IAUS300, Nature of prominences and their role in Space Weather

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Poster Session I: Prominences

A MULTI-SPACECRAFT VIEW OF A GIANT FILAMENT ERUPTION DURING 26/27 SEPTEMBER 2009

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We analyze multi-spacecraft observations of a giant filament eruption that occurred during 26 and
27 September 2009. The filament eruption was associated with a relatively slow coronal mass ejection
(CME). The filament consisted of a large and a small part, both parts erupted nearly simultaneously.
Here we focus on the eruption associated with the larger part of the filament. The STEREO
satellites were separated by about 117 degree during this event, so we additionally used SoHO/EIT and
CORONAS/TESIS observations as a third eye (Earth view) to aid our measurements. We measure
the plane-of-sky trajectory of the filament as seen from STEREO-A and TESIS view-points. Using
a simple trigonometric relation, we then use these measurements to estimate the true direction
of propagation of the filament which allows us to derive the true R=R?-time profile of the filament
apex. Furthermore, we develop a new tomographic method that can potentially provide a more robust
three-dimensional reconstruction by exploiting multiple simultaneous views. We apply this method
also to investigate the 3D evolution of the top part of filament. We expect this method to be useful
when SDO and STEREO observations are combined. We then analyze the kinematics of the eruptive
filament during its rapid acceleration phase by fitting different functional forms to the height-time
data derived from the two methods. We find that, for both methods, an exponential function fits the
rise profile of the filament slightly better than parabolic or cubic functions. Finally, we confront these
results with the predictions of theoretical eruption models.

FILAMENT CONNECTIVITY AND "RECONNECTION"

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Stable long lived solar filaments during their lives can approach each other, merge, and form circular structures. Since filaments follow large scale polarity inversion lines (PILs) of the photospheric magnetic field, their evolution reflects changes of the photospheric field distribution. On the other hand, filament interaction depends on their internal magnetic structure reviled in particular by filament chirality. Possibility of magnetic field line reconnection of neighbor filaments is discussed. Daily H-alpha filtergrams were analyzed for the period of maximum activity of the 23rd solar cycle. Examples of connectivity changes in a course of photospheric field evolution are presented. Sometimes filaments show pattern that is not easy to interpret. In some H? filtergrams, crossing filaments are seen, as well as filaments combined into trident-like or three-pointed-star-like structures. We have found that all crossing filaments reveal quadrupolar magnetic configurations of the photospheric field and presume the presence of null points in the corona.

Effect of shear flow on damping of linear non-adiabatic MHD waves in a prominence medium.

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We study the effect of shear flow on the damping of linear non-adiabatic magnetoacoustic waves in slab like solar prominences. We consider a homogeneous, isothermal and unbounded medium permeated by a uniform magnetic field. The adiabaticity is removed by including the optically thin radiative losses, thermal conduction and heating term in energy equation. The initial flow is assumed to be directed along x axis of the slab and vary linearly in z axis. We obtain a dispersion relation for MHD waves and solve it numerically to study the time damping of these waves. It is found that shear flow influences the time damping of magnetoacoustic waves.

Multi-wavelength observations of the failed eruption of a filament and associated M6.2 flare

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We present multi-wavelength observations of the failed eruption of a magnetic flux rope that occurred in active region NOAA 10646 on 2004 July 14 using TRACE, RHESSI, and NoRH observations. The earliest signatures of pre-flare coronal activity are observed in EUV 171 Å images and X-ray observations up to 25 keV in the form of sequential brightening of three coronal loops, overlying the filament. The onset of the filament eruption is accompanied with the impulsive rise of HXR and MW emissions. The impulsive phase is characterized by three prominent peaks observed simultaneously in HXR and MW profiles which are spatially and temporally associated with the fast rise of the magnetic flux rope. Following the flare maximum, the eruption slowed down and was subsequently stopped by the overlying field lines at a height of 5 × 10^4 km. Our observations indicate that the flare emission is caused due to the reconnection of the rising flux rope and the surrounding low-lying magnetic loops. We discuss a possible scenario to elucidate HXR and MW sources associated with different phases of the rising flux rope which finally failed to erupt and discuss its implications for models of solar eruptions.

Where Do Solar Filaments Form?: Consequences for Theoretical Models

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This study examines the locations where large, stable solar filaments form relative to magnetic bipoles lying underneath them. The study extends the earlier work of F. Tang to include two additional classification categories for stable filaments and to consider their population during four distinct phases of the solar cycle. With this new classification scheme, results show that over 92% of filaments form in flux distributions that are nonbipolar in nature where the filament lies either fully (79%) or partially (13%) above a polarity inversion line (PIL) external to any single bipole. Filaments that form within a single bipole (traditionally called Type A) are not as common as previously thought. These results are a significant departure from those of F. Tang. Consistency with the earlier work is shown when our data are regrouped to conform to the two-category classification scheme for filaments adopted by F. Tang. We also demonstrate that only filaments that form along the external PIL lying between two bipoles (62% of the full sample, traditionally called Type B) show any form of solar cycle dependence, where their number significantly increases with magnetic activity over the solar cycle. Finally, current observations and theoretical models for the formation of filaments are discussed in the context of the present results. We conclude that key elements in the formation of the majority of filaments considered within this study must be the convergence of magnetic flux resulting in either flux cancellation or coronal reconnection.

Coronal Loop Mapping to Infer the Best Magnetic Field Models for Active Region Prominences.

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Imaging has always played a pivotal role in acquiring an understanding of the physics of the solar corona - from the first photographic images of the solar eclipse in 1860 by Secchi, to the coronograph images in 1931 by Lyot, to the Solar Maximum Mission's UVSP images in 1982 by Tandberg-Hanssen, and to today's Solar Dynamics Observatory's images. We will discuss a new, rapid, and flexible manual method to map on-disk individual coronal loops of a two-dimensional EUV image into a three-dimensional coronal loop. This method employs cubic Bezier (*) splines to map an entire coronal loop using only four free parameters per loop. Using the coronal loops as surrogates of magnetic field lines, the set of 2D splines for an active region is transformed to the best 3D magnetic fields for a particular coronal model. The results restrict the magnetic field models derived from extrapolations of magnetograms to those admissible and inadmissible via a fitness parameter. This method is an important tool in determining the fitness of magnetic field models for the solar corona. We outline explicitly how the coronal loops can be employed in constraining competing magnetic field models using the transformed 3D coronal splines. This method uses the minimization of the misalignment angles between the magnetic field model and the best set of 3D field lines that match a set of closed coronal loops. For active region AR 11117, the fitness parameter for potential, Minimum Dissipation Rate, and data-driven MHD models are compared and we also discuss the fitness parameter connection to the magnetic energy.
(*) Pierre Étienne Bézier (1910?1999) was a French engineer at Renault and professor at the Conservatoire National des Arts et Métiers, Paris. He patented and popularized, but did not invent, the Bézier curves and surfaces that are now used in most computer-aided design software.

Magnetic fields of an active region filament from full Stokes analysis of Si 10827 and He I 10830 A

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Vector magnetic fields of an active region filament in the photosphere and upper chromosphere are obtained from spectro-polarimetric observations recorded with the TIP II at German VTT. We apply Milne-Eddington inversion on full Stokes vectors of the photospheric Si I 1082.7 nm and the upper chromosperhic He I triplet at 1083.0 nm to obtain magnetic field vector and velocity maps in two atmospheric layers. Significant difference is present in the aspect of magnetic field strength, field orientation, Doppler velocity etc of two layers. The observation findings are consistent with the emergence of an flux rope with a subsequent formation of a filament.

Simulation of Sigmoid Structure and Filament Eruption of AR11283 using a Three-dimensional Data-driven Magnetohydrodynamic Model

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We present an analyses of the magnetic structures of AR11283 during the period September 6, 2011 using the vector magnetogram obtained from Helioseismic and magnetic image (HMI) on-board the Solar Dynamics Observatory (SDO) together with a 3D data-driven CESE-MHD model (Jiang, et al 2012; Wu et al. 2006). The focus of our analyses is the evolution of the 3D coronal magnetic field and eruption in response to the change of photospheric magnetic field. The non-potentiality of magnetic characteristics such as (i) the lengh of the magnetic shear along the main neutral line (Lss), (ii) unsigned magnetic flux (F), (iii) the magnetic energy flux across the photosphere to the corona, (iv) the current system and (v) the free magnetic energy of the active region are presented. The simulated magnetic field configuration has revealed the Sigmoid which has been compared with images recorded by the Atmosphere Image Assembly (AIA)/SDO. It shows remarkable resemblance. This sigmoid feature apparently becomes unstable when it erupts. The simulated magnetic non-potential characteristics are used to investigate the conditions for the initiation of filament eruption.

PROMINENCE FORMATION AND DESTRUCTION: SIMULATING THE FULL LIFECYCLE IN MULTI-D

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The origin and overall dynamics of the cool dense plasma in solar prominences have long been outstanding problems in solar physics. In earlier numerical simulations [2], we demonstrated the in-situ formation of a quiescent prominence in a sheared magnetic arcade by chromospheric evaporation and radiative condensation in a multi-dimensional magnetohydrodynamic model. The present work revisits and improves many facets of this model, and allows to cover the full lifecycle of a prominence from its initial rapid thermal instability-mediated trigger, to its growth and stable lifetime as a macroscopic condensation, up to its fascinating destruction when the induced evaporation ceases. We can do so by extending the previous work to a larger domain resolved at even higher resolution (adopting a more accurate numerical scheme in our grid-adaptive approach along the way [1]), and by prescribing a more realistic localized heating restricted to finite chromospheric regions. With these improvements, we reproduce the formation of a curtain-like prominence which grows in its self-modified magnetic environment and find a new phenomenon characterized by the coexistence of the static large-scale prominence and dynamic coronal rain occuring in the overlying loops. The total condensation rate of the prominence and the coronal rain is quantified and compares favoribly to observational results. This in turn restricts the observationally hardly known heating parameters, so our model aids to relate prominence growth with heating quantifications. When the localized heating is gradually switched off, the central prominence expands laterally beyond the range of its self-created magnetic dips and prominence matter falls down along the arched loops in a spectacular display of curtainlike drainage events. The dipped loops thereby recover their initially arched shape and the prominence plasma eventually drains completely to the chromospheric regions, and the next lifecycle can start once more.
[1] R. Keppens et al., JCP 231, 718 (2012)
[2] C. Xia, P.F. Chen, & R. Keppens, ApJ Letters 748, L26 (2012)

Multidimensional modeling of prominence formation and coronal rain dynamics

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We use a 2.5-dimensional, fully thermodynamically and magnetohydrodynamically compatible model to imitate the formation process of normal polarity prominences on top of initially linear force-free arcades above photospheric neutral lines. Based on sheared magnetic arcades hosting chromospheric, transition region, and coronal plasma, we perform a series of numerical simulations to do a parameter survey for multi-dimensional evaporation-condensation prominence models. The investigated parameters include the shearing angle of the magnetic arcade, the strength and spatial range of the localized chromospheric heating, and cover symmetric and asymmetric circumstances.
In the symmetric cases, we analyze the growth rate of accumulated prominence mass, overall force balance, and morphology and how these aspects relate to the input heating parameters. Some of our modeled prominences develop additional internal structure, with the side boundaries of the prominence resembling sawteeth, when the magnetic field of the arcade is strong. Indeed, when the lateral growing prominence can not bend the arched loops fast enough, segments of the prominence body residing in self-created magnetic dips fall down to the chromosphere along the arched loops. This drags extra mass from inside the magnetic dips to stream down until all prominence mass in the affected loops drains to the chromosphere. Consecutively, the evacuated loops reform condensations, and this phenomenon propagates from lower to higher loops. This realizes a down-streaming channel adjacent to an up-streaming channel, reforming the prominence as it rises, and we suggest these long-lived streams connecting the prominence and the chromosphere resemble the barbs of prominences. They also shed light on the mass recycling puzzle of prominences in general.
In asymmetric cases, We demonstrate how thermal instability and catastrophic cooling can induce a spectacular display of in-situ forming blob-like condensations which then start their intimate dynamical ballet on top of initially linear force-free arcades above photospheric neutral lines. Our magnetic arcades host chromospheric, transition region, and coronal plasma, and by following coronal rain dynamics for over 80 minutes physical time, we collect enough statistics to quantify blob widths, lengths, velocity distributions, and other characteristics which directly match with modern observational knowledge. Our virtual coronal rain displays the deformation of blobs into V-shaped like features, interactions of blobs due to mostly pressure-mediated levitations, and gives the first views on blobs which evaporate in situ, or get siphoned over the apex of the background arcade.

The role of photospheric shearing motions in a filament eruption related to the 2010 April 3 CME

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Coronal mass ejections (CMEs) are huge expulsion of solar plasma and magnetic field in the interplanetary medium. Understanding the physics that lies beyond the CME initiation is one of the most fascinating research questions. Several models have been proposed to explain the initiation of CMEs. However, which model better explains the different aspects of the initiation process and the early evolution of the CMEs is a subject of ongoing discussion.
We investigate the magnetic field evolution of NOAA 11059 in order to provide a further contribution to our understanding of the possible causes and mechanisms that lead to the initiation of the geoeffective CME that occurred on 2010 April 3.
Using KSO H? images we determine the chirality of the active region and some properties of the filament that eventually erupted. Using SOHO/MDI line-of-sight magnetograms we investigate the magnetic configuration of NOAA 11059 by means of both linear force free and potential field extrapolations. We also determine the photospheric velocity maps using the Differential Affine Velocity Estimator (DAVE).
We find that the magnetic configuration of the active region is unstable to the torus instability. Moreover, we find that persistent shearing motions characterized the negative polarity, resulting in a southward, almost parallel to the meridians, drift motion of the negative magnetic field concentrations.
We conclude that persistent and coherent shearing motions played a significant role in facilitating the eruption. These shearing motions increased the axial field of the filament eventually bringing the fluxrope axis to a height where the onset condition for the torus instability was satisfied. Our observations show that both the magnetic configuration of the system and the photopsheric dynamics that preceded the event, were favourable for the eruption to occur.

Emerging dimmings of active regions observed by the Solar Dynamics Observatory

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Using the observations from the Atmospheric Imaging Assembly and the Helioseismic and Magnetic Imager on
board the Solar Dynamics Observatory, we statistically investigate the emerging dimmings (EDs) of 24 isolated
active regions (IARs) from 2010 June to 2011 May. All the IARs show EDs in lower-temperature lines (e.g.,
171 Å) at their early emerging stages.Meanwhile, in higher temperature lines (e.g., 211 Å), the ED regions brighten
continuously. There are two types of EDs: fan-shaped and halo-shaped. There are 19 fan-shaped EDs and 5 haloshaped
ones. The EDs appear to be delayed by several to more than ten hours relative to the first emergence of
the IARs. The shortest delay is 3.6 hr and the longest is 19.0 hr. The EDs last from 3.3 hr to 14.2 hr, with a mean
duration of 8.3 hr. Before the appearance of the EDs, the emergence rate of the magnetic flux of the IARs is between
1.2× 10^19 Mx/hr to 1.4 × 10^20 Mx/hr. The larger the emergence rate is, the shorter the delay time is. While the
dimmings appear, the magnetic flux of the IARs ranges from 8.8 × 10^19 Mx to 1.3 × 10^21 Mx. These observations
imply that the reconfiguration of the coronal magnetic fields due to reconnection between the newly emerging flux
and the surrounding existing fields results in a new thermal distribution which leads to a dimming for the cooler
channel (171 Å) and brightening in the warmer channels.

The Promise of Bayesian Analysis for Prominence Seismology

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Prominence seismology aims to determine difficult to measure physical parameters in prominence plasmas by a combination of observed and theoretical properties of waves and oscillations. Current inversion techniques have been successful in the determination of Alfvén travel times, magnetic field strengths, and density structuring, using fine structure oscillations. Yet, the inference of difficult to measure parameters is not an easy task. We propose the use of inversion techniques in the Bayesian framework, which enables us to infer the most probable values of the relevant parameters compatible with the observed wave properties, and to extract their confidence levels incorporating observed uncertainties in a consistent manner. The technique is now being successfully applied to coronal seismology. Examples are provided on its potential for the determination of physical parameters in oscillating prominence fine structures. The method also enables to perform model comparison to assess, e.g., the plausibility of alternative damping mechanisms of prominence oscillations.

Structure and Dynamics of Eruptive Prominences on the Quiet Sun

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In this presentation, we will briefly review our work on observations and magnetic field modeling of the quiescent prominence that erupted on 2010 December 6. We find that the height and location of the field line dips in our non-linear force free field model with twisted flux rope can roughly replicate those of the observed prominence. The model suggests that the observed asymmetric emission on the two sides of the filament channel
is due to the fact that bright features on the northern side of the channel are the lower legs of the field lines that turn into the flux rope. We also find that asymmetric reconnection induced by the asymmetric distribution of the magnetic fields on the two sides of the filament may cause the observed rolling motion at the early phase of the eruption. Then we will present preliminary results on the investigation of one polar crown prominence that erupted on 2012 March 12. This prominence is viewed at the east limb by SDO/AIA and displays a simple vertical-thread structure. Bright U-shape (horn-like) structure is observed surrounding the upper portion of the prominence before the eruption and becomes more prominent during the eruption. When viewed on the disk, STEREO-B shows that this prominence is composed of series of vertical threads and displays a loop-like structure during the eruption. We focus on the magnetic support of the prominence by studying the structure and dynamics before and during the eruption using observations from SDO, Hinode, and STEREO. We will explore magnetic field modeling of this prominence using the flux rope insertion method. We will also present preliminary analysis on the thermodynamics of the prominence, namely DEM analysis of the cavity surrounding the prominence, as well as column density measurements.

Observational Study of Large Amplitude Longitudinal Oscillations in a Solar Filament

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On 20 August 2010 an energetic disturbance triggered large amplitude longitudinal oscillations in a filament. This disturbance produced damped oscillations in almost the entire filament. In the present work we analyze this periodic motion in the entire filament to characterize the damping and restoring mechanism of the oscillation. Our method involves placing slits along the axis of the filament at different angles with respect to the magnetic field and fitting the resulting oscillation pattern to decaying sinusoidal and Bessel functions. With this method we find the direction of the motion, the period, and the decaying time of the oscillation. Our preliminary results support the theory presented by Luna and Karpen (2012) that the restoring force of large amplitude longitudinal oscillations is solar gravity in the tube where the threads oscillate, and the damping mechanism is the ongoing accumulation of mass onto the oscillation threads. Following Luna and Karpen (2012) we have determined the intensity and radius of curvature of the dipped magnetic field along the filament, as well as the mass accretion rate of the filament-threads.

Two distinct peculiar ?dimming channels? observed by SDO/AIA

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In this work, we report two distinct peculiar «dimming channels» which observed by SDO/AIA in all the seven EUV wavelengths on July 12, 2012. The «dimming channel» here refers to the long narrow dimming region which is embraced by a flare ribbon during its first formation. Our results show that: (1) the intensity in the dimming channels dropped dramatically during the solar eruption and failed to acquire recruit in the following several hours; (2) the dimming channels seem to be located around the border of the solar active region AR 11520; (3) the flare ribbons which edge the dimming channels came forth earlier than the dimming region; (4) each dimming channel along with its the flare ribbon lace are likely to be located in the same magnetic polarity. Based on these results we discussed possible formation mechanism of the dimming channels.

The Influence of Coronal Radiation on Prominence Plasma

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Prominences, also known as filaments, are cool, dense structures located in the corona. They are influenced by the coronal radiation illuminating them. Many emission lines are found in the coronal spectrum, and the impact of these lines on the properties of the prominence plasma is examined.
To do this we model the hydrogen spectrum emitted by a one dimensional prominence slab under non-LTE conditions. We use CHIANTI to compute the intensity of the coronal radiation received by a point located in the corona. This is then used as boundary condition to solve the radiative transfer equation in the prominence.This allows us to investigate the effect of the coronal radiation on the properties of the plasma and on the intensities of the emitted hydrogen lines.

Evolution of a Group of Coronal Holes Associated with Eruption of Nearby Prominences and CMEs

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We present the detailed study a set of activities developed on the solar disk during the period of February 07-13, 2012, based on multispectral analyze of ground-based and spacecraft (mainly STEREO/SDO) observations, including SDO/HMI magnetograms. This set involves the evolution of group of coronal holes (CHs), including the early stages of formation of one long-lived CH, two small active regions, the disappearance of various filaments (located within 20° distance from the boundary of CHs), and a pre- and post-evolution of several associated Coronal Mass Ejections (CMEs). We found the sequence of certain topological perturbations of whole CHs and their surroundings and the formation of a new CH associated with the emergence/ disappearance of small magnetic dipoles (located between CH's boundary and prominences), that additionally is associated mostly with a post-evolution of prominences eruption and subsequent CMEs. Generally, we observe the emergence of magnetic dipoles associated with the formation of dimming regions and the disappearance of magnetic dipoles associated with the shrinkage of CHs, both processes throughout post-evolution of prominence eruption and CMEs. Moreover, the disappearance of magnetic dipoles, not directly linked to the post-evolution of prominences eruption and CMEs, states the formation of a new CH from the dimming region, which at the same time grows and reconnects with the other CH, becoming a large long-lived coronal hole. We discuss the possible small-scale magnetic reconfiguration as an explanation of these observational results.

Partially ionized plasma downflows and vertical threads in solar prominences

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Observations of limb prominences often show material falling along vertical threads and moving with an acceleration smaller than that of free-fall. A simple partially ionized plasma model is used to investigate these vertical downflows, which are generated by a mass condensation in the corona. From our calculations, the mass injection gives rise to the formation in ~200 s of a dense blob that falls with a roughly constant acceleration of 15?70 m s$^{?2}$ and a density of 4?10 × 10^{-11} kg m$^{?3}$.
For a fully ionized plasma it is found that the gas pressure gradient is responsible for reducing the effect of solar gravity. In the absence of charged particles, neutrals behave like a fully ionized gas. In a partially ionized gas the mass condensation gives rise to the formation of a neutral and a charged blob that, in the absence of friction between these two species, fall with different accelerations. The friction force, however, plays a prominent role since it quickly couples charged particles and neutrals and makes them fall jointly with a constant acceleration.

On reliable magnetic measurements in prominences and chromosphere

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A success in «weak» magnetic fields measurements depends on the performance of the key components of any magnetic procedure: the telescope, the polarimeter, and the recording system. So far, the prominence polarimetry is carried out rarely in spite of the existence of the advanced polarimetrs and the recording systems. The role of the telescope is analyzed in the frame of recording the Stokes parameters of the faint objects located near the bright ones. The non-prominence signatures in the final focal plane of the telescope are estimated for coronagraphic high-altitude, total solar eclipse and space observations: the continuum corona, the sky brightness, and the stray light. The reliable ground-based V-profile recording is shown to strongly depend on the stray light caused by diffraction at the entrance aperture and scattering at micro-roughness of the primary optics. The acceptable level of the stray light is calculated for several apertures. Prospects for the chromosphere and prominence magnetic measurements are noted for the future 4 m EAST and ATST.

A Statistical Study on Characteristics of Disappearing Prominences

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A disappearing or erupting prominence has a coronal mass ejection (CME) associated with it most of the time. If one has to predict the onset of CMEs, it is essential to monitor prominences on the solar disc, also known as filaments. For this purpose, an automated algorithm has been developed for detection and tracking of filaments observed in full-disc H-alpha images. This algorithm identifies all the filaments present on the disc, and tracks them through the full period of observation to generate their physical attributes such as size and length. The algorithm is applied to several filaments on the day of their disappearance, and a day before the disappearance. This enables us to study the change in attributes of the disappearing filaments between the two days. Based on these attributes, a threshold criterion would be established, which can be utilised to predict potential disappearance of a filament during real-time monitoring. The algorithm also accurately provides the onset time of the filament disppearance.

Statistical comparison of synthetic and observed Lyman line profiles of quiescent prominence fine structures

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In our previous work (Gunar et al., 2010) we have used several statistical criteria to compare the hydrogen Lyman line profiles from a quiescent prominence observed on 25 May 2005 by SoHO/SUMER with the synthetic ones computed using the 2D multi-thread model. The prominence observations in the whole Lyman spectrum (including Lyman alpha) were carried out during the 15 Medoc observing campaign. Histograms of line-profile characteristics, such as integral intensities, Lyman decrement, assymetry of peaks, depth of central reversal, for observed and synthetic profiles were compared. In present work we are doing similar statistical comparison for other prominences observed during the observing campain. It is still not known whether each prominence fine-structure thread has its own prominence-corona transition region (PCTR) or a prominence has only its general PCTR. We use the statistical comparison of observed and synthetic Lyman spectra to test these two scenarios.

Prominences in EVE spectra: the contributions from large solar structures

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The EVE instrument on SDO is making accurate measurements of the solar spectral irradiance in the EUV between 30 and 1069 angstroms, with 1 A spectral resolution and 10 s sampling rate. These data define solar variability in the "Sun-as-a-star" mode and reveal many interesting kinds of variation. Its high sensitivity also makes it suitable for spectroscopic diagnostics of solar features such as flares. Here we present EVE's potential contribution to the diagnostics of large-scale, slowly evolving features such as prominences and active regions, and what we can learn from this.

SDO/AIA Observations of Coronal Condensation in Funnel Prominences as Return Flows of the Chromosphere-Corona Mass Cycle

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It has recently been proposed that prominences are manifestations of a magneto-thermal convection process that involves ever-present dynamic descents of cool material threads and upflows of hot bubbles (Berger et al. 2011 Nature). On global scales, prominences may play an important role as the return flows of the chromosphere-corona mass cycle. A critical step in this cycle is the condensation of million-degree coronal plasma into T

Measuring magnetic fields in prominences: the effect of multiple scattering on polarisation

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Solving the problem of polarized line formation in prominences is a hard task. Simplifications are therefore necessary. As time goes on those simplifications should however be dropped in search of an improved measurement. In the last ten years we have witnessed for example how both Hanle and Zeeman effect have to be taken into account together for an appropriate interpretation of the Stokes profiles of the much observed He I lines.
In this contribution I will present the result of dropping a second approximation: the absence of multiple scattering in prominences. While it has been customary to assume that He atoms in prominences are polarized by the anisotropic illumination of the photosphere below, this is not the case and there is also an isotropic illumination from the prominence itself. Taken into account this contribution alters the polarization emitted and therefore biases the measurement of the magnetic field. I will show how to take this into account and what errors it induces, particularly in the inclinations of the magnetic field measured through analysis of the He 10830 line.

Prominence MHD models and their eigenmodes

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In this work new two-dimensional magnetohydrodynamic (MHD) equilibria representing quiescent prominences or filaments are built by solving the ideal and nonlinear MHD equations using a relaxation method. The MHD equilibria balance Lorentz forces, gravity, and pressure gradients and the prominence contains a cold and dense core surrounded by a hot coronal environment. The magnetic field lines connect to the photosphere and include the presence of dips. Examples of the application of the method are shown for two and three-dimensional geometries. The natural oscillations or eigenmodes of the numerically determined models are also investigated, paying special attention to transverse and longitudinal oscillations. We show how the information derived from the MHD simulations in 3D can be used for a better interpretation of real prominence oscillations.

Rayleigh-Taylor Instability in Prominence Partially Ionized Plasma

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We study the modification of the classical criterion for the linear onset and growing rate of the Rayleigh-Taylor instability (RTI) in a partially ionized (PI) plasma both in the one-fluid and two-fluid descriptions, considering a generalized induction equation and linealizing the resulting set. The configuration with heavier plasma on the top of lighter one becomes always unstable because of the presence of a neutral species, who do not feel directly the stabilising effect of the magnetic field. In the classical stability regime the growing rate for PI plasma is very small, since the collisions prevent the neutral fluid to fully develop the RTI. In the classical instability regime the growing rate for PI plasma is lowered, but for the considered theoretical values of the collision frequencies and diffusion coefficients for solar prominences the differences with the MHD case are small. Hence, PI modify some aspects of the RTI instability, since it takes into account that neutrals do not feel the stabilizing effect of the magnetic field. For solar prominence plasma, our model gives the resulting timescale comparable with the observed lifetimes of the threads, and this is a hint that the PI effects should be included regarding the equilibrium and instabilities of the prominence fine structures. Among the PI effects considered, ambipolar diffusion turns out to be the leading one, while the remaning terms are much less significant.

Detection of partial ionization effects in prominences with observed Doppler velocities

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Prominences are a very strong candidate to display non-MHD effects due to partial ionization, since they are dense and relatively cool objects, in which the ionisation degree is not fully known but it is assumed to be around 50%. To measure observationally the diffusion velocity between different species we need to measure simultaneously the velocities of ionised and neutral atoms in approximately the same position. In prominences the dense material is accumulated in filamentary structures called threads, whose width is under 0.3" (from observations with space telescopes in Hα). Since prominence plasma properties are very similar to the chromospheric plasma, we need to use chromospheric lines with good spectral resolution. We present the results for the observations carried in the Vacuum Tower Telescope (VTT) in the Observatorio del Teide (Canary Islands, Spain): high-cadence simultaneous observations of a CaII and HeI lines. The Doppler velocity shows a high correlation between both lines, with deviations close to the random noise. The implications of these results are discussed.

Strategies for the inversion of He I 10830 A data

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The physical properties of chromospheric structures can be obtained from the inversion of spectropolarimetric data obtained in the He I 10830 A multiplet. In this contribution we present several strategies that we have devised during the years to obtain reliable inversions with Hazel, specially focused towards the inversion of prominences. The role of degeneracies and ambiguities are discussed in some detail.

Solar Activity Monitoring of Flares and CMEs Precursors through Lyman-Alpha Imaging and Tracking of Filaments and Prominences

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Events preceding the onset of a flare are called 'precursors', and one of the prominent precursors is a newly emerging bipolar region at the surface, which may interact with pre-existing magnetic field in the corona and trigger a flare. Another well-known precursor is the activation, or eruption, of a filament that is composed of relatively cool plasma (around 10000 K), floated in the hot coronal plasma. Both emerging regions and filaments are very well observed in Lyman-Alpha (in Space) and H-alpha (on ground), both on the disk and at the limb, and we expect that their combination can lead to better identification of changes at the origin of major eruptions and most important coronal mass ejections (CMEs).
Lyman-Alpha can provide early (precursor) detection on the disk, hours before the event, of filament/prominence eruptions (better than the He II line, well suited only for limb observations). Lyman-Alpha imaging, in that respect, would be a high value Space Weather complementary product to EUV imaging available on other satellites.
We discuss Lyman-Alpha sensitivity to flares compared to H-Alpha (1000 times advantage) based on LYRA/PROBA-2 observations (observed signatures on light curves almost reaching 1% of the integrated flux) and Hida Observatory H-Alpha observations (filtergrams and spectroheliograms). Lyman-Alpha flares and precursors studies are pursued through recent observations campaigns with a spare Lyman detector of LYRA. This interesting possibility to open and watch for flares from a promising region implies, accordingly, to rely on good precursors indications to limit filter's degradation.
These considerations are pointing the interest for future Lyman-Alpha irradiance measurements coupled, for precursors identification, to solar disk imaging, as proposed by the SWUSV (Space Weather and Ultraviolet Solar Variability) Microsatellite Mission.

Propagating waves transverse to the magnetic field in a solar prominence

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We have observed a quiescent prominence with the Hinode Solar Optical Telescope (SOT, in Ca II and H-alpha lines), Sacramento Peak Observatory (in H-alpha, H-beta and Sodium-D lines), and THEMIS/MTR (Télescope Héliographique pour l'Étude du Magnétisme et des Instabilités Solaires/MulTi Raies, providing vector magnetograms), and SDO/AIA (Solar Dynamics Observatory Atmospheric Imaging Assembly, in EUV) over a 4 hour period on 2012 October 10. The small fields of view of SOT, Sac Peak and THEMIS are centered on a large pillar-like prominence footpoint extending towards the surface. This feature appears in the larger field of view of the 304 A band, as a large, quasi-vertical column with material flowing horizontally on each side.
The THEMIS/MTR data indicate that the magnetic field in the pillar is essentially horizontal and the observations in the optical wavelengths show a large number of horizontally aligned features on a much smaller scale than the pillar as a whole.
The data are consistent with a model of cool prominence plasma trapped in the dips of horizontal field lines.
The SOT and Sac Peak data show what appear to be moving wave pulses. These pulses, which include a Doppler signature, move vertically, perpendicular to the field direction, along quasi-vertical columns. The pulses have a velocity of propagation of about 10 km/s, a period about 260 sec, and a wavelength around 2000 km.
We interpret these waves in terms of fast magneto-sonic waves and discuss possible wave drivers.

Analysis of the Density Evolution of In-falling Prominence Material from the 7th June 2011 CME

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On the 7th June 2011, a large filament suspended over NOAA active region 11226 in the south-west quadrant of the solar disc became unstable and erupted into a complex CME (Bloomfield et al, Astronomy & Astrophysics, November 2012). Some of the filament material then formed cohesive 'blobs' in the corona, many of which fell back to the quiet Sun.
Using the method developed by Williams et al (Astrophysics Journal, March 2013) for determining the column density of such material, we determine the column density and estimate the true density and mass of several of these 'blobs' over the course of their descent to study their evolution.
The method uses two spatially-coherent images of a small square of the surface of the Sun which a blob moves across, the first frame acting as the background measure of emission and the second showing dark material in absorption. The images were collected from Solar Dynamics Observatory's Atmospheric Imaging Assembly (SDO AIA), and the background image was chosen at the time immediately before it became occulted. The absorption is due to the amount of material present and the absorption cross-section of the population, and as such the column density may be estimated directly from the decrease in intensity. This method is applied to five passbands (94, 131, 171, 194 and 211Å), and the results are combined by fitting decrease in intensity as a function of wavelength, giving a stronger determination of column density.
The ultimate aim of this investigation is to analyse the Rayleigh-Taylor instability which the blobs have been shown to undergo by Innes et al (Astronomy and Astrophysics 540, 2012). By obtaining a quantitative assessment of this in-falling material, the physical conditions for such an occurrence will be investigated.

Dynamics of a filament.

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We investigate the dynamics and the eruption of a large filament in the central part of the active region NOAA 11106 observed near the central meridian on Sept 17. This filament was observed in Ha with the THEMIS telescope in the Canary Islands in both modes (MTR and MSDP) and in 304 Å with the EUV imager (AIA) on board of the Solar Dynamic Observatory (SDO). The dynamics in the chromospheric layers is inferred from MSDP observations. The most striking feature is the upward velocity in the filament itself and the presence of downward velocities outside along the filament. Different velocities interpretations are discussed : bisector measurments, cloud models, determinations using filtergrams. In 304 Å , we observed bright moving knots along the filament, simulating a counterstreaming flow, which underwent a failed eruption at 17:03 UT. The material came back after the eruption. The frequent brightenings observed in 304 Å suggest the occurrence of reconnections of the magnetic field lines.

AIA-Observed Filament Eruption Catalog

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We report the development of a filament eruption catalog for events observed by the Atmospheric Imaging Assembly (AIA)
aboard the Solar Dynamics Observatory (SDO). Events were collected from the Heliophysics Event Knowledgebase (HEK) and
further manual inspection of the data. Various characteristics of each eruption were determined with the goal of
compiling statistics on the general nature of filament eruptions and to provide a resource for studies of particular
events. These characteristics include the symmetry of the eruptions, whether or not twisting motions were observed, the
presence and orientation of thread-like structures, and a number of others. Information about flares and CMEs is
compiled along with movies from several instruments. Height-time plots and column density measurements are also made for
a number of events.

Mapping of prominence plasma parameters from eclipse observations

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We construct the maps of quiescent-prominence temperatures, electron densities and geometrical thicknesses. For this we use the RGB signal of prominence white-light emission detected during the total solar eclipse on August 1, 2008 in Mongolia and co-temporal H? spectra taken at Ond? ejov observatory. The method of disentangling the electron density and geometrical (effective) thickness was described by Jej?i? and Heinzel (2009) and is used here for the first time to analyze the spatial variations of prominence parameters. The electron density is increasing towards the bottom of the prominence which we explain by an enhanced photoionization due to the incident solar radiation. To confirm this, we construct 2D radiative-transfer model with realistic prominence illumination.

FORWARD Codes: Now with Widgets!

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The FORWARD suite of SolarSoft IDL codes converts an analytic model or simulation data cube into a form directly comparable to observations. Observables such as extreme ultra violet, soft X-ray, white light, and polarization images from the Coronal Multichannel Polarimeter (CoMP) can be reproduced. The observer's viewpoint is also incorporated in the forward analysis and the codes can output the results in a variety of forms in order to easily create movies, Carrington maps, or simply observable information at a particular point in the plane of the sky. We present a newly developed front end to the FORWARD codes which utilizes IDL widgets to facilitate ease of use by the solar physics community. Our ultimate goal is to provide as useful a tool as possible for a broad range of scientific applications.

Cut-off wavenumber of Alfvén waves in partially ionized plasmas of the Solar Atmosphere

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Alfvén (fast) wave dynamics in resistive single-fluid magnetohydrodynamics shows the presence of cut-off wavenumber i.e. Alfvén (fast) waves with wavenumbers higher than the cut-off value are evanescent. The cut-off wavenumber appears in both, fully and partially ionized plasmas. To point out the reason for the appearance of a cut-off wavenumber, we start with three-fluid equations (with electrons, protons and neutral hydrogen atoms) and make consecutive approximations until the usual single-fluid description is obtained. We solve the dispersion relation of linear Alfvén waves at each step and seek for the approximation responsible of the cut-off wavenumber appearance. The cut-off wavenumber in single-fluid MHD is the result of neglecting the inertial and Hall terms.

On Critical Heights and Longitudinal Magnetic Field Strength in Prominences

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A retrospective statistical analysis of the former magnetic measurements by «the Fabry-Perot magnetograph + the 50 cm coronagraph» assembly is presented: an angular resolution in filtergrams of 1-1.5 arc second, a magnetic resolution of 8 arc seconds, an accuracy of about 5 G. The distributions on maximum height observed and on the longitudinal magnetic fields strengths reveal multimodality. The probabilities of minima are estimated basing on the Student criterion. The peak values of 50Mm and 30-35 G are found to be the critical heights and magnetic field strengths and correspond to the pre-eruption stages of quiescent prominences. The reported study was partially supported by RFBR (research project No. 11-02-00631), IAU, SCOSTEP, SF2A and KLSA/CAS.

24 synoptic maps 1974-1982 (ascending phase of cycle XXI) of 323 prominence average magnetic fields measured by the Hanle effect

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The observations of the Hanle effect (linear polarization) were performed by J.L. Leroy at the Pic-du-Midi coronagraph. The polarimetric accuracy is on the order of 1.e-4. The polarimeter was equipped with a filter and the observed He I D3 line was globally observed and not resolved in its two components. The Hydrogen H_alpha or H_beta lines were quasi-simultaneously observed in the last years. Besides, the theory of the Hanle effect was developed in the density matrix formalism (Bommier, 1977, thèse de 3ème cycle, Bommier & Sahal-Bréchot, 1978, Bommier, 1980), and the inversion method developed (Bommier, Leroy, Sahal-Bréchot, 1981). The ambiguity is resolved by using the statistical results of Leroy, Bommier, Sahal-Bréchot (1984), confirmed by the multi- and optically thick line analysis of Bommier, Landi Degl'Innocenti, Leroy, Sahal-Bréchot (1994), and also unpublished results from two following days observations, where the geometrical change in the scattering due to the solar rotation, enables also the ambiguity solution (Bommier, Leroy, Sahal-Bréchot, 1981). The horizontality of the field vector was established by the Stokes II spectropolarimetric observations interpreted by Athay, Querfeld, Smartt, Landi Degl'Innocenti, Bommier (1983, 13 prominences) and Querfeld, Smartt, Bommier, Landi Degl'Innocenti, House (1985, 2 prominences), where the two components of He I D3 could be resolved (see also the multiline observations of Bommier, Landi Degl'Innocenti, Leroy, Sahal-Bréchot, 1994). In this poster, we present the synoptic maps of filaments of the Meudon Observatory, on which we have reported the 323 prominences average field vector (one field per observed prominence). The photospheric magnetic polarities and the neutral line are taken from the McIntosh maps. A general structure of the solar magnetic field above the neutral line, appears as a result.

Total mass loading of prominences estimated from their multi-spectral observations

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The total mass of several quiescent prominences observed in EUV by the AIA instrument on board SDO, in soft X-rays by the XRT on Hinode and in H? by the MFS spectrograph of the Ond?ejov observatory was estimated using a spectroscopic method based on the work of Heinzel et al. (2008). The optical thickness in EUV, and subsequently the column mass of the prominence plasma, is derived by comparison of the depression of the EUV radiation at prominences under study caused by the absorption in the resonance continua of hydrogen and helium and by the coronal emissivity blocking, with the depression in X-rays, where only the emissivity blocking occurs. The total mass of the prominence is then obtained by integration of the column mass over the whole prominence area. Moreover, nonsymmetrical distribution of the coronal X-ray and EUV emissivity in front of and behind the prominence was taken into account using a fraction of the emissivity from behind the prominence estimated iteratively by comparing the ratio of the optical thickness at 193 Å and 211 Å derived from observations with the theoretical value calculated according to Anzer and Heinzel (2005). Ionization degree of hydrogen is determined from H? spectra using empirical dependences and the extensive catalog of non-LTE models calculated by Heinzel et al. (1994). Asymmetry of coronal emission estimated from 193 Å and 211 Å AIA channel is compared with the unique average value estimated from 193 Å intensities measured at the disk edge and just above the limb. It was found that also the quiet corona around the prominence is rather inhomogeneous and using a unique average asymmetry of its emissivity for the whole prominence can cause errors in estimation of the total prominence mass.

Automated detection, characterization, and tracking of filaments from SDO data

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Thanks to the cadence and continuity of AIA and HMI observations, SDO offers unique data for detecting, characterizing, and tracking solar filaments, until their eruptions, which can be associated to coronal mass ejections. Because of the requirement of short latency when aiming at space weather applications, and because of the important data volume, only an automated detection can be worked out. We present the code "FILaments, Eruptions, and Activations detected from Space" (FILEAS) that we are developing at IAS for the automated detection and tracking of filaments. Detections are based on analysis of AIA 30.4 nm He II images and on magnetic polarity inversion lines derived from HMI. Following the tracking of filaments as their rotate with the Sun, filament characteristics are computed. We discuss the algorithms and performances of the code, and we compare its results with filaments detected in Halpha and already present in the Heliophysics Events Knowledgebase. We finally discuss the possibility of using this code for detecting eruptions in real time.

Imaging and spectroscopic measurements of ejected mass and UV emission in a CME

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The mass of erupting prominence material can be quasi-spectroscopically inferred from the photo-ionisation obscuration of emission behind this mass of cool plasma (Williams et al. 2013), thanks to the rapid cadence of AIA EUV images in the short wavelength band. In this work, we compare this quasi-spectroscopic approach with actual spectra from Hinode EIS to disentangle the contribution of emission from absorption to the AIA images, and to gain further information about the temperature and dynamics of the plasma responsible for the emission seen in the immediate vicintiy of the erupting prominence material.

3D dynamical structuring of a high latitude erupting prominence: 1- Analysis of the cool plasma flows before the eruption.

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A quiescent high latitude prominence was observed on November 14, 2011, using high resolution H? fast imaging (60 fps; .5"/px) to look at the fine scale structure and its dynamics. It erupted the following day. Image processing was used to reconstruct images at a 30 s cadence to become free of seeing effects. The deduced high signal/noise ratio permits an analysis of proper motions inside keeping an excellent resolution. Both vertical structures with moving up and down elongated features and a more horizontal significant spine are considered. Additionally, a typical vortex structure is analyzed with great details, showing a 3D behavior. A movie is provided as well as, for the first time, artificially produced stereograms to illustrate the 3D behavior. Using the Fourier local correlation tracking algorithm, we demonstrate that prior to the prominence eruption, radial counter-flows are observed in threads with a dominant downward motion of plasma blobs or plasmoids and that the top part of the H? prominence shows a strong vortex motion of chromospheric temperature plasma suspended and still confined by the magnetic field ½ day prior to the eruption.

Rayleigh-Taylor unstable modes in filament threads

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Short-lived horizontal threads lying parallel to the photosphere are thought to be the building blocks of many solar filaments. The possible link between Rayleigh-Taylor instabilities and thread lifetimes is investigated. We calculate the eigenmodes of a thread modelled as a Cartesian slab under the presence of gravity and using the incompressible assumption for the magnetohydrodynamic (MHD) perturbations. The system allows a mode that is always stable, independently of the value of the Alfvén speed in the thread. On the contrary, the slab model permits another mode that is unstable and localised at the lower interface when the Alfvén speed is low. The growth rates of this mode can be very short, of the order of minutes for typical thread conditions.

Two-ribbon flare without a filament eruption: Slipping magnetic reconnection observed with SDO/AIA

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We present SDO/AIA observations of an X-class flare observed on July 12, 2012. The flare is a two-ribbon one with a sigmoid-to-arcade evolution. Hot Fe XVIII - Fe XXIV loops are seen slipping along the developing flare ribbons, which are observed in all SDO/AIA bands. Individual contributions to the AIA bands are estimated using the DEM analysis. Slippage velocities are estimated. The slipping reconnection is predicted by the 3D-MHD model of Aulanier et al. (2012), which also explains the shape of the ribbons and the general flare morphology. We discuss the relation of the active region filament located between the ribbons to the developing flux rope. This distinction is important, since the filament does not erupt, even though a CME is observed by both STEREO spacecrafts. The relation of the individual features with several radio events are investigated.

The polar belts of prominence occurence as an indicator of the solar magnetic field reversal

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The global magnetic field of the Sun is the determining parameter of spreading the solar wind in the interplanetary space. The global field changes the polarity synchronically with the cycle of solar activity. The interesting indicator of the polarity change are so-called polar belts of the prominences' occurence . The article shows the performance of these belts on observational work from 1967 to 2010. It suggets other authors to compile their observation's data in a such way which is described in Rusin et al.,1988.

Kappa-distributions and the Temperature Structure of the Prominence-Corona Transition Region

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A strong gradient of temperature and density in the prominence-corona transition region (PCTR) can form the non-Maxwellian electron distribution with an enhanced number of particles in the high energy tail ? the kappa distribution. We have investigated the influence of these kapa-distributions on DEM of PCTR derived from observed line intensities. Generally, the kappa distributions influence both the ionization and excitation equlibrium. The ionization peaks are wider and shifted in the comparison with the Maxwellian distribution. Important consequence of kappa-distribution presence is formation of the emision lines in much wider temperature ranges. This behavior infuences also the shapes of DEM. They are flatter than for the Maxwellian distribution. The line contribution functions and emission in AIA bands were calculated for the kappa-distributions in PCTR. The implications for formation temperature of observed AIA band emissions are discussed.

Self-cancellation of ephemeral regions in the quiet Sun

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With the observations from the Helioseismic and Magnetic Imager aboard the Solar Dynamics Observatory, we
statistically investigate the ephemeral regions (ERs) in the quiet Sun. We find that there are two types of ERs:
normal ERs (NERs) and self-canceled ERs (SERs). Each NER emerges and grows with separation of its opposite
polarity patches which will cancel or coalesce with other surrounding magnetic flux. Each SER also emerges and
grows and its dipolar patches separate at first, but a part of the magnetic flux of the SER will move together and
cancel gradually, which is described with the term «self-cancellation» by us. We identify 2988 ERs, among which
there are 190 SERs, about 6.4% of the ERs. The mean value of self-cancellation fraction of SERs is 62.5%, and the
total self-canceled flux of SERs is 9.8% of the total ER flux. Our results also reveal that the higher the ER magnetic
flux is, (1) the easier the performance of ER self-cancellation is, (2) the smaller the self-cancellation fraction is, and
(3) the more the self-canceled flux is. We think that the self-cancellation of SERs is caused by the submergence of
magnetic loops connecting the dipolar patches, without magnetic energy release.

Coronal magnetic field modeling using stereoscopy constraints

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To obtain the 3D-structure of coronal magnetic loops two complementary methods have been used in the past: 1) Extrapolating the measured photospheric field vector into the corona and 2) Stereoscopy with coronal EUV images from the two STEREO-spacecraft. Some authors tried to combine the two methods. They used the extrapolation of the magnetic field, in most cases with linear force-free models, in order to do a better identification and match of the loop pairs for the
stereoscopic reconstruction.
Within this work we present a novel approach and use stereoscopic reconstructed loops from STEREO/EUVI as a constraint for nonlinear force-free coronal magnetic field extrapolations. For this aim we extended a nonlinear force-free optimization code by an additional functional, which monitors and minimizes the difference of the force-free magnetic field model and the 3D plasma loops.

Solar wind fluctuations and solar activity long-term swing: 1963-2012

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In this study we investigate the time variation of several solar activity indices using yearly and or 27-day average on earth orbit to understand links between solar activity parameters. We achieve our research by investigating several data plotted using averages. We also investigate pixel diagrams built with the criterions defined by Zerbo et al. 2012, and select the years with highest solar activity and estimate their energy level mean to the polar cap index used as a proxy of Joule heating (Francis K. et al.,1999).
The solar activity begins with the development of the solar wind cycle and ends by the minimum of the spots of the following cycle. Its total duration is of the order of 17-19 years. Main results suggest relationship between solar activity and plasma flux parameters.
We learn that solar wind is only one of the contributing factors to geomagnetic activity and that there are a close links between the coronal hole which is the region of open field lines and the injection and dissipation of surprising and important energy in the interplanetary medium. This implies the necessity to deal with space phenomenon by considering the severe interconnection between solar activity indices for interplanetary and earth environment weather forecasting.

High-resolution spectroscopy of a giant solar filament

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High-resolution spectra of a giant solar quiescent filament were taken with the Echelle spectrograph at the Vacuum Tower Telescope (VTT; Tenerife, Spain). A mosaic of various spectroheliograms (Halpha, Halpha +- 0.5A and Na D2) were chosen to examine the filament at different heights in the solar atmosphere. In addition, full-disk images (He I 10830 and Ca II H) of the Chromspheric Telescope (ChroTel) and full-disk magnetograms of the Helioseismic and Magnetic Imager (HMI) were used to complement the spectra. The filament with extremely large linear dimensions (> 740 arcsec) was observed in November 2011 while it traversed the northern solar hemisphere. Line-of-sight velocity maps inferred from Halpha and Na D2 Doppler shifts are presented to scrutinize the flows along the filament. The contrast profiles were also computed to infer additional physical properties using cloud model inversions.

The Magnetic Structure of Solar Prominence Cavities: New Observational Signature Revealed by Coronal Magnetometry

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The Coronal Multi-channel Polarimeter (CoMP) obtains daily full-Sun above-the-limb coronal observations in linear polarization, allowing for the first time a diagnostic of the coronal magnetic field direction in quiescent prominence cavities. We find that these cavities consistently possess a characteristic ``lagomorphic'' signature in linear polarization indicating twist or shear extending up into the cavity above the neutral line. We demonstrate that such a signature may be explained by a magnetic flux-rope model, a topology with implications for solar eruptions. We find corroborating evidence for a flux rope structure in the pattern of concentric rings within cavities seen in CoMP line-of-sight velocity.

Evolution of the 3D topology of active region 11158 during 4 days

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The active region (AR) 11158 has produced several large flares during its lifetime. Based on the high productivity of flares in this AR, we hypothesize that the large-scale magnetic topology has not changed drastically in this period. With the cylindrical equal area (CEA) data from Solar Dynamical Observatory (SDO) / Helioseismic and Magnetic Imager (HMI), we can get the magnetic field in the corona by nonlinear force-free field (NLFFF) extrapolation using Wiegelmann's method. We calculate the squashing degree factor Q in the volume refer to the equation proposed by Pariat & Démoulin (2012). The result does show that there are large-scale quasi-separatrix layers (QSLs) which cross each other during most of the time. We also see some small-scale QSLs related to the X2.2 flare happened on 2011 February 15, which manifest different magnetic connectivity between the flux rope and the arcade around. With SDO/AIA, we confirm that QSLs at the photosphere coincide with flare ribbons, suggesting that energetic particles impact the chromosphere following field lines inside the QSLs.

Observations of Overlying Extreme-ultraviolet Arches confining the eruption of a Filament

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Using the multi-wavelength data from the Atmospheric Imaging Assembly (AIA) onboard the Solar Dynamic Observatory (SDO), we report a failed filament eruption in NOAAAR11339 on 2011 November 3. This eruption was associated with an X1.9 flare, but without any distinct CME, coronal dimming or EUV wave according to the observations from SECCHI EUVI and COR1 onboard the spacecraft STEREO B. Some magnetic arcades above the filament was observed distinctly in EUV channels, especially in 94 ?A and 131 ?A, before and during the filament eruption process. Our results show that the overlying arcades expanded along with the ascent of the filament at first until they reached a projected height of about 49 Mm above the Sun's surface, where they stopped. The following filament material was observed to be confined by the stopped EUV arcades and not to escape from the Sun. These results support that the overlying arcades play an important role in preventing the filament to erupt outward successfully.

Magnetic properties of coronal pseudo-streamers

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Like helmet streamers, pseudo-streamers (or unipolar streamers) appear as radially-extended regions of enhanced density in white-light coronagraphs, but their magnetic properties are quite different. A helmet streamer occurs at a meeting of opposite polarity open field, whereas the field in a pseudo-streamer is all the same polarity, although the open field still belongs to two separate flux domains. A basic pseudo-streamer consists of two extended magnetic arcades next to each other surrounded by open field of the same polarity as the outer feet of the arcades. A separator is present above the arcades where the four flux domains meet. Pseudo-streamer topology can be difficult to determine in the corona due to line of sight effects. We present initial work on a topological pseudo-streamer study that aims to identify pseudo-streamers and similar features with coronal polarization measurements, which directly probe the magnetic field. We model several magnetic topologies and their coronal polarization signatures and compare these to multiple observations of pseudo-streamers.

Multidimensional radiative transfer effects on scattering polarization in He1083 line in solar prominences

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Main information about vector magnetic fields in solar prominences comes from the state-of-the-art
inversion codes (e.g. HAZEL), where 1D plane-parallel slab models are used in order to solve radiative
transfer problem inside the prominence. Here we study 2D slabs which are finite in x and y coordinates
and therefore allow us to inspect effects of radiative losses through the lateral boundaries as well as
effect of the «edges» on emerging Q/I and U/I profiles of scattering polarization in diagnostically important He1083 triplet. Line is modeled as a typical two-level atom line, which is created by scattering of incident anisotropic radiation. Q/I and U/I scattering polarization is result of joint action of
scattering processes and vector magnetic field (i.e. Hanle effect). We demonstrate differences between
1D and 2D models and speculate on systematic errors in the inversion process which could arise due to
the neglect of effect of multidimensionality.

Poster Session II: CME - ICME - Space Weather

Statistical Investigation of Physical Parameters of Coronal Mass Ejection in 2002-2012

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Until now, the prediction of space weather effects suffers from a substantial problem: the radial propagation speed of halo CME (i.e. CMEs with Sun-Earth line direction that are known to be the main drivers of space weather disturbances) toward the Earth cannot be measured directly. One of the ways for solving this problem is investigate possible relations between CME parameters and characteristics of ejection and then applied them to halo CMEs. Therefore, in this work, we have explored how the parameters of coronal mass ejections (CME) such as linear speed, kinetic energy and mass, depend on CME's position Angle and width angle. For this purpose we have analyzed 245 CME events associated with eruptive prominences (EP) for a period from January 2002 to November 2012. The data were primarily provided by Large Angle and Spectrometric Coronagraph Experiment on board Solar and Heliospheric Observatory (SOHO /LASCO) coronagraphs and Manua Loa Solar Observatory (MLSO). Also we used from LASCO CME Catalog for Characteristics of CMEs. Statistical analysis of data shows that the mass of the CMEs increases with the rises of their width to 80 degree and after that their mass is constant. It is to be noted that the deviation of CMEs was mainly toward the equator, with the increases of width in the Eastern Hemisphere (0 ? 180 degree), the events occurrence was towards the equator, and the other way Western Hemisphere (180 - 360 degree) shows a little differences. We also found that the speed distributions for events are well fitted with Gaussian function. This finding implies that the parameters of coronal mass ejections with EP have a significant effect on their characteristics and propagation.

Correlation between Interplanetary Parameters and Geomagnetic Indices during Geomagnetic Storms in 2010-2011

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In this paper, we investigate the possible relationship of interplanetary parameters of solar wind and interplanetary field with ground-based geo-magnetic indices. To carry out this study, we have used 21 geomagnetic events happened in period of January 2010 to December 2011 that all of them are selected with Dst To simplify this analysis; one event with sharp shock of (October 25, 2011) and the other with diffuse shock of (September 17, 2011), have been studied. It has been shown that there is a definite correlation between changes in the solar wind and the interplanetary magnetic field parameters and ground-based geomagnetic response.

EUV Solar Corona Sources of Geomagnetic Disturbances in the Solar Cycle 24

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In this work, we investigate possible relationship between the activity development in the solar corona and conditions in the solar storms. For this study, we have selected 24 solar events in period of Jan 2010 to late Dec 2011 (rising phase of solar cycle 24) corresponding to geomagnetic storms with geomagnetic indexAp> 25 nT. We use from ACE and WIND spacecraft for characteristics of solar storms and then trace back to the solar corona observed by SOHO/EIT. Therefore, the search for coronal signatures which are probably associated with the disturbed solar wind conditions was performed. The coronal sources of these 24 events are identified, such as filament eruptions, eruptions in active regions, and coronal holes. It is shown that halo and partial halo CMEs observed within the Large Angle and Spectrometric Coronagraph Experiment on board Solar and Heliospheric Observatory (SOHO /LASCO) coronagraphs are not necessary indicators of Earth directed eruptions, and coronal EUV dimming can be used as a complementary indicator. Also, the multi-structure events could be generated by different combination of structures and some of them can produce greater storms than others.

Filament eruptions, flares, and CMEs in an active region complex observed by SDO

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We investigate the violent events occurring in the cluster of two active regions, NOAA numbers 11121 and 11123, observed in November 2010 by the Solar Dynamic Observatory. Within one day the magnetic field intensity increased by 40% with the emergence of new groups of bipoles in AR 11123, where three filaments are seen along the very complex inversion line. Several events occurred on 11 November that led to the destabilization of the filaments, subsequent flares, and CMEs. We analyze, in particular, the one starting at around 7:15 UT. Based on a topology computation and analysis, we propose a scenario to explain the destabilization of the magnetic configuration, a filament eruption and two consecutive flares, one of them accompanied by a CME. The topology analysis can explain later eruptive events observed in the same complex.

Comparison of Helicity Signs in Interplanetary CMEs and Their Solar Source Regions

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If all coronal mass ejections (CMEs) have flux ropes, then the CMEs should keep their helicity signs from the Sun to the Earth according to the helicity conservation principle. This study presents an attempt to answer the question from the Coordinated Data Analysis Workshop (CDAW), «Do all CMEs have flux ropes?», by using a qualitative helicity sign comparison between interplanetary CMEs (ICMEs) and their CME source regions. For this, we select 34 CME?ICME pairs whose source active regions (ARs) have continuous SOHO/MDI magnetogram data covering more than 24 hr without data gap during the passage of the ARs near the solar disk center. The helicity signs in the ARs are determined by estimation of cumulative magnetic helicity injected through the photosphere in the entire source ARs. The helicity signs in the ICMEs are estimated by applying the cylinder model developed by Marubashi (Adv. Space. Res., 26, 55, 2000) to 16 second resolution magnetic field data from the MAG instrument onboard the ACE spacecraft. It is found that 30 out of 34 events (88 %) are helicity sign-consistent events, while four events (12 %) are sign-inconsistent. Through a detailed investigation of the source ARs of the four sign-inconsistent events, we find that those events can be explained by the local helicity sign opposite to that of the entire AR helicity (28 July 2000 ICME), incorrectly reported solar source region in the CDAW list (20 May 2005 ICME), or the helicity sign of the pre-existing coronal magnetic field (13 October 2000 and 20 November 2003 ICMEs). We conclude that the helicity signs of the ICMEs are quite consistent with those of the injected helicities in the AR regions from where the CMEs erupted.

A Multi-wavelength Observational Study of Eruption Processes of Active Prominences in the Solar Active Region NOAA 11261

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A better understanding of the physics underlying the eruption of solar prominences can be achieved through the analysis of multi-wavelength observational data of prominences and their associated flares with high temporal and spatial resolution. We therefore examined (1) the temporal variation of morphology and plasma properties of two active prominences located in the solar active region NOAA 11261 using SDO/AIA EUV images, (2) the injection of magnetic helicity through the photospheric surface around the prominences using SDO/HMI line-of-sight magnetogram data, and (3) the time profiles of radio, EUV, and soft X-ray fluxes produced by the flares related to the prominence eruption. As a result, we found that: (1) a prominence (P1) was vigorously developed during the pre-eruptive phase (01:30-03:20 UT on 2011-Aug-04) along the magnetic polarity inversion line with small-scale EUV brightenings, temperature increases, plasma flows, and significant injections of positive (right-handed) helicity in and around P1; (2) P1 began to erupt and expand as a pre-flare occurred in the region underneath the western part of P1 at 03:45 UT; (3) P1 split into two parts: i.e., the western part rapidly erupted by producing a typical two-ribbon flare, while the eastern part coalesced into a pre-existing prominence (P2); (4) P2 became unstable due to the coalescence with the eastern part of P1, and it finally erupted with clockwise untwisting motions.

Characterization of intermittent structures in the solar wind

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The solar wind (SW) is a suitable natural scenario to study the intermittent nature of magnetohydrodynamic (MHD) turbulence for systems with low dissipation rate. In particular, nonlinear wave-wave interactions can be characterized by the degree of phase correlation and by departures from Gaussianity of the magnetic field. In this work, we studied in situ observations of magnetic
field intensity from the spacecraft ACE, which is located near one astronomical unit from the Sun, in the SW near Earth. We compute the phase coherence index analyzing two sets of observations, each one consisting of approximately three month during 2008 and 2012, respectively. From these sets of data we characterize some intermittent features of the magnetic field intensity corresponding to a solar maximum and a solar minimum.

SEP's during Halloween storms and space weather

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The solar energetic particles (SEP's) could be accelerated to higher energies of order of MeV per nucleon. A modified model for SEP's acceleration has been given and applied for Halloween storms event during the decline phase of solar cycle 23. The estimated values of the solar magnetic field during the solar particle event were introduced. The solar magnetic field describes a sophisticated feature of discrete sectors/regions over the period that starts from 28 October 2003 to 4 November 2003. The applications of the suggested model on the solar particle event show that a homogeneous structure is in agreement with the observations.
The SEP and CME events lead to severe effects in geo-space and on earth, such as power blackouts, disruption of communications, and damage to satellites. Daily Geomagnetic storm changes, during Halloween storms were studied

The dynamical behavior of Magnetic Clouds: From 0.3 to 5.4 astronomical units

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Transient magnetized plasma structures expelled from the Sun can
produce strong distortions in the terrestrial environment. In particular, a subset of these structures called Magnetic Clouds (MCs) present an enhanced, smooth magnetic field with a coherent rotation when observed in situ by a probe.
Magnetic Clouds are expected to expand during their travel from
the Sun to the outer heliosphere
due to the decrease of the solar wind pressure with heliodistance.
Typical spatial scales of MCs allow to study them within the
magnetohydrodynamic (MHD) framework.
Then, using an MHD theoretical
model which considers self-similar expansion, together with magnetic
and plasma data from a sample of MCs observed by Helios 1-2 and
Ulysses, we analyze the evolution of the MC size for solar distances from 0.3 to 5.4 AU.
We compared the expansion behavior observed at the inner heliophere
(from 0.3 to 1 AU) with that found at the outer heliosphere
(from 1.5 to 5.4 AU).
A significant subset of the studied events presents a linear trend in the radial bulk velocity profile, which can be associated with a self-similar expansion of the structure, with a size evolving locally as a power law (with exponent ζ) of
heliodistance. We analyze separately events presenting this linear
velocity profiles (we named them as 'non-perturbed') from the ones
that do not present this characteristic (we named them 'perturbed').
For the outer heliosphere, we found that the exponent ζ is
significantly different for 'perturbed' and 'non-perturbed' MCs,
finding $\zeta_{non-perturbed}=1.05\pm 0.34$ and
$\zeta_{perturbed}=0.28\pm 0.52$. A similar value was found in a
previous work for the inner heliosphere. These results were consistent with expectations given from some previous numerical simulations.

Galactic cosmic ray decreases associated to non-interacting magnetic clouds during the 23rd solar cycle

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It is known that the presence of magnetic clouds (MCs) in the vicinity of Earth causes the deepest decreases in galactic cosmic ray (GCRs) flux at ground level (i.e., Forbush decreases). We present here a selection of Forbush decreases, which are associated to non-interacting MCs, and perform a statistical study on the shock/ejecta components for a subset of this events. By looking for correlation between the most relevant parameters of MCs and GCRs, we propose causality mechanisms to explain the observed correlations. In particular, we determine the relevance of each of the physical processes involved in the GCRs modulation, such as: diffusion, magnetic cloud expansion and trapping times of confinement.

Statistics of magnetic autocorrelation lengths in the Solar Wind

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There remain unanswered questions regarding the evolution of turbulent properties in different solar wind regimes, and their role in the dynamics of the Sun-Earth system. In this work we analyze the evolution of the spatial structure of interplanetary magnetic field fluctuations, by examining the heliospheric autocorrelation functions (R) based on «in situ» observations and using classical single-spacecraft techniques. Correlation lengths derived from R can be viewed as a measure of the integral scale of the turbulence. We focus on the evolution of these correlation lengths based on an analysis made at different heliodistances from the Sun, using observations from the Helios, ACE and Ulysses spacecraft. We distinguish different turbulent properties for the Parker-type Solar Wind and different transients, including some geoeffective transients which affect space weather conditions, as interplanetary coronal mass ejections or magnetic clouds.

Investigating the Initiation and dynamics of Flux-rope CMEs

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Recent SDO observations reveal that coronal mass ejections (CMEs) often originate from the eruption of magnetic flux ropes. In the slow rise phase of CMEs, the flux rope lies along the polarity inversion line and first appears as a twisted channel in the AIA high temperature passbands, such as 131 A and 94 A. The hot channel will rise slowly with the velocity of 10-100 km/s typically, probably due to the increase of magnetic pressure of the flux rope or the decrease of magnetic tension over the flux rope. In the impulsive acceleration phase of CMEs, the hot channel quickly develops into the semi-circular flux rope-like structure with rapid increasing of upward movement velocity. In the meantime, the expanding of the hot channel compresses the surrounding magnetic field and plasma, which successively stack and form the CME leading front. From detailed kinematical analysis, we find that: (1) the impulsive acceleration of the hot channel begins prior to the onset of impulsive energy releasing of associated flare, (2) the speed of the hot channel is always faster than that of the LF in the field of view of AIA. These results suggest that the hot channel is the flux rope that solar community is looking for. It can exist prior to the solar eruption and its ideal instability probably plays a key role in the transition from the slow rise phase to the impulsive acceleration phase.

The Space Weather & Ultraviolet Solar Variability Microsatellite Mission

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We present the ambitions of the SWUSV (Space Weather & Ultraviolet Solar Variability) Microsatellite Mission that encompasses three major scientific objectives: (1) Space Weather including the prediction and detection of major eruptions and coronal mass ejections (Lyman-Alpha and Herzberg continuum imaging); (2) solar forcing on the climate through radiation and their interactions with the local stratosphere (UV spectral irradiance from 180 to 400 nm by bands of 20 nm, plus Lyman-Alpha and the CN bandhead); (3) simultaneous radiative budget of the Earth, UV to IR, with an accuracy better than 1% in differential. The paper briefly outlines the mission and describes the 5 proposed instruments of the model payload: SUAVE (Solar Ultraviolet Advanced Variability Experiment), an optimized telescope for FUV (Lyman-Alpha) and MUV (200?220 nm Herzberg continuum) imaging (sources of variability); UPR (Ultraviolet Passband Radiometers), with 64 UV filter radiometers; a vector magnetometer; thermal plasma measurements and Langmuir probes; and a total and spectral solar irradiance and Earth radiative budget ensemble (SERB,Solar irradiance & Earth Radiative Budget). SWUSV is proposed as a small mission to CNES and to ESA for a possible flight as early as 2017?2018.

Estimation of Plasma Properties and Magnetic Field in a Prominence-like Structure as Observed by SDO/AIA

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We analyze a prominence-like cool plasma structure as observed by Atmospheric Imaging Assembly (AIA) onboard the Solar Dynamics Observatory (SDO). We perform the Differential Emission Measure (DEM) analysis using various filters of AIA, and also deduce the temperature and density structure in and around the observed flux-tube. In addition to deducing plasma parameters, we also find an evidence of multiple harmonics of fast magnetoacoustic kink waves in the observed prominence-like magnetic structure. Making use of estimated plasma parameters and observed wave parameters , under the baseline of MHD seismology, we deduce magnetic field in the flux-tube. The wave period ratio P1/P2 = 2.18 is also observed in the flux-tube, which may carry the signature of magnetic field divergence where we estimate the tube expansion factor as 1.27. We discuss constraints in the estimation of plasma and magnetic field properties in such a structure in the current observational perspective, which may shed new light on the localized plasma dynamics and heating scenario in the solar atmosphere.

ICMEs Associated with Major Geomagnetic Storms Over the Solar Cycle 24.

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The on-going Solar Cycle has brought a low geomagnetic activity compared with the previous one. A lower number of fast coronal mass ejections(CMEs) as well as a non-favourable magnetic configuration may be the cause of this phenomenon. In this study, we present the main characteristics of the Interplanetary CMEs (ICMEs) associated with the major Geomagnetic Storms (Dst

Multiwavelength Observations of Helical Kink Instability as a Trigger of Solar Flare and CME in AR NOAA 11163

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We present multiwavelength observations of helical kink instability as a trigger of a coronal mass ejection (CME) that occurred in active region NOAA 11163. The CME was associated with an M3.5 limb flare. SDO/AIA observations suggest the development of helical kink instability in the erupting prominence, which implies a flux rope structure of the magnetic field. A brightening starts below the apex of the prominence with its slow rising motion (~100 km s?1) during the activation phase. A bright structure, indicative of a helix with ~3-4 turns, was transiently formed at this position. The corresponding twist of ~6?-8? is sufficient to generate the helical kink instability in a flux rope according to recently developed models. A slowly rising blob structure was subsequently formed at the apex of the prominence, and a flaring loop was observed near the footpoints. Within 2 minutes, a second blob was formed in the northern prominence leg. The second blob erupts (like a plasmoid ejection) with the detachment of the northern prominence leg, and flare intensity maximizes. The first blob at the prominence apex shows rotational motion in the counterclockwise direction in the plane of sky, interpreted as the unwinding motion of a helix, which erupts to give the CME. RHESSI hard X-ray (HXR) sources show the two footpoint sources and a loop-top source during the flare. We found RHESSI HXR flux, soft X-ray flux derivative, and CME acceleration in the low corona correlate well, which is in agreement with the standard flare model (CSHKP). We also discuss the possible role of ballooning as well as torus instabilities in driving the CME. We conclude that the CME and flare were triggered by the helical kink instability in a flux rope and accelerated mainly by the torus instability.

The contraction of overlying coronal loop and the rotating motion of a sigmoid filament during its eruption

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We present an observation of overlying coronal loop contraction and rotating motion of the sigmoid filament during its eruption on 2012 May 22 observed by Solar Dynamics Observatory (SDO). Our results evidenced that the twist can be transported into the filament from the lower atmosphere to the higher atmosphere. The successive contraction of the coronal loops was due to a suddenly reduced magnetic pressure underneath the filament, which was caused by the rising of the filament. Before the sigmoid filament eruption, there was a counterclockwise flow in the photosphere at the right feet of the filament and the contraction loops and a convergence flow at the left foot of the filament. Moreover, two coronal loops overlying the filament first experienced brightening, expansion and contraction successively. At the beginning of the rising and rotation of the left part of the filament, the second coronal loop exhibited rapid contraction. The top of the second coronal loop also showed the counterclockwise rotation during the contraction process. During the filament expansion, the right part of the filament also exhibited the counterclockwise rotation like a tornado. The magnetic helicity in the photosphere was calculated by using LCT method.

Role of filament plasma remnants in ICMEs leading to geomagnetic storms

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We studied cases of interplanetary coronal mass ejections associated with solar eruptive filaments. Filament plasma remnants embedded in these structures were identified using plasma, magnetic and compositional signatures while the topology of flux rope structures is modeled by Grad-Shafranov reconstruction technique. These features when impacted the Earth's terrestrial magnetosphere - ionosphere system, resulted in geomagnetic storms. During the main phase of associated storms, along with high density plasma structures, polarity reversals in the Y-component (dawn-to-dusk) of interplanetary electric field seem to trigger major auroral substorms with concomitant changes in the polar ionospheric electric field. Here, we investigate the role in which the plasma dynamics and magnetic structuring in presence of the prompt penetration of the electric field into the equatorial ionosphere affected the space weather while highlighting the complex geomagnetic storm-substorm relationship.

Spectral observations of filament activation

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Activation of the quiescent filament fragment and the EUV events associated with the latter are investigated. As of 2012 June 14, the filament fragment was located at e11n27.
The time sequence of spectra in range of the H??486.1 nm line (obtained with the Horizontal Solar Telescope at the Sayan Solar Observatory), the EUV/AIA images, and magnetograms from the SDO data are used for analysis. The wavelet analysis is applied for the Doppler velocities in the filament and in the photosphere under the latter before the filament activation. The correlation between the upward motion velocity of filament during activation and the EUV events inside and around the filament is studied. The ~5 min Doppler velocity oscillations increase in the entire filament before its activation. The velocity of the disturbance removing from the photosphere to the filament region is about 180 km/s. Bright points at the filament channel edges and emission loops above the filament in the AIA bands appear a few minutes after the filament upward motion start. The increase in the filament upward motion velocity had a impulse character, and the maximal velocity reached 110 km/s.

Role of the terrestrial bow shock on magnetic clouds' structure: 1. CLUSTER observations downstream of the bow shock

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Magnetic clouds are known as very geoeffective structures, in the sense that they can be at the origin of large magnetic storms in the Earth's environment, as measured by the Dst index. An important parameter considered in the geoeffectiveness studies is the North-South component of the Interplanetary Magnetic Field (IMF). But the correlation between geoeffectiveness and IMF is not straightforward and statistical studies revealed a much more complex situation. Indeed, before reaching the magnetosphere, the magnetic clouds encounter first the bow shock which decreases the solar wind velocity down to sub-sonic and sub-Alvénic values, modifies the magnetic field structure, and finally changes the conditions of the interaction with the magnetosphere. These modifications can be observed by the CLUSTER satellites along orbits that go out of the magnetosphere and cross the region downstream of the bow shock. We show cases where the magnetic field structure of the magnetic clouds is maintained. But we also observed cases where it is strongly modified, with large rotations of the magnetic field. We interpret these modifications as a function of the magnetic field direction relative to the local normal, leading to different shock conditions: quasi-parallel, quasi-perpendicular, ... The consequences are that the interaction of these magnetic clouds with the magnetosphere and thus their geoeffectiveness differ from what could be assumed from their initial configuration in the solar wind. This effect stresses the need of modeling to predict accurate interaction conditions with the magnetosphere.

Role of the terrestrial bow shock on magnetic clouds' structure: 2. 3D analytical MHD model

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Magnetic clouds (MC) figure among the most important drivers of magnetic storms. In the solar wind, they present a very distinctive structure. However, before reaching the magnetosphere, MCs encounter the bow shock which modifies their structure, and therefore may influence their geoeffectivity. In order to understand how the magnetic structure of MCs is altered by the shock, a simple analytical MHD model is used to calculate the magnetic field strength and direction inside the magnetosheath. We present several outputs of the model, corresponding to different MC axis orientations and to different impact parameters. The variation of the magnetic field direction from the solar wind to the magnetosheath appears to be strongly driven by the shock obliquity. Asymmetries due to different shock configurations may arise inside the magnetosheath. Moreover, the magnetic field north-south component can even reverse in some parts of the magnetosheath. The model outputs are compared with spacecraft observations. Finally, we discuss the impact of our conclusions on MCs' geoeffectivity.

From solar eruption to transformer saturation: the space weather chain

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The main Space Weather Events of the Solar Cycle 23 are listed with their subsequent effects on ground infrastructure, such as power grids. The analysis includes a brief description of their origin (location, time and accompanied solar events), their signatures in the solar wind as recorded at 1AU (ACE satellite) and detailed explanations of their effects on the ground. The differences in the response of the geomagnetic to the same solar event in the polar, auroral and low-latitude regions will be discussed in more detail. Effects on power grids will be presented in terms of the currents in the transformers.

3D dynamical structuring of a high latitude erupting prominence: 2- Analysis of the coronal context and eruption.

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We primarily used AIA (SDO) coronal and transition region (TR) filtergrams processed to improve the signal/noise ratio, to look at the details of the erupting southern high-latitude prominence on 14 - 15 November 2013. The intermingled cool chromospheric and TR details with the hot more stretched coronal details are particularly striking. The prominence is a part of a southern polar crown filament which is too faint to derive its chirality from the observed internal fine structure as it is usually possible for active region filaments, although internal motions observed within the prominence in H? suggest negative helicity of the flux rope, which is not unusual but not typical for the southern hemisphere. The details of the eruption are analyzed using additional SECCHI (STEREO) simultaneous filtergrams and also, the LASCO coronagraph data. The magnetic context is discussed, including the use of a computed PFSS map, although photospheric magnetic fields inferred from HMI magnetograms are rather weak near the filament location. A likely scenario is suggested taking into account the 3D peculiarities.

Observations and modeling of magnetic reconnection driven by CME expansion

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Observations from NASA's Solar Dynamics Observatory of an unusually massive filament eruption on 7 June 2011 provide for the very first time images of a magnetic reconnection region in the solar corona. The reconnection occurs at a current sheet that forms between the erupting magnetic structure and a neighbouring active region. This scenario is supported by a numerical simulation of the eruption. Dense, cool back-flowing filament plasma is observed to be re-directed andheated in situ, producing coronal-temperature emission around the reconnection region. These results providethe first direct observational evidencethat a large-scale re-configuration of the coronal magnetic field takes place during solar eruptions via the process of magnetic reconnection.

Statistical relationship between CME speed and soft X-ray intensity of the associated flare during solar cycle 23

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We present the statistical study of CME velocities reported by the SOHO/LASCO catalogue and Soft X-Ray measurements from the GOES satellite during the period between 1996 and 2008, to explore the possible correlation between CME speed and parameters of the associated X-ray flare, as the peak flux. One of the principal disadvantages in this sort of studies is that since we can only measure the projected CME speed, an existing correlation may be smeared out if one considers CMEs irrespective of their location on the Sun. In our work we focused on very specific CMEs, which originate near the solar limb (so that projection effects are minimized), have position angles PA=60°-120° and PA=240°-300° and linear velocity ? 300 km/s. The flare association is inferred from the timing association and the linear speed of the CME. We have found a positive correlation about 0.5 for 66 events with solar origin between longitudes 70 and 85 degrees. In this work we will study the correlation of these data in more detail, because the fact of finding a high-quality correlation is relevant to Space Weather, since the continuously measured Soft X-Ray flux of the Sun could be useful to find an approximation of the CME speed and possibly, the transit time of the CME from the Sun to the Earth.

Different Stages of Evolution of Prominence and the Associated CMEs

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We study different stages of the evolution of large quiescent prominence, mainly considering its dynamic and thermal instabilities occurred near the boundary of coronal hole and away from it, based on Ha and EUV images and magnetograms; in order to identify a critical condition (such as a minimum distance between the boundary of coronal hole and prominence, emergence of a new magnetic flux or magnetic reconnection) linked to the instability and general evolution of prominence and formation of associated non-flare Coronal Mass Ejections (CMEs). In addition, we analyze the correlation between each evolutional stage of prominence and the geoeffectiveness of associated different CMEs. Our observations indicate a peculiar activity of filament associated with the emergence of a new magnetic flux; also suggest an important involvement of nearby coronal hole in the general evolution of prominence (and vice versa), which in turn is correlated to dynamics and geoeffectiveness of associated non-flare CMEs.

Solar high energy observations within SEPServer project: spatially resolved X-ray observations of flares associated with SEP events

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Solar Energetic Particles (SEP) are associated with solar flares and their (sometimes) related fast coronal mass ejections (CMEs). The main aim of the FP7 SEPServer project is to build an on-line server that will provide the space research community with in situ SEP measurements and related electromagnetic observations for a set of solar flares and SEP events that occurred during the last solar cycle. Within this project, we are using high energy data recorded by RHESSI spacecraft to examine the signatures of long duration hard-X ray emission in association with the production of SEPs, and the potential link with CMEs. We shall investigate whether these observations may put some light on the origin of the longitudinal spread of SEP events.

Analysis of SC23 major geomagnetic storms produced by CMEs

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In this study we analysed the link between coronal mass ejection (CMEs), interplanterary CMEs (ICMEs) and major geomagnetic storms of solar cycle (SC) 23 with focus on geomagnetic response. Some of these CMEs are associated with eruptive filaments. We analyse the interdependence between geomagnetic field measurement, represented by the geomagnetic index Dst and the injected energy into terrestrial magnetosphere, using Burton equation. We find that all the 25 events in this study are framed into two distinct categories given by the trend line of the correlation coefficient, for different time intervals of the main phase of geomagnetic storms, taken into account the delay time for magnetosphere response.

Solar Near-relativistic Electron Release History on 1998 April 20

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We present the analysis of a large solar near-relativistic (NR; > 50 keV) electron event observed by the Electron, Proton and Alpha Monitor (EPAM) on board the ACE spacecraft on 1998 April 20. The particle event showed a rapid rise phase with onset at about 10:30 UT. It was preceded by a prominence eruption which was observed at the southwest limb of the Sun, where an M1.4 X-ray flare was also reported at 10:00 UT. A fast (1863 km/s) CME was first seen above 3 solar radii at 10:07 UT. Distinct radio emission episodes were observed. Those included a moving type IV burst between 9:40 and 10:00 UT, followed by a series of DH type III bursts observed below 2 MHz and a type II burst at 5-10 MHz. Several hours after these emissions a series of bursts was observed above the western limb at 164 MHz.
We use a particle transport model to infer the propagation conditions in the interplanetary medium and the injection history of the NR electrons observed in-situ. The simulation results reveal an extended and sparse release of particles. The first release occurs at 10:20 UT, during the brightest group of type III bursts. Other later sporadic release episodes are obtained. A later release episode appears after 13:00 UT, at about the time when bursty emission above the west solar limb becomes visible at 164 MHz.
This work is carried out within the SEPServer project (funded by the European Union through its FP7), which aims at facilitating the joint study of in situ measurements of energetic particles and the related electromagnetic signatures in the corona.

Signatures of magnetic reconnection and current sheet formation during an X1.8 flare associated with prominence eruption

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We present RHESSI and TRACE observations of an X1.8 solar flare from active region NOAA 10656. The event occurred at the west limb of the Sun and is associated with the eruption of an active region filament. This long duration event was marked by multiple HXR bursts that are observed up to 100?300 keV energies. The first HXR burst is characterized by strong and prolonged non-thermal HXR emission right at the flare onset, evidencing an extended phase of particle acceleration related to the early stages of the filament eruption. The later three HXR bursts show impulsive characteristics during which prominence undergoes rapid upward expansion. We observe a bright and elongated coronal structure in EUV images formed below the erupting prominence which is co-spatial with an extended 50-100 keV coronal HXR sources. This phase is accompanied with very high plasma temperatures of ~31 MK and followed by the detachment of the prominence from the solar source region. From the location, timing, strength, and spectrum of HXR emission, we conclude that the prominence eruption is driven by the distinct events of magnetic reconnection. The analysis further reveals that the ejection of prominence is caused by the formation of a current sheet underneath which then reconnects to produce the subsequent eruption and non-thermal emission.

Magnetic reconnection at the leading edge of a solar erupting loop and an ICME

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CMEs and coronal loops are related to twisted magnetic flux tubes, which can be either present before the solar filament eruption or is built up by reconnection of a sheared arcade. Flux emergence, dispersion of the external magnetic field, and/or reconnection of field lines above/ below the flux rope are mechanisms that can trigger the eruption (Schmieder et al. ASR 51, 1967, 2013). In order to probe the mechanism of reconnection above the flux rope, we report the observation of magnetic reconnection at the leading edge of a coronal loop and an ICME, respectively, using remote and in situ data.
First, we report high spatially-resolved observation of a solar eruptive event on 3 November 2010, emanating from an active region behind the east solar limb.(Zimovets et al., A&A 547, A6, 2012). The relative dynamics of multi-thermal eruptive plasmas and of type-II radio bursts are observed in detail by the AIA instrument of SDO and the Nançay Radioheliograph, respectively. The leading edge (LE) of the eruptive plasmas (T ? 1?2 MK) moved upward from the flare region at a speed of v ? 900?1400 km s?1. It is found that the low-frequency component (LFC) source of the splitted type-II burst is situated above the high-frequency component (HFC) source ahead of the LE. Our interpretation of the type-II burst band-splitting is that the LFC component is emitted from the upstream region of the shock, whereas the HFC is emitted from the downstream sheath region. The energetic electrons associated with the production of type-II bursts are possibly related to magnetic reconnections and/or other plasma heating and particle acceleration processes at the leading edge of an erupting solar loop (Foullon et al. ApJ 767, 170, 2013).
Second, we report the in situ observation of current sheets, turbulence, and magnetic reconnections at the leading edge of an ICME detected by Cluster upstream of the Earth's bow shock on 21 January 2005 (Chian & Munoz ApJL 733, L34, 2011; EAS 55, 327, 2012). We present the observational evidence of two magnetically reconnected current sheets in the vicinity of a front magnetic cloud boundary layer with the following characteristics: (1) a Kolmogorov power spectrum in the inertial subrange of the magnetic turbulence, (2) the scaling exponent of structure functions of magnetic fluctuations exhibiting multi-fractal scaling predicted by the She? Leveque magnetohydrodynamic model, and (3) bifurcated current sheets with the current density computed by both single- and multi-spacecraft techniques.
Finally, we discuss the impact of the ICME of 21 January 2005 on geomagnetic activities. A comparison of the time series of magnetic field fluctuations detected by ACE at the L1 point in the solar wind with the data measured by ground magnetometers in Brazil shows a close correlation of the geomagnetic field with the ICME, which is indicative of the solar wind turbulence being a driver of space weather (Miranda et al. IAU Symp. 264, 363, 2011).
Our two findings provide evidence of magnetic reconnections at the leading edge of an erupting coronal loop and an ICME.

On the recurrent eruptions of a large filament observed during August 2012

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Eruptive filaments are often known to be associated with CMEs. Some of these eruptive filament associated CMEs are potential drivers of space weather and the cause of major geomagnetic storms at the earth. One of the major constraints in investigating the driving force of these CMEs is the difficulty in estimating their onset time. Particularly in the case of eruptive filaments, monitoring their activation becomes crucial for forewarning of its disappearance in H-alpha and/ or in EUVI, hence for estimating the time of onset of associated CME. We report observations of a large filament that underwent recurrent partial eruptions before its complete eruption on August 8, 2012. We implement an automated detection algorithm developed by us for estimation of different attributes of this filament and study its evolution during these eruptions. Based on these attributes we determine the onset of the eruptions. We compare these onset times with that of the associated CMEs observed by LASCO-coronaraphs. This is also used to understand temporal relationship of EUV, X-ray flux variation with disappearance in H-?.Our results show the importance of such studies in understanding the mechanism of CME initiation and possible role of eruptive filaments for the same. This work contributes to the research for European Union Seventh Framework Programme (FP7/2007-2013) for the Coronal Mass Ejections and Solar Energetic Particles (COMESEP) project under Grant Agreement No. 263252.

Evolution of the 5 January 2005 CMEs associated with eruptive filaments in inner heliosphere

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On 5 January 2005, LASCO/SoHO observed two CMEs associated with eruptive filaments with different initial velocities and acceleration. The second CME accelerates much faster than the earlier and the resulting interaction has been reveled inin-situspacecraft measurements by the presence of magnetic holes at border of the two distinct magnetic clouds. At their interface region, these magnetic clouds have embedded filament plasma that shows a complex magnetic structures with a distinct magnetic flux rope configuration; these have been modeled by the Grad - Shafranov reconstruction technique. The geomagnetic consequences of these structures have been associated with substorms in recovery phase of a storm and detailed analysis is presented inSharma et al., 2013.

In the poster presented here, we highlight the comparison of shape and extent of two filament plasma remnants in magnetic clouds as revealed by three - dimensional (3D) reconstruction and analysis from the Solar Mass Ejection Imager (SMEI) data associated with thesein-situmeasurements. The results provide an overview of the two eruptive filaments on 5 January 2005 and their interplanetary propagation.

Poster Session III: Star ejecta

Stellar ejecta from falling comet-like bodies: young stars

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High-resolution spectral observations of young stars with dense protoplanetary discs like Beta Pictoris led to discovery of variable emission lines of metal atoms, Na, Fe etc., that indicate the presence of fluxes of comet-like evaporating bodies falling onto the stars, FEBs. Assuming the presence of stellar atmospheres similar to the solar atmosphere, we show that some FEBs passing through the stellar chromosphere and photosphere will be accompanied by generation of stellar photospheric ejecta due to impulse production of high-temperature plasma in the relatively very thin sub-photosphere layer. Impulse, explosive character of the process is connected with high-velocity irradiation of the falling body by atmospheric particles resulting fully mechanical crushing of the body by aerodynamic pressure within chromosphere, transversal expansion of the crushed mass under the action of pressure gradient on the frontal surface of the body, sharp aerodynamic deceleration of the flattening body in the sub-photosphere layer.

Poster Session IV: Instrumentation

Featuring dark coronal structures: physical signatures of filaments and coronal holes for automated recognition

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Filaments may be mistaken for coronal holes when observed at extreme ultraviolet (EUV) images; however, a closer and more careful look reveals that their photometric properties are different. The combination of EUV images with photospheric magnetograms shows some characteristic differences between filaments and coronal holes. We have performed analyses with 7 different AIA wavelengths (94, 131, 171, 211, 193, 304, 335) and HMI magnetograms obtained in September 2011 and March 2012 to study coronal holes and filaments from the photometric, magnetic, and also geometric point of view, since projection effects play an important role on the aforementioned traits.

A system for near real-time detection of filament eruptions at Kanzelhöhe Observatory

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Kanzelhöhe Observatory (kso.ac.at) performs regular high-cadence full-disk observations of the solar chromosphere in the H-alpha and CaIIK spectral lines as well as the solar photosphere in white-light. In the frame of ESA's Space Situational Awareness (SSA) activities, a new system for near real-time Halpha image provision through the SSA SWE portal (swe.ssa.esa.int) and for automatic alerting of flares and erupting filaments is under development.
Image segmentation algorithms, based on optical flow image registration, for the automatic detection of solar filaments in real time H-alpha images have been developed and implemented at the Kanzelhöhe observing system. We present first results of this system with respect to the automatic
recognition and segmentation of filaments and filament eruptions on the Sun.

Solar Radio Imaging-Spectroscopy Observations in cm-dm Wavelengths

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To address fundamental processes in the solar eruptive phenomena it is important to have imaging-spectroscopy over centimetric-decimetric wave range. The Chinese Spectral Radioheliograph (CSRH) in 0.4-15 GHz range with high time, space and frequency resolutions is being constructed to achieve this goal. The perspectives to open new observational windows on solar flares and CMEs will be achieved by mapping the radio emission from unstable electron populations during the process of the energy release. CSRH is located in a radio quiet region in Inner Mongolia of China. The array of CSRH-I in 0.4-2.0 GHz with 40 4.5m antennas has been established and starts test observations. The first solar images have been obtained by CSRH-I. The 60 2m antennas for array of CSRH-II in 2-15 GHz have been mounted and assembled.. The progress and current status of CSRH are introduced. (With CSRH Team)

New Coronal Imaging Instrumentation

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We will discuss two major directions for a next generation of coronal imaging instruments: very high resolution imagers for the study of reconnection microphysics, and wide-field instruments, for the study of the transition from a closed inner corona to an open outer corona. Recent advances in methods of fabricating and assembling the required optics will be discussed, along with some proposed instrument concepts for implementing the next generation of space-based coronal imagers.

Coronal Multi-channel Polarimeter at the Lomnicky Peak Observatory

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Coronal Multi-channel Polarimeter (CoMP-S), developed by HAO/NCAR, has been introduced to regular operation at the Lomnicky Peak Observatory (High Tatras in northern Slovakia, 2633 m a.s.l.) of the Astronomical Institute of Slovak Academy of Sciences.
We present here technical parameters of current version of the instrument and its potential for observations of prominences in the visual and near-IR spectral regions. First examples of results derived from observations of prominences in the H_alpha and CaII 854 emission lines during a coordinated observing campaign of several instruments in October 2012 are presented. A planned upgrade of the instrument detectors for observations of velocities and magnetic fields using far-IR emission lines is described as well.

Infrared Stokes Polarimeter at NAOJ/Mitaka as a Prominence Magnetograph

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We have been operating an infrared Stokes spectro-polarimeter, whose observing wavelength bands include the He I 10830 and Fe I 15648 lines. A couple of full-Sun, full-Stokes maps in both wavelength bands are taken on a daily basis, with the polarization sensitivity better than 10^-3. With this sensitivity, the helium polarization maps clearly show the atomic and Hanle polarization besides the Zeeman polarization, particularly in prominences/filaments. On these polarization maps, we can track the magnetic field signals of the prominences/filaments during their passages on the solar disk. Therefore, this instrument works as a "synoptic prominence magnetograph". In the conference, we show some examples of the polarimetric data of the prominences/filaments (both quiescent and eventually erupted ones).

On 2D Linear Polarimetry in Prominences

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An approach for high-precision 2D linear imaging polarimetry is briefly described. The key components of the approach are reducing random errors by the use of «statistical» data, reducing systematic errors based on the use of a special algorithm of data reduction, obtaining the 2D distributions of the polarization degree, polarization angle and the sign of the angle (polarization « images»), a low sky brightness, a low scattered-light telescope, uniformity of the polarizer performance for any point of the image. Polarization «images» of an H-alpha prominence of March 29, 2006 above the west limb show the co-existence of the «+» and «-» polarities in the prominence. The potential of the approach for prominence magnetic research is noted. The reported study was partially supported by RFBR (research project No. 11-02-00631), IAU, SCOSTEP, SF2A and KLSA/CAS.

The Heliophysics Feature Catalogue, a tool for the study of solar features long-term behavior

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The behavior of filaments and prominences during the Solar Cycle is a signature of Sun's activity. It is therefore important to follow their evolution during the cycle, in order to be able to associate it with the various phases of the Solar Cycle as well as with other Solar features or events.
The virtual observatory HELIO provides information that can be used for such studies, especially its Heliophysics Feature Catalogue gives a unique access to the description of various features during around one cycle. Features available are: filaments, prominences, photospheric and coronal active regions, coronal radio emission, type III radio bursts, coronal holes and sunspots. Web interfaces allow the user to query data for these features. Useful information can also be shared with other HELIO services, such as Heliophysics Event Catalogue, which provides access to dozens of tables of events such as flares, CMEs, ...