fully convective stars such as M/L dwarfs and T Tauri stars, where the observed solid body rotation precludes the generation of field by velocity shear mechanisms common to many mean field dynamo theories. These stars show a high level of magnetic activity so that an alternate mechanism, such as a small scale turbulent dynamo, is responsible for the generation of the magnetic field in the stellar interior. To model the interaction between turbulent convection and magnetic field deep in the interior of stars, it is necessary to consider a gravitationally stratified atmosphere in a spherical geometry.

It is not yet feasible with current computing resources to run fully compressible, global, spherical MHD simulations; however, it is possible to simulate models based on the anelastic approximation to the fully compressible MHD equations. The anelastic approximation only treats density perturbations in the buoyancy force, permitting larger simulation timesteps by filtering out acoustic waves. We report on the development of a 3-d spherical anelastic MHD code, "SANMHD". The design of SANMHD is to be portable across multiple architectures ranging from PC workstations to massively parallel supercomputers. The code is also highly modular to facilitate the investigation of a variety of physical scenarios. The code spectrally decomposes physical variables in the polar and azimuthal directions while using finite differencing schemes in the radial direction; this allows stellar interior models to be used as a background reference state. SANMHD uses an ideal equation of state and includes rotation and a radiative heat flux.

## SH52A-0476 1330h POSTER

### Generalized magnetic helicity, large scale magnetic field, and dynamo saturation

Leonardo J. Milano<sup>1</sup> (+1 302-831-1579; lmilano@bartol.udel.edu)

William H. Matthaeus<sup>1</sup>

Pablo Dmitruk<sup>1</sup>

<sup>1</sup>Bartol Research Institute, University of Delaware, 217 Sharp Lab, Newark, DE 19716

Dynamo effect allows the creation of large scale magnetic fields through a purely mechanical driving. This effect has long been postulated to saturate when the self-generated large scale magnetic field grows above a certain threshold. On the other hand, some numerical results show an apparent suppression of the dynamo effect [1] in the presence of a strong, large scale, externally supported magnetic field. Here we show that the overall behavior in these extreme cases, as well as in intermediate cases, can be understood in terms of: (i) conservation of a generalized form of magnetic helicity; and (ii) a proper separation of scales. These results

lend additional perspective to the sometimes difficult issue of the relationship between the physics of externally supported- and locally supported mean magnetic fields. Research supported in part by NSF grants ATM-0105254 and ATM-9977692.

[1] D. C. Montgomery, W. H. Matthaeus, L. J. Milano and P. Dmitruk, *Phys. Plasmas*, **9** 1221 (2002)

## SH52A-0477 1330h POSTER

### Plasma Heating by Pedersen Current Dissipation From the Photosphere to the Upper Chromosphere

Michael L. Goodman (304-368-9300; mgoodman@isr.us)

Institute for Scientific Research, 1000 Technology Drive - Suite 1110, Fairmont, WV 26554, United States

An MHD model is used to estimate the contribution of Pedersen current dissipation, as a function of height  $z$ , to plasma heating from the photosphere to the upper chromosphere. The model computes the particle diffusion velocities, normalized to the local drift velocity, transverse to a vertical magnetic field for a seven species plasma of electrons, protons, a proxy heavy ion, HeI, HeII, HeIII, and H. The proxy heavy ion is a single species representation of singly ionized C, Si, Al, Mg, Fe, Na, and Ca. The temperature and particle densities as functions of  $z$  are given by VAL model C. Collisions between all unlike particle species are taken into account. The diffusion velocities are used to compute the heating rate per unit volume  $Q(z)$ , normalized to the maximum possible heating rate per unit volume at height  $z$ , due to Pedersen current dissipation.  $Q$  is the fraction of energy in the current density perpendicular to the magnetic field that is dissipated by collisions. Solutions to the model suggest that: (i) The solar chromosphere above photospheric magnetic fields with strengths  $\sim 10^2 - 10^3$  G is heated by Pedersen current dissipation; (ii) This heating mechanism first becomes effective at heights corresponding to the lower chromosphere as defined by VAL; (iii) It is the rapid increase of charged particle magnetization with height in the lower chromosphere that triggers the rapid onset of intense heating by Pedersen current dissipation, where the magnetization is the ratio of the cyclotron frequency to the total collision frequency with unlike particles; (iv)  $Q(z)$  rapidly decreases to zero for  $z > \sim 2100$  km due to strong magnetization transforming the current perpendicular to the magnetic field into a Hall current, which is not dissipative; (v) The protons and the proxy heavy ions carry essentially all of the Pedersen current. These results suggest that network and internetwork regions of the chromosphere are heated by Pedersen current dissipation. The model does not assume or predict any form for the mechanism that drives the heating. However, the results of the model are consistent with previous predictions that magnetoacoustic waves heat network regions of the chromosphere through Pedersen current dissipation driven by a wave generated convection electric field. It is proposed that this wave heating mechanism also makes a major contribution to heating internetwork regions of the chromosphere. This work was supported by National Science Foundation grant ATM 9816335.

## SH52A-0478 1330h POSTER

### GOES-12 SXI Operational Calibration

Victor J. Pizzo<sup>1</sup> (303-497-6608; vpizzo@sec.noaa.gov)

Steven M. Hill<sup>1</sup> (303-497-3283; shill@sec.noaa.gov)

Christopher Balch<sup>1</sup> (303-497-5693; cbalch@sec.noaa.gov)

<sup>1</sup>NOAA/SEC, 325 Broadway, Boulder, CO 80305, United States

The prototype Solar X-ray Imager (SXI) was lofted into orbit aboard the NOAA GOES-12 spacecraft on 23 July 2001. The results of pre-launch ground-based optical tests have been combined with an extensive set of imagery taken during the post-launch checkout period from late August through mid December 2001 to establish an operational calibration for the full instrument performance. Although the nickel-coated mirror is a conventional Wolter-I grazing incidence optic, the detector consists of an MCP-enhanced CCD configuration not previously used for direct solar imaging. A full set of calibration data for each optical component (mirror, filters, detector) as well as for net system throughput have been derived and are available on the SXI website (<http://sec.noaa.gov/sxi/ScienceUserGuide.html>). In addition, a wide variety of information on instrument spatial resolution, point-spread function, dynamic range, photon statistics, and gain dependence (related to voltage settings for the MCP) have been derived. An improved background correction has been developed and applied to the recent release of the post-launch data now publicly available in FITS format. Special instrument topics including issues related to solar pointing and image timing aboard a geosynchronous platform, CCD blooming properties, detector flat-field effects, and response to SEP events are also detailed.

## SH52A-0479 1330h POSTER

## Soft X-ray and Extreme Ultraviolet Dimmings and Traveling Transients Observed in Association with CMEs

Steven M Hill<sup>1</sup> (303-497-3283; steven.hill@noaa.gov)Christopher Balch<sup>1</sup> (Christopher.Balch@noaa.gov)Victor J Pizzo<sup>1</sup> (Vic.Pizzo@noaa.gov)<sup>1</sup>NOAA Space Environment Center, R/SEC 325 Broadway, Boulder, CO 80305, United States

Soft X-ray (SXR) observations have shown that a relatively rapid dimming often is observed in coronal regions near the apparent source of a coronal mass ejection (CME). These dimmings have a close temporal correlation with the CME initiation and its associated post-flare arcade. Similar dimmings have been observed in the Extreme Ultraviolet (EUV). It has been postulated that these dimmings represent mass loss due to expansion and opening of magnetic field lines during the early stages of a CME. Typically the dimming time scale is much faster than the cooling time scale. We have studied several CME-associated dimming events occurring near the solar limb in late 2001 using observations made in EUV bands by SOHO/EIT and in SXR bands by both Yohkoh/SXT and the GOES-12 SXI instrument. The observations are of moderate cadence and spatial resolution, but are unusual in that they include full EUV and SXR event coverage from start to finish. In addition, the SXI observations in the 0.6-6.0 nm band bridge the thermal ranges accessible to EIT and SXT. Comparison of SXR and EUV data show that while there is sometimes a clear correlation between dimming regions seen in the SXR and EUV bands this is not generally the case. In addition, the higher cadence, multi-filter SXI data show the actual formation and growth of a dimming region. The high cadence data also is examined for the temporal relationship between the impulsive flare phase, the dimming, and the CME initiation. Finally, multi-filter analysis is consistent with the view that the dimming of a region is due to mass loss and not temperature decrease.

URL: <http://www.sec.noaa.gov/sxi/>

## SH52A-0480 1330h POSTER

## RHESSI Observation of an Occulted Hard X-ray Flare

Paula Balciunaite<sup>1</sup> (balciunaite@ssl.berkeley.edu)Steven Christe<sup>1,2</sup> (schriste@ssl.berkeley.edu)Sam Krucker<sup>1</sup> (krucker@ssl.berkeley.edu)R. P. Lin<sup>1,2</sup> (rlin@ssl.berkeley.edu)<sup>1</sup>Space Sciences Lab, University of California, Berkeley, CA 94720-7450, United States<sup>2</sup>Physics Department, University of California, Berkeley, CA 94720-7450, United States

We present an observation of an occulted GOES C2 class flare which occurred on 13 May 2002 10:50-22:20 UT taken by the recently launched Reuven Ramaty Solar Spectroscopic Imager mission (RHESSI) in open-shutter mode. The flare is inferred to originate 34 degrees behind the east limb by tracking the most probable originating active region (NOAA Active Region 9957). This relatively large occultation could explain why no impulsive flare phase was observed. The hard X-ray (8-15 keV) source centroid position as a function of time initially shows a constant position just above the solar limb for approximately 2 hours. Then the source appears to rise above the limb, in a manner that could not be due solely to solar rotation. RHESSI CLEANed images at 7" resolution demonstrate coronal source motion as a function of time. Presently we are investigating spectra with resolution down to 1 keV and energy coverage down to 3 keV and the derived temperature and emission measure. A limb flare observed on 21 April 2002 00:30-04:00 UT is presented as a comparison.

## SH52A-0481 1330h POSTER

## RHESSI Hard X-ray imaging spectroscopy of the 2002 July 23 Solar Gamma-ray Flare

Sam Krucker<sup>1</sup> (krucker@ssl.berkeley.edu)Gordon J Hurford<sup>1</sup> (ghurford@ssl.berkeley.edu)Richard A Schwartz<sup>3</sup> (richard@stars.gsfc.nasa.gov)Robert P Lin<sup>1,2</sup> (rlin@ssl.berkeley.edu)David M Smith<sup>1</sup> (dsmith@ssl.berkeley.edu)<sup>1</sup>Space Sciences Lab, University of California, Berkeley, CA 94720-7450, United States<sup>2</sup>Physics Department, University of California, Berkeley, CA 94720-7450, United States<sup>3</sup>NASA-GSFC/SSAI, NASA Goddard Space Flight Center, Greenbelt, MD 20771, United States

The GOES X4.8 flare of 23 July 2002 is the first gamma-ray flare seen by the recently launched Reuven Ramaty High Energy Solar Spectroscopic Imager (RHESSI). In this paper, first results of X-ray (>3 keV) imaging spectroscopy of this flare are discussed and related to images seen in EUV (TRACE, EIT), H $\alpha$  (BBSO), and radio waves (Nobeyama). In particular, solar flare bremsstrahlung emission above 300 keV is imaged for the first time.

During the first minutes of the impulsive phase of the flare, three main hard X-ray (>30 keV) sources are seen. Two of the sources show similar spectra with a break around 60 keV and exponents around -1.7 below the break and -3.0 above. The spectrum of the third source (that is observed in-between the two other sources, but slightly displaced to the side) is best fitted with a single power law with an exponent of around -3.0.

Later in the impulsive phase, only the two sources with similar spectra are seen. The spatial separation of these sources is linearly increasing with a velocity of ~36 km/s over more than 5 minutes. This separation is comparable to the footprint separation reported by Sakao et al. (1994).

More detailed analysis on the temporal evolution of the spectra and a comparison with imaging observations at other wavelengths will be presented.

## SH52A-0482 1330h POSTER

## RHESSI Observations of Solar Hard X-ray Flares and the Relative Timing of Interplanetary Type III Radio Bursts

Emily Rauscher<sup>1</sup> (emily\_r@ssl.berkeley.edu)Sam Krucker<sup>1</sup> (krucker@ssl.berkeley.edu)Robert P. Lin<sup>1,2</sup> (rlin@ssl.berkeley.edu)<sup>1</sup>Space Sciences Lab, University of California, Berkeley, CA 94720-7450, United States<sup>2</sup>Physics Department, University of California, Berkeley, CA 94720-7450, United States

The Reuven Ramaty High Energy Solar Spectroscopic Imager (RHESSI) allows more detailed imaging of solar hard X-ray flares than has been available before. The hard X-ray sources seen in solar flares are believed to be the result of accelerated electrons streaming down the legs of a magnetic loop and colliding with the denser plasma at the footpoints, releasing hard X-rays through bremsstrahlung. Interplanetary type III radio bursts are evidence of accelerated electrons leaving the Sun. We have begun a study of the temporal correlation of hard X-ray flares and interplanetary type III radio bursts to investigate the acceleration processes behind these events. The RHESSI data from February 12 through July 23 have been temporally compared with WIND/WAVES data to find correlation between hard X-ray events and interplanetary type III radio bursts. Relatively simple events with and without type III bursts have been chosen for spatial investigation. This involves making RHESSI hard X-ray (>20 keV) images and overlaying these onto corresponding EUV images from EIT and TRACE and images from MDI.

## SH52A-0483 1330h POSTER

## Magnetic Fields in the Solar Photosphere are not Force-free

Barry J LaBonte (443-778-3840; barry.labonte@jhuapl.edu)

Johns Hopkins University, Applied Physics Laboratory 11100 Johns Hopkins Road, Laurel, MD 20723

Coronal magnetic fields are often inferred from the extrapolation of photospheric magnetic observations. The assumptions that the fields are potential or force-free are not correct in the photosphere. The magnitude of the forces and the sheet currents they drive are determined from observations of the magnetic field vector made with the Imaging Vector Magnetograph at Mees Solar Observatory.

## SH52A-0484 1330h POSTER

## Hard X-ray Microflares down to 3 keV

Steven Christe<sup>1</sup> (510-642-1397; schriste@cluster3.ssl.berkeley.edu)Sam Krucker<sup>1</sup> (krucker@ssl.berkeley.edu)R. P. Lin<sup>1,2</sup> (rlin@sunsport.ssl.berkeley.edu)Gordon Hurford<sup>1</sup> (ghurford@ssl.berkeley.edu)Richard A. Schwartz<sup>3</sup> (richard.schwartz@gsfc.nasa.gov)<sup>1</sup>Space Sciences Lab, University of California, Berkeley, CA 94720-7450, United States<sup>2</sup>Physics Department, University of California, Berkeley, CA 94720-7450, United States<sup>3</sup>SSAI Laboratory for Astronomy and Solar Physics, NASA Goddard Space Flight Center, Greenbelt, MD 20771, United States

The excellent sensitivity, spectral and spatial resolution, and energy coverage down to 3 keV provided by the Reuven Ramaty Solar Spectroscopic Imager mission (RHESSI) allows for the first time the detailed study of the locations and the spectra of solar microflares down to 3 keV. During a one hour quiet interval (GOES soft X-ray level around B6) on May 2, 1:40-2:40UT, at least 7 microflares occurred with the largest peaking at A6 GOES level. The microflares are found to come from 4 different active regions including one behind the west limb. At 7" resolution, some events show elongated sources, while others are unresolved point sources. In the impulsive phase of the microflares, the spectra can generally be fitted best with a thermal model plus power-law above ~6-7 keV. The decay phase sometimes can be fit with a thermal only, but in some events, power-law emission is detected late in the event indicating particle acceleration after the thermal peak of the event. The power-law fits extend to below 7 keV with exponents between -5 and -8, and imply a total non-thermal electron energy content between  $10^{26}$ - $10^{27}$  ergs. Since the total energy in non-thermal electrons is very sensitive to the value of the power-law and the energy cutoff, these observations will give us better estimates of the total energy input into the corona. Presently, microflare observations on June 22 02:20-06:10UT are being analyzed and are expected to corroborate these results.

## SH52A-0485 1330h POSTER

## Coronal Dimming and the Relationship to Coronal Mass Ejections

Richard A Harrison<sup>1</sup>Tim A Howard<sup>2</sup> (+44 121 414 6262; tim.howard@physics.org)George M Simnett<sup>2</sup><sup>1</sup>Space Science Department, Rutherford Appleton Laboratory, Chilton, Didcot, Oxfordshire OX11 0QX, United Kingdom<sup>2</sup>School of Physics and Astronomy, University of Birmingham, Edgbaston, Birmingham B15 2TT, United Kingdom

Around the onset time of coronal mass ejections (CME) it is frequently observed by the LASCO coronagraphs on SOHO that the mass content of the low corona is depleted. Spectral observations by the coronal diagnostic spectrometer (CDS) (also on SOHO) are able to confirm that this "coronal dimming" is in fact due to mass loss rather than temperature variations. An important question is whether the observed mass loss represents the actual mass ejected in the CME, or the mass required to replenish the coronal mass ejected in the CME. Clearly the timing of the mass loss observed in the low corona to the timing of the CME is critical in answering this question. We present recent results of dedicated campaigns using CDS to investigate this phenomenon; and we also examine the LASCO-C1 data from 1996-1998 (June) for additional information on the relationship between CME onsets and coronal dimming.

## SH52A-0486 1330h POSTER

## Forecasting Daytime Seeing Conditions Using a Mesoscale Numerical Weather Prediction Model

Joel B. Mozer<sup>1</sup> (505-434-7037; jmozer@nso.edu)Nathan J. Van Wey<sup>2</sup> (nvanwey@neo.rr.com)Sara C Gordon<sup>3</sup> (sara.gordon@hanscom.af.mil)George Y Jumper<sup>1</sup> (george.jumper@hanscom.af.mil)Guy P. Seeley<sup>3</sup> (guy.seeley@hanscom.af.mil)<sup>1</sup>Air Force Research Laboratory, Space Weather Center of Excellence AFRL/VSBX PO Box 62, Sunspot, NM 88349, United States<sup>2</sup>Perry High School, 3737 Harse Ave, SW, Massillon, OH 44646, United States<sup>3</sup>Radex, Inc., 3 Preston Court, Bedford, MA 01730, United States

"Seeing" is an astronomical term to describe the quality of observing conditions due to optical turbulence in the Earth's atmosphere which can blur images of astronomical objects. The ability to diagnose and

forecast daytime seeing conditions at a specific location would be of use to solar observatories in scheduling observations and interpreting data, as well as a source of supporting information for site surveys of future telescopes. In the present work, we explore the feasibility of using the Air Force Weather Agency's MM5 forecasts over the continental United States (CONUS) as input to an AFRL optical turbulence modeling tool, to forecast seeing out to 48 hours in the future at several sites proposed for the Advanced Technology Solar Telescope (ATST). These forecasts are compared with optical turbulence measurements made at these sites using the Solar Differential Image Motion Monitor (S-DIMM) and SHADOW BAnd Ranger (SHABAR) instruments. These comparisons show a positive correlation between forecast and measured daytime seeing.

**SH52A-0487 1330h POSTER**

**Coronal blast waves detected in soft X-rays**

Josef Khan<sup>1</sup> (jik@astro.utu.fi)

Hugh S Hudson<sup>2</sup> (510-643-0333; hudson@ssl.berkeley.edu)

Nariaki V Nitta<sup>3</sup> (nitta@lmsal.com)

<sup>1</sup>Tuorla Observatory, University of Turku, Turku 21500, Finland

<sup>2</sup>Space Sciences Lab, University of California, Berkeley, CA 94720, United States

<sup>3</sup>LMSAL, Lockheed Martin Solar and Astrophysics Lab, Palo Alto, CA 94304, United States

Several examples of rather clear X-ray detection of coronal blast waves have now been reported (e.g., Khan and Aurass, A&A 383, 1018, 2002). Interestingly, most of them have been reported from two particular active regions - NOAA 8100 (November 1997) and 8210 (April-May 1998). The soft X-ray observations in some cases have high time resolution and the ability to look close to the core of the flare responsible for the wave. We summarize the observations to date, emphasizing the distinction between ejecta (magnetic loops) and freely running waves. Related observations now exist at metric and centimetric wavelengths, in the EUV, and in chromospheric lines (H-alpha and He 10830), and we describe the observational relationships among these different observations.

**SH52A-0488 1330h POSTER**

**EUV Dimmings: Simple or Enigmatic?**

B. J. Thompson<sup>1</sup> (301 286 3405; barbara.thompson@gsfc.nasa.gov)

D. A. Biesecker<sup>1</sup>

L. Ofman<sup>2</sup>

O. C. St. Cyr<sup>1</sup>

M. J. Wills-Davey<sup>3</sup>

<sup>1</sup>NASA GSFC, Code 682, Greenbelt, MD 20771, United States

<sup>2</sup>Catholic University of America, Code 682, Greenbelt, MD 20771, United States

<sup>3</sup>MSU Department of Physics, 264 EPS Building MSU-Bozeman POB 173840, Bozeman, MT 59717, United States

EUV dimmings are large-scale depletions in coronal EUV emission associated with coronal mass ejections. Their occurrence is nearly perfect in correlation with fast CMEs. Many of the EUV dimming observations appear to correspond well in appearance and behavior to SXR dimmings. It has been assumed that the dimmings are merely the location of the CME mass removal in the corona, and that their similar appearance to coronal holes is because they are transient coronal holes with fieldlines opened by the coronal mass ejection. However, not all CMEs have dimmings, and large-scale EUV dimmings have also been caused by heating of local plasma, and due to absorption by cool material "clouds" evolving in the wake of an eruption. Additionally, there are several ways in which these regions "heal," presumably due to the closing down of the open field lines. The presentation will include a range of EUV dimming observations, a discussion of their origin, and what they might imply about the nature of the associated CMEs.

**SH52A-0489 1330h POSTER**

**Critical Analysis of the Total Solar Irradiance Database Available for SDO Mission Science**

Richard C Willson (+1-619-522-2945; acrim@acrim.com)

Columbia University, 1001 B Ave. Suite 200, Coronado, CA 92118, United States

The total solar irradiance (TSI) database that will be available to SDO science teams has yet to be defined. The 'overlap strategy' employing contiguous TSI experiments can maintain long-term traceability better than 5 ppm/year. Compilation of a precise long-term composite TSI database from extant TSI observations will be discussed as an illustration of the approach. The measurement strategy required to extend this task will be discussed.

URL: <http://www.acrim.com>

**SH52A-0490 1330h POSTER**

**Force-Free Fields Having More Energy Than Open Fields and Their Role in Coronal Mass Ejections**

G S Choe<sup>1</sup> (1-609-243-2629; gchoe@pppl.gov)

C Z Cheng<sup>1</sup> (1-609-243-2648; fcheng@pppl.gov)

<sup>1</sup>Princeton Plasma Physics Laboratory, Princeton University, P. O. Box 451, Princeton, NJ 08543-0451, United States

In typical CME observations, a CME loop expands outward and a radially stretched open field structure is eventually formed. For this transition of field configuration to occur spontaneously, the closed field configuration before the eruption must have more energy than the open field configuration. This possibility is, however, precluded by the Aly-Sturrock theorem, according to which closed force-free fields with the same boundary normal field distribution do not have more energy than the corresponding open field. Here we note that in their proofs of the theorem, Aly and Sturrock assume that a limiting configuration of energy increasing sequences should exist and that the energy of this configuration is the energy supremum. These two conditions are far from trivial. In this paper, we report counterexamples in which the Aly-Sturrock theorem is invalid. We have constructed force-free fields in multiple flux systems with current sheets and found that some of them have more energy than the open field. We investigate how the geometrical properties of those force-free solutions depend on the imposed field connectivity. A comparison of our solutions with observational features is presented, and the dynamical evolution of those force-free fields toward eruption is discussed.

**SH52A-0491 1330h INVITED POSTER**

**The SHARPP Instrument on the Solar Dynamics Observatory Mission**

Russell A Howard<sup>1</sup> (202-767-3137; howard@solar.nrl.navy.mil)

J Daniel Moses<sup>1</sup> (202-404-4108; mores@solar.nrl.navy.mil)

Dennis G Socker<sup>1</sup> (202-767-2093; socker@solar.nrl.navy.mil)

<sup>1</sup>Naval Research Laboratory, EO Hulbert Center for Space Research, Washington, DC 20375, United States

The Solar Heliospheric Activity Research and Prediction Program (SHARPP) was selected by NASA for inclusion on the Solar Dynamics Observatory (SDO) mission. SDO is the first mission within the International Living With a Star program. SHARPP consists of a complement of seven EUV solar disk imagers collected into a package called the Atmospheric Imaging Assembly and a white light coronagraph called the KCOR. The AIA will observe the solar disk at seven wavelengths simultaneously with a cadence of about 10 seconds and a pixel size of about 0.7 arc seconds. The KCOR will observe the white light corona from 2-15 solar radii with a cadence of about 1 minute. The details of the science program and instrument configuration will be described.

**SH52A-0492 1330h POSTER**

**MH4D, an MHD Algorithm on an Unstructured Tetrahedral Grid.**

Roberto Lionello<sup>1</sup> (1-858-826-6771; Roberto.Lionello@saic.com)

Dalton D. Schnack<sup>1</sup> (1-858-826-6021; Dalton.D.Schnack@saic.com)

<sup>1</sup>Science Applications International Corporation, 10260 Campus Point Dr., San Diego, CA 92121-1578, United States

We report our progress in the development of MH4D (Magnetohydrodynamics on a TETRAhedral Domain). MH4D is a massively-parallel, device-independent numerical code for the solution of the resistive and viscous MHD equations on an unstructured grid of tetrahedra. The unstructured mesh allows the resolution to

be increased in the regions of physical interest. Consequently, MH4D can model problems with a wide range of spatial scales (e.g., active regions in the large scale corona). A variational formulation of the differential operators ensures accuracy and the preservation of the analytical properties of the operators ( $\nabla \cdot \mathbf{B} = 0$ ), and self-adjointness of the resistive and viscous operators. The combined semi-implicit treatment of the waves and implicit formulation of the diffusive operators can accommodate the wide range of time scales present in the solar corona. The capability of mesh refinement and coarsening is also included. MH4D is currently capable of solving the resistive diffusion equation and the equations of hydrodynamics. Preliminary results will be presented.

**SH52A-0493 1330h POSTER**

**Ion-Ion Two-Stream Instability in Relativistic Solar and Astrophysical Phenomena**

Selig Kainer<sup>1,2</sup> (301-286-7685; selig.kainer@gsfc.nasa.gov)

Melvyn L. Goldstein<sup>1</sup> (301-286-7828; melvyn.goldstein@gsfc.nasa.gov)

D. Aaron Roberts<sup>1</sup> (301-286-5606; aaron.roberts@gsfc.nasa.gov)

<sup>1</sup>NASA Goddard Space Flight Center, Code 692, Greenbelt, MD 20771, United States

<sup>2</sup>BKG Research, 3622 Ordway Street, NW, Washington, DC 20016, United States

One of the proposed mechanisms for heating and particle acceleration in solar flares is through the action of a DC electric field upon a thermal plasma. Using numerical particle simulations, we show that the action of the electric fields in relativistic situations (produced either through long-acting fields or sufficiently high field strengths) leads both to direct electron and ion acceleration and to further acceleration due, initially, to the electron two-stream instability. A direct consequence of the electron two stream instability in the relativistic regime is the excitation of the ion-ion two-stream instability. This arises through electron-depletion in the phase space occupied by the ions while simultaneously the generation of relativistic electrons also acts to hinder electrons from canceling out the collective electric field fluctuations of the ion distribution. Thus the ion distribution becomes unstable under the action of the electric field and through wave-particle interactions. We show under what conditions such an ion-ion two-stream instability can arise and the conditions that could produce high-energy ions such as are observed in solar flares and in astrophysical phenomena.

**SH52A-0494 1330h INVITED POSTER**

**The Helioseismic and Magnetic Imager for the Solar Dynamics Observatory**

Philip H. Scherrer (1-650-723-1504; pscherrer@solar.stanford.edu)

W.W. Hansen Experimental Physics Laboratory, Stanford University, 455 Via Palou, Stanford, CA 94305-4085, United States

The NASA Living With a Star (LWS) Solar Dynamics Observatory (SDO) mission is now in Phase-A of its development. The instrument complement has been selected and includes the Helioseismic and Magnetic Imager (HMI). The primary goal of the HMI investigation is to study the origin of solar variability and to characterize and understand the Sun's interior and the various components of magnetic activity. HMI will make measurements of the motion of the solar photosphere to study solar oscillations and measurements of the polarization in a spectral line to study all three components of the photospheric magnetic field. HMI will produce data to determine the interior sources and mechanisms of solar variability and how the physical processes inside the Sun are related to surface magnetic field and activity. It also will produce data to enable estimates of the coronal magnetic field for studies of variability in the extended solar atmosphere. HMI observations will enable establishing the relationships between the internal dynamics and magnetic activity in order to understand solar variability and its effects, leading to predictive capability, one of the key elements of the Living With a Star (LWS) program.

The broad goals described above will be addressed in a coordinated investigation in a number of parallel studies. These segments of the HMI investigation are to observe and understand these interlinked processes: Convection-zone dynamics and the solar dynamo; Origin and evolution of sunspots, active regions and complexes of activity; Sources and drivers of solar activity and disturbances; Links between the internal processes and dynamics of the corona and heliosphere; and Precursors of solar disturbances for space-weather forecasts.

All HMI data will be available to all for analysis after only minutes to days of automated processing. The dedicated efforts of many in the solar community will

be needed to exploit the full potential of HMI and every effort will be made to make such contributions possible.  
URL: <http://hmi.stanford.edu>

**SH52A-0495 1330h POSTER****Numerical Simulations of Solar Active Region Magnetoconvection**

Marc L DeRosa<sup>1</sup> ([derosa@lmsal.com](mailto:derosa@lmsal.com))

Neal E Hurlburt<sup>1</sup> ([hurlburt@lmsal.com](mailto:hurlburt@lmsal.com))

<sup>1</sup>Lockheed Martin Solar and Astrophysics Lab, O/L9-41 B/252 3251 Hanover St., Palo Alto, CA 94304, United States

Vigorous fluid motions associated with the observed patterns of supergranulation, mesogranulation, and granulation on the sun are likely to play a large role in the continual emergence, evolution, and redistribution of magnetic field within solar active regions. To investigate such non-linear dynamics, we have constructed numerical simulations of fully compressible magnetized fluids, each contained within curved, spherical segments nominally located near the top of the solar convection zone. Overturning motions having length scales comparable to that of solar supergranulation are driven by imposing a solar-like heat flux through the bottom of the domain.

We present recent results of several idealized active region simulations within thin spherical segments, each spanning  $60^\circ \times 30^\circ$  in longitude and latitude and extending up to  $0.04 R_\odot$  in radius. We are able to investigate the analogs of both plage and active regions by varying the amount of magnetic flux that permeates the layer. Simplified field-line extrapolations into the volume above the spherical segments are then used to assess how the corona might respond to the structure and evolution of magnetic field emerging through the solar photosphere.

This work was supported by NASA through grant NAG 5-3077 to Stanford University and by Lockheed Martin Independent Research and Development funds.  
URL: <http://www.lmsal.com/~derosa>

**SH52A-0496 1330h POSTER****Phase Sensitive Detection for the SORCE Total Irradiance Monitor**

Greg Kopp<sup>1</sup> (303-735-0934; [Greg.Kopp@LASP.Colorado.edu](mailto:Greg.Kopp@LASP.Colorado.edu))

George Lawrence<sup>1</sup> ([George.Lawrence@LASP.Colorado.edu](mailto:George.Lawrence@LASP.Colorado.edu))

Gary Rottman<sup>1</sup> ([Gary.Rottman@LASP.Colorado.edu](mailto:Gary.Rottman@LASP.Colorado.edu))

Tom Woods<sup>1</sup> ([Tom.Woods@LASP.Colorado.edu](mailto:Tom.Woods@LASP.Colorado.edu))

<sup>1</sup>Laboratory for Atmospheric and Space Physics, University of Colorado 1234 Innovation Dr., Boulder, CO 80303, United States

The Total Irradiance Monitor (TIM) on the Solar Radiation and Climate Experiment (SORCE) will measure the total solar irradiance (TSI). The TIM will report four TSI measurements daily, continuing the current 24-year record of solar irradiance through SORCE's goal 5-year mission life. This instrument was designed to achieve a relative standard uncertainty (1  $\sigma$  precision) of 100 parts per million (ppm) and a precision and long-term uncertainty of 10 ppm/year.

The major innovation the TIM brings to spaceborne TSI measurements is phase sensitive detection. This new instrument was designed from the ground up with the primary consideration being low-noise performance at the shutter fundamental, minimizing parasitic effects at and in-phase with the instrument's shutter. The DSP-controlled thermal balance and this phase sensitive detection method reduce sensitivity to thermal fluctuations and noise, enabling the instrument's high precision. We describe in detail here the phase sensitive detection algorithm used for the TIM.

URL: <http://lasp.colorado.edu/sorce/>

**SH52A-0497 1330h POSTER****Comparison of Recent Total Irradiance Measurements**

Roger Helizon<sup>1</sup> (818-354-2488; [roger@simdac.jpl.nasa.gov](mailto:roger@simdac.jpl.nasa.gov))

Judit Pap<sup>2</sup> (301-286-7511; [papj@marta.gsfc.nasa.gov](mailto:papj@marta.gsfc.nasa.gov))

<sup>1</sup>Jet Propulsion Laboratory, MS 171-400 4800 Oak Grove Dr., Pasadena, CA 91109, United States

<sup>2</sup>University of Maryland, Baltimore County, NASA/GSFC, Code 680.0, Greenbelt, MD 20771, United States

Total solar irradiance has been measured since 1978 from various satellites. Since the absolute accuracy of

the current irradiance measurements is about 0.2%, one needs to compile composite irradiance time series to study long-term changes and to establish whether there are any secular variations over the last two and half decades. In this paper we compare the UARS/ACRIM II and SOHO/VIRGO total irradiance data as well as the SOHO/VIRGO and ACRIM III total irradiance. Our main goal is to validate the newly processed ACRIM II total irradiance. Comparison of the SOHO/VIRGO and ACRIM III data will also help to establish whether the high total irradiance values for the maximum of solar cycle 23 represent real solar, rather than, instrumental events.

**SH52A-0498 1330h POSTER****Visualizing and Interpreting Very High Resolution Solar Movies**

Richard A Shine<sup>1</sup> ([shine@shimmer.lmsal.com](mailto:shine@shimmer.lmsal.com))

Neal Hurlburt<sup>1</sup> ([hurlburt@lmsal.com](mailto:hurlburt@lmsal.com))

Alan M Title<sup>1</sup> ([title@lmsal.com](mailto:title@lmsal.com))

Richard W Nightingale<sup>1</sup> ([ngale@lmsal.com](mailto:ngale@lmsal.com))

<sup>1</sup>Lockheed Martin Advanced Technology Center, 251 Hanover Street, Palo Alto, CA 94304, United States

Benefiting from advances in detector technology, image compression, and data storage capacities, current and upcoming solar instruments, especially the Solar Dynamics Observatory (SDO) due to be launched in 2007, will produce immense amounts of data in the form of movies with individual images in the 2048x2048 (4 Mpixel) to 4096x4096 (16 Mpixel) range. This is beyond the capability of most contemporary computer or video displays but several are now becoming available. In order to develop concepts and software for working with existing and future data sets, we have been working with a 9 Mpixel IBM T221 LCD display driven by an SGI Octane 2 workstation. This is a desktop display with a 22 inch diagonal screen. We will demonstrate our prototype system using several combinations of movies from the Swedish Vacuum Solar Tower (SVST) at La Palma, and the TRACE and SOHO satellites and discuss some approaches for the more challenging SDO data products.

**SH52B MCC: 124 Friday 1330h****Particle Populations Upstream of the Earth's Bow Shock: Observations, Theory, and Simulations II (*joint with SM*)**

**Presiding:** A Posner, University of Kiel; H Kucharek, University of New Hampshire

**SH52B-01 1330h****Gyrophase-Restricted 70 keV-1 MeV Ion Beams Near the Foreshock Boundary**

Karim Meziane<sup>1</sup> (506-458-7923; [karim@unb.ca](mailto:karim@unb.ca))

Mark Wilber<sup>2</sup> (510-643-6896; [wilber@ssl.berkeley.edu](mailto:wilber@ssl.berkeley.edu))

Robert P. Lin<sup>2</sup> ([boblin@ssl.berkeley.edu](mailto:boblin@ssl.berkeley.edu))

George K. Parks<sup>2</sup> ([parks@ssl.berkeley.edu](mailto:parks@ssl.berkeley.edu))

<sup>1</sup>University of New Brunswick, Physics Department, Box 4400, Fredericton, NB E3B 5A3, Canada

<sup>2</sup>Space Sciences Laboratory, University of California, Centennial Dr. at Grizzly Peak Blvd, Berkeley, CA 94720, United States

We report on gyrophase-restricted ion beams up to energies of 2 MeV seen by Wind in the Earth's distant foreshock ( $\sim 65 R_E$ ). These distributions are characterized by unexpected properties: they retain phase coherence over many gyroperiods of travel and in the absence of waves with sufficient power to trap them; the observed gyrophases are nearly constant in spite of variations in the estimated shock distance that are several gyroradii in scale; and they often have two peaks  $\sim 180^\circ$  apart in gyrophase. The dispersion observed in particles of differing energies, and good agreement with model calculations suggest that these were likely produced by the shock drift acceleration of a pre-existing energetic seed population. The emergence of two-sided distributions at lower computed  $\theta_{BN}$  values is consistent with the remote sensing of a thin ion foreshock layer. In this instance, gaps in gyrophase distributions would indicate incident directions for particles that have their guiding centers situated outside of the foreshock layer.

URL: <http://sprg.ssl.berkeley.edu/~wilber/papers/foreshockGRL>

**SH52B-02 1345h****Polar Upstream of the Bow Shock**

J. F. Fennell<sup>1</sup> (310 336 7075;

[joseph.fennell@aero.org](mailto:joseph.fennell@aero.org)); J. Roeder<sup>1</sup>; J. B Blake<sup>1</sup>; A. Korth<sup>2</sup>; M. Carter<sup>3</sup>; P. Daly<sup>2</sup>; R. Friedel<sup>4</sup>; T. Fritz<sup>5</sup>; M. Grande<sup>3</sup>; C. Perry<sup>3</sup>

<sup>1</sup>The Aerospace Corporation, MS:M2-259 POBox 92957, Los Angeles, CA 90009, United States

<sup>2</sup>Max Planck Institute for Aeronomy, Postfach 20, Max Planck Strasse 2, Katlenberg-Lindau D 37191, Germany

<sup>3</sup>Rutherford Appleton National Laboratory, Chilton, Didcot, Ox OX110QX, United Kingdom

<sup>4</sup>Los Alamos National Laboratory, MS: D-466, Los Alamos, NM 87545, United States

<sup>5</sup>Boston University, Center for Space Physics 725 Commonwealth Ave, Boston, MA 02215, United States

The Cluster and Polar spacecraft have their apogees close in local time and in April 2001 these spacecraft were traversing the pre-noon regions. On 13 April, 2001 Polar's apogee was near 25 deg. magnetic latitude and it traversed the dayside plasma sheet and entered the magnetosheath and even the solar wind near apogee. The Cluster satellites were upstream of the bow shock during the 0400-1200 UT interval of interest. The event occurred during the recovery phase of a magnetic storm. An interplanetary shock was observed at ACE near 0705 UT and reached Earth near 0735 UT on this day. At the initial shock arrival, the solar wind pressure increased by a factor of three and the solar wind speed increased from 590 to 760 km/sec, but Polar stayed inside the plasma sheet. Near 0935 UT the solar wind density and pressure rose by an order of magnitude and Polar passed from the plasma sheet into a magnetosheath like plasma. As the event continued, Polar passed into the solar wind. During this interval the Cluster satellites observed a very intense and hot solar wind population and the interplanetary field turned strongly southward. Polar observed a burst of hot plasma and energetic particles near 1020 and 1040 UT as the field became less southward. Polar reentered the magnetosheath near 1100 UT as the dynamic pressure dropped rapidly and the IMF turned northward. Polar experienced a second short transition into the solar wind near 1245 UT, and returned into a magnetosheath-like plasma for the next few hours. While in the solar wind, Polar observed transitory fluxes of very energetic ions which may be bow-shock associated, leakage from the compressed magnetosphere or possibly hot flow anomalies. We will discuss the combined Polar-Cluster observations during this event with emphasis on the source of the energetic ions observed upstream of the bow shock.

**SH52B-03 1400h****Cyclic and Sub-Cyclic Self-Reformation of Quasi-Parallel Shocks in PIC Simulations**

Bertrand Lembege<sup>1</sup> (33-1-39-25-47-70; [bertrand.lembege@cetp.ipsl.fr](mailto:bertrand.lembege@cetp.ipsl.fr))

Ken Tsubouchi<sup>1</sup> (33-1-39-25-47-65; [ken.tsubouchi@cetp.ipsl.fr](mailto:ken.tsubouchi@cetp.ipsl.fr))

<sup>1</sup>CETP-UVSQ-CNRS, 10-12 Avenue de l'Europe, Velizy 78140, France

Self reformation of quasi-parallel shocks is analyzed with the help of full particle simulations. Present results fully recover the formation of cyclic self-reformations of the shock front previously evidenced with hybrid simulations by Scholer (1993). In addition, it is shown that, within one main cyclic period, (i) shorter-time subcycles are identified and are characterized by a strong emission of whistler precursor from the ramp, (ii) these precursors are steepened over spatial scale less than one ion inertia length, and (iii) intermittent (short-time life) spiky electrostatic field are emitted within one subcycle. These processes are shown to have a strong impact on the local ion reflection and on the shock self-reformation.