2014 LWS Meeting
Abstracts – Poster Presentations
(by day/session, as of October 29, 2014)

Monday, Nov. 3 – Poster Session P1/P2
Featuring Topics 2a, 2b, and Hinode/IRIS Splinters

Poster Topic 2a. *Evolving Coronal Mass Ejections from Corona, through the Heliosphere, into Geospace*

101 ***Statistical Characteristics of Filament Eruptions Obtained by the EUV Spectroscopic Observations***
Kanda, Natsuo (1), nkanda@stelab.nagoya-u.ac.jp; and Shinsuke Imada (1).
(1) Nagoya University, Japan

It is often observed that the flares followed by coronal mass ejection are associated with the filament eruptions. However, some filament eruptions definitely fail to erupt close to the solar surface. Currently, we do not clearly understand the reason why some filaments fail to erupt. In this study we statistically analyze 82 flares by Hinode/EUV imaging spectrometer (EIS) and Solar Dynamic Observatory (SDO)/Atmospheric Imaging Assembly (AIA). We select the flare which GOES class is larger than M and occurred from April 2010 through February 2014. We determine the doppler velocity of the filament during the eruptions by Hinode EIS. We found that there are typically two types of events. First is the events dominated most part of erupting filament by the blueshift and the other is the events dominated most part of the filament by the redshift. The typical velocity of redshift is less than 100km/s (71.4%) and blueshift is less than 80km/s (76.2%). By using AIA observation we also determine the apparent velocity of filament. We also determine the length of the filament from AIA observation. Furthermore, we determine the highest point which filaments can reach to from AIA observation and determine whether the filament eruptions succeed or fail. In this study we discuss whether there are any relationship between the dynamical property of the filament and the success/failure of eruption.

102 ***Probing the Density and Magnetic Fields of Erupted Solar Filament Plasma***
Carlyle, Jack (1, 2), j.carlyle@ucl.ac.uk; David R. Williams (1); Lidia van Driel-Gesztelyi (1, 3, 4); Davina Innes (2); Andrew Hillier (5); and Sarah Matthews (1).
(1) Mullard Space Science Laboratory, University College London, Surrey, UK
(2) Max-Planck Institut für Sonnensystemforschung, Göttingen, Germany
(3) LESIA-Observatoire de Paris, CNRS, UPMC Univ. Paris 06, Univ. Paris-Diderot, Meudon, France
(4) Konkoly Observatory, Budapest, Hungary
(5) Kwasan and Hida Observatories, Kyoto University, Kyoto, Japan

On the 7th of June 2011 a unique eruption occurred on the Sun: material was flung into the solar atmosphere where it was seen to expand by several orders of magnitude, before much of the matter returned to the Sun in discrete, dense condensations, or 'blobs'. These blobs appear in absorption in EUV wavelengths, which allows us to determine their density by using SDO/AIA images in a quasi-spectroscopic way. Here we present the fundamentals of this technique and determine the characteristic densities of the in-falling erupted material. We also analyse the morphology and dynamics of the blobs as they pass through the quiet corona, demonstrating the presence of the Rayleigh-Taylor instability. Using the calculated density and observed spatial scales, it is possible to determine the associated magnetic field strength within the Coronal Mass Ejection (CME) that modifies the RT instability. This work provides interesting insight into the density and magnetic field strength in CMEs using new methods and observations of a fascinating, unique event.

103 ***Automated Kinematics Analysis of Off-Limb Coronal Bright Fronts Observed with SDO/AIA***

Kendrick, Alexander (1), akendrick@g.hmc.edu; and Kamen Kozarev (2).
(1) Harvey Mudd College, Claremont, CA, USA
(2) Harvard-Smithsonian Center for Astrophysics, Cambridge, MA, USA

Coronal mass ejections (CMEs) are thought to generate shock waves in the low and middle corona, which are seen by the Atmospheric Imaging Assembly (AIA) as associated extreme ultraviolet (EUV) large-scale coronal bright fronts (CBFs). Shocks associated with CMEs are known to accelerate ions to very high energies, creating solar energetic particles (SEPs). However, it is not presently known whether the low-coronal shocks seen as CBFs are efficient in accelerating particles to SEP energies. We investigate a number of CME events over a period from 2010-2014, using an automated algorithm to measure the kinematics of the associated CBFs in AIA data. We focus on off-limb events, since they allow for better determination of the three-dimensional structure of CBFs. Using a new suite of computer programming tools, we are able to automatically compute velocities and accelerations associated with the observed CBFs. The statistical analysis performed in this study will provide a database of promising CBFs for future analysis of shock evolution using data-driven magnetic field and shock acceleration models.

104 ***A Kinematic Study of Eruptive Prominences***

Evans, Kaitlin (1), kaitline.evans@gmail.com; Patrick McCauley (1); and Yingna Su (2).
(1) Harvard-Smithsonian Center for Astrophysics, Cambridge, MA, USA
(2) Purple Mountain Observatory, Nanjing, China

We present a kinematic study of eruptive prominences using data from the Atmospheric Imaging Assembly (AIA) aboard the Solar Dynamics Observatory (SDO). We analyze 304 Angstrom images for a sample of roughly 60 well-observed limb events selected from a catalog of prominence eruptions. First, a linear slice that best characterizes the overall trajectory of the prominence is selected. Height-time plots are then constructed from the emission along the slice as it evolves in time. The leading edge of the prominence is fit to find its velocity and acceleration as the eruption progresses. We observe two distinct phases: a slow-rise phase characterized by a linear profile and a fast-rise characterized by an exponential one. The point where the linear and exponential components are equal is defined as the onset of the fast rise phase, which we take to be the onset of the associated Coronal Mass Ejection (CME). We extend our fit to predict the arrival time and velocity of the filament at the field of view of the Large Angle and Spectrometric Coronagraph (LASCO) aboard the Solar and Heliospheric Observatory. By comparing these results with CME velocities recorded from LASCO/C2 observations, we can infer if there is additional acceleration between the AIA and LASCO fields of view.

105 ***Characterizing Twisting and Rolling Motions in Prominence Eruptions***

McKillop, Sean (1), smckillop@cfa.harvard.edu; Mari Paz Miralles (1); Nicholas Murphy (1); Patrick McCauley (1); and Yingna Su (1,2).
(1) Smithsonian Astrophysical Observatory, Cambridge, MA, USA
(2) Purple Mountain Observatory, Nanjing, China

Panasenco et al. [1] report observations of several CMEs that display a rolling motion about the axis of the erupting prominence. Murphy et al. [2] present simulations of line-tied asymmetric magnetic reconnection that make a falsifiable prediction regarding the handedness of rolling motions of flux ropes during solar eruptions. Mass motions in prominence eruptions tend to be complicated, and characterizing these motions is a challenge. We aim to determine the differences between twisting and rolling motions. If rolling motions are detected then we will investigate the handedness prediction. We use magnetograms from HMI to determine the strength and asymmetric properties of the photospheric magnetic field in the regions of interest. We use AIA observations to determine the handedness of the rolling motions. We then compare the photospheric magnetic information with the handedness to determine if there is a relationship between the two. Finally, we will discuss prospects for diagnosing rolling motions of erupting prominences using off-limb IRIS observations.

[1] O. Panasenco, S. Martin, A. D. Joshi, & N. Srivastava, J. Atmos. Sol.-Terr. Phys., 73, 1129 (2011).
[2] N. A. Murphy, M. P. Miralles, C. L. Pope, J. C. Raymond, H. D. Winter, K. K. Reeves, D. B. Seaton, A. A. van Ballegooijen, & J. Lin, ApJ, 751, 56 (2012).

106 ***SDO/AIA and STEREO/EUVI Observations of Prominence Dynamics during a Series of Eight Homologous Flares Leading to a CME Eruption***

Panesar, Navdeep Kaur (1,2), panesar@mps.mpg.de; D. E. Innes (1); Alphonse. C. Sterling (3); and Ronald. L. Moore (3).
(1) Max Planck Institute for Solar System Research, Gottingen, Germany
(2) Center for Space Plasma and Aeronomic Research (CSPAR), UAH, Huntsville, AL, USA
(3) Heliophysics and Planetary Science Office, Marshall Space Flight Center, Huntsville, AL, USA

Homologous flares are eruptive events that occur repetitively in the same active region, with similar structure and morphology. A series of at least eight homologous flares occurred in active region NOAA 11237 over 16 – 17 June 2011. A filament is rooted in the active region with an overlying coronal cavity. The active region appears on the southeast solar limb as seen from SDO/AIA, and on the disk as viewed from STEREO-B/EUVI; the dual perspective allows us to study in detail behavior of prominence/filament material entrained in the magnetic field of the repeatedly-erupting system. Each of the eruptions was mainly confined, with active-region prominence material being ejected from the core of the erupting region onto outer-lobe loops of the active region. The eruption series repeatedly disrupted material of a quiet-Sun extension of the prominence, and that material became suspended at progressively higher heights above the surface. Two final eruptions from the core region destabilized the field holding that material, instigating a coronal mass ejection (CME).

107 ***Initiation and Early Evolution of the Coronal Mass Ejection on May 13, 2009 from EUV and White-Light Observations***

Reva, Anton (1), reva.antoine@gmail.com; Artem Ulyanov (1); Sergey Bogachev (1); and Sergey Kuzin (1).
(1) Lebedev Physical Institute, Moscow, Russia

We present the results of the observations of a coronal mass ejection (CME), which occurred on May 13, 2009. The most important feature of these observations is that the CME was observed from the very early stage (the solar surface) up to a distance of 15 solar radii (Rsun). Below 2 Rsun, we used the data from the TESIS EUV telescopes obtained in the Fe 171 Å and He 304 Å lines, and above 2 RSun, we used the observations of the LASCO C2 and C3 coronagraphs. The CME was formed at a distance of 0.2–0.5 Rsun from the Sun's surface as a U-shaped structure, which was observed both in the 171 Å images and in white-light. Observations in the He 304 Å line showed that the CME was associated with an erupting prominence, which was located not above–as predicts the standard model–but in the lowest part of the U-shaped structure close to the magnetic X-point. The prominence location can be explained with the CME breakout model. Estimates showed that CME mass increased with time. The CME trajectory was curved–its helio-latitude decreased with time. The CME started at latitude of 50 degrees and reached the ecliptic plane at distances of 2.5 Rsun. The CME kinematics can be divided into three phases: initial acceleration, main acceleration, and propagation with constant velocity. After the CME onset COES registered a sub-A-class flare.

108 ***The Launch and Evolution of a Coronal Mass Ejection Flux Rope***

Howard, T. A. (1), howard@boulder.swri.edu; and C. E. DeForest (1).
(1) Southwest Research Institute, Boulder, CO, USA

It is well known that the common coronal mass ejection (CME) is driven by an intrinsic magnetic flux rope. Parts of this flux rope are manifest in coronagraphs as a dark cavity in a "classic" CME configuration, while other parts are measured by in-situ spacecraft in the form of what is known as a magnetic cloud. It is this flux rope component that is widely believed to drive strong magnetic reconnection at the Earth, leading to the most severe geomagnetic storms. Forecasting the behavior of CME flux ropes is difficult, as we are limited to these 1-dimensional (in-situ) or 2-dimensional (white light) measurements, leaving us to deduce the 3-dimensional structure through modeling. We present a narrative of the onset and evolution of a 3-D CME flux rope using observations alone. We identify the onset mechanisms required to completely dislodge the flux rope from the Sun, the geometric evolution of the complete structure as it evolves through the solar wind, and the implications of its impact with the Earth and near-Earth in-situ spacecraft. We find that for even this "simple" CME, the flux rope narrative is quite complex, leading us to question the validity of over-simplified narratives of CME evolution.

109 ***Observations and Analysis of the Non-Radial Propagation of Coronal Mass Ejections near the Sun***

Liewer, Paulett (1), Paulett.Liewer@jpl.nasa.gov; Robin Colaninno (2); Olga Panasenco (3); and Angelos Vourlidas (2).
(1) Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, USA
(2) Space Sciences Division, Naval Research Laboratory, Washington, DC, USA
(3) Advanced Heliophysics, Pasadena, CA, USA

Coronal Mass Ejection (CME) trajectories are often observed to deviate from radial propagation from the source while within the coronagraph fields-of-view (R < 15-30 Rsun). To better understand non-radial propagation within the corona, we analyze the trajectories of four CMEs for which both the source and 3-D trajectory can be well determined from solar imaging observations, primarily using observations from the twin Solar TErrestrial RElations Observatory (STEREO) spacecraft. A potential field source surface model is used to determine the direction of the magnetic pressure force exerted on the CMEs at various heights in the corona. One case shows the familiar gradual deflection of a polar crown filament CME towards the heliospheric current sheet and streamer belt by the large-scale coronal magnetic fields. In two cases, we find that strong active region fields cause an initial asymmetric expansion of the CME that gives rise to apparent rapid deflection and non-radial propagation from the source. For all four cases, within the limitations of the potential field source surface model, the coronal magnetic fields appear to guide the CMEs out through the weak field region around the heliospheric current sheet even when the current sheet is highly inclined and warped.

110 ***Shocks Inside Coronal Mass Ejections: Properties and Geo-Effectiveness***

Lugaz, Noé (1), noe.lugaz@unh.edu; and C. J. Farrugia (1).
(1) Space Science Center and Dept. of Physics, University of New Hampshire, Durham, NH, USA

Shock propagating inside coronal mass ejections (CMEs) may compress the magnetic field inside these CMEs by a factor of 2-3, which may result in enhanced geo-effectiveness. Here, we report on ~50 fast-mode forward shocks propagating inside coronal mass ejections measured by Wind and ACE at 1~AU from 1997 to 2006. These shocks propagate in very different upstream conditions as compared to typical CME-driven shocks, with a median upstream Alfvenic speed of 90 km/s and a plasma beta of ~0.1. 19 of these complex events were associated with an intense geomagnetic storm within 12 hours of the shock detection at Wind, and 13 were associated with a drop of the Dst of more than 50 nT between 3 and 9 hours after the shock detection. We discuss some of the properties of these shocks and some of the mechanisms which may result in the enhanced geo-effectiveness. We also use past numerical simulations and remote-sensing analyses to further investigate how the shock and CME properties vary during the interaction.

111 ***Analyzing 3D CMEs with the Time Convolution Mapping Method***

Thompson, Barbara J. (1), barbara.j.thompson@nasa.gov; Mario M. Bisi (2); Ryun Young Kwon (3); M. Leila Mays (1,4); Ian G. Richardson (1,5); and Angelos Vourlidas (6).
(1) NASA Goddard Space Flight Center, Greenbelt, MD, USA
(2) Rutherford Appleton Laboratory (RAL) Space, Oxfordshire, UK
(3) George Mason University, Fairfax, VA, USA
(4) Catholic University of America, Washington, DC, USA
(5) University of Maryland, College Park, MD, USA
(6) Space Department, John Hopkins University, Applied Physics Lab, Laurel, MD, USA

In the era of combined STEREO and SOHO observations, significant advances have been made in determining the 3D structure of CMEs. However, there is some ambiguity involved in separating the "true" CME from CME-associated brightenings. We employ a simple yet versatile image processing technique called "Persistence Mapping" that is useful for the visualization and depiction of gradually evolving or intermittent structures in coronal imagery. The Time Convolution Mapping Method (TCMM) convolves the extrema identified in the Persistence Map data product with the time at which the CME reached the associated extrema. TCMM mapping reveals several features separate from the simplified "expanding loop" topology, accomplishing two important things: 1) it allows a much more accurate determination of the trajectory and expansion in CME images, affording a significant improvement in the determination of the 3D kinematics of the "true" CME, and 2) it provides a map of how the CME is impacting the surrounding corona and produces impact profiles that can also be extrapolated to 3D. These impact profiles can be used to infer shock propagation, SEP production sites, and can be mapped into lower coronal phenomena such as EUV waves and dimmings.

112 ***Plasma Eruptions Seen in EIS during a C8.3 Flare on 2014 April 4***

Watanabe, Tetsuya (1), watanabe@uvlab.mtk.nao.ac.jp; Hirohisa Hara (1); Kyoko Watanabe (2); and Shinsuke Imada (3).
(1) NAOJ, Mitaka, Tokyo, Japan
(2) Institute of Space and Astronautical Science (ISAS), / Japan Aerospace Exploration Agency (JAXA), Sagamihara, Kanagawa. Japan
(3) Solar-Terrestrial Environment Laboratory, Nagoya University, Chikusa, Nagoya, Japan

A C8.3 flare was an eruptive flare starting at 2014 April 4 13:34 (UT) during the iHOP245 campaign. EIS observed the flare with an EIS study ID 458 (Cam_flare_diag). Despite of the impulsiveness and the simplicity of its light curve, the filament eruption at the beginning of the flare presents a lot of complicated velocity structures, and each filament shows high-speed up and down plasma motions. Hot plasmas with temperature Te > 10^7 K seen in FeXXIII 263.76A were also created in erupting filaments, but were mainly observed as those falling back to the surface with other plasmas of cooler temperatures. Hot flare arcade was then created around the maximum phase with large turbulent velocity and partly still with large outflow velocity.

113 ***DEM Analysis of a EUV Wave Generated by a CME***

Vanninathan, Kamalam (1), kamalam.vanninathan@uni-graz.at; Karin Dissauer (1); Astrid Veronig (1); Eduard Kontar (2); Maria Madjarska (3); and Iain Hannah (2).
(1) University of Graz, Austria
(2) University of Glasgow, Scotland, UK
(3) Armagh Observatory, Armagh, UK

EUV waves are large scale disturbances that occur in association with Coronal Mass Ejections (CMEs) and are best visible in the AIA 193, 211 channels. These waves propagate in three dimensions throughout the solar corona and possibly trigger other eruptions and oscillations on the Sun far away from the CME site. There is requirement for plasma diagnostics of the wave front and its surroundings to understand the reaction of the corona to the passage of the wave. In this study we make use of perturbation profiles, which are intensity vs distance plots, to identify the wave front and track its position as it propagates away from the CME site. The intensities thus calculated, from the different AIA coronal channels, are used as input for a DEM analysis on the wave front plasma. In this way we study the evolution of the wave front with time and comment on the temperature and density changes that occur on the local plasma as the wave passes over.

114 ***Thermal Analysis of EUV Waves Observed with SDO/AIA***

Boerner, Paul (1), boerner@lmsal.com; Mark Cheung (1); Nariaki Nitta (1); and Karel Schrijver (1).
(1) Lockheed Martin Solar and Astrophysics Laboratory, Palo Alto, CA, USA

One of the most striking observational characteristics of the solar corona as seen in the EUV with SDO/AIA is the occurrence of large-scale wavelike fronts that propagate away from the sites of some eruptions. However, the nature of these fronts, and their relationship with coronal mass ejections, sympathetic flares, and solar energetic particles is difficult to determine without quantitative diagnostics. We describe a new technique for determining the temperature and density change responsible for the observed wavefronts, and apply it to a number of notable CMEs. The resulting parameters can be compared with the predictions of a variety of proposed explanations for the appearance of coronal EUV waves, including fast-mode MHD waves and non-wave phenomena.

115 ***Parameterizing Coronal Dimmings Associated with Coronal Mass Ejections***

Mason, James Paul (1), james.mason@lasp.colorado.edu; Thomas Woods (1); Amir Caspi (1); David Webb (2); Angelos Vourlidas (3); and Barbara Thompson (4).
(1) Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder, CO, USA
(2) ISR, Boston College, Chestnut Hill, MA, USA
(3) Naval Research Laboratory, Washington, DC, USA
(4) NASA Goddard Space Flight Center, Greenbelt, MD, USA

Prior work has established the physical mechanisms that can lead to the observation of coronal dimming during a solar eruptive event and analyzed the impact of one mechanism in particular, mass loss dimming, on extreme ultraviolet (EUV) irradiance and localized radiance for a single, relatively simple event (Mason et al., ApJ, 789, 61, 2014). That work also established a technique for isolating the effect of the gradual phase flare peak in coronal dimming lines (e.g., Fe IX 171 A and Fe XII 195 A) using the SDO/EVE solar EUV irradiance data to determine mass loss dimming component, which is comparable to more detailed analysis with SDO/AIA solar EUV images. Here, we apply the technique to additional events with no a priori preference for event simplicity. Two two-week periods in 2011 were selected and approximately 40 dimming events subjectively identified with SDO/AIA. We determine the occurrence of the various physical processes and their relative contributions to the overall observed dimming. Additionally, we parameterize the corrected SDO/EVE dimming for comparison with CME kinematics (mass and velocity) as determined by SOHO/LASCO and STEREO/COR observations.

116 ***Abstract Withdrawn***

117 ***Investigating the Origin and Evolution of Magnetic Flux Ropes in the Heliosphere***

Linton, Mark, mark.linton@nrl.navy.mil, US Naval Research Laboratory, Washington, DC, USA.

We present the goals and planned research investigations of the recently formed Living with a Star Targeted Science Team addressing the Focused Science Topic ‘Flux Ropes from the Sun to the Heliosphere.’ This interdisciplinary team will address the fundamental aspects of flux rope formation and evolution, including the emergence of magnetic flux from the solar interior, the formation of flux ropes in the solar atmosphere, their eventual eruption and subsequent evolution as coronal mass ejections (CMEs), and their propagation as interplanetary coronal mass ejections (ICMEs). The team goal is to closely couple observations, models, and simulations to develop a deep understanding of the properties of CME flux ropes from their birth in the solar atmosphere to their arrival at Earth and beyond. The team investigations will focus on answering three key questions:

1) How do magnetic flux ropes form in emerging active regions?
2) How does flux emergence lead to the eruption of CME flux ropes?
3) How are ICME flux ropes distorted by their interaction with the interplanetary medium?

This presentation will review the capabilities of the team, and will present the research investigations planned by the team to address these fundamental questions about the origin and evolution of CME flux ropes.

This work is funded by the NASA Living with a Star program.

118 ***Mapping the Alfvén Speed profile in the Inner Heliosphere using Type II Radio Bursts***

Bain, Hazel (1), hbain@ssl.berkeley.edu; Peter Sullivan (1); Juan Carlos Martinez Oliveros (1); David Sundkvist (1); and Stuart D. Bale (1).
(1) Space Sciences Laboratory, University of California Berkeley, Berkeley, CA, USA

It is well accepted that interplanetary Type II radio bursts are the manifestations of electron acceleration in shocks driven by propagating coronal mass ejections (CMEs). The interplanetary medium plays a role in the formation and propagation of CME driven shocks. In particular, a shock is generated when the driver is traveling faster than the local fast magnetosonic speed, vF. It is therefore important for our understanding of shock propagation to understand how the profile of vF changes as a function of distance from the sun. We present results from a survey of coronal and interplanetary type II radio bursts, using radio observations from STEREO/WAVES and WIND/WAVES, to determine the distance at which the type II emission was produced and the speed of the associated CME shock. By establishing regions of the corona and interplanetary medium that are predisposed to shock formation, we map out the profile of the fast magnetosonic speed, and in turn infer the local Alfvén speed.

119 ***Future Observations of Coronal Temperature and Electron Velocity with the Spherical Occulter Coronagraph CubeSat (SpOC Cube)***

Chamberlin, Phillip C. (1), phillip.c.chamberlin@nasa.gov; Joseph M. Davila (1); Douglas Rabin (1); and Nelson L. Reginald (1,2).
(1) NASA Goddard Space Flight Center, Greenbelt, MD, USA
(2) Catholic University of America, Washington, DC, USA

Conventional solar coronagraphs, which detect broad-band photospheric light Thomson-scattered by coronal electrons, measure only electron density along the line of sight and the transverse (plane-of-sky) velocity of transients. A new and simple experimental technique, based on the Imaging Spectrograph of Coronal Electrons (ISCORE) that was proven during ground-based eclipse measurements by Reginald et al. (2003, 2004, 2009, 2011, 2014), uses a set of filters in a coronagraph to derive the thermal electron temperature and electron bulk flow speed in the radial direction in the low solar corona. Measurement of these coronal parameters will significantly improve solar wind measurements and heliospheric models as they propagate transients from the lower solar atmosphere through the heliosphere towards the Earth and other planets.

A proposal was submitted to the 2014 H-TIDS CubeSat call titled Spherical Occulter Coronagraph CubeSat (SpOC Cube). This 6U CubeSat bus will be integrated with a coronagraph detector and optics, including necessary filters and filter-changing mechanism. The primary mission will deploy an 8-cm diameter, black-painted, free-flying spherical occulter, leading to the name Spherical Occulter Coronagraph CubeSat, or SpOC Cube. After occulter deployment, the actively controlled 6U CubeSat will provide inertial formation flying with this passive sphere between it and the Sun to provide a coronagraph with approximately 2.0 m separation between the occulter and optics, which is farther than any current space-based coronagraph, leading to better signal-to-noise due to suppressed diffraction from the occulter as well as improved vignetting in the low corona. The formation flying and passive secondary make this all possible within a 6U CubeSat. The EM-1 orbit is advantageous as it will be out of the significant influence of Earth's atmospheric density variations and changing gravitational forces, greatly simplifying all aspects of formation flying. SpOCCube is directly scalable to future solar coronagraphs on the scale of an Explorer-class mission, SpOC-Ex, which would provide larger occulter-optics separations for even better signal/noise and vignetting performance that could push imaging and plasma diagnostics down to <1.05 solar radii.

120 ***The Future of Heliospheric Imaging***

DeForest, C. E. (1), deforest@boulder.swri.edu; and T. A. Howard (1).
(1) Southwest Research Institute, Boulder, CO, USA

The field of heliospheric imaging has come of age. With its foundations laid in the 1970s with the Helios spacecraft, the field itself is now over 10 years old, starting with the Solar Mass Ejection Imager launch in 2003. Like coronagraphs, heliospheric imagers observe white light that has been Thomson scattered off free electrons in the solar wind, but at larger distances from the Sun and across a much larger angular range. Now that we are reaching the limits of what scientific information can be extracted from the current generation of heliospheric imager, it is imperative that we consider the direction of the field beyond this generation. We present an exposition of the future of heliospheric imaging based on the remaining areas of exploration of Thomson scattering, lessons learnt from current and prior generations of imager, and the balance between instrument design and data processing.

Poster Topic 2b. *Dynamics of Energetic Particles, Wave-Particle Interactions, Shocks, Turbulence*

121 ***Evidence for a Co-Spatial Return Current in RHESSI Solar Flare Spectra***

Alaoui, Meriem (1,2), meriem.alaouiabdallaoui@nasa.gov; and Gordon D. Holman (1).
(1) NASA Goddard Space Flight Center, Solar Physics Laboratory, Greenbelt, MD, USA
(2) Dept. of Physics, The Catholic University of America, Washington, DC, USA

Solar flares accelerate electrons in the corona which then stream toward the dense chromosphere. They lose their energy through collisions with the ambient plasma, heating the plasma and radiating bremsstrahlung X-rays. Due to the high flux of energetic electrons required to explain observed X-ray fluxes, as well as strong evidence that suggests ion and electron beams are not streaming together, the high current carried by

the electrons would be pinched off by its associated magnetic field if it is not neutralized. A co-spatial return current in the background plasma provides this neutralization. The induced electric field driving this return current is responsible for electron energy losses proportional to the electric field strength. This produces a flattening of the hard X-ray spectrum at low photon energies.

We investigate the possibility of explaining RHESSI spectra in terms of a 1D return-current model. We choose four flares with strong spectral breaks (flattening) at lower energies, around a few deka-keV, that cannot be explained by Compton back-scattering (albedo) or non-uniform ionization. We then fit the spatially integrated spectra using a 1D return-current model in which electrons lose energy by return-current losses until they reach the thick-target chromosphere, where they lose all of their energy by Coulomb collisions. Our main results are: (1) The data can be well fitted with the return current model; (2) the time evolution of parameters such as the total potential drop, the beam electron density, the drift speed of the return-current electrons and the return-current electric field as compared to the classical Dreicer electric field all indicate that return-current losses might be important for the chosen flares; (3) limits on the resistivity can be derived from the fitted potential drop and deduced electron beam flux density. These limits provide a test for the adequacy of classical (Spitzer) resistivity.

122 ***Solar Wind Speed-Temperature-Acceleration Relation***

Case, Anthony (1), tonycase@cfa.harvard.edu; and Justin Kasper (1,2).
(1) Smithsonian Astrophysical Observatory, Cambridge, MA, USA
(2) University of Michigan, Ann Arbor, MI, USA

It has been suggested that the well-known correlation between solar wind speed and temperature arises naturally from symmetries in the solar wind energy equation. In the presence of turbulent heating this explanation is only valid for high Alfven Mach number wind undergoing uniform expansion. We provide supporting evidence for this theory by studying the temperature of solar wind protons at 1 AU as a function of proton speed, Alfven Mach number, and the acceleration of the wind defined as the rate of change of speed over a range of time-scales. We confirm earlier evidence of the sensitivity of temperature to acceleration in addition to velocity. We show that the proton temperature for all solar wind with mach number greater than eight and proton speed between 300 and 800 km/s is reproduced by a three-parameter model that depends only on velocity and acceleration. The continuity of the model across this range in speeds is surprising, given the different coronal conditions and acceleration mechanisms generally attributed to slow and fast solar wind. We investigate the accuracy of the model as a function of the averaging time-scale used to calculate the acceleration and discuss the implications of those time-scales on future measurements by Solar Probe Plus and Solar Orbiter.

123 ***Continuum Emission Observed by IRIS During Solar Flares***

Daw, Adrian (1), adrian.daw@nasa.gov; Adam Kowalski (2,1); Joel Allred (1); and Gianna Cauzzi (3).
(1) NASA Goddard Space Flight Center, Greenbelt, MD, USA
(2) University of Maryland, College Park, MD, USA
(3) INAF-Ossevatorio Astrofisico di Arcetri, Firenze, Italy

Fits to IRIS spectra observed from the brightest kernels during the impulsive phase of solar flares are presented, providing long-sought constraints on the UV/white-light continuum emission that can discriminate between a hot blackbody component and hydrogen recombination emission. Implications for electron beam heating during flares are discussed.

124 ***Characterizing Turbulent Flow in Quiescent Prominences***

Freed, Michael (1), micfreed@gmail.com; Michaelah Wilburn (2); and David McKenzie (1).
(1) Montana State University, Bozeman, MT, USA
(2) Transylvania University, Lexington, KY, USA

Understanding the motion of plasma in quiescent prominences is important in determining how the magnetic field structure can become entangled to trigger eruptions. Hinode/Solar Optical Telescope (SOT) observations have already demonstrated the existence of convective flows and Kelvin-Helmholtz instabilities around the plume component inside these prominences. Our research uses the same observations to make quantitative measurements of the turbulent diffusive flows in these coronal structures. Fourier local correlation tracking (FLCT) is used to derive velocity fields from SOT observations of prominence plasma sheets. Analysis of these velocity fields in turn provides a measurement of the temporal and/or spatial length scales associated with the energy dissipation and diffusivity.

125 ***Comparison between Visible White Light and EUV Continuum Enhancement in Solar Flares with Hinode/SOT and EIS***

Kawate, Tomoko (1), t.kawate@qub.ac.uk; Kyoko Watanabe (2); Shinsuke Imada (3); Kyoung-Sun Lee (2); and Naoki Iwamoto (4).
(1) Queen's University Belfast, UK
(2) Inst. of Space and Astronautical Science (ISAS) / Japan Aerospace Exploration Agency (JAXA), Japan
(3) Nagoya University, Japan
(4) Ibaraki University, Japan

It has been said that nonthermal electrons in solar flares precipitating to the solar surface produce white light emissions in visible wavelength. Emission mechanisms of the white light flares are still under discussions, but it is important phenomena to discuss the energetics of the solar/stellar flares and particle acceleration problems. Most of the white light flare observations are of free-free or Hydrogen Balmer/Paschen free-bound continua, and there are few discussions of the effect of nonthermal electrons in UV continua though we can discuss that for the analogy of the visible white light flares. One of the reasons is difficulty of imaging observations to resolve continuum in UV band, which contains too many lines. Therefore, we need wide range spectral information in addition to the temporal and spatial resolutions.

We analyze several flares with SOT and EIS, and investigate the temporal and spatial relationship between visible white light flare kernels and EUV continuum enhancements. We find that, in impulsive phase, EUV free-bound continuum of He II enhances at the chromospheric flare kernels and, in gradual phase, EUV free-free continuum enhances in the flare loop. The He II free-bound continuum at the footpoint decays rapidly after the impulsive phase. Thus, we can say that the emission is originated from nonthermal particles.

In this presentation, we show our results of EUV continuum imaging spectroscopy and discuss the factor of nonthermal effects of EUV white light flares.

126 ***Extracting Solar Energetic Particle Injection Histories and Decay Phase Propagation Directly from Observations***

Roelof, Edmond C. (1), edmond.roelof@jhuapl.edu; Dennis K. Haggerty (1); David Lario (1); and Robert B. Decker (1).
(1) The Johns Hopkins University, Applied Physics Laboratory, Laurel, MD, USA

We present recent results from SEP events wherein we have applied novel equations derived from the collisionless Vlasov equation that can extract both the SEP injection history during the rise-to-maximum phase and the propagation parameters during the decay phase. RISE-TO-MAXIMUM PHASE. We use a non-linear functional equation for extracting the SEP injection time history (for events magnetically well-connected to the accelerating shock). The extraction algorithm is applied directly to the SEP anisotropy measurements (without recourse to any simulations or modeling). It is based on nearly scatter-free propagation inside the radius of the spacecraft, but it allows for any form of propagation in the region beyond the spacecraft. The method immediately empirically separates the “first-crossing” SEPs from the later “multiple-crossing” SEPs (back-scattered from beyond the spacecraft and mirrored inside the radius of the spacecraft). POST-MAXIMUM AND DECAY PHASE. The strong (beam-like) anisotropy in well-connected events is diminished as the intensity nears its maximum by the arrival of the back-scattered SEPs from beyond the spacecraft. This can produce a slowly decaying particle “reservoir”. Energy loss and magnetic drift transport then both become important for “multiple-crossing” SEPs. The correct energy loss formula is the key to understanding compositional signatures of energetic ion species; it predicts that the decay-phase time histories of different species should be organized by total energy/charge. This is the straight-forward explanation of the seemingly puzzling “energy shifts” that bring intensity histories of different ion species (e.g., O, Fe) into remarkable agreement when they are compared at “shifted” values of energy/nucleon.

127 ***Thermodynamics of Solar Wind Electrons***

Salem, Chadi (1), salem@ssl.berkeley.edu; Marc Pulupa (1); and Stuart Bale (1).
(1) Space Sciences Laboratory, University of California, Berkeley, CA, USA

We present a comprehensive statistical analysis of solar wind electrons using the electron analyzers of the 3D-Plasma instrument on the Wind spacecraft. This work uses a sophisticated algorithm developed to analyze separately the different populations - core, halo and strahl - of the electron velocity distribution function (eVDF) up to 'super-halo' energies (2 keV). The code determines their respective set of parameters through fits to the measured eVDF, taking properly into account spacecraft charging and other instrumental effects. We use here several years (half a solar cycle, approximately 1.5 million of independent measurements) of core, halo and strahl electron parameters to investigate the properties of these different populations and the physical processe(s) that likely act to control and regulate them.

We discuss new results obtained on (1) the electron temperature anisotropies and their variation with collisions and/or solar wind fluctuations and instabilities, (2) the properties of core and halo drifts in the solar wind proton frame, (3) the electron heat flux, and (4) the electron strahl. These new observations emphasize the non-negligible role of Coulomb collisions in shaping the electron distribution function and regulating of the thermal and supra thermal electrons, but that the solar wind electron expansion and compression are limited fundamentally by some instabilities under certain conditions.

Poster Topic 5. *Hinode / IRIS Splinter Sessions*

128 ***Study of High-Speed Flows Associated with Chromospheric Transients around a Sunspot***

Katsukawa, Yukio (1), yukio.katsukawa@nao.ac.jp; K. Otsuji (1); and T. Tarbell (2).
(1) National Astronomical Observatory of Japan, Mitaka, Tokyo, Japan
(2) Lockheed Martin Solar & Astrophysics Laboratory, Palo Alto, CA, USA

Lots of transient events taking place in and around a sunspot, such as penumbral microjets, jets above a light bridge, Ellerman bombs, and chromospheric anemone jets. It has not been well understood yet how fast flows are driven associated with such events and how the flows influence the upper chromosphere and transition region. One of the reasons is little knowledge on temporal evolution of chromospheric spectra with high spatial resolution. We ran a joint observation (IHOP250) with HINODE and IRIS to capture spectroscopic signatures of chromospheric transients and their temporal evolution. Highest cadence Ca H filtergrams were taken with HINODE SOT simultaneous with spectro-polarimetric observations of the photosphere. IRIS obtained Mg II, C II, and Si IV spectra with a high-temporal cadence sit-and-stare program. Several sunspots have been successfully observed with enough overlap between HINODE and IRIS. We'd like to report results of the program, especially on temporal evolution of chromospheric spectra of penumbral microjets and their relationship with photospheric magnetic fields.

129 ***IRIS Observations of the Transition Region Above Sunspots***

Tian, Hui (1), hui.tian@cfa.harvard.edu; L. Kleint (2); H. Peter (3); M. Weber (1); E. DeLuca (1); K. Reeves (2); S. McKillop (1); N. Schanche (1); B. De Pontieu (2); and the IRIS team.
(1) Harvard-Smithsonian Center for Astrophysics, Cambridge, MA, USA
(2) Lockheed Martin, Solar and Astrophysics Lab, Palo Alto, CA, USA
(3) Max Planck Institute for Solar System Research, Göttingen, Germany

NASA's IRIS mission is providing high-cadence and high-resolution observations of the solar transition region (TR) and chromosphere. We present results from IRIS observation of the transition region above sunspots. The major findings can be summarized as following: (1) Many subarcsec bright dots are present in SJI 1330Å and 1400Å images obtained in high-cadence observations. These bright dots are observed in the penumbrae of all sunspots we inspected, and are occasionally present in the umbrae and light bridges of some sunspots. Some bright dots show apparent movement with a speed of 10-40 km/s (either outward or inward). The lifetime of these penumbral dots is mostly less than 1 min. The most obvious spectral features are the absence of the O IV 1401 line and the broadened Si IV line profiles. Some bright dots appear to be located at the footpoints of coronal loops. Many of them are likely generated by impulsive reconnection in the TR and chromosphere. (2) Strongly nonlinear sunspot oscillations can be clearly identified in both the slit jaw images of 2796Å, 1400Å and 1330Å, and spectra of the bright Mg II, C II and Si IV lines. The temporal evolution of the line core is dominated by the following behavior: a rapid excursion to the blue side, accompanied by an intensity increase, followed by a linear decrease of the velocity to the red side. The maximum intensity slightly lags the maximum blue shift in Si iv, whereas the intensity enhancement slightly precedes the maximum blue shift in Mg ii. We find a positive correlation between the maximum velocity and deceleration, a result that is consistent with numerical simulations of upward propagating magneto-acoustic shock waves.

We also demonstrate that the strongly nonlinear line width oscillation, reported both previously and here, is spurious. (3) Persistent supersonic downflows at TR temperatures are clearly detected in many sunspots. Many of them appear to be associated with sunspot plumes. (4) The normally reserved C II and Mg II line profiles are almost Gaussian in the sunspot umbra, suggesting a greatly reduced opacity in the sunspot atmosphere.

E-Posters – Session P1

130-E ***Hinode, SDO AIA, and CoMP Observations of a Coronal Cavity with a Hot Coronal Cavity with a Hot Core***

Jibben, Patricia (1), pjibben@cfa.harvard.edu; and Kathy Reeves (1).
(1) Harvard-Smithsonian Center for Astrophysics, Cambridge, MA, USA

Coronal cavities are low emission regions often situated around quiescent prominences. Prominences may exist for days or months prior to eruption and the magnetic structure of the cavity during the quiescent period is important to understanding the pre-eruption phase. We describe observations of a coronal cavity with a hot core situated above a polar crown prominence. The cavity, visible on the southwest limb, was observed for a period of three hours as a Hinode Coordinated Observation (HOP 114). Using Hinode's X-ray Telescope (XRT) and EUV Imaging Spectrometer (EIS) we present the thermal emission properties and coronal velocity structures of the cavity. We find the core has hotter temperatures than the surrounding plasma and there is evidence of turbulent velocities within the cavity. We also investigate the interaction of the cavity with the prominence material using Solar Dynamic Observatory (SDO) Atmospheric Imaging Assembly (AIA) data and H-alpha data from Hinode's Solar Optical Telescope (SOT). We find evidence of hot plasma at the spine of the prominence reaching into the cavity. These observations suggest a cylindrical flux tube best represents the cavity structure. The magnetic structure of the cavity is further discussed using data from the Coronal Multichannel Polarimeter (CoMP).

This work is supported by under contract SP02H1701R from Lockheed-Martin to SAO, contract NNM07AB07C from NASA to SAO and grant number NNX12AI30G from NASA to SAO.

131-E ***Filament Eruptions Observed by the Solar Dynamics Observatory***

McCauley, Patrick (1), pmccauley@cfa.harvard.edu; Yingna Su (2); Kaitlin Evans (1); Nicole Schanche (1); and Sean McKillop (1).
(1) Harvard-Smithsonian Center for Astrophysics, Cambridge, MA, USA
(2) Purple Mountain Observatory, Nanjing, China

We present a catalog of filament eruptions observed by the Atmospheric Imaging Assembly (AIA) aboard the Solar Dynamics Observatory (SDO). Over 800 events were culled from the Heliophysics Event Knowledgebase and incorporated into an online catalog for general use. Several observational characteristics are recorded for each event. These include the type of filament, the symmetry of the eruption, its predominant direction, evidence for twist, the presence of vertical threads, and the presence of a coronal cavity. Associated flares and coronal mass ejections are also recorded. For events on the limb, height-time plots that characterize the kinematics of the eruptions are included. This poster summarizes the characteristics of the ensemble along with the features of the online catalog.

132-E ***The EUV Connection to CMEs and "Blobs"***

Schanche, Nicole (1), nschanche@cfa.harvard.edu; Kathy Reeves (1); and Leon Golub (1).
(1) Smithsonian Astrophysical Observatory, Cambridge, MA, USA

Extended coronal structures around active regions and coronal mass ejections (CMEs) have often been seen in the extreme-ultraviolet (EUV) channels to the full extent of the AIA and SWAP fields of view (~1.3 and 1.7 Rsun). These events can later be seen in the white-light LASCO data. However, because of the gap in data between current EUV telescopes and LASCO data, it is difficult to definitively trace events from the solar surface out through the corona. We compared the events classified as halo CMEs in the white-light LASCO CACTus catalog from July-November 2013 to the AIA and SWAP data collected around those events. We discovered that roughly 80% of events could be seen in the EUV using both regular and running difference movies. Furthermore, we looked at "blobs" that occur in post-CME ray structures, as seen in LASCO data. These blobs have been interpreted as consequences of plasmoid instability in the current sheet. In some cases we have found possible links in the EUV data. We conclude that a larger field-of-view telescope would make it possible to establish a link for the development of these structures and events from the disk out to several solar radii, complementing the traditional white-light methods.

133-E ***Coronal Mass Ejections and associated Shocks: Build-up and propagation in a complex environment***

Stenborg, Guillermo (1), guillermo.stenborg.ctr@nrl.navy.mil; and Monique Pick (2).
(1) College of Science, George Mason University, Fairfax, USA
(2) LESIA-Observatoire de Paris, CNRS, Meudon, France

The high cadence and multi-temperature observations obtained by the Atmospheric Imaging Assembly (AIA) instrument onboard the Solar Dynamic Observatory (SDO) combined with extreme ultraviolet imagery from the STEREO/SECCHI suite is contributing to a deeper understanding of coronal dynamic phenomena already observed by former missions from single view points. In particular, they help shed light on the genesis and early development of coronal mass ejection events. Aided by radio imaging, we analyzed the early stages of a particular couple of homologous CME events that were observed to experience a strong deflection in latitude before reaching two solar radii. Extreme ultraviolet images obtained from two quasi-perpendicular perspectives show that the overall progress of both events in the low corona can be synthesized as follows: i) formation of a CME bubble minutes after an, interestingly, moderate X-ray flare; ii) development of a shock wave, which appears to be driven by the CME feature during its early development; iii) deceleration of the lateral expansion rate of the CME, which apparently leads to the decouple of the CME shock, allowing its free propagation until apparently stopped at a coronal hole boundary; and iv) reflection of a wave–like feature at that boundary. Solar radio emissions, namely Type II, Type III, and dm bursts, were also recorded along their development. In this work, we use this comprehensive data set to investigate how the ambient coronal structures affected the crucial milestones in the development of these events, and in particular attempt to unravel the direction of propagation observed in the SOHO/LASCO field of view (FoV), which radically differs from the direction observed in the AIA FoV.

Tuesday, Nov. 4 – Poster Session P1/P2

Featuring Topics 4a, 4b

Poster Topic 4a. *Origins of Solar Magnetic Fields, Variability, and Effects at Earth*

201 ***The On-Orbit Performance of the Helioseismic and Magnetic Imager Instrument***

Bush, Rock I. (1), rbush@solar.stanford.edu; S. Couvidat (1); and the HMI Team.
(1) Solar Physics Group, Stanford University, Stanford, CA, USA

Over the last four years, the Helioseismic and Magnetic Imager (HMI) instrument on the Solar Dynamics Observatory spacecraft has been observing the Sun. The primary observations are 4096 by 4096 pixel full Sun images taken at multiple polarizations and wavelengths across the 617.3 nm Fe I absorption line. From these filtergrams, line of sight Dopplergrams and magnetograms are constructed at a 45s cadence and vector magnetograms are computed with a 720s cadence. Between 1 May 2010 and 31 July 2014, over 71 million images were taken by the HMI instrument with a total image recovery of 99.97%. Over this same time period, the Dopplergram and line-of-sight solar magnetogram coverage was 98.4%.

In addition to details on the observing programs and data recovery, the on-orbit performance will be discussed. The standard calibration and trending measurements will be described including the instrument thermal performance, focus, filter tuning, image correction and end to end transmission. The mission to date trends of these parameters will be presented along with a synopsis of instrument anomalies.

202 ***Automatic vs. Human detection of Bipolar Magnetic Regions: Using the best of both worlds***

DeLuca, Michael D. (1), mdd40@pitt.edu; Andrés Muñoz-Jaramillo (2); and Dana Longcope (2).
(1) University of Pittsburgh, PA, USA
(2) Montana State University, Bozeman, USA

The Sun follows a roughly 22-year cycle of high and low activity. This activity is driven mainly by the magnetic field buried in the Sun, which erupts through the surface to form tilted Bipolar Magnetic Regions (BMRs). The collective action of BMRs drives the solar cycle, and lends hints as to the internal structure of the Sun's magnetic field. To that end, we have assembled a detailed catalog of BMRs with the intent of studying their collective statistical properties. Our catalog contains BMRs detected in magnetograms taken by the MDI instrument on board the SOHO satellite and was constructed using the Bipolar Active Region Detection (BARD) code developed specifically for this purpose. After the application of the fully automated algorithm, tracking and labeling of BMRs is improved through supervision by a human observer. This gives our catalog an unprecedented level of consistency and quality, making it ideal for solar cycle studies.

In this presentation we show how to take advantage of this catalog to probe the connection between the surface and internal magnetic fields, as well as the long-term evolution of BMR properties like flux and tilt (properties that are critical for understanding the progression of the solar cycle and improving its prediction).

203 ***Simulation Study of Hemispheric Asymmetry in Solar Cycle Activities***

Kusano, Kanya (1), kusano@nagoya-u.jp; Daishi Syukuya (1); and Daiko Shiota (1).
(1) Solar-Terrestrial Environment Laboratory, Nagoya University, Nagoya, Japan

The observations suggested solar activities systematically create hemispheric asymmetries. For instance, there is a tendency that the hemisphere in which the sunspot activity is more active than another is switched between the early half and the late half of each solar cycle. Svalgaad and Kamide (2013) recently pointed out that the time gap of polar field reversal between the north and south hemisphere is simply a consequence of the asymmetry of sunspot activity. However, the mechanism underlying the asymmetric feature in solar cycle activities is not yet well understood. In this paper, in order to explain the cause of the asymmetry from the theoretical point of view, we investigate the relationship between the dipole-type component and the quadrupole-type component of magnetic field in solar cycle using the mean field theory based on the flux transport dynamo model. As a result, we found that there are two different attractors of solar cycle, in which the north and south polar field is first reversed, respectively, and that the flux transport dynamo model well explains the relationship between the hemispheric asymmetry of sunspot activity and the polar field reversal. It is also shown that the structure of attractor is mainly determined by the magnetic Reynolds number. On the basis of those results, we try to interpret the variability of recent solar cycle as a dynamical behavior between the two attractors.

204 ***Variability of Energetic Protons at the Outer Edge of the Inner Radiation Belt as Observed by Van Allen Probes***

Jaynes, Allison N. (1), allison.jaynes@lasp.colorado.edu; Daniel N. Baker (1); Xinlin Li (1); Shri Kanekal (2); and Craig Kletzing (3).
(1) Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder, CO, USA
(2) NASA Goddard Space Flight Center, Greenbelt, MD, USA
(3) University of Iowa, Iowa City, IA, USA

While the inner proton belt is typically characterized as stable, the population does exhibit dynamics, especially at the outer edge of the inner zone. Multi-MeV proton flux outside of L~2 can be increased as a result of solar energetic proton (SEP) events or suppression of the geomagnetic cutoff during storm times, sometimes leading to rapid enhancements. Conversely, losses in this same region can be caused by the effect of magnetic field distortion on adiabatic motion, or pitch-angle scattering from EMIC waves at low L. Since the stable <100 MeV proton population at L>1.5 is largely a product of the inward diffusion of trapped solar protons, an understanding of the dynamic trapping region is crucial to fully describe the inner proton belt. While such variation described above is said to be relatively rare, we present data from the REPT instrument of >20 MeV inner belt protons showing significant variation throughout the mission above L~2.5, and discuss the relation of such dynamics to geomagnetic activity and wave-particle interaction. We show a dependence of outer edge proton losses on solar wind dynamic pressure and Dst index, and investigate the effects of field line curvature scattering, its energy dependence and resulting pitch angle distributions of this variable proton population.

205 ***Revision of the Sunspot Number***

Svalgaard, Leif, leif@leif.org, Stanford University, Stanford, CA, USA.

At the conclusion of the 4th Sunspot Number Workshop, issues have been identified and quantified that cause the discrepancies between the International Sunspot number and the Group Sunspot Number. The two series have been reconciled and how show no significant difference. One side-effect of this effort has been that the notion of a Grand Modern Maximum in solar activity is no longer tenable.

206 ***The New Hinode/XRT Synoptic Composite Image Archive and Derived Solar Soft X-ray Irradiance***

Takeda, Aki (1), takeda@solar.physics.montana.edu; Keiji Yoshimura (1); and Steve Saar (2).
(1) Montana State University, Bozeman, MT, USA
(2) Smithsonian Astrophysical Observatory, Cambridge, MA, USA

Hinode/XRT synoptic observation program continues to obtain daily full-sun images taken with several types of broadband X-ray filters from November 2006 to the present. Synoptic images are processed into composite images to increase the overall dynamic range, and archived at the XRT data site Since November 2013, the new XRT synoptic composite image archive (http://solar.physics.montana.edu/HINODE/XRT/SCI/latest_month.html) has been opened for the public use with the following improvements in the image quality.
(1) Composite images are made of 3 different exposures instead of 2 since the Jun 2013 data for the better photometry for the entire intensity range.
(2) Correction of the satellite pointing information in FITS headers, which guarantees precise co-alignment with the images from external data source.
(3) Cosmetic correction of the dark spots due to the contamination on the surface of the CCD.
(4) Removal of the stray light component, which some of the filters has significantly suffered since May 2012.

Use of our synoptic composite images obtained with multiple wavelength bands enables to derive soft X-ray irradiance of the sun for the recent 7 years. This period includes the recent solar activity minimum (2008-2009) when the GOES/XRS flux data were often times under the detection limit. Comparing and combining with GOES flux data will contribute to improve the quality and availability of the existing solar irradiance data in the soft X-ray spectral range.

207 ***Some Results From a New Algorithm for Using Available SDO/EVE/MEGS-A Data as Reference Solar Spectra for the EVE/ESP Absolute Solar Irradiance Calculations***

Didkovsky, Leonid (1), leonid@usc.edu; Seth Wieman (1); and Don Woodraska (2).
(1) Space Sciences Center, University of Southern California, Los Angeles, CA, USA
(2) Laboratory for Atmospheric and Space Physics, Univ. of Colorado, Boulder, CO, USA

A problem with the EVE/MEGS-A channel which changed its status from regular observations to a test mode has prompted the development of a new algorithm for EVE/ESP data reduction. This algorithm uses MEGS-A spectra measured before the problem occurred as reference spectra for determining irradiance values from EVE/ESP measurements taken after MEGS-A was put into test mode. We describe some results from our evaluation of this new algorithm using a number of available daily averaged MEGS-A spectra representing different levels of solar activity determined based on the ESP quad-diode effective count rates.

208 ***SOHO/CELIAS/SEM 26-34 nm Absolute Irradiance Time Series from 1996 to 2014: A revised calibration and comparison with solar indices***

Wieman, Seth (1), wieman@usc.edu; and Leonid Didkovsky (1).
(1) Space Sciences Center, University of Southern California, Los Angeles, CA, USA

We present a new version of the SOHO/Solar EUV Monitor (SEM) 26-34 nm calibrated irradiance data obtained from measurements which span a time interval from the beginning of SEM operation in 1996 until now. It has recently been demonstrated that for the period of overlap between the SOHO and SDO missions, processing the SEM data using time-dependent reference spectra and updated SEM channel response functions results in SEM absolute irradiances that are in good agreement with those from the SDO/EVE. In the present work, we apply this approach to the entire SEM data set and additionally incorporate a revised degradation model that incorporates calibration under-flight measurements from 12 sounding rockets between 1996 and 2012. We discuss the formulation of the degradation model, verify it based on comparisons with concurrent measurements from SDO/EVE for recent dates, and present long-term comparisons of the new version of the SEM time series with the F10.7 and Mg-II core to wing ratio solar activity indices.

209 ***FISM-P: Modeling Solar VUV Variability Throughout the Solar System***

Thiemann, Edward (1); Thiemann@lasp.colorado.edu; Philip C. Chamberlin (2); and Francis Eparvier (1).
(1) Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder, CO, USA
(2) Solar Physics Laboratory, NASA Goddard Space Flight Center, Greenbelt, MD, USA

First developed in 2007, the Flare Irradiance Spectral Model (FISM) is an empirical model of the solar vacuum ultraviolet (VUV: 0-190 nm) irradiance spectrum from 0.1 to 190 nm at 1 nanometer spectral resolution with a 1 minute time cadence. This latest iteration, called FISM-Planetary (FISM-P), estimates mean daily irradiances throughout the solar system using weighted interpolation of the best available proxies for each layer of the solar atmosphere (chromosphere, transition region, cool corona, and hot corona). In addition to daily irradiances, planetary 1-minute (flaring) irradiances are available if the planet is positioned such that the flaring emissions are observed by instruments at Earth or MAVEN EUV at Mars. FISM has been successfully used as an input for ionospheric and thermospheric models for Earth, Mars, as well as comparisons of photoelectrons at Earth and Mars, and surface charging of the moon. FISM-P now provides the capability for similar studies throughout the solar system and when combined with the MAVEN EUV channels (H Ly-α, 17-22 nm, and 0-6 nm), will provide unprecedented accuracy at Mars. Although it is not the instrument's primary mission, MAVEN EUV with FISM-P will provide a unique position from which to study VUV variability over the course of a solar rotation, and will be orbiting about the far side of the sun at a period coinciding with reduced STEREO science operations, demonstrating the multifaceted utility of including relatively low cost solar sensors on future planetary probes.

210 ***Extreme Ultraviolet Late Phase Flares: Before and during the Solar Dynamics Observatory mission***

Woods, Thomas N., tom.woods@lasp.colorado.edu, Univ. of Colorado, LASP, Boulder, CO, USA

The solar extreme ultraviolet (EUV) observations from the Solar Dynamics Observatory (SDO) have revealed interesting characteristics of warm coronal emissions, such as Fe XVI 335 Å emission, that peak soon after the hot coronal X-ray emissions peak during a flare and then sometimes peak for a second time hours after the X-ray flare peak. This flare type with two warm coronal emission peaks, but only one X-ray peak, has been named the EUV late phase (Woods et al., 2011). These flares have the distinct properties of 1) having a complex magnetic field structure with two initial sets of coronal loops, with one upper set overlaying a lower set, 2) having an eruptive flare initiated in the lower set and disturbing both loop sets, 3) having the hot coronal emissions emitted only from the lower set in conjunction with the X-ray peak, and 4) having the first peak of the warm coronal emissions associated with the lower set and its second peak emitted from the upper set many minutes to hours after the first peak and without a second X-ray enhancement. The disturbance of the coronal loops by the eruption is at about the same time, but the relaxation and cooling down of the heated coronal loops during the post-flare reconnections have different time scales with the longer, upper loops being significantly delayed from the lower loops. The difference in these cooling time scales is related to the difference between the two peak times of the warm coronal emission and is also apparent in the decay profile of the X-ray emissions having two distinct decays, with the first decay slope being steeper (faster) and the delayed decay slope being smaller (slower) during the time of the warm coronal emission second peak. The frequency and relationship of the EUV late phase decay times between the Fe XVI 335 Å two flare peaks and X-ray decay slopes are examined using three years of SDO EUV Variability Experiment (EVE) data, and the X-ray dual decay character is then exploited to estimate the frequency of EUV late phase flares during the past four solar cycles. This study indicates that the frequency of EUV late phase flares peaks before and after each solar cycle minimum.

211 ***SDO-EVE Data Products: Improvements and Plans***

Woodraska, Donald (1), don.woodraska@lasp.colorado.edu; Brian Templeman (1); Tom Woods (1); Frank Eparvier (1); Andrew Jones (1); Leonid Didkovsky (2); and Seth Weiman (2).
(1) Laboratory for Atmospheric and Space Physics, Univ. of Colorado, Boulder, CO, USA
(2) Space Sciences Center, University of Southern California, Los Angeles, CA, USA

The Solar Dynamics Observatory (SDO)–EUV Variability Experiment (EVE) measures the full-disk solar irradiance over a wavelength range that is important for Earth's ionosphere-thermosphere region. EVE science data products provide calibrated measurements of solar emission from multiple detectors with both broadband, and 0.1 nm spectral resolutions. Products are available over a range of time cadences including 0.25 second, 10-second, and daily averages. Routine science data products have been greatly improved with the release of version 4. In this poster, we highlight the improvements over the previous version, and discuss the plans for the next version.

212 ***Mid-term Periodicities of the LYRA Data Spectrum***

Wauters, Laurence (1), Laurence@oma.be; and M. Dominique (1).
(1) Royal Observatory of Belgium, Brussels, Belgium

The Lyra channels data like other solar data have their own time spectrum. We will compare the LYRA channels spectrum to the Solar data spectrum for sunspots data and for 10.7 radio flux but also for X-Ray flares events. We let the data pop up at different periodicities, nevertheless we are mainly interested in the corresponding peridicity between each signals. In this paper, we will consider each data set between 2010 and 2014. For this range of date, the LYRA data is also compared to other irradiance instruments like EVE (Woods et al., 2012) and SORCE (Rottman, Woods, and Sparn, 1993; Woods, Rottman, and Ucker, 1993).

213 ***Negative Flare Emissions Observed in EUV by SDO/AIA***

Xu, Yan (1), ghn.njit@gmail.com; Chang Liu (1); Wenda Cao (2); Ju Jing (1); and Haimin Wang (1).
(1) Space Weather Research Lab, New Jersey Institute of Technology, Newark, NJ, USA
(2) Big Bear Solar Observatory, New Jersey Institute of Technology, Newark, NJ, USA

In this study, we present a large flare showing negative emissions in the EUV passbands observed by SDO/AIA. Contrary to ordinary flare emission represented by an increase of intensity, negative flare emission refers to as a decrease of intensity during flares. In the literature, negative flare emissions were usually reported by stellar observations. Only a few negative solar flares were observed in He I D3 in 1970s and one event observed in the near Infrared at 8542 Å in 2001. On 07 January 2014, an X1.2 flare occurred near the solar disk center with a complex magnetic configuration, showing multiple flare ribbons. Among them a remote flare ribbon is located to the southwest from the flare core region. A small portion of the remote ribbon became darkened from about 18:45 UT, while the rest of the ribbon remained bright. This darkening lasted for more than one hour and did not show obvious motion. Therefore, we exclude the possibility of transient coronal hole associated with EUV waves. By comparing with SDO/HMI LOS magnetograms, we find that the negative flare regions are associated with weak magnetic fields, lower than 50 Gauss. In contrast, the bright flare ribbons are co-spatial with strong magnetic fields above 200 Gauss. Furthermore, we investigate the properties of the negative emission by examining the temporal evolution of its intensity and area. Finally, we discuss the possible mechanisms in generating the negative emissions.

Poster Topic 4b. *Modeling and Forecasting Space Climate and Space Weather Events*

214 ***Study on Triggering Process using SDO Data***

Bamba, Yumi (1,2), y-bamba@stelab.nagoya-u.ac.jp; and Kanya Kusano (1,3).
(1) Solar-Terrestrial Environment Laboratory, Nagoya University, Nagoya, Japan
(2) Inst. of Space and Astronautical Science (ISAS), Japan Aerospace Exploration Agency (JAXA), Japan
(3) Japan Agency for Marine-Earth Science and Technology (JAMSTEC), Japan

The underlying mechanism of flare trigger remains elusive although it is important not only as a scientific subject but also for space weather forecasting. Recently, Bamba+(2013) analyzed four major flares to elucidate

flare trigger mechanism. They confirmed that the observed signatures strongly support the flare trigger model presented by Kusano+(2012), that solar flares can be triggered by the interaction between the sheared arcade and one of the two types of small magnetic disturbances. In this study, we analyzed more flare events to examine the flare trigger model. We chose 16 flare events occurred within ±600 arcsecs from the disk center and the initial flare ribbons were clearly detected on the both sides of PIL. SDO observes full disk of the sun with high cadence and multiple wavelengths although the spatial resolution is lower than that of Hinode/SOT. We used HMI filter and vector magnetograms, and AIA 304Å, 1600Å images. We inferred the locations of the flare trigger regions from the initial flare ribbon and configurations of line-of-sight magnetic field. Then we investigated the evolution of transverse magnetic fields and emissions of AIA images in detail. As a result, we identified the trigger regions even in complex event whose initial flare ribbon is extremely curved. Moreover, we confirmed that the triggering process of at least 5 flares are consistent are consistent with Kusano's flare trigger model. Our result suggests that high cadence vector magnetograms and multiple wavelength observations are powerful for the study on flare trigger processes.

215 ***Coordinated Solar Observation and Event Searches using the Heliophysics Events Knowledgebase (HEK)***

Timmons, Ryan (1), ryan.p.timmons@lmco.com; and Neal Hurlburt (1).
(1) Lockheed Martin Advanced Technology Center, Palo Alto, CA, USA

We present new capabilities of the HEK allowing for joint searches, returning overlapping data from multiple instruments (IRIS, SOT, XRT, EIS) that also include particular solar features and events (active regions, (large) flares, sunspots, etc.). The new search tools aid the process of finding particular observations from non-synoptic instruments.

216 ***Uncertainties in Solar Synoptic Maps and Implications for Space Weather Prediction***

Bertello, Luca (1), lbertello@nso.edu; A. A. Pevtsov (2); G. J. D. Petrie (1); and P. Macneice (3).
(1) National Solar Observatory, Tucson, AZ, USA
(2) National Solar Observatory, Sunspot, NM, USA
(3) NASA Goddard Space Flight Center, Greenbelt, MD, USA

Synoptic charts of the photospheric magnetic flux are used widely for a modeling of the magnetic field in the corona and the heliosphere. Recently, the National Solar Observatory began producing accompanying maps of uncertainties (http://solis.nso.edu/0/ermaps/6302l_er2138-2157.html), which can be used to estimate the uncertainty in the results of coronal models. These maps of uncertainties represent the spatial variance of the magnetic flux distribution that contributes to each bin in the synoptic chart. We will describe a method to compute synoptic magnetic flux spatial variance charts, and discuss the effects of these uncertainties on models of the coronal magnetic field and the solar wind speed.

217 ***Particle Acceleration in the Low Corona Over Broad Longitudes***

Gorby, Matthew (1), matthew.gorby@unh.edu; Nathan Schwadron (1); Tibor Török (2); Cooper Downs (2); Roberto Lionello (2); Jon Linker (2); Viacheslav Titov (2); Zoran Mikić (2), Pete Riley (2); Mihir Desai (3); and Maher Dayeh (3).
(1) University of New Hampshire, Durham, NH, USA
(2) Predictive Science, Inc., San Diego, CA, USA
(3) Southwest Research Institute, San Antonio, TX, USA

Recent work on the coupling between the Energetic Particle Radiation Environment Module (EPREM, a 3D energetic particle model) and Magnetohydrodynamics Around a Sphere (MAS, an MHD code developed at Predictive Science, Inc.) has demonstrated the efficacy of compression regions around fast coronal mass ejections (CMEs) for particle acceleration low in the corona ($\sim 3 - 6$ solar radii). These couplings show rapid particle acceleration over a broad longitudinal extent ($\sim$ 80 degrees) resulting from the pile-up of magnetic flux in the compression regions and their subsequent expansion. The challenge for forming large SEP events in such compression-acceleration scenarios is to have enhanced scattering within the acceleration region while also allowing for efficient escape of accelerated particles downstream (away from the Sun) from the compression region. We present here the most recent simulation results including energetic particle and CME plasma profiles, the subsequent flux and dosages at 1AU, and an analysis of the compressional regions as efficient accelerators.

218 ***Triggering Mechanism and Predictability of Solar Eruptions***

Kusano, Kanya (1), kusano@nagoya-u.jp; Yumi Bamba (1); Daiko Shiota (1); Shinsuke Imada (1); and Shin Toriumi (2).
(1) Solar-Terrestrial Environment Laboratory, Nagoya University, Nagoya, Japan
(2) National Astronomical Observatory of Japan, Mitaka, Tokyo, Japan

Solar eruptions, such as solar flares and coronal mass ejections, are the most catastrophic events in our solar system, and the primary cause of severe space weather. Since, however, the triggering mechanism of solar eruptions is still not sufficiently understood, our capacity to predict the occurrence of them is substantially hindered. Here, we study this problem by systematically surveying the nonlinear dynamics caused by a wide variety of magnetic structures in terms of three-dimensional magnetohydrodynamic simulations and the analyses of data provided by Hinode and the Solar Dynamics Observatory (SDO) satellites. As a result, we found that there are at least two different types of solar eruptions, which are initiated through the different processes called the "Eruption-induced Reconnection" and the "Reconnection-induced Eruption." The comparison of simulations and observations suggests that two different configurations of magnetic field on the polarity inversion line favor the onsets of those two types of eruptions, respectively. Both the two configurations consist of the sheared magnetic arcade and the small magnetic bi-polar fields, which are reversed to the potential component or the non-potential component of arcade, respectively. These results imply that not only the large-scale sheared magnetic field but also the small-scale magnetic disturbance may determine when, where and how the solar eruptions can occur. Therefore, we conclude that the sophisticated observation of a solar magnetic field vector is necessary for forecasting solar eruptions. Finally, we will discuss about a new methodology to improve the predictability of onset of solar eruptions based on our study.

219 ***The CME Geomagnetic Forecast Tool (CGFT)***

Dumbovic, Mateja (1), mateja.dumbovic@gmail.com; Andy Devos (2); Luciano Rodriguez (2); Bojan Vrsnak (1); Emil Kraaikamp (2); Bram Bourgoignie (2); and Jasa Calogovic (1).
(1) Hvar Observatory, Zagreb, Croatia
(2) Royal Observatory of Belgium, Brussels, Belgium

The CME Geomagnetic Forecast Tool (CGFT) is one of the forecast tools implemented in the COMESEP alert system, an automated space weather alert system developed within the FP7 project COMESEP running since January 2014 at http://comesep.eu/alert/. The CGFT provides an estimation of the CME arrival probability and its likely geoeffectiveness, based on CME parameters, as well as an estimate of the geomagnetic-storm duration. More specifically, CME geoeffectiveness is estimated based on the CME width and speed, source position and X-ray class of the associated flare and expressed using Disturbance storm time (Dst) index.

The CGFT was "fine-tuned" to the automated detection tools used in the COMESEP alert system, namely CACTus (CME detection), Solardemon, and Flaremail (flare detection). Furthermore, additional analysis of the statistical properties of CME geoeffectiveness was performed in order to improve threshold values for the different Dst storm levels. We compare these changes to the estimations provided by already issued alerts and evaluate CME geoeffectiveness forecast on an independent sample.

This work has received funding from the European Commission FP7 Project COMESEP (263252), "Dynamics of the Solar System" association's research grant (at Royal Observatory of Belgium), and Croatian science foundation.

220 ***Lessening the Effects of Projection for Line-of-Sight Magnetic Field Data***

Leka, K. D. (1), leka@cora.nwra.com; G. Barnes (1); and E. L. Wagner (1).
(1) NorthWest Research Associates, Boulder, CO, USA

We present a method of treating line-of-sight magnetic field data in the context of reconstructing the radial-directed component of the solar magnetic field photospheric boundary. Treating the data in this way lessens the projection effects which present themselves when the line-of-sight component is treated with the popular "mu-correction" for areas of the Sun away from disk center. We compare this new boundary-field treatment to the radial component derived from SDO/HMI full-disk vector magnetograms and discuss the implications for data analysis and modeling efforts, especially in the context of the solar polar areas.

This work was made possible through contracts with NASA, NSF, and NOAA.

221 ***Challenges in Understanding Heliospheric Disturbances before Making Space Weather Predictions Useful***

Nitta, Nariaki, nitta@lmsal.com, Lockheed Martin STAR Labs (Space Advanced Technology Research and Development Laboratories), Palo Alto, CA, USA.

Solar Cycle 24 has not produced extreme space weather events at Earth comparable to the Halloween 2003 events. However, there have been a number of geomagnetic storms more intense than Dst of 100 nT as well as several major solar energetic particle (SEP) events at Earth. Before predicting geomagnetic storms and radiation storms, it is necessary to make a firm link of solar activity, notably coronal mass ejections (CMEs), with interplanetary CMEs (ICMEs) and shock waves. This Cycle has benefitted from the Solar Dynamics Observatory that provides uninterrupted and high-quality full-disk images at Earth, and the Solar Terrestrial Relations Observatory that has observed CMEs away from the Sun-Earth line and unambiguously isolated those that are directed toward Earth. This presentation evaluates how these observations have refined our understanding of the origins of ICMEs and helped models reproduce the arrival times of the disturbances, and discusses what may be critically missing and yet essential for achieving useful predictions in the future. We have tested the link of CMEs and coronal eruptions with ICMEs and shock waves in both directions for Cycle 24 events. It is found that the link may not be as strong as usually expected or required. Studying the solar sources of large SEP events, we find that the detection and intensity of SEP events may not be clearly explained by simple models.

222 ***On the High and Low Points of the Sun-Earth Connection***

McIntosh, Scott W. (1), mscott@ucar.edu; Robert J. Leamon (2); Fraser T. Watson (3); Giuliana de Toma (1); and Rebecca Centeno-Elliott (1).
(1) High Altitude Observatory, National Center for Atmospheric Research, Boulder, CO, USA
(2) Department of Physics, Montana State University, Bozeman, MT, USA
(3) National Solar Observatory, Boulder, CO, USA

Recent observational findings suggest that the 11(-ish) solar sunspot cycle is a pattern resulting from the interaction, or interference, of large scale magnetic field bands that evolve within the Sun's convective interior over its 22-year magnetic polarity reversal cycle. These toroidal magnetic bands are anchored deep in the solar convection zone and migrate from high latitudes to the equator over 22 years, and new analysis techniques have allowed us to trace their migration from birth to death. We will see that the spatio-temporal interaction of these magnetic bands helps us frame the landmarks of the sunspot cycle with a surprising realization that, once considered, simultaneously permits insight into grand minima and the most extreme solar eruptions - the high and low points of the Sun-Earth Connection. Further, it is possible that, with refinement and an ongoing commitment to synoptic observational programs, these results offer greatly improved forecast skill on monthly, annual, decadal and centennial timescales while a comprehensive physical model can be developed.

223 ***Challenges in Forecasting Geomagnetic Storms***

Zheng, Yihua, Yihua.Zheng@nasa.gov, NASA Goddard Space Flight Center, Space Weather Laboratory, Greenbelt, MD, USA.

Solar Cycle 24 has produced 12 major geomagnetic storms (where Dstmin < -100 nT) with 3 in 2011, 6 in 2012, 2 in 2013, and 1 in 2014 (as of 29 July 2014). Detailed analysis of each event will be given in terms of its solar driver(s): CME, coronal hole high speed solar wind stream (HSS), multiple CMEs or combination/interactions of CME and HSS. While some of these storms are associated with a fast and wide CME, the cases involving a slow or common CME(s) (and interactions with HSS) are particularly interesting. These events pose great challenges for accurate space weather forecasting since operationally the slow and average CMEs tend to receive less attention (at times get ignored). The characteristics of these challenging, not-so-fast yet geoeffective CME events (such as their coronal signatures, interactions with their surrounding solar wind structure(s), etc.) will be examined in detail, with the goal of extracting common and telltale feature(s) (if there are any) of these CMEs that distinct them from CMEs of a similar category. Similarly those attention-grabbing, fast and wide CMEs originating near the center of the solar disk yet with little geoefectiveness will also be discussed.

224 ***Abstract Withdrawn***

225 ***An Analysis of the Degradation of the EVE MEGS-A Filters: Do we understand what is happening?***

Jones, Andrew (1), andrew.jones@lasp.colorado.edu; and Marie Dominique (2).
(1) Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder, CO, USA
(2) Royal Observatory of Belgium, Brussels, Belgium

The degradation of the MEGS -A1 and -A2 filters shows very different behavior. These filters are physically very close to each other, and will therefore be exposed to the same environment. As MEGS also provides spectral degradation information we will try to understand observed differences.

226 ***Soft X-ray Irradiance Measured by the Solar Aspect Monitor on the Extreme Ultraviolet Variability Experiment***

Lin, Cissi Y. (1), incen@vt.edu, Scott Bailey (2); Andrew Jones (3); Don Woodraska (3); Thomas N. Woods (3); Frank G. Eparvier (3); and Amir Caspi (3).
(1) University of Texas at Arlington, TX, USA.
(2) Virginia Tech, Blacksburg, VA, USA
(3) LASP, University of Colorado, Boulder, CO, USA

The Solar Aspect Monitor (SAM) is a pinhole camera on the Solar Dynamics Observatory (SDO) Extreme-ultraviolet Variability Experiment (EVE). SAM projects the solar disk onto the CCD through a metallic filter designed to allow only solar photons shortward of 7 nm to pass. Contamination from energetic particles and out-of-band irradiance is, however, present. We present a technique for isolating the 0.1 to 7 nm integrated irradiance from the SAM signal to produce broadband irradiance for the time period of the SAM observations. The results of this analysis agree with the zeroth-order product from the EUV SpectroPhotometer (ESP) – a separate instrument on EVE and has a photodiode measuring the same bandwidth – within 25%. We also present the photon event detection algorithm and its application toward spectral irradiance and feature studies.

227 ***The Miniature X-ray Solar Spectrometer (MinXSS) CubeSat***

Woods, Thomas N. (1), tom.woods@lasp.colorado.edu; Amir Caspi (1); Philip C. Chamberlin (2); Andrew R. Jones (1); Rick Kohnert (1); Xinlin Li (1, 3); James P. Mason (1); Scott E. Palo (3); and Stan Solomon (4).
(1) Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder, CO, USA
(2) Solar Physics Laboratory, NASA Goddard Space Flight Center, Greenbelt, MD, USA
(3) Department of Aerospace Engineering Sciences, University of Colorado, Boulder, CO, USA
(4) National Center for Atmospheric Research (NCAR), Boulder, CO, USA

Solar extreme ultraviolet (EUV) and soft X-ray (SXR) emission is the primary driver of upper atmospheric dynamics in Earth's ionosphere, thermosphere, and mesosphere (ITM). The 1-5 nm wavelength range is particularly important, as it is thought to contain the greatest enhancement in radiated energy during solar flares. These wavelengths are preferentially absorbed in the D- and E- regions of the ionosphere, including the mesopause; because of the steep cross-section for photoionization, due primarily to the K-edges of atomic N and O, the specific altitude where energy absorption is concentrated depends strongly on wavelength, and hence the resulting solar-driven dynamics are critically dependent on the spectral energy distribution within this wavelength band. While there is a long history of broadband, spectrally-integrated measurements of the total radiated energy within this spectral range, there have been very few spectrally-resolved observations that could provide insight into the wavelength distribution of that energy. Consequently, it has proven difficult to reconcile observed ionospheric dynamics with those predicted using broadband observations.

The Miniature X-ray Solar Spectrometer (MinXSS), a 3U CubeSat funded under NASA's Heliophysics Technology and Instrument Development for Science (H-TIDeS) program, will directly address these issues. Using a new SXR spectrometer incorporating a cooled silicon drift detector (SDD) design, MinXSS will observe solar SXR emission ~0.5 to ~30 keV (~0.04-2.4 nm) with ~0.15 keV FWHM resolution (~0.5 nm FWHM @ 2.4 nm, ~0.5 pm FWHM @ 0.04 nm), thus providing direct measurements of the solar

spectral irradiance over a significant fraction of the poorly-observed 1-5 nm range. MinXSS is currently in Phase C, with integration expected to be completed in Fall 2014 and delivery in Feb 2015, for deployment from the International Space Station in April 2015. The ~7-12 month expected mission life will allow MinXSS to sample a wide variety of solar activity, including quiet, active, and flaring. With its excellent spectral resolution, MinXSS will provide crucial insight into the spectral energy distribution in the solar SXR emission that will improve our understanding of both solar variability in the SXRs and the resulting effects of that emission on Earth's upper atmosphere and ionosphere.

228 ***New Window of Solar Physics: Solar observations with ALMA***

Shimojo, Masumi (1), masumi.shimojo@nao.ac.jp; Antonio Hales (2); Tsuyoshi Sawada (2); Richard Hills (3); Anthony Remijan (2); Stuartt Corder (2); Pavel Yagoubov (4); Masahiro Sugimoto (2); Shin'ichiro Asayama (5); Roman Brajsa (6); Tim Bastian (7); and Solar development study team of NA & EU-ARC.

(1) Nobeyama Solar Radio Observatory, National Astronomical Observatory of Japan, Tokyo, Japan

(2) Joint ALMA Observatory, Santiago, Chile

(3) Cavendish Laboratory, University of Cambridge, Cambridge, UK

(4) European Southern Observatory, Garching, Germany

(5) Chile Observatory, National Astronomical Observatory of Japan, Santiago, Chile

(6) Hvar Observatory, Faculty of Geodesy, University of Zagreb, Zagreb, Croatia

(7) National Radio Astronomy Observatory, Charlottesville, VA, USA

The Atacama Large Millimeter/submillimeter Array (ALMA) is a radio interferometer for astronomy with extremely high performance that can also observe the Sun with less than 1 arcsec resolution. Because millimeter/submillimeter wave images probe high-energy electrons (>1 MeV) and chromospheric plasma, the data obtained with ALMA will give us new windows for flare physics and chromosphere studies. Solar observations of ALMA are in the commissioning phase. We carried out solar observing campaigns for commissioning and succeeded synthesizing solar images from the interferometric data obtained on 27 October 2013. To open solar observations of ALMA to heliophysics community, we are currently focusing our effort on data calibration methods. In the paper, we present selected preliminary results and discuss the current status of ALMA solar observations.

229 ***Space Weather Prediction with the DSCOVR Spacecraft***

Szabo, Adam, Adam.Szabo@nasa.gov, NASA Goddard Space Flight Center, Greenbelt, MD, USA.

The NOAA funded, NASA built and Air Force launched Deep Space Climate Observatory (DSCOVR) spacecraft will start real-time solar wind measurements from the Sun-Earth first Lagrange point in mid 2015. The spacecraft will carry a fluxgate magnetometer, Faraday Cup positive ion detector and a top-hat electron electrostatic analyzer. These unprecedentedly high time resolution measurements will allow improvements both in accuracy and robustness of incoming space weather events. In addition, coupled with ACE real time observations, shock front orientations can be determined for forecasting purposes. For post event analysis, the combination of DSCOVR, ACE, and Wind measurements will enable the unique reconstruction of the 3D topology of the near-Earth solar wind and its transients.

230 ***The SSALMONetwork: Potential science with ALMA as predicted by numerical simulations***

Wedemeyer, Sven, svenwe@astro.uio.no (1); Tim Bastian (2); Roman Brajsa (3); and Miroslav Barta (4).

(1) University of Oslo, Norway

(2) National Radio Astronomy Observatory, Charlottesville, VA, USA

(3) Hvar Observatory, University of Zagreb, Croatia

(4) European ALMA Regional Center, Czech node, Ondrejov, Czech Republic

The Atacama Large Millimeter/submillimeter Array (ALMA) provides a new powerful tool for observing the solar chromosphere at high spatial, temporal, and spectral resolution. ALMA has already begun its operation in the Chilean Andes and first solar test observations have been carried out in order to develop observing strategies for regular solar campaigns in the near future. Numerical simulations of the solar atmosphere and instrumental effects can help to further constrain and optimize future observing

modes for ALMA. Here, we demonstrate the potential of ALMA for high-resolution observations of the solar chromosphere, which will allow for a new view on the dynamic fine-structure of the chromosphere in quiet Sun and active regions, on prominences and flares and much more.

On September 1st, 2014, the Solar Simulations for the Atacama Large Millimeter Observatory Network (SSALMON) has been initiated with the aim to promote the scientific potential and to further develop solar observation modes for ALMA. This effort is connected to two currently ongoing ALMA development studies, which include scientists from around the globe involving NRAO, ESO, NAOJ, the Czech ALMA ARC node at Ondrejov and many other institutions. The SSALMONetwork, which in particular focuses on modeling aspects, comprises already 27 members from 14 countries (as of October 1st) and welcomes new members, who are interested in solar ALMA observations (http://ssalmon.uio.no).

E-Posters – Session P2

231-E ***SABER Observations of the Effects of Solar Variability in the Upper Atmosphere***

Hunt, Linda (1), Linda.A.Hunt@nasa.gov; Marty Mlynczak (2); Chris Mertens (2); Tom Marshall (3); and Jim Russell III (4).
(1) SSAI, Inc., Hampton, VA, USA
(2) NASA Langley Research Center, Hampton, VA, USA
(3) GATS Inc., Newport News, VA, USA
(4) Hampton University, Hampton, VA, USA

The Sounding of the Atmosphere using Broadband Emission Radiometry (SABER) instrument on the Thermosphere-Ionosphere-Mesosphere Energetics and Dynamics (TIMED) satellite has been making continuous measurements of the vertical distribution of infrared radiation emitted by various atmospheric gases (ozone, water vapor, nitric oxide, and carbon dioxide) since January 2002, providing important information about the radiation budget in the upper atmosphere. In addition, a consistent dataset of temperature, ozone, atomic oxygen, atomic hydrogen and related energetics parameters has been derived. The SABER data clearly indicate the influence of both long- and short-term solar variability on the temperature and composition of the upper atmosphere. We show these effects over the duration of the SABER mission, from near solar maximum at the time of launch, through the unusual minimum between solar cycles 23 and 24, and into the relatively weaker maximum of solar cycle 24.

232-E ***An Empirical Equatorial Spread-F Model Developed from FORMOSAT-3/COSMIC Scintillation Observation During 2007-2013***

Chen, Shihping (1,2), chensp1984@gmail.com; Dieter Bilitza (1,3); and Jann Yenq Liu (2,4).
(1) George Mason Univ., School of Physics Astronomy & Computational Science, Fairfax, VA, USA
(2) National Central University, Institute of Space Science, Taiwan
(3) NASA GSFC, Heliospheric Laboratory, Greenbelt, MD, USA
(4) National Space Organization, Taiwan

Equatorial spread-F (ESF) is the signal scattered from field-aligned irregularities occurring in the geomagnetic equatorial region and recorded by ionograms. The amplitude and phase fluctuation also called radio scintillation is a sensitive detector of ionospheric density irregularity, however, ground-based observation are confined to continental area and very scarce of oceanic data. Since the launch of FORMOSAT-3/COSMIC (F3/C) in 2006, the constellation formed by six LEO satellites continues to receive L1-band (1.5 GHz) signal from GPS system. The F3/C occultation scintillation index S4 has already been calculated and recorded for 7 years, and the 72° orbital inclination enables F3/C to obtain global observations, which makes it an ideal database for constructing a global model. In this report, we will present and discuss an empirical model of ESF occurrence rate calculated from F3/C scintillation database. A comparison with IRI-2012 ESF occurrence rate is also provided as a reference.

233-E ***IRIS Observations of a Novel, Hybrid Prominence-Coronal Rain Complex in a Supra-arcade Fan Geometry***

Liu, Wei (1,2), weiliu@lmsal.com; Xudong Sun (2); Patrick Antolin (3); Thomas Berger (4); and Takenori Okamoto (5).
(1) Lockheed Martin Solar and Astrophysics Laboratory, Palo Alto, CA, USA
(2) Stanford University, Stanford, CA, USA
(3) National Astronomical Observatory of Japan, Mitaka, Tokyo, Japan
(4) NOAA Space Weather Prediction Center, Boulder, CO, USA
(5) Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency, Yoshinodai, Sagamihara, Japan

Solar prominences and coronal rain are intimately related phenomena, both involving cooling condensation as part of the return flow of the chromosphere-corona mass cycle (e.g., Antolin et al. 2010, ApJ; Berger et al. 2011, Nature). Quiescent prominences consist of numerous long-lasting, filamentary downflow streams, while transient coronal rain falls along well-defined curved paths. The physical reason for such morphological differences remains unclear. We report a novel, hybrid prominence-coronal rain complex in an arcade-fan geometry observed by IRIS and SDO/AIA, which may provide new insights into this question. The fan region above the arcade hosts a prominence sheet consisting of vertical threads with broad Mg II k/h line widths. As the prominence material descends to the arcade, it turns into coronal rain sliding down coronal loops with line widths 2-3 times narrower. We propose that such different line widths suggest distinct plasma and magnetic conditions. The supra-arcade fan (cf., similar to those in flares; McKenzie 2013, ApJ) is likely situated in a current sheet, where the magnetic field is weak and the plasma-beta could be high, a favorable condition for producing turbulent flows like those filamentary prominence threads. In contrast, the underlying arcade likely has a stronger magnetic field and a low-beta environment, such that the coronal rain is guided along magnetic field lines (e.g., Reale et al. 2013, Science). We will discuss the implication of these novel observations for unifying solar prominence and coronal rain phenomena.

234-E ***Improving Synchronic Maps with Far-Side Active Region Emergence***

Upton, Lisa (1), upton.lisa.a@gmail.com; and David H. Hathaway (2).
(1) University of Alabama, Huntsville, USA
(2) NASA Ames Research Center, Moffett Field, Mountain View, CA, USA

Synchronic maps (i.e., maps of the Sun's photospheric magnetic field over the entire surface at a single instant in time) often serve as the inner boundary condition for global coronal magnetic field and solar wind models. Currently, we use a surface flux transport model to construct synchronic maps every 15 minutes with a resolution of 1024 by 512 in longitude-latitude. This model assimilates magnetic data from SDO/HMI full-disk line-of-sight magnetograms and advects the magnetic field with differential rotation and meridional flow profiles taken directly from the motions of the magnetic elements. Rather than using a diffusivity coefficient, this model explicitly incorporates well-resolved cellular convective flows with spatial and temporal characteristics that match observations, thus retaining the magnetic network structure observed on the Sun.

While this model accurately transports the active regions that are observed on the near-side of the Sun, active regions that emerge on the far-side are neglected until they appear in the observations. Far-side active regions will obviously have a substantial impact on the global coronal field configuration and must be included in useful synchronic maps. We will discuss our attempts to incorporate far-side active region emergence into our flux transport model. We will also illustrate the impact of these improvements.

Wednesday, Nov. 5 – Poster Session P3/P4

Featuring Topics 1a, 1b

Poster Topic 1a. *Magnetic Energy and Field from Solar Interior to Corona and Heliosphere*

301 ***The Origin of Solar Magnetism - Large-scale Dynamos in Local and Global Convective Dynamo Simulations***

Masada, Youhei, ymasada@harbor.kobe-u.ac.jp, Department of Computational Science, Kobe University, Kobe, Hyōgo, Japan.

It is widely accepted that the solar magnetism is caused by a large-scale dynamo operating in the solar interior. An ultimate goal of this subject is to reproduce observed spatiotemporal evolution of the solar magnetic field, such as cyclic polarity reversals and butterfly-shaped migrations, in the framework of magnetohydrodynamics (MHD). Although a growing body of evidence is accumulating to reveal large-scale dynamos in numerical MHD models of solar-like stars, unsolved questions remain to be answered if full MHD description of the solar dynamo mechanism is to be attained.

In this workshop, our recent efforts on numerical solar/stellar dynamo modeling are reviewed (Masada et al. 2013; Masada & Sano 2014a,b). In Masada et al. (2013), we studied the effects of penetrative convection on MHD dynamos in rotating spherical shell, and found that a strong large-scale magnetic field which undergos quasi-regular polarity reversals is spontaneously organized in the stable layer. In Masada & Sano (2014a), a successful direct numerical simulation (DNS) of large-scale dynamo by rigidly rotating convection in local Cartesian domain is reported. Furthermore, by comparing the local DNS and a mean-field dynamo model coupled with the DNS, Masada & Sano (2014b) quantitatively demonstrated that the oscillatory α^2-dynamo wave, excited and sustained in the convection zone, is responsible for the large-scale magnetic activities, like polarity reversal and spatiotemporal migration, observed in the local DNS. On the basis of our recent findings, we discuss a possible connection between the α^2-dynamo and the solar magnetism.

302 ***Study of Mechanisms of Energy Build-up and Release in Solar Flares***

Pithadia, Manisha (1), mp.space@yahoo.com; Arun K. Awasthi (2); Tushar Bhatt (1); and Rajmal Jain (1).
(1) Kadi Sarva Vishwavidyalaya (Kadi Global University), Gandhinagar, India
(2) Aryabhatta Research Institute of Observational Sciences, Nainital, India

We investigate the mechanisms for the build-up and release of energy in solar flares. We consider the free magnetic field energy in the active region as the major source of energy build-up in the corona, while gradient and rotation angle of the active region as the cause of the flares. Therefore we undertake the measurement of magnetic field complexity employing HMI/SDO magnetograms to constrain the possible mechanisms providing the energy on one hand and causing trigger of flares on the other hand. We have analyzed 14 super active regions during year 2010-2014 considering that each has produced minimum 50 flares of ≥C1.0 class during its passage on the disk. We measure the magnetic flux [Φ] to quantifying the energy made available from photosphere to the corona, while gradient (d*H*/dz) and rotation angle (Ψ) of the active region are measured to quantify the energy release process in the corona. The estimated magnetic flux, gradient and rotation are found to vary between 0.9X1025 -2.8X1026 Mx, 0.015 – 1.25 X 10-2 gauss/cm and, -87 – +90 degrees respectively. Moreover, we study the coronal *GOES* X-ray intensity variation to quantify the changes in simultaneous to the magnetic field variations in the photosphere. We compare the variation of the photospheric magnetic complexity (cause) parameter and X-ray flare energy loss rate (consequence) as a function of time and find common periodicities in the cause and consequence parameters. Comparison also enables us to establish an empirical relationship among cause and consequence parameters which may lead to predict the eruption.

303 ***On Magnetic Polarity Reversal and Surface Flux Transport During Solar Cycle 24***

Sun, Xudong (1), xudong@stanford.edu; Todd Hoeksema (1); Yang Liu (1), and Junwei Zhao (1).
(1) HEPL, Stanford University, Stanford, CA, USA

As each solar cycle progresses, remnant magnetic flux from active regions (ARs) migrates poleward to cancel the old-cycle field. We report this polarity reversal process during cycle 24 using four-year data (2010-2014) from the Helioseismic and Magnetic Imager. The AR flux reached a low maximum over two years earlier in the north and varied significantly in both hemispheres. The reversal is relatively slow, north-south asymmetric, and episodic. We estimate that the global axial dipole changed sign in October 2013; the northern and southern polar fields (mean above 60 degree latitude) reversed in November 2012 and March 2014, respectively, about 16 months apart. Notably, the poleward "surges" of flux alternated in polarity, giving rise to multiple reversals in the north. We show that the surges of the trailing (preceding) sunspot polarity tend to correspond to normal (inverse) mean sunspot tilt, higher (lower) AR flux, or slower (faster) mid-latitude near-surface meridional flow, while exceptions occur during low magnetic activity. The AR flux and the mid-latitude poleward flow speed exhibit a clear anti-correlation. We discuss how these aspects can be reconciled in a surface flux transport process inclusive of a field-dependent AR inflow, which contributes to the solar cycle variability.

304 ***A Curiously Ineffective Solar Event***

Hoeksema, J. Todd, todd@sun.stanford.edu, Stanford University, Stanford, CA, USA.

January 2014 provided an excellent opportunity to explore the development of a complex, flaring active region using HMI vector magnetic field observations. NOAA region 11944 and its surroundings (SHARP 3563) were interesting because a near disk-center x-class flare on 7 January was associated with a large halo CME, but the geomagnetic response was minimal.

305 ***Distribution of Magnetic Fields in the Quiet-Sun Internetwork***

Jafarzadeh, Shahin (1), shahin.jafarzadeh@astro.uio.no; David Buehler (2); Sami Solanki (2); and Luc Rouppe van der Voort (1).
(1) Institute of Theoretical Astrophysics, University of Oslo, Norway
(2) Max Planck Institute for Solar System Research, Goettingen, Germany

Inclination of the magnetic field in the quiet-Sun internetwork has been reported in the literature as a mostly horizontal field, an isotropic distribution of weak fields, or even predominantly vertical fields. These results have been often based on Stokes profile inversions. However, the majority of the quiet-Sun internetwork cannot be well treated by inversions; due to weak Stokes (in particular Stokes Q and U) signals.

Here, we aim to obtain a reliable distribution of the magnetic field's inclination in internetwork regions by combining the results obtained from inversions of the Stokes parameters (only at pixels with significant Stokes signals) and those measured from a recently proposed geometric approach (based on measurements of locations of magnetic bright points at two heights). We use observations from Hinode/SOT and SST/CRISP and form images of all Stokes parameters with an optimum signal-to-noise ratio. We show that the magnetic fields can be reliably computed only for a small fraction of the internetwork areas. Both horizontal and vertical fields are obtained.

306 ***Different Photospheric Magnetic Properties at Footpoints between Hot and Warm Coronal Loops in Active Regions***

Kasuga, Megumi (1), kasuga.megumi@nao.ac.jp; and Hirohisa Hara (1,2).
(1) Department of Astronomy, School of Science, The University of Tokyo, Bunkyo-ku, Japan
(2) National Astronomical Observatory of Japan, Mitaka, Tokyo, Japan

We have investigated the magnetic connectivity between the photosphere and corona and the photospheric magnetic properties at the footpoints of coronal loops in active regions. After the co-alignment of the images obtained by Hinode, TRACE, and SOHO, we have identified the footpoints of hot and warm coronal loops in the active-region plage. We have studied the photospheric magnetic properties at loop footpoints from the Hinode spectro-polarimetric data and the horizontal velocity of the photospheric magnetic field from the Hinode Stokes-V filtergraph data by a local correlation tracking method. We have found that

the footpoints of hot loops with a low magnetic filing factor contain photospheric magnetic elements that move faster than that of warm loops with a higher magnetic filling factor. The difference in the photospheric magnetic filling factor between hot and warm coronal loops is consistent with the previous study by Katsukawa and Tsuenta (2005). We have confirmed their conjecture on the different photospheric horizontal velocities between hot and warm loops from the Hinode observations. We discuss the difference in coronal heating for different magnetic properties of coronal loops on the photosphere.

307 *Anti-Hale Sunspot Groups*

Norton, Aimee (1), aanorton@stanford.edu; and Bruce McClintock (2).
(1) Stanford University, Stanford, CA, USA
(2) University of Southern Queensland, Australia

Bipolar sunspot groups serve as diagnostics of the solar cycle, providing information as to how sunspots form, rise through the convection zone, and appear in the photosphere. We analyze Debrecen Photohelographic white-light data and Mt Wilson magnetogram data from 1974-2014 (late cycle 20-early cycle 24). The advantage of the Mt Wilson catalogue, provided by Li and Ulrich (2012), is that the magnetic polarity information allowed for the determination of tilt angles that were anti-Hale in configuration, meaning tilt values ranged from 0-360 as opposed to +/-90 degrees, common in other catalogues. Our results show that anti-Hale sunspots are distributed throughout solar cycles 21-23 as 8.4 percent of the total number of sunspots. Meaning, 8.4 percent of all bipolar sunspot regions are misclassified as Hale in traditional catalogues. The average latitude of anti-Hale regions does not differ from the average latitude of all regions. This is true for both hemispheres. The anti-Hale sunspots display a relative size distribution similar to a log-normal distribution of all sunspots, meaning there is no preferred size for anti-Hale sunspots. The distribution of anti-Hale sunspot tilt angles are broadly distributed between 0-360 degrees with only a hint of having a preferred EW direction that is ~180 degrees from their expected Joy's law angle. A slightly higher number, 13.8 percent are anti-Hale within 5 degrees of the Equator, due to the misalignment of the magnetic equator and geometric equator. We discuss these results in the context of the greater literature of Joy's law, the dynamics of emerging active regions as observed with HMI/SDO, simulations of rising flux tubes in the convection zone and the Coriolis force.

308 *Time Variation of Vertical Velocity Structures during Disappearance of Granules on the Photosphere*

Oba, Takayoshi (1), oba.takayoshi@ac.jaxa.jp; Yusuke Iida (2); and Toshifumi Shimizu (2).
(1) SOKENDAI, The Graduate University for Advanced Studies, Kanagawa, Japan
(2) Institute of Space and Astronautical Science (ISAS) / Japan Aerospace Exploration Agency (JAXA), Kanagawa, Japan

On the solar surface, there are bright cellular patterns which are called granules, separated by narrow dark regions named intergranular lanes. These spatial patterns result from surface convection. The general picture of the granulation is that hot bubbles rise up and then turn to downward motions as the material cools down, but dynamical behaviors of the materials, in particular, granular disappearance which roughly corresponds to the evolution from upflow to downflow, have not yet been investigated in detail observationally. We therefore investigate a vertical velocity structure depending on the height and its time variation while granules disappear using spectrum obtained by Solar Optical Telescope (SOT) on board the Hinode satellite. SOT/Spectropolarimeter (SP) observes the spectrum including the Fe I 630.13/630.25nm lines formed on the photosphere. Considering the fact that wavelength with the higher absorption coefficient in the core of line shows the structure at higher layer, we obtained a wavelength shift at each absorption level from wing to core. As the intensity of granules decreases, the downward motion with the velocity of roughly less than 1km/s appears from the upper edge of the photospheric layer. It means that the material on the granules gradually falls when granules disappear. Generation time of that downflow depends on each granule ; some downflow originates before intensity decreases in the granule, others after that. In this time, we will discuss the general description of convective vertical structure when granule disappear.

309 *Inferring Magnetic Evolution in Supra-Arcade Fan Structures*

Scott, Roger B. (1), rscott@physics.montana.edu; Dana W. Longcope (1); David E. McKenzie (1); and Michael S. Freed (1).
(1) Montana State University, Bozeman, MT, USA

Recent attempts to characterize the apparent motion of supra-arcade fan structures have revealed bulk velocity and displacement spectra that may give insights into the energy distribution in supra-arcade plasma sheets. In order to form a more complete picture of the energy balance in these structures it is important to understand the magnetic field on a similar scale. In previous work we used velocity fields derived from local correlation tracking (LCT) as source functions for a 2D induction equation, which provided a means for evolving the magnetic field from an assumed initial condition. In the current work we have refined our methodology in order to better treat regions where the LCT derived velocity is unreliable. By introducing a simplified momentum equation in low-signal areas we are able to eliminate persistent magnetic artifacts and, simultaneously, simulate the generation and radiation of Alfvén waves. Additionally, estimates of magnetic power spectral density, energy density, and plasma beta are significantly improved from the previous work. It is our hope that this study will serve to improve our understanding of the interplay between the plasma and the magnetic field in the supra-arcade region.

310 ***Wave Propagation in the Internetwork Chromosphere: Comparing IRIS Observations of Mg II h and k with Simulations***

Fleck, Bernhard (1), bfleck@esa.nascom.nasa.gov; B. De Pontieu (2); J. Leenaarts (3); T. M. D. Pereira (4); and T. Straus (5).
(1) European Space Agency, c/o NASA Goddard Space Flight Center, Greenbelt, MD, USA
(2) Lockheed Martin Solar and Astrophysics Lab, Palo Alto, CA, USA
(3) Institute for Solar Physics, Stockholm University, Sweden
(4) Institute of Theoretical Astrophysics, University of Oslo, Norway
(5) Instituto Nazionale di Astrofisica (INAF), Astronomical Observatory of Capodimonte (OAC), Naples, Italy

The objective of this study is to explore the dynamics of the upper internetwork chromosphere using high-resolution spectroscopic "sit-and-stare" time series obtained with the Interface Region Imaging Spectrogragh (IRIS) in the Mg II h and k lines. The Mg II h and k lines reveal a particularly complex spatio-temporal behavior, which strongly depends on the magnetic field topology. We focus on six parameters in both the h and k line: the Doppler shift and intensity of the central reversal (h_3 and k_3) and the blue and red emission peaks (h_{2v}, h_{2r}, k_{2v}, k_{2r}). In an effort to better understand what physical parameters can be extracted from these lines and to put our interpretation of the observations on more solid grounds, we extend our analysis to synthetic spectra obtained from numerical simulations and compare the results to the observations.

311 ***Comparison of Spectral Signatures of Mg II h, k and Ca II K Lines on a Plage Region***

Kawate, Tomoko (1,2), t.kawate@qub.ac.uk; Kiyoshi Ichimoto (2); and Satoru UeNo (2).
(1) Queen's University Belfast, United Kingdom
(2) Kyoto University, Japan

Since July 2013, IRIS has been providing high resolution UV spectroscopic data, which are novel for solar observations. Though it is very interesting to see the UV spectral data which contain the information of the dynamics of chromosphere and transition region with IRIS, interpreting the data is difficult because they are highly complicated.

It will be a great advantage if we have an observing channel of Mg II h,k lines in addition to Ca II K line on the Solar UV-Visible-IR Telescope (SUVIT) onboard Solar-C, but it has not been decided if we have it since extending the observing wavelength down below 300nm for the SUVIT optics is a non-trivial technical challenge. Thus we have to make a critical investigation of the scientific significance of Mg II observation by using IRIS data on the view point of difference of expected scientific result from Ca II K observation.

We performed a spectroscopic observation with Domeless Solar Telescope at Hida Observatory of Kyoto University in Japan. The data are spectroheliograph in Ca II K, H-alpha and Ca II IR 8542 A of a plage region, and simultaneously observed with IRIS Mg II h, k. From these data, we compared the difference of spectral manifestations of Mg II h, k and Ca II K and discuss expected new output with high resolution Mg II observation.

In this presentation, we introduce our spectroscopic data and results, and discuss the importance of Mg II observation for SUVIT/Solar-C.

312 ***Chromospheric and Transition Region Signatures of Emerging Magnetic Flux Bubbles: First Observations with IRIS and SST***

Hansteen, Viggo (1), viggoh@astro.uio.no; Ada Ortiz (1); Luis Bellot (2); Mats Carlsson (1); Luc Rouppe van der Voort (1); and Bart De Pontieu (3).
(1) Institute of Theoretical Astrophysics, University of Oslo, Norway
(2) Instituto de Astrofisica Andalucia, Granada, Spain
(3) Lockheed Martin Space and Astrophysics Laboratory, Palo Alto, CA, USA

We study granular sized magnetic flux emergence events that occur in a flux emergence region in NOAA 11850 on September 25, 2013. During that time, the first co-observing campaign between the Swedish 1 m Solar Telescope and the IRIS spacecraft was carried out. Simultaneous observations of the Halpha 656.28 nm and Ca II 854.2 nm chromospheric lines, and the Fe I 630.25 nm photospheric line, were made with the CRISP/SST spectropolarimeter reaching a spatial resolution of 0."14. At the same time, IRIS was performing a four-step dense raster of the said emerging flux region, taking slit-jaw images at 133 (C II transition region), 140 (Si IV, transition region), 279.6 (Mg II k, core, upper chromosphere), and 283.2 nm (Mg II k, wing, photosphere), obtaining thus the highest resolution images ever taken of the upper chromosphere and transition region. The photospheric and chromospheric properties of the emerging magnetic flux bubbles have been described in detail in Ortiz et al. 2014, ApJ 781, 126. However, in the current work we are able to follow such lower atmosphere observations of flux emergence up to the transition region with unprecedented spatial and temporal resolution. We describe the properties (size, time delays, lifetime, velocities, temperature) of the observed signatures of flux emergence in the transition region. We believe this may be an important mechanism of transporting energy and magnetic flux to the upper layers of the solar atmosphere, namely the transition region and corona, at least in cases when active regions are formed by flux emerging through the photosphere.

313 ***The Quasi-Annual Forcing of the Sun's Eruptive, Radiative and Particulate Output***

Leamon, Robert (1,2), robert.j.leamon@nasa.gov; Scott McIntosh (3); Larisza Krista (4); Roger Ulrich (5); Jerald Harder (6); Greg Kopp (6); Thomas Woods (6); Justin Kasper (7); Michael Stevens (7); Hugh Hudson (8); and Pete Riley (9).
(1) Montana State University, Bozeman, MT, USA
(2) NASA Headquarters, Washington, DC, USA
(3) National Center for Atmospheric Research, High Altitude Observatory, Boulder, CO, USA
(4) NOAA/ CIRES, University of Colorado, Boulder, CO, USA
(5) University of California, Los Angeles, CA, USA
(6) LASP, University of Colorado, Boulder, CO, USA
(7) Harvard-Smithsonian Center for Astrophysics, Cambridge, MA, USA
(8) University of California, Berkeley, CA, USA
(9) Predictive Science, Inc., San Diego, CA, USA

The eruptive, radiative, and particulate output of the Sun are modulated by our star’s enigmatic 11-year sunspot cycle. Over the past year we have identified observational signatures which illustrate the ebb and flow of the 11-year cycle – arising from the temporal overlap of migrating activity bands which belong to the 22-year magnetic activity cycle. As a consequence of this work we have deduced that the latitudinal interaction of the oppositely signed magnetic activity bands in each hemisphere (and across the equator near solar minimum) dramatically impacts the production of Space Weather events such as flares and Coronal Mass Ejections (CMEs). The same set of observations also permits us to identify a quasi-annual variability in the rotating convecting system which results in a significant local modulation of solar surface magnetism. That modulation, in turn, forces prolonged periods of significantly increased flare and CME production, as well as significant changes in the Sun's ultraviolet (UV), extreme ultraviolet (EUV), and X-Ray irradiance. We propose that that there are global-scale waves propagating along the bottom of the convection zone in the shear layer known as the tachocline and we are observing their impact on the surface magnetism, driven by buoyancy modifications of flux tubes in the deep convection zone.

314 ***Chromospheric Evaporation in a Recent Joint IRIS/EIS Flare Observation***

Mason, Helen (1), hm11@damtp.cam.ac.uk; V. Polito (1); K. Reeves (2); G. Del Zanna; and L. Golub (2).
(1) University of Cambridge, DAMTP, Centre for Mathematical Sciences, Cambridge, UK
(2) Harvard-Smithsonian Center for Astrophysics, Cambridge MA, USA

Chromospheric evaporation during the impulsive phase of a flare is interpreted as the result of intense heating of the chromospheric plasma to flare temperatures with consequent expansion and filling of coronal loops. Spectral signatures of chromospheric evaporation are velocity blueshifts in high temperature emission, which were first observed in the X -ray wavelength range.

In this work we present a recent observation of a C6.5 class flare obtained with both the Interface Region Imaging Spectrometer (IRIS) and the EUV Imaging Spectrometer (EIS) in February 2014. We follow the details of the impulsive phase with IRIS and the gradual decay phase with EIS. Of particular interest is the Fe XXI emission line observed by IRIS, which is formed at 10 MK. It represents the highest temperature emission line observed in the IRIS wavelength range, and its intensity is typically enhanced during solar flares. Thanks to the high spatial and spectral resolution of the IRIS spectrograph, we are able to observe blueshifts at the flare ribbons during the impulsive phase. IRIS Slit-Jaw Images are used to precisely locate the flare kernels where the blueshifted emission originates. Hot (10 MK) Fe XXIII and Fe XXIV emission from the filled coronal loops is also observed by EIS during the decay phase.

315 ***IRIS and Hinode SOT Observations of Small Photospheric Field Effects on the Chromosphere***

Tarbell, Ted, tarbell@lmsal.com, Lockheed Martin Solar and Astrophysics Lab., Palo Alto, CA, USA.

IRIS and Hinode SOT have made about a dozen simultaneous, coaligned observations associated with HOP 243 (quiet sun) and HOP 250 (active region plage and sunspots). These are unique observations because the SOT Spectro-Polarimeter ran an unusual mode that provides both high cadence (~1 minute) and high sensitivity in time series over a narrow field of view, which includes the IRIS slit. IRIS also collected high-cadence spectra in sit-and-stare or small raster modes and slit-jaw images. SOT NFI magnetograms and Ca images are also available for context over a wider FOV and as coalignment aids. The Level-1 SP maps of apparent photospheric longitudinal and transvere magnetic fields and Level-2 MERLIN inversions results have similar spatial and temporal resolution to IRIS data and higher sensitivity and accuracy in magnetic fields than any other coordinated observations with IRIS. They are full of small intra-network field elements emerging, cancelling and interacting with longer-lived, stronger field structures. The poster presents an initial sample of chromospheric (and occasionally transition region) responses to these transient photospheric magnetic fields. Some of the pitfalls in processing and coaligning these types of data are also discussed. This work was supported by the NASA IRIS and Hinode contracts at LMSAL.

316 ***Daniel K. Inouye Solar Telescope: Collaborations and synergies between DKIST***

Martinez Pillet, V., vmpillet@nso.edu (1); T. Rimmele (2); and the DKIST team National Solar Observatory.
(1) National Solar Observatory, Boulder, CO, USA
(2) National Solar Observatory, Daniel K. Inouye Solar Telescope, Pukalani, HI, USA.

The 4m Daniel K. Inouye Solar Telescope (DKIST) will be the largest solar facility ever built. Designed to meet the needs of critical high resolution and high sensitivity spectral and polarimetric observations of the sun, this facility will support key experiments for the study of solar magnetism and its influence on the solar wind, flares, coronal mass ejections and variability in solar output. Its coronagraphic capabilities will allow direct measurements of the coronal magnetic field with unprecedented sensitivity. The design allows the facility to operate over a broad wavelength range (0.35 to 28 microns). The state-of-the-art adaptive optics system provides diffraction limited imaging and the ability to resolve features approximately 20 km on the Sun. Five first light instruments will be available at the start of operations: Visible Broadband Imager (VBI; National Solar Observatory), Visible SpectroPolarimeter (ViSP; High Altitude Observatory), Visible Tunable Filter (VTF; Kiepenheuer Institute, Germany), Diffraction Limited NIR Spectropolarimeter (DL-NIRSP; University of Hawaii) and the Cryogenic NIRSpectropolarimeter (Cryo-NIRSP; University of Hawaii). Site construction on Haleakala, HI began in December 2012 and is progressing on schedule. Operations are scheduled to begin in 2019. We provide a brief update on the development and construction of the facility and discuss plans for operations, including the DKIST Data Center development.

317 ***NuSTAR's First Solar Observations: Search for Transient Brightenings / Nanoflares***

Marsh, Andrew (1), anjmarsh@ucsc.edu; I. G. Hannah; L. Glesener (3); D. Smith (1); B. Grefenstette (4); S. Krucker (3,5); H. S. Hudson (3,1); G. Hurford (3); S. White (6); A. Caspi (7); S. Christe (8); A. Shih (8); R. Mewaldt (4); M. Pivovaroff (9); J. Vogel (9); and the NuSTAR Science Team.
(1) University of California, Santa Cruz, CA, USA
(2) University of Glasgow, UK
(3) University of California, Berkeley, CA, USA
(4) California Institute of Technology, Pasadena, CA, USA
(5) University of Applied Sciences Northwestern (FHNW), Switzerland
(6) Air Force Research Laboratory, USA
(7) LASP, University of Colorado, Boulder, CO, USA
(8) NASA Goddard Space Flight Center, Greenbelt, MD, USA
(9) Lawrence Livermore National Laboratory, Livermore, CA, USA

We present a timing analysis of the Sun with the NuSTAR hard X-ray (HXR) telescope, searching for transient brightenings / nanoflares in the quiet Sun and active regions. A substantial amount of flare energy goes into accelerating electrons. HXR observations are a crucial tool for understanding this non-thermal emission and the energy release in flares. RHESSI is able to study this emission over many orders of magnitude (active region flares from X-class to A-class microflares), but it cannot detect the emission from smaller events. Such "nanoflares" have been postulated as a possible source of coronal heating and their existence and relationship to larger flares is still uncertain. In order to detect these events in HXRs, instruments more sensitive than RHESSI are required. Launched in 2012, the astrophysics mission NuSTAR uses focusing optics to directly image X-rays between ~2-80 keV. Although not optimized for solar observations, NuSTAR's highly sensitive imaging spectroscopy will be used to search for the faintest X-ray emission from the Sun. These solar observations will begin in September 2014; here we present the first results of our search for transient brightenings that could relate to nanoflares.

318 ***Simulated Time Lags of Hinode/XRT and SDO/AIA Lightcurves as an Indication of Loop Heating Scenario***

Alexander, Caroline (1), caroline.e.alexander@nasa.gov; Amy Winebarger (1); and Roberto Lionello (2).
(1) NASA Marshall Space Flight Center, Huntsville, AL, USA
(2) Predictive Science, Inc., San Diego, CA, USA

The precise nature of the heating mechanism (location, duration) in coronal loops is still a matter of enormous research. We present results from a 1D hydrodynamic loop simulation of a coronal loop which was run using different parameters such as loops length (50, 200, and 500 Mm), maximum temperature reached (3MK and 10MK), and abundances. For each scenario the model outputs were used to calculate the corresponding lightcurves as seen by XRT/Be-thin and various EUV AIA channels. The lag time between the peak of these lightcurves was computed using cross-correlation and plotted as a function of loop length. Additional results were computed using the 0D EBTEL code in order to test the compatibility of the two codes and to investigate additional loop lengths. Initial results indicate that the long (>5000s) lags observed in the ~100Mm loops of active regions can only be reproduced using photospheric abundances and much longer loop lengths.

319 ***Modeling Nanoflare-Heated Solar Coronal Active Regions***

Allred, Joel (1), joel.c.allred@nasa.gov; and Vladimir Airapetian (1).
(1) NASA Goddard Space Flight Center, Greenbelt, MD, USA

High spatial resolution images of corona active regions (AR) in the extreme-ultraviolet (EUV) with Hinode, TRACE, SDO, and Hi-C suggest that the solar corona is a non-uniform environment structured into bundles of magnetic loops heated to temperatures exceeding 5 MK. Measurements of emission measures (EM) for ARs provide clues to time dependence of the heating mechanism: static versus impulsive. Here we present results from a parameter study modeling the EUV/SXR emission produced in ARs using an impulsive

nanoflare heating model. From HMI vector magnetograms, we have performed non-linear force free field (NLFFF) extrapolations to estimate the coronal magnetic field. We have traced field lines in closed field regions within the AR to obtain more than 10,000 individual flux tubes and have simulated nanoflares within each of these using a 1D hydrodynamic code. We have varied the energy released by nanoflares as a function of magnetic field strength, loop length, flare duration and frequency. From the simulations, we can construct 3D models of the EUV/SXR emission produced by the ARs. We compare the simulated emission with that observed by AIA to constrain the heating parameters.

320 ***Characterizing the Properties of Coronal Magnetic Null Points***

Barnes, Graham (1), graham@nwra.com; Eric Wagner (1); and Marc DeRosa (2).
(1) NorthWest Research Associates, Boulder, CO, USA
(2) Lockheed Martin Solar and Astrophysics Laboratory, Palo Alto, CA, USA

The topology of the coronal magnetic field plays a role in a wide range of phenomena, from Coronal Mass Ejections (CMEs) through heating of the corona. One fundamental topological feature is the null point, where the magnetic field vanishes. These points are natural sites of magnetic reconnection, and hence the release of energy stored in the magnetic field. We present preliminary results of a study using data from the Helioseismic and Magnetic Imager aboard NASA's Solar Dynamics Observatory to characterize the properties and evolution of null points in a Potential Field Source Surface model of the coronal field. The main properties considered are the lifetime of the null points, their distribution with height, and how they form and subsequently vanish.

This work is supported by NASA/LWS Grant NNX14AD45G.

321 ***Abstract Withdrawn***

322 ***Dissipation of MHD Turbulence and Heating of Coronal Loops in Non-flaring Active Region Cores***

Cadavid, (Ana) Cristina (1), ana.cadavid@csun.edu; John Lawrence (1); Damian Christian (1); David Jess (2); and Giuseppina Nigro (3).
(1) California State University Northridge, Northridge, CA, USA
(2) Queen's University, Belfast, Ireland
(3) Universita' della Calabria, Rende, Italy

We use EUV observations from AIA/SDO to examine the evolution of and energy deposition into coronal loops in non-flaring AR cores. We isolate the hot Fe XVIII and Fe XXI components of the 94 Å and 131 Å by modeling and subtracting the "warm" contributions to the emission. We define "inter-moss" regions as those with the smallest projected line-of-sight magnetic fields in contemporaneous HMI data. The time evolution of the inter-moss intensity, temperature, and electron density indicate that the loops are impulsively heated in a mode compatible with nanoflare storms. Fourier power spectra of the hot 131 Å signals, when averaged over the set of loops, present three scaling regimes: < 3 min, 3-8 min, 8-240 min. Long-periods correspond to 1/f noise; intermediate indicate a persistent process and short periods show white noise. Similar results, compatible with nanoflare statistics, are found for the time dependence of energy dissipation calculated via a 2D "hybrid" shell model of loop magneto-turbulence, based on reduced magnetohydrodynamics (MHD). This model reaches very large Reynolds numbers, not yet accessible in simulations of 3D MHD, and allows calculation of long energy dissipation time series, crucial for comparison to the data. For the future, 3D MHD turbulence models have shown that the kind of fast magnetic reconnection that is required for flare-like processes can be achieved by the wandering of stochastic magnetic fields at sub-resolution scales. Since the turbulent model fits the observations it suggests the presence of fast heating mechanisms in AR loops.

323 ***Observations of a Solar Flare in Association with a Quiescent Filament Eruption***

Foord, Adi (1,2), adi.foord@nasa.gov; and Gordon Holman (1).
(1) NASA Goddard Space Flight Center, Greenbelt, MD, USA
(2) Catholic University of America, Washington, DC, USA

We present an analysis of multi-waveband observations of the eruption of a quiescent solar filament over a 2-day time span, from 2013 September 29 to 2013 September 30. The instruments used include the Reuven Ramaty High Energy Solar Spectroscopic Imager (RHESSI), the Solar Dynamics Observatory (SDO), and the Fermi Gamma-ray Space Telescope. The GOES class of the event was C1. The GOES light curve for this event includes a small impulsive-phase peak beginning September 29 at 22:00 UT that lasts almost 10 minutes. A more gradual peak follows, lasting for 3 hours between September 29 22:30 UT and September 30 1:30 UT. RHESSI detected X-ray emission between 3-12 keV, but was in spacecraft nighttime during the impulsive phase of the flare. Sodium iodide detectors on the Fermi Gamma-ray Burst Monitor (GBM) show a small peak in the 10-14 keV channels during the impulsive phase. SDO Atmospheric Imaging Assembly (AIA) movies during the time span show that the filament lies outside any active region on the sun, and spans a length on the order of 600 arcseconds. Spatially resolved RHESSI emission during the gradual phase is found to come from an area along the post-eruption arcade, close to the westward expanding ribbon but confined to a length of only 150 arcseconds. We infer the strength and geometry of the magnetic field during the eruption with the SDO Helioseismic and Magnetic Imager (HMI) and find a small (~ 100 arcseconds long) dipolar element within the filament channel that appears to correlate spatially with the RHESSI emission. The dipolar element is observed to also expand apart, similar to the ribbons of the arcade, with magnetic field strengths as high as 1000 Gauss before the eruption. We conclude that a flare can occur outside an active region in association with a quiescent filament eruption if sufficiently high magnetic flux is present in the vicinity of the filament.

324 ***Evidence for Wave Heating of the Quiet Corona***

Hahn, Michael (1), mhahn@astro.columbia.edu; and Daniel Wolf Savin (1).
(1) Columbia University, New York City, NY, USA

We have inferred the properties of waves in quiet Sun regions based on spectroscopic line widths. The non-thermal line broadening is proportional to the amplitude of Alfvenic waves. Using a Potential Field Source Surface (PFSS) magnetic field model, we trace the evolution of line widths along inferred magnetic field lines. In order to mitigate line of sight effects, we select regions that are isothermal and where the field lines remain oriented close to perpendicular to the line of sight. Our results indicate that the waves are damped starting at a height that is positively correlated with the overall length of the loop. That is, for longer loops, the damping occurs starting at a larger height. This suggests that heating of quiet Sun loops occurs over a region entered on the loop top and extends over a large fraction of the loop. We estimate that there is enough energy flux in waves injected at the base of quiet Sun regions to account for coronal heating in such structures.

325 ***Long-Term Periodicities in Polar Coronal Holes***

Kirk, Michael S. (1), michael.s.kirk@nasa.gov; Shea Hess-Webber (2); and W. Dean Pesnell (1).
(1) NASA Goddard Space Flight Center, Greenbelt, MD, USA
(2) George Mason University, Fairfax, VA, USA

Polar coronal holes are near-permanent features on the sun, capping the northern and southern solar poles in EUV and x-ray images for a majority of the solar cycle. They are understood as the primary source of the fast solar wind, which demarcates the quiescent heliospheric environment. Polar holes are also observed to have strong solar cycle dependence: becoming more stable and prominent in solar minimum and disappearing at solar maximum. Using the perimeter tracking methods of defined by Kirk *et al.* (2009) and refined by Hess-Webber *et al.* (2014), we identify the perimeter of polar coronal holes during solar cycle 23 and the first half of cycle 24 and characterize the hole by its centroid. We utilize the entirety of the EIT image archive on SOHO and AIA images on SDO for the work. A measurement of the axial symmetry of the polar holes is seen to have clear solar cycle dependence. Polar coronal holes are aligned with the solar rotation axis during minimum and have a maximum off-axial perturbation of about 8 degrees in the declining phase of the solar cycle. These deviations from axial asymmetry propagate out into the heliosphere and are observable in complementary solar wind measurements.

326 ***Solar Coronal Holes and Open Magnetic Flux***

Lowder, Chris (1), clowder@physics.montana.edu; Jiong Qiu (1); Robert Leamon (1); and Dana Longcope (1).
(1) Montana State University, Bozeman, MT, USA

Using SDO/AIA and STEREO/EUVI EUV data in conjunction with an instrument-specific adaptive intensity thresholding algorithm, we are able to track coronal hole boundaries across the entire solar surface at a cadence of 12 hours. SOHO/EIT provides earlier era data, allowing the building EUV coronal hole maps over the course of a solar rotation. We find that for solar cycle 23 the unsigned magnetic flux enclosed by coronal hole boundaries ranges from (2-5)x10^22 Mx, covering 5%-17% of the solar surface. For solar cycle 24 this flux ranges from (2-4)x10^22 Mx, covering 5%-10% of the solar surface. Using a surface flux transport model, we compare observational coronal hole boundaries and computed potential open field for solar cycles 23 and 24. From both our observed coronal holes and modeled open magnetic field, we find that low-latitude regions contribute significantly to the total open magnetic flux, and should be considered in more significant detail.

327 ***A Study of the Relations Between Large-Scale Active Region Canopies and Filament Formation over a Year***

Saar, Steven H. (1), saar@cfa.harvard.edu; and Karen Muglach (2,3).
(1) Smithsonian Astrophysical Observatory. Cambridge, MA USA
(2) NASA Goddard Space Flight Center, Greenbelt, MD, USA
(3) Artep, Inc., Ellicott City, MD, USA

There is evidence that active region canopies may be a significant locus of filament formation. To investigate this, we have studied a year-long time series of AIA data with an automated solar region identifier, modified to also find canopies. The canopy locations are then compared with the locations of filaments as seen in H alpha. We estimate the fraction of filaments which are formed in connection with canopies, and explore what canopy properties (e.g., size, location, proximity to active regions) make filament generation more likely.

328 ***Time Variation of X-ray Bright Point Properties with Hinode XRT***

Saar, Steven H. (1), saar@cfa.harvard.edu; and Joan Schmelz (2,3).
(1) Smithsonian Astrophysical Observatory. Cambridge, MA USA
(2) University of Memphis, Memphis, TN, USA
(3) National Science Foundation

The long time series of synoptic Hinode XRT measurements of the solar corona permits detailed study of solar structures on dynamo cycle timescales. We take advantage of this to take a first look at the evolution of XBP properties over the Hinode mission. Using an automated X-ray bright point (XBP) finder and filter ratios we have calibrated against DEMs derived from EIS and multifilter XRT observations, we explore the distribution of XBP sizes, locations, and average temperatures and how these evolve in snapshots from 2007 - 2014.

329 ***A Study of Acceleration Mechanisms of X-ray Jets***

Sako, Nobuharu (1), sako@solar.mtk.nao.ac.jp; Masumi Shimojo (1,2); Tetsuya Watanabe (1,2); and Takashi Sekii (1,2).
(1) The Graduate University for Advanced Studies (SOKENDAI), Hayama, Japan
(2) National Astronomical Observatory of Japan (NAOJ), Mitaka, Tokyo, Japan

To study the acceleration mechanism of X-ray jets, we analyze 31 X-ray jets in active regions, 59 X-ray jets in quiet regions, and 60 X-ray jets in coronal holes from XRT data, and classify X-ray jets into the evaporation jet and the magnetic-driven jet. No large differences in the morphological parameters are found for the jets in the ARs, the QRs, and the CHs. While the jet speed, the thermal energy, the heating flux of the footpoint flare, and the temperature of the jets in the ARs are larger than those in the QRs and the CHs. We classify the X-ray jets in the ARs, the QRs, and the CHs into the evaporation jet and the magnetic-driven jet using the speed and the temperature of the jets. We found that both evaporation jets and magnetic-driven jets are produced in the ARs, the QRs, and CHs, respectively.

330 ***Role of Jetlets and Transient Bright Points in the Sustainability of Solar Coronal Plumes***

Stenborg, Guillermo (1), guillermo.stenborg.ctr@nrl.navy.mil; and N. -E. Raouafi (2).
(1) College of Science, George Mason University, Fairfax, USA
(2) The Johns Hopkins University Applied Physics Laboratory, Laurel, Maryland, USA

Detailed analysis of high-resolution observations from the Solar Dynamic Observatory (SDO) shows that small-scale, transient magnetic activity plays a key role in the formation and evolution of solar coronal plumes.

The focus is on the role of transient structures at the footpoints in sustaining coronal plumes for relatively long periods of time (i.e., several days). In addition to nominal jets occurring prior to and during the development of plumes, the data show that a large number of jetlets (i.e., small jets) and plume transient bright points (PTBP) occur on time scales of tens of seconds to a few minutes. These features are the result of quasi-random cancellations of fragmented and diffuse minority magnetic polarity with the dominant unipolar magnetic field concentration over an extended period of time. They unambiguously reflect a highly dynamical evolution at the footpoints and are seemingly the main energy source for plumes. This suggests a tendency for plumes to be dependent on the occurrence of transients (i.e., jetlets, and PTBPs) resulting from low rate magnetic reconnection.

331 ***Atmospheric Vortex Flows – New results and implications***

Wedemeyer, Sven, svenwe@astro.uio.no (1); Eamon Scullion (2); Yoshiaki Kato (3); Oskar Steiner (4); and Luc Rouppe van der Voort (1).
(1) University of Oslo, Norway
(2) Trinity College Dublin, Ireland
(3) Kiepenheuer Institute for Solar Physics, Freiburg, Germany
(4) European ALMA Regional Center, Czech node, Ondrejov, Czech Republic

High-resolution observations with the Swedish 1-m Solar Telescope (SST) and the Solar Dynamics Observatory (SDO) reveal atmospheric vortex flows on different spatial scales. The smaller "magnetic tornadoes" are so far primarily detected as so-called chromospheric swirls. Detailed numerical simulations show that the observed chromospheric plasma motion is caused by the rotation of magnetic field structures, which is driven by photospheric vortex flows at the magnetic footpoints. Rotating magnetic field structures are also observed on larger spatial scales in 'giant solar tornadoes', which are probably the rotating legs of solar prominences. Here we address open questions concerning the connection between small-scale and giant tornadoes, their contribution to transporting energy into the corona, their potential role as source of twist and instability of prominences, and their dependence on the ambient magnetic field.

Poster Topic 1b. *Reconnection and Magnetic Instabilities in Geospace, Heliosphere, and Solar Atmosphere*

332 ***Nanoflare Heating Model and the Reconnection of Solar Coronal Loops***

Asgari-Targhi, Mahboubeh (1), masgari-targhi@cfa.harvard.edu; E. E. DeLuca (1); and M. A. Berger (2).
(1) Harvard-Smithsonian Center for Astrophysics, Cambridge, MA, USA
(2) SECAM, University of Exeter, Devon, UK

Using Parker's original model of reconnection, we analyze and estimate the degree of reconnection that is likely to take place between braided magnetic field lines in coronal loops. Using the avalanche model of reconnection, we show that the reconnected field lines evolve to a self-organized critical state and the frequency distribution of the braid sequences after the reconnection and the energy released during the reconnection follows a power law distribution. We provide some observational test of this picture.

333 ***Survey of Active Region Magnetic Field Models***

DeLuca, Edward (1), edeluca@cfa.harvard.edu; Antonia Savcheva (1); and Sarah Millholland (1,2).
(1) Harvard-Smithsonian Center for Astrophysics, Cambridge, MA, USA
(2) University of St. Thomas, Saint Paul, MN USA

We will present a review of active regions that have been modeled using the Coronal Modeling System flux rope insertion method. Statistics on the goodness of fit and field configurations before the onset of instability will be presented with the goal of understanding the characteristics of sigmoidal active region evolution.

334 ***Solar Polar Jets Driven by Magnetic Reconnection with Gravity and Wind***

DeVore, C. Richard (1), c.richard.devore@nasa.gov; Judith T. Karpen (1); and Spiro K. Antiochos (1).
(1) NASA Goddard Space Flight Center, Greenbelt, MD, USA

Polar jets are dynamic, narrow, radially extended structures observed in solar EUV emission near the limb. They originate within the open field of coronal holes in “anemone” regions, which are intrusions of opposite magnetic polarity. The key topological feature is a magnetic null point atop a dome-shaped fan surface of field lines. Applied stresses readily distort the null into a current patch, eventually inducing interchange reconnection between the closed and open fields inside and outside the fan surface (Antiochos 1996). Previously, we demonstrated that magnetic free energy stored on twisted closed field lines inside the fan surface is released explosively by the onset of fast reconnection across the current patch (Pariat et al. 2009, 2010). A dense jet comprised of a nonlinear, torsional Alfvén wave is ejected into the outer corona along the newly reconnected open field lines. Now we are extending those exploratory simulations by including the effects of solar gravity, solar wind, and expanding spherical geometry. We find that the model remains robust in the resulting more complex setting, with explosive energy release and dense jet formation occurring in the low corona due to the onset of a kink-like instability, as found in the earlier Cartesian, gravity-free, static-atmosphere cases. The spherical-geometry jet including gravity and wind propagates far more rapidly into the outer corona and inner heliosphere than a comparison jet simulation that excludes those effects. We report detailed analyses of our new results, compare them with previous work, and discuss the implications for understanding remote and in-situ observations of solar polar jets.

This work was supported by NASA’s LWS TR&T program.

335 ***The HXR and EUV Energetics of Microflares***

Hannah, Iain, iain.hannah@glasgow.ac.uk, University of Glasgow, Glasgow, UK.

Microflares are small active region flares (GOES A,B-class) that demonstrate similar signatures of electron acceleration and plasma heating as larger flares. This, combined with their high occurrence rate, simpler configurations and weaker emission that does not substantially saturate observations, makes them ideal candidates for studying flare energetics. Here we report on some recent microflares, using RHESSI HXR data to estimate the non-thermal energy and the thermal response to this in both RHESSI SXR and SDO/AIA EUV. We use a regularized inversion method (Hannah & Kontar 2012, 2013) to determine the Differential Emission Measure (DEM) from which we can quantify the thermal properties of the microflares (i.e. density, radiative loss, and energy). This coupling of RHESSI and SDO/AIA allows us to present a comprehensive study of non-thermal and thermal energetics in a selection of microflares.

336 ***Statistics of AIA's EUV Response to Solar Flares***

Herman, Daniel (1,2), hermand@reed.edu; Katherine Reeves (1); and Henry Winter (1).
(1) Center for Astrophysics, Harvard-Smithsonian, Cambridge, MA, USA
(2) College, Reed, Portland, OR, USA

According to the standard model of solar flare evolution, flares will undergo an impulsive HXR emission phase prior to any subsequent Hα flash and SXR decay phase. However, outside of the standard model, some flares are observed to have a pre-flare brightening phase visible in EUV and SXR. Using data from Solar Dynamic Observatory’s Atmospheric Imaging Assembly (SDO-AIA), we attempt to narrow down statistical patterns in the brightening of AIA’s many EUV passbands. Since each passband corresponds to coronal plasma at different temperatures, the ordering of their brightening corresponds to the thermal evolution of flaring plasma. Different orderings correspond to different possible energy transport mechanisms occurring

as the pre-flare phase transitions into the impulsive phase (particle acceleration vs. thermal conduction). In order to create an extensive flare sample, EUV images of several thousand local events are chosen for analysis by the Flare Detective Module from AIA full-disk images. Using another computerized search, we find primary and secondary peaks for each AIA lightcurve generated from the selected flare frames. These peaks are matched into event groups based on temporal and spatial correlation and the relative ordering of each AIA channel is recorded. Statistical analysis of this time difference data reveals whether any solar flare class has a detectable pattern in EUV brightening.

337 ***Comparative Study of Hinode/EIS Spectroscopic Observation and Ionization Non-Equilibrium Calculation of Chromospheric Evaporation During a Solar Flare***

Imada, Shinsuke (1), shinimada@stelab.nagoya-u.ac.jp; Izumi Murakami (2); and Tetsuya Watanabe (3).
(1) Solar-Terrestrial Environment Laboratory, Nagoya University, Japan
(2) National Institute for Fusion Science, Japan
(3) National Astronomical Observatory of Japan, Japan

The mechanism of eruptive solar flares was the long standing problem after its discovery. Nowadays it is widely believed that a solar flare is a consequence of magnetic reconnection. These days the standard model of eruptive flares which is based on magnetic reconnection, namely CSHKP model has been established. One of the predicted characteristics from the models is chromospheric evaporation. When thermal energy in the corona precipitates into the dense underlying chromosphere through thermal conduction, the plasma responds dynamically. The thermal pressure in the chromosphere increases, and the over pressure condition in the chromosphere drive the material from chromosphere to corona. This process is very dynamic. Therefore, the evaporating plasma may not reach to the thermal equilibrium. In this study, first we will show the Hinode/EIS spectroscopic observations of chromospheric evaporation. We can clearly see that the relatively strong (~100km/s) redshift in FeXIV or XV can be observed at the footpoint during impulsive phase. We cannot explain this redshift in relatively high temperature with standard chromospheric evaporation model. Thus we have studied the effect of time-dependent ionization and the recombination processes. We discuss the chromospheric evaporation with 1D hydrodynamic and time dependent ionization calculation. We find that the evaporating plasma is far from equilibrium condition. We discuss the chromospheric evaporation, especially ~100km/s redshift component in FeXIV or XV, by comparison between the numerical simulation including time-dependent ionization effect and the Hinode/EIS spectroscopic observations.

338 ***Jets in the Solar Wind: What are measureable contributions from coronal jets***

Korreck, Kelly, kkorreck@cfa.harvard.edu, Harvard-Smithsonian CfA, Cambridge, MA, USA.

Coronal jets are reconnection events that are found most easily in coronal holes both polar and equatorial. Previous studies of coronal jets have associated the jets with microstream peaks in Ulysses solar wind data (Neugebauer, 2012). Through utilizing a long-term study of jets in coronal observations by XRT and AIA, we explore the signatures of these jets in ACE data. We use luminosity versus magnetic flux scaling law from Schwadron, McComas, & Deforest (2006) to examine the predicted solar wind contribution of these jets and compare with solar wind data.

339 ***Simulation Study of Rapid Change of Photospheric Magnetic Field Associated with Solar Flares***

Kusano, Kanya (1), kusano@nagoya-u.jp; Yusuke Itahashi (1); Yumi Bamba (1); and Daiko Shiota (1).
(1) Solar-Terrestrial Environment Laboratory, Nagoya University, Nagoya, Japan

Vector magnetogram observations indicated that the transverse magnetic field may increase rapidly after solar flares, although it is energetically thought that the sheared field should be consumed by flares. Although some models have been proposed to explain the rapid increase of transverse field, e.g. as an implosion, the detail mechanism is not well understood yet. In order to reveal the mechanism causing the rapid change of sheared magnetic field, we reanalyzed the data of simulations, which were recently developed by Kusano et al. (2012). As a consequence, we found that the increase of horizontal field can be caused by the compression of sheared magnetic field. Flare reconnection generates the post flare arcade, which is piled up on the sheared magnetic field existing on the polarity inversion line. Since the piling up of magnetic flux in flare arcade causes the compression of horizontal magnetic field on the polarity inversion line, the horizontal field below arcade can increase, even though the averaged intensity of sheared field in the flaring region is decreased by flare. This explanation indicates that, although the magnetic field lines of amplified horizontal component are not reconnected, the increase of sheared field is permanent as a consequence of flare reconnection.

340 ***Plasma Sheets in Post-CME Flares: Turbulent Dynamics versus Temperature Variations***

McKenzie, David (1), mckenzie@solar.physics.montana.edu; Michael Freed (1); Roger Scott (1); and Dana Longcope (1).
(1) Montana State University, Bozeman, MT, USA

Images of the coronal structures associated with post-CME flares reveal the presence of fan-like structures above the flare arcades. Using these same image sequences, made in soft X-ray and EUV wavelengths, we have learned the fan-like structures are regions of complicated physics, with multi-million-degree plasmas persisting for many hours, and apparently violent dynamics. Our recent analyses have employed local correlation tracking to measure the apparent flows, resulting in velocity fields that show the hallmarks of turbulence, including temporally and spatially varying vorticity. However, questions remain as to whether the apparent motions are truly indicative of plasma dynamics, or merely temperature variations bringing the plasma into/out of the passband of the observing instruments. We explore, using multi-wavelength observations, the degree to which temperature variations can explain the observed features.

341 ***A Topological View at Observed Flare Features: An Extension of the Standard Flare Model to 3D***

Savcheva, Antonia (1), asavcheva@cfa.harvard.edu; Etienne Pariat (2); Sean McKillop (1); Elizabeth Hanson (3); Yingna Su (1); and Edward DeLuca (1).
(1) Harvard-Smithsonian Center for Astrophysics, Cambridge, MA, USA
(2) Paris Observatory, Meudon, France
(3) University of California, Berkley, CA, USA

We conduct topology analysis of erupting non-linear force-free field (NLFFF) configurations of eight sigmoidal active regions observed with Hinode/XRT and SDO/AIA. The NLFFF models are computed using the flux rope insertion method and unstable models are utilized to represent the erupting configurations. Topology analysis shows that the quasi-separatrix layers (QSLs) in the chromosphere match well the flare ribbons observed in these regions. In addition, we show that low-lying QSLs associated with the rising flux rope change shape and extent to match the separating flare ribbons as observed by AIA. Post-flare loops are fit well by field lines lying under the generalized X-line at the bottom of the flux rope. We show a correspondence in the evolution of the post-flare loops from a strong-to-weak sheared state and the behavior of the field lines as the flux rope expands in the corona. We show that transient corona holes are associated with the footprints of the flux rope in the low atmosphere. In addition, we compute the reconnected flux in one of the regions and using information from the models constrain how much energy has been released during the event. We use this kind of topology analysis to extend the standard CME/flare model to full 3D and find implications to reconnection in 3D.

342 ***Observations of the Formation of the Hot Loop Arcades in the Mg XII 8.42 Å Line***

Shestov, Sergey (1), sshestov@gmail.com; Anton Reva (1); Sergey Bogachev (1); and Sergey Kuzin (1).
(1) Lebedev Physical Institute, Moscow, Russia

We present observations of hot arcades by the Mg XII spectroheliograph, which built direct monochromatic images of hot plasma in the Mg XII 8.42 Å resonance line. The observed arcades formed above polarity inversion line between NOAA 09847 and 09848 four times at 09:18, 14:13, and 22:28 UT in 2002 February 28 and at 00:40 UT in 2002 March 1. The evolution of the arcades followed the same scenario: a) a small flare appeared near the edge of the still invisible arcade; b) the arcade brightened in a wave-like manner - closer loops brightened earlier; c) intensity of the arcade gradually decreased during approximately 1 hour. The arcades behavior differs from the standard flare model. We think that each arcade formed due to the instabilities of the current sheet, which existed beforehand above the arcade apex.

343 ***Dynamics of Solar Flare Kernels Observed with 3D Spectroscopy in H-alpha Line and SDO***

Suematsu, Yoshinori (1), suematsu@solar.mtk.nao.ac.jp; and Satoru Ueno (2).

(1) National Astronomical Observatory of Japan, Osawa, Mitaka, Tokyo, Japan
(2) Hida Observatory, Kyoto University, Kurabashira, Takayama, Japan

Using a field integral (3D) spectroscopy in H-alpha line, GOES C- and M-class flares on 3 November 2011 were observed by the Domeless Solar Telescope, Hida Observatory. The data demonstrate that simultaneous spectroscopic observations over extended solar structures, at a high spatial resolution and temporal cadence, are important to track and understand the physics of transient phenomena happening in impulsive flare kernels. We made monochromatic images at given wavelengths in the H-alpha line and nearby continuum to co-align the data with X-ray and UV images from SDO. To reveal a dynamical properties of the flare kernels, we carried out line profile analysis and derived 2-D distribution of parameters such as line-of-sight velocity and line width. The results clearly show the rapid development of red asymmetry at the flare kernels, giving a large downward Doppler shift of up to 50 km/sec. The accompanied formation of coronal dynamic flaring loop structures seen in SDO X-ray images are consistent with a scenario of downward motion of compressed chromospheric flare kernels due do impulsive heat flow from the corona to the chromosphere and simultaneous evaporation of the chromospheric material into the corona.

344 ***Reconnection and Spire Drift in Coronal Jets***

Moore, Ron (1,2), ron.moore@nasa.gov, Alphonse Sterling (2); and David Falconer (1,2).
(1) University of Alabama in Huntsville, Huntsville, AL, USA
(2) NASA Marshall Space Flight Center, Heliophysics and Planetary Science, Huntsville, AL, USA

It is observed that there are two morphologically-different kinds of X-ray/EUV jets in coronal holes: standard jets and blowout jets. In a standard jet, the spire is a single-strand spike that does not expand sideways and is much narrower than the base of the jet throughout the life of the jet. In a blowout jet, in its growth phase, the spire is a multi-stranded spray that expands sideways to become about as wide as or wider than the jet's base. In both kinds: (1) in the base of the jet there is closed magnetic field that has one foot in flux of polarity opposite that of the ambient open field of the coronal hole, and (2) in coronal X-ray/EUV images of the jet there is typically a bright point in the edge of the base. In the conventional scenario for jets of either kind, the bright point is a compact flare arcade, the downward product of interchange reconnection of closed field in the base with impacted ambient open field, and the upper product of this reconnection is the jet-outflow spire. In either kind of jet it is also often observed that the spire drifts sideways, usually away from the bright point. We present some examples of the bright point and the spire drift in observed standard jets and blowout jets. With cartoons of the magnetic field and its reconnection in jets, we point out: (1) if the bright point is a compact flare arcade made by interchange reconnection, then the spire should drift toward the bright point, and (2) if the bright point is instead a compact flare arcade made, as in a filament-eruption flare, by internal reconnection of the legs of the erupting sheared-field core of a lobe of the closed field in the base, then the spire, made by the interchange reconnection that is driven on the outside of that lobe by the lobe's internal convulsion, should drift away from the bright point. Therefore, from the observation that the spire often drifts away from the bright point, we infer: (1) in X-ray/EUV jets of either kind in coronal holes the interchange reconnection that generates the jet-outflow spire often does not make the bright point; instead, the bright point is made by reconnection inside erupting closed field in the base, as in a filament eruption, the eruption being either a confined eruption for a standard jet or a blowout eruption (as in a CME) for a blowout jet, and (2) in this respect, the conventional reconnection picture for the bright point in coronal jets is often wrong for observed coronal jets of either kind.

345 ***Numerical Experiment of Emergence of Kink-unstable Flux Tube to Understand Formation of Delta-sunspots***

Takasao, Shinsuke (1), takasao@kwasan.kyoto-u.ac.jp; Yuhong Fan (2); Mark Cheung, (3); and Kazunari Shibata (1).
(1) Kyoto University, Kyoto, Japan
(2) High Altitude Observatory, National Center for Atmospheric Research, Boulder, CO, USA
(3) Lockheed Martin Solar and Astrophysics Laboratory, Palo Alto, CA, USA

The so-called "delta-sunspots" are known to be among the most flare-productive active regions in the solar atmosphere. Observations show that a fraction of the delta-sunspots emerge with strong magnetic shear and with polarity orientations not following the Hale-polarity rule obeyed by the majority of active regions.

To understand the observed evolution of these active regions, MHD simulations have been carried out in which a subsurface twisted kink-unstable flux tube emerges from the convection zone into the solar atmosphere. From the simulations, unlike the previous expectations based on the rigid emergence of a knotted tube, we found that a kinked tube can form a complex photospheric magnetic structure during the emergence. The photospheric magnetic polarities exhibit rotational motion and their evolution is coupled to coronal field conditions (rapid expansion and possibly reconnection). We identified that the spot rotation is driven by the torque arising from the mismatch in twist between the coronal part and parent flux tubes. On the basis of the idealized numerical experiments, we will discuss the complex magnetic field evolution and the energy transport process. This study would be important for understanding the formation of delta-sunspots with complex structures.

346 ***Core Electron Heating in Solar Wind Reconnection Exhausts***

Pulupa, Marc (1), pulupa@ssl.berkeley.edu; C. Salem (1); T. D. Phan (1); J. T. Gosling (2); and S. D. Bale (1,3).
(1) Space Sciences Laboratory, University of California, Berkeley, CA, USA
(2) Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder, CO, USA
(3) Physics Department, University of California, Berkeley, CA, USA

We present observational evidence of core electron heating in solar wind reconnection exhausts. We show two example events, one which shows clear heating of the core electrons within the exhaust, and one which demonstrates no heating. The event with heating occurred during a period of high inflow Alfvén speed (VAL), while the event with no heating had a low VAL. This agrees with the results of a recent study of magnetopause exhausts, and suggests that similar core electron heating can occur in both symmetric (solar wind) and asymmetric (magnetopause) exhausts.

347 ***Observation of Magnetic Reconnection and Recurrent Cool Jets in Emerging Active Region NOAA 11974***

Toriumi, Shin (1), shin.toriumi@nao.ac.jp; Yukio Katsukawa (1); and Patrick Antolin (1).
(1) National Astronomical Observatory of Japan, Tokyo, Japan.

We present our recent observation of emerging active region (AR) NOAA 11974 using Hinode, IRIS and SDO. This AR appeared on the southern hemisphere of the Sun and showed a significant flux emergence from February 10, 2014. We focused on the further emergence between February 13 to 14, which is composed of two emerging bipoles, and found that the negative patch of an emerging bipole interacts with the pre-existing positive flux and repeatedly shows intensity enhancements in the chromospheric images. These brightenings were followed by dark collimated plasma flows (cool jets) in the coronal images: lifetime ~10-20 min, apparent height ~10-30 Mm. In the collision site of the two emerging bipoles, we also detected flux cancellation and chromospheric brightenings with strong blueshifts: duration ~10 min, rising speed ~100 km/s. By combining these observations, we speculate that (1) the two emerging fields reconnect with each other to create longer coronal loops that link the outermost polarities (i.e., the resistive emergence) and (2) the emerging field reconnects with the pre-existing field to recurrently launch the cool jets.

348 ***Abstract Withdrawn***

349 ***Steps Toward Multiscale Coupling: Shear Driving in Kinetic Simulations***

Black, Carrie (1), Carrie.Black@nasa.gov; Spiro K Antiochos (1); Judith T Karpen (1); C Richard DeVore (1); Kai Germaschewski (2); and Naoki Bessho (2).
1) NASA Goddard Space Flight Center, Heliophysics Division, Greenbelt, MD, USA
2) University of New Hampshire, Durham, NH, USA

The explosive energy release in solar eruptive phenomena believed to be due to magnetic reconnection. In the standard model for coronal mass ejections (CME) and/or solar flares, the free energy for the event resides in the strongly sheared magnetic field of a filament channel. The pre-eruption force balance consists of an upward force due to the magnetic pressure of the sheared field countered by a downward tension due to

overlying unsheared field. Magnetic reconnection disrupts this force balance, therefore, it is critical for understanding CME/flare initiation, to model the onset of reconnection driven by the build-up of magnetic shear. In MHD simulations, the application of a magnetic-field shear is a trivial matter. However, kinetic effects are important in the diffusion region and thus, it is important to examine this process with PIC simulations as well. The implementation of such a driver in PIC methods is nontrivial, however, and indicates the necessity of a true multiscale model for such processes in the solar environment. The field must be sheared self-consistently and indirectly to prevent the generation of waves that destroy the desired system. In the work presented here, we show the implementation of a velocity shear driver perpendicular to the plane of reconnection in a system with open boundary conditions. This material is based upon work supported by the National Science Foundation under Award No. AGS-1331356.

350 ***Application of Wavelet Analysis on Conjugate High Latitude Geomagnetic ULF Pulsations***

Xu, Zhonghua (1), zxu77@vt.edu; C. Robert Clauer (1); hyomin Kim (1); Daniel R. Weimer (1), and Xia Cai (1).
(1) Virginia Polytechnic Institute and State University, Blacksburg, VA, USA

The interactions between the solar wind and geomagnetic field produce a variety of space weather phenomena, which can impact the advanced technology systems of modern society including, for example, power systems, communication systems, and navigation systems. One type of phenomena is the geomagnetic ULF pulsation observed by ground-based or in-situ satellite measurements. Here, we describe a wavelet-based index and apply it to study the geomagnetic ULF pulsations observed in Antarctica and Greenland conjugate magnetometer arrays. The wavelet indices computed from these data show spectrum, correlation, and magnitudes information regarding the geomagnetic pulsations. The results show that the geomagnetic field at conjugate locations responds differently according to the frequency of pulsations. We also examine the results in terms of different solar wind driving conditions measured by THEMIS and ACE satellites. This is particularly relevant to the conjugate behavior of dayside ULF pulsations. The index is effective for identification of the pulsation events and measures important characteristics of the pulsations. It could be a useful tool for the purpose of monitoring geomagnetic pulsations.

351 ***Solar Irradiance Impacts on Earth's Atmosphere Ion-Neutral Processes***

Lewis, Maggie (1), maggie.lewis@aggiemail.usu.edu; Jan J. Sojka (1); Michael David (1); Robert W. Schunk (1); Tom Woods (2); and Frank Eparvier (2).
(1) CASS, Utah State University, Logan, UT, USA
(2) LASP, University of Colorado, Boulder, CO, USA

Solar irradiance interactions with atmospheric neutrals have a marked optical depth wavelength dependence. This optical depth dependence manifests itself as the source of the main E- and F-region ionospheric layers. The ion-neutral interactions in the E-region are associated with molecular ion processes. In this region the time constants are almost as rapid as the solar irradiance flare time constants. In the F-region, however, the ion-neutral processes not only involve a production and loss balance but include diffusion. This leads to significantly longer F-layer time constants. The F-layer manifests an integrated response to flares temporal dynamics. Solar flare phases themselves also exhibit a significant wavelength dependences. The major enhancements in the irradiance during flares occurs at the shortest wavelengths, which leads specifically to E-region enhancements. In contrast, the late phase of a flare occurs at wavelengths that enhance the F-region. The presentation will explore these different ion-neutral dependences.

E-Posters – Session P3

352-E ***First Reconstruction of the 3-D Subsurface Magnetic Structure of Emerging Solar Active Regions Using Magnetic Vector Maps from HMI/SDO***

Chintzoglou, Georgios (1), gchintzo@gmu.edu; and Jie Zhang (1).
(1) George Mason University, Fairfax, VA, USA

Solar Active Regions (ARs) are 3-D magnetic structures generated at a depth in the Solar Convection Zone (SCZ). Once they reach the photospheric surface and emerge, they have the potential of being the sources of severe Space Weather. However our knowledge for their detailed 3-D structure is largely limited, coming mostly from numerical simulations and basic theoretical assumptions.

In Chintzoglou & Zhang 2013, a novel image time-stacking technique was proposed for reconstructing the 3-D subsurface structure for solar ARs during the phase of emergence, taking full advantage of the high time-cadence and high-spatial resolution Line-of-Sight (LOS) magnetogram observations from the Helioseismic & Magnetic Imager (HMI) aboard the Solar Dynamics Observatory (SDO). The validity of the technique is based on the reasonable assumption that, for newly emerging ARs, the time variation on the photosphere is dominated by the spatial variation along the vertical direction of an emerging 3-D structure.

In this study we extend the time-stacking technique to make use of full magnetic vector magnetograms (i.e. maps of Bx, By, Bz at the photosphere) for the 3-D reconstruction instead of merely using the LOS observations. In addition, the validity of this technique is tested using synthetic vector magnetograms from a 3D MHD simulation of an emerging AR. The produced 3-D vector datacube allows for the first time the detailed investigation of the full 3-D magnetic structure & connectivity as well as the calculation of the Magnetic Helicity and the Free Energy contained in the reconstructed sub-photospheric structure.

353-E ***Cool Plasma Observed in the FUV using IRIS***

Schmit, Donald (1,2), schmit.dj@gmail.com; and Davina Innes (3).
(1) Lockheed Martin Solar and Astrophysics Laboratory, Palo Alto, CA, USA
(2) Bay Area Environmental Research Institute (BAERI), Sonoma, CA, USA
(2) Max Planck Institute for Solar System Research, Germany

Cool plasma in the outer solar atmosphere is commonly observed in prominences and coronal rain. Theory suggests that these phenomena are related to cooling, and analysis of observations provides a constraint on the time-dependent energetics of the chromosphere and corona. Using the IRIS SG and SJI datasets, we discuss new observations of molecular absorption features in the Si IV emission lines near 1400A. The presence of molecules above the transition region provides an extreme example of complex structure and dynamics at the chromosphere-corona interface. There are two morphological models that can explain the absorption features: cool plasma hundreds of kilometers above the photosphere or a localized transition region deeply embedded in the photosphere. We discuss the merit of these scenarios and introduce complementary IRIS observations of inverted temperature structure in Ellerman bombs and diffuse Si I continuum absorption above active region loops.

354-E ***Active Regions from Birth to Decay: SDO/Hinode/STEREO observations***

Ugarte-Urra, Ignacio (1), ignacio.ugarte-urra.ctr.sp@nrl.navy.mil; Harry Warren (2); and Peter Young (1).
(1) George Mason University, Fairfax, VA, USA
(2) Naval Research Laboratory, Washington, DC, USA

Active regions are characterized by a rapid area growth and magnetic flux and radiance increase, followed by a slower decay that can last for several weeks. The total lifetime of the regions depends on the area of maximum development and therefore its total magnetic flux. Taking advantage of the complete solar sphere coverage provided by the combination of STEREO and SDO and Hinode observations, we investigate the global active region properties (EUV radiance, magnetic flux, area, polarity separation, emission measure) of ten active regions observed by the three satellites. We use STEREO to establish their lifetimes and define the phases in the active region evolution. Then we use AIA/SDO images to determine the Fe XVIII (5-8 MK) moderate cadence evolution as a function of the HMI magnetic flux limb-to-limb, and the EIS/Hinode to characterize the temperature contributions to the emission measure in the different phases of the active region's lifetime. These properties set up a context for the discrepancies encountered in the results of the differential emission measures of active regions in single snapshots and their interpretation in terms of low and high frequency heating in the corona.

355-E ***Modeling a Super-Hot, Above-the-Loop-Top Thermal HXR Source as the Slow-Shock-Heated Reconnection Outflow***

Brewer, Jasmine (1,2), jasmine.brewer@colorado.edu; Dana Longcope (2); Jiong Qiu (2); and Amir Caspi (3).
(1) Physics Dept., University of Colorado, Boulder, CO, USA
(2) Physics Dept., Montana State University, Bozeman, MT, USA
(3) Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder, CO, USA

The accepted picture of solar flares holds that magnetic reconnection releases stored magnetic energy and converts that into heat, radiation and non-thermal particle energy. In one model of this process, by Petschek, reconnection converts magnetic energy first into bulk kinetic energy, which is then thermalized by slow magnetosonic shocks. We show that this scenario can explain dense, super-hot (>30MK) loop-top sources observed in hard X-rays. Using a numerical model based on a time-dependent, three-dimensional generalization of Petschek's model, we model the loop-top source observed by RHESSI in the compact X-class flare on 26 Feb 2004. The lengths and magnetic field strengths of the post-reconnection loops are constrained using observations, and the reconnection rate is computed from the observed motion of the flare ribbons. The only remaining free parameters in the model are the length and temperatures of the pre-flare loops and the discontinuity in field direction across the current sheet at which the reconnection is assumed to occur. We are able to tune these three free parameters to match the shape and magnitude of the spectrum observed by RHESSI. The large density required to thermalize the electrons and generate the bright HXR emission results primarily from the slow-shock compression in the reconnection outflow. Evaporation driven by thermal condition creates a second, cooler component which compares favorably with the soft X-ray emission observed by GOES.

This work was support by grants from NSF-REU and NASA SR&T.

Thursday, Nov. 6 – Poster Session P3/P4

Featuring Topics 3a and 3b, and Poster Topic 1b Electronic Posters

Poster Topic 3a. *Ion-Neutral Interactions within Earth's Atmosphere and the Solar Atmosphere*

401 ***Why is Non-Thermal Line Broadening of Lower Transition Region Lines Independent of Spatial Resolution?***

De Pontieu, Bart (1,2), bdp@lmsal.com; Scott McIntosh (3); Juan Martinez-Sykora (4,1); Hardi Peter (5); and Tiago Pereira (2).
(1) Lockheed Martin Solar & Astrophysics Laboratory, Palo Alto, CA, USA
(2) Institute of Theoretical Astrophysics, University of Oslo, Norway
(3) High Altitude Observatory, National Center for Atmospheric Research, Boulder, CO, USA
(4) Bay Area Environmental Institute, Sonoma, CA, USA
(5) Max Planck Institute for Solar System Physics, Göttingen, Germany

Spectral observations of the solar transition region (TR) and corona typically show broadening of the spectral lines beyond what is expected from thermal and instrumental broadening. The remaining non-thermal broadening is significant (10-30 km/s), correlated with the intensity, and has been attributed to waves, macro and micro turbulence, nanoflares, etc. Here we study spectra of the low TR Si IV 1403 Å line obtained at high spatial and spectral resolution with the Interface Region Imaging Spectrograph (IRIS). We find that the large improvement in spatial resolution (0.33\arcsec) of IRIS compared to previous spectrographs (2\arcsec) does not resolve the non-thermal line broadening which remains at pre-

IRIS levels of 20 km/s. This surprising invariance to spatial resolution indicates that the physical processes behind the non-thermal line broadening either occur along the line-of-sight (LOS) and/or on spatial scales (perpendicular to the LOS) smaller than 250 km. Both effects appear to play a role. Comparison with IRIS chromospheric observations shows that, in regions where the LOS is more parallel to the field, magneto-acoustic shocks driven from below impact the low TR leading to strong non-thermal line broadening from line-of-sight integration across the shock at the time of impact. This scenario is confirmed by advanced MHD simulations which also reproduce the long-known puzzling correlation between non-thermal line broadening and intensity of the line. In the simulations, the shocks cause this correlation, but only if ambipolar diffusion between ions and neutrals in the partially ionized chromosphere is taken into account. In regions where the LOS is perpendicular to the field, the prevalence of small-scale twist is likely to play a significant role in explaining the invariance and the correlation with intensity.

402 ***On the Multi-Threaded Nature of Solar Spicules***

Skogsrud, Håkon (1), hakon.skogsrud@astro.uio.no; L. Rouppe van der Voort (1); and B. De Pontieu (1,2).
(1) Institute of Theoretical Astrophysics, University of Oslo, Norway
(2) Lockheed Martin Solar & Astrophysics Lab, Palo Alto, CA 94304 USA

A dominant constituent in the dynamic chromosphere are spicules.

Spicules at the limb appear as relatively small and dynamic jets that are observed to everywhere stick out. Many papers emphasize the important role spicules might play in the energy and mass balance of the chromosphere and corona. However, many aspects of spicules remain a mystery. In this poster we shed more light on the multi-threaded nature of spicules and their torsional component. We use high spatial, spectral and temporal resolution observations from the Swedish 1-m Solar Telescope in the H-alpha spectral line. The data targets the limb and we extract spectra from spicules far out from the limb to reduce the line-of-sight superposition effect. We discover that many spicules display very asymmetric spectra with some even showing multiple peaks.

To quantify this asymmetry we use a double Gaussian fitting procedure and find an average velocity difference between the single Gaussian components to be between 20-30 km/s for a sample of 57 spicules. We observe that spicules show significant sub-structure where one spicule consists of many ‘threads’. We interpret the asymmetric spectra as line-of-sight superposition of threads in one spicule and therefore have a measure for a perpendicular flow inside spicules which will be important for future numerical model to reproduce. In addition we show examples of lambda-x-slices perpendicular across spicules and find spectral tilts in individual threads providing further evidence for the complex dynamical nature of spicules.

403 ***Properties of the Partially Ionised Flare Chromosphere Deduced from SDO Lyman Continuum Observations***

Fletcher, Lyndsay (1), lyndsay.fletcher@glasgow.ac.uk; and Ryan O. Milligan (2).
(1) University of Glasgow, UK
(2) QUB / CUA / NASA Goddard Space flight Center, Greenbelt, MD, USA

The hydrogen Lyman recombination continuum emerges from the partially ionised solar atmosphere, and is well observed by the EVE MEGS-B instrument onboard SDO. The continuum colour temperature obtained from the slope of the Lyman continuum, the emergent intensity and the position angle of the flare can be used together in the Eddington-Barbier relation to determine the departure coefficient of the first level of hydrogen at the location of continuum formation. In past observations, the colour temperature was found to decrease during solar flares, indicating that the emergent intensity originates from a cooler layers than in the quiet Sun, the overlying layers having been made optically thin as they ionise due to flare heating. We examine the Lyman continuum in a number of large flares observed by MEGS-B, charting the evolution with time of the colour temperature and departure coefficient, and examining correlations with other radiation signatures of flare heating.

404 ***Chromospheric Radiative Energy Loss and Spectrum***
Fontenla, Juan, johnf@digidyna.com, NorthWest Research Associates, Boulder, CO, USA.

I will discuss the latest advances in this topic for quiet- and active-Sun regions. Particularly important are the non-LTE deep visible lines and the near-UV spectral regions that are both important for the cooling/heating of the chromosphere. These processes must be considered for realistically modeling the solar chromosphere physical structure and emitted spectrum of various states of magnetic activity of the solar atmosphere. The near-UV is also very important for the heating and photochemistry of ozone in the Earth stratosphere. However, these two spectral regions are not independent. Furthermore, the lower-upper non-LTE radiative interaction is very important but depends on not yet sufficiently known processes, probably molecular ones, which constitute the so-called “missing UV opacity”.

405 ***The (PIP) Code: A new astrophysical code to study partially ionised plasma***
Hillier, Andrew (1), andrew@kwasan.kyoto-u.ac.jp; Naoki Nakamura (1); and Shinsuke Takasao (1).
(1) Kwasan and Hida Observatory, Kyoto University, Kyoto, Japan

Due to the low temperatures of many astrophysical systems (e.g. stellar atmospheres and protoplanetary disks), there is insufficient energy to fully ionise the plasma. In this regime, drift between ions and neutrals occurs because of the different forces they feel, a process that can be dynamically important for energy dissipation. We have developed a numerical code to study partially ionised plasma in astrophysical systems. This code, the (PIP) code, contains two separate schemes, a fourth-order central difference type and an HLL type, where either can be used to solve the magnetohydrodynamic and hydrodynamic equations with collisional coupling between the ion and neutral fluids. In this paper we present the first results from the studies currently being undertook by the code group members. This includes a 2D study of the plasmoid formation and dynamics in a reconnecting current sheet.1D studies of slow shock formation in relation to a reconnection outflow and of shock propagation through a partially ionised atmosphere. And an investigation of the 3D dynamics of the Kelvin-Helmholtz instability. All of these studies take into account partial ionization effects

406 ***Molecular Hydrogen in the Chromosphere, IRIS Observations and a Simple Model***
Jaeggli, Sarah (1), jaeggli@solar.physics.montana.edu; Philip Judge (2); and Han Uitenbroek (3).
(1) Montana State University, Bozeman, MT, USA
(2) High Altitude Observatory, National Center for Atmospheric Research, Boulder, CO, USA
(3) National Solar Observatory, Sacramento Peak, Sunspot, NM, USA

The formation of the fluorescent lines of molecular hydrogen (H2) in the ultraviolet is a careful balance between temperature, pressure, opacity, and irradiation from the transition region. While cool temperatures promote the formation of molecules, the pressure rapidly deceases with height from the photosphere to the chromosphere, making the formation of H2 increasingly unlikely. In order to produce emission, UV photons of sympathetic wavelength must excite H2 into upper levels, the depth to which H2 can be irradiated is limited by the UV opacity, which is dominated by the photoionization of Si I and C I. Due to this sensitivity in their formation, the lines of H2 have the potential to tell us about the conditions at the very base of the chromosphere. We are currently developing partial NLTE treatment of the H2 abundance and level populations in order to perform spectral synthesis within the framework of the Rybiki-Hummer (RH) radiative transfer and chemical equilibrium code. In this talk I will present the first results using this treatment and its comparison with IRIS observations.

Poster Topic 3b. *Heliosphere-Magnetosphere Interactions from Bowshock to Geotail*

407 ***Empirical Model of Chorus Wave Distribution in the Outer Radiation Belt***
Agapitov, Oleksiy (1,2), agapitov@ssl.berkeley.edu; Anton Artemyev (3); Didier Mourenas (4); and Vladimir Krasnoselskikh (4).
(1) Space Sciences Laboratory, University of California, Berkeley, CA, USA
(2) Taras Shevchenko National University of Kyiv, Astronomy and Space Physics Dept., Kyiv, Ukraine

(3) Space Research Institute, Moscow, Russia
(4) LPC2E, CNRS - University of Orleans, Orleans, France

Accurately modeling wave-particle interactions in the radiation belts requires detailed information on wave amplitudes and wave-normal angle distributions over L-shells, magnetic latitudes, magnetic local times, and for various} geomagnetic activity conditions. In this work, we develop a statistical, parametrical model of VLF emission amplitudes, obliqueness, and spectral power distribution, using wave measurements performed in the chorus frequency range during ten years (2001-2010) aboard the Cluster spacecraft. We used data from the STAFF-SA experiment, which spans the frequency range from 8.8 Hz to 3.56 kHz. The proposed statistical model is presented in the form of an analytical function of the normalized wave frequency f/fce, the magnetic local time, L-shell, magnetic latitude, and either the Dst index or the Kp index. It can be directly applied for numerical calculations of the charged particles pitch-angle and energy diffusion coefficients in the outer radiation belt, allowing studying with unprecedented detail their statistical properties and their important variations with geomagnetic activity.

E-Posters – Session P4

408-E ***Strand-like Structure and Characteristic Spectral Signatures of Transversely Oscillating Flux Tubes in the Solar Corona***

Antolin, Patrick (1), patrick.antolin@nao.ac.jp; T. Van Doorsselaere (2); T. Yokoyama (3); T. Okamoto (4); B. De Pontieu (5); and H. Uitenbroek (6).
(1) National Astronomical Observatory of Japan, Japan
(2) Centre for mathematical Plasma Astrophysics, KU Leuven, Belgium
(3) Department of Earth and Planetary Sciences, University of Tokyo, Japan
(4) Institute of Space and Astronautical Science (ISAS) / Japan Aerospace Exploration Agency (JAXA), Sagamihara, Kanagawa, Japan
(5) Lockheed-Martin Solar and Astrophysics Laboratory, Palo Alto, CA, USA
(6) National Solar Observatory, Sunspot, NM, USA

High resolution observations of the solar corona in EUV lines, or in chromospheric lines through prominence or coronal rain observations, indicate strand-like structure and ubiquitous low-amplitude transverse motions. Furthermore, recent observations of a prominence with IRIS and Hinode report a tendency for non-thermal line broadening to increase with height and specific out-of-phase behaviour between transverse motions and Doppler shifts. Based on a 3D MHD numerical model and appropriate radiative transfer, we suggest an explanation for the observed features. Our model is based on previous numerical work showing that transverse MHD oscillations can lead to Kelvin-Helmholtz instabilities that deform the cross-sectional area of loops. We show that the instability can occur for low wave amplitudes for long and thin coronal or prominence loops, matching those presently observed in the corona. The vortices generated from the instability are velocity sheared regions with enhanced emissivity hosting current sheets. Strands result as a complex combination of the vortices, the line-of-sight angle and optical thickness. While the transverse displacement of the loop axis damps quickly, the vortices and azimuthal flows retain the main dynamics clearly in Doppler shifts and line broadening, especially at the edges of loops. The instability extracts the energy from the boundary layer in which resonant absorption takes place, and converts it into heat through ohmic and viscous dissipation in the current sheets and vortices.

409-E ***Tracing Mass and Energy Flows in the Solar Atmosphere using Radiation-MHD Simulations***

Zacharias, Pia (1), pia.zacharias@astro.uio.no; and Jorrit Leenaarts (2).
(1) Institute of Theoretical Astrophysics, University of Oslo, Oslo, Norway
(2) Institute for Solar Physics, Stockholm University, Stockholm, Sweden

We use the Bifrost stellar atmosphere code to perform 3D radiation MHD simulations of the solar atmosphere. The focus of this study is on the temporal evolution of magnetic field structures extending from the convection zone to the corona and their underlying dynamics. By adding tracer particles to the simulation, we are able to follow the magnetic field lines properly and to investigate the generation and propagation of

waves traveling into the corona. By tracking the evolution of the observed perturbations in time, we provide new insights on the physical processes driving them and on their role in the chromosphere-corona mass cycle.

410-E ***Initiation of AR-AR Reconnection After Flux Emergence***

Kobelski, Adam (1), akobelsk@nrao.edu; Daniel B. Seaton (2); Matthew J. West (2); and David E. McKenzie (3).
(1) National Radio Astronomy Observatory, Green Bank, WV, USA
(2) Royal Observatory of Belgium, Brussels, Belgium
(3) Montana State University, Bozeman, MT, USA

Magnetic reconnection is one of the most important and fundamental processes in astrophysics, but is not yet fully understood. The speed at which reconnection occurs and the MHD instability that instigates the reconnection are still heavily debated. Observational signatures of reconnection can provide necessary information for improving our understanding of how magnetic energy is dissipated in the sun and universe. Here we perform an observational study utilizing images from SWAP onboard PROBA2 and Hinode/XRT as well as HMI magnetograms to provide empirical insights into the factors which control the rate of reconnection by studying the initiation of flux transfer between newly emerged active regions (ARs) and nearby pre-existing active regions. We have measured the delay between flux emergence as seen in HMI data and signatures of reconnection between active regions observed with SWAP and XRT for 8 events. In 6 of the cases we find delays that are similar to those reported previously in the literature; we also find one case with a much shorter delay, and one case in which the two ARs do not appear to connect during the time span studied. These results are consistent with the separator reconnection discussed in Longcope et al., 2005.

411-E ***Supersonic Outflows Observed Along a Filament Eruption***

Williams, David R. (1), d.r.williams@ucl.ac.uk; Lucie Green (1); Deborah Baker (1); Lidia van Driel-Gesztleyi (1,2); David Long (1); and Miho Janvier (3).
(1) Mullard Space Science Lab, University College London, UK
(2) Observatoire de Paris, LESIA, France
(3) University of Dundee, UK

The standard model of flux rope eruptions includes topological locations where reconnection is expected. Spectroscopic observations of temperature and, in particular, flow speed at these sites can help identify the interaction of this flux rope with its surroundings. We present unique observations of the same ions in a filament eruption by Hinode/EIS and SDO/AIA, in which extended regions of supersonic flow are spectroscopically detected along the flank of cool and mega-kelvin filament material ejected in a CME. Analysis of the pre-eruption topology indicates that as the filament expands, there is reconnection between the host flux rope and the surrounding magnetic field, driving narrow flows from near the flux rope's photospheric footpoints – a non-standard but potentially common feature alongside the standard model of an isolated flux rope erupting.