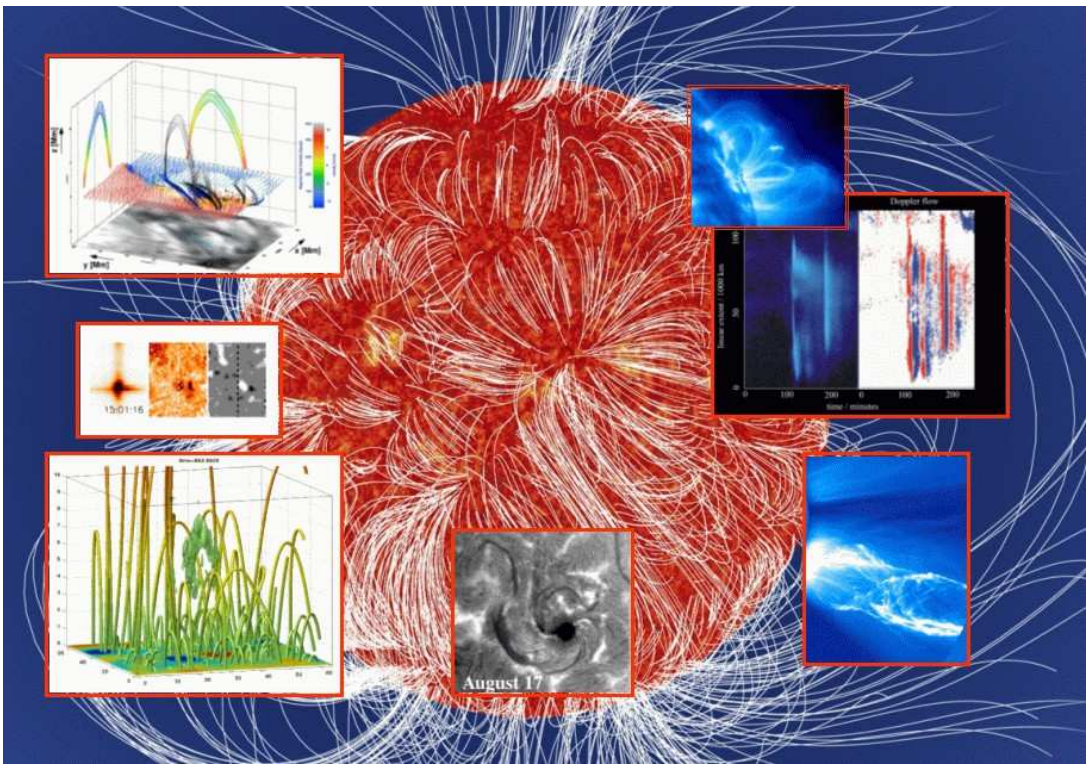
Chromospheric and Coronal Magnetic Fields



Program + Abstracts
26th August 2005

http://www.mps.mpg.de/meetings/ccmag/

Katlenburg-Lindau
30 August - 2 September, 2005

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Chromospheric and Coronal Magnetic Fields I

Tuesday, 09:15-10:45 **Chair: Sami Solanki**

The solar X-ray corona: consequence of an untidy magnetic topology

Eugene N. Parker[1]

(1) University of Chicago

The X-ray corona of the Sun consists of the diffuse X-ray background and the bright X-ray loops (107 erg/cm2 sec) confined in the strong (100 Gauss) bipolar fields of magnetic active regions. The bipolar fields are rooted in the solar granules which continually intermix the photospheric footpoints of the bipolar fields and progressively interlace the field lines. The intermixing is too slow to produce MHD waves. The magnetic field is never far from static equilibrium. The interlacing of the field lines, on scales of 100-1000 km, produces magnetic stresses within the field that drive the field toward internal surfaces of tangential discontinuity (current sheets). This is the familiar rapid reconnection process, in which the field gradients are driven to ever increasing steepness, so that the slight electrical resistivity soon eats up the interlacing components of the field as fast as the magnetic stresses can steepen the gradients. We suggest that this process is the principal heat source responsible for the X-ray corona of the Sun. It predicts that there are large numbers of nanoflares and picoflares throughout the X-ray loops. Katsukawa and Tsuneta find evidence in the Yohkoh X-ray observations of myriads of brightness fluctuations of the order of 1021 - 1023 ergs over times of 100 sec., opening the way for direct quantitative observational studies of the phenomenon.

Presentation: **Invited Talk**
Time: 09:15 - 10:00

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Coronal Magnetic Field Measurements - Optical/IR

Steven Tomczyk[1]

(1) HAO/NCAR

Direct quantitative observation of magnetic fields in the solar corona is difficult. However, significant progress has been made recently. I will summarize current work on the measurement of coronal magnetic fields at optical and IR wavelengths. The various methods for the determination of magnetic fields will be introduced. Since recent work has concentrated on spectropolarimetry of forbidden coronal emission lines, this technique will be discussed in detail with regard to the capabilities of the method and measurement limitations and expected uncertainties. A detailed description of past and current work will be given with an emphasis on recent work on the 1074.7 and 1079.8 FeXIII lines and the 3.9 micron SiIX line.

Presentation: **Invited Talk**
Time: 10:00 - 10:30

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On the reconstruction of the coronal magnetic field from coronal Hanle / Zeeman observations.

M.Kramar[1], B.Inhester[1]

(1) Max Planck Institute for Solar System Research

The magnetic field contains the dominant energy per unit volume in the solar corona and therefore plays an important role in most coronal phenomena. But until now, no direct measurement of the magnetic field vector distribution in the corona could be made. Models of the coronal magnetic field rely almost enterely on extrapolations of photospheric magnetic field observations. Some indirect information about the coronal magnetic field, however, can be obtained using the longitudinal Zeeman or Hanle effects on emissions at magnetically sensitive coronal transition lines. The longitudinal Zeeman effects provide the line-of-sight component of the magnetic field integrated over the line-of-sight. Polarimetric measurements of the Hanle effect yields information about the magnetic field orientation integrated along the line-of-sight.
We have investigated whether a tomographic reconstruction based on these observations allows to obtain a reliable model of the vector magnetic field in the whole solar corona. The inversion problem is strongly ill-posed. To improve the condition of the inversion problem we use the fact that the magnetic field has to satisfy $\nabla \cdot \vec{B} = 0$ as an additional regularization constraint. The use of this constraint, however, may require additional solar surface magnetogram data as boundary condition. With the help of this constraint, we show that it is possible to reconstruct both the strength and direction of the magnetic field from the mentioned above observations. The reconstructed field contains details, which cannot be obtained with a traditional extrapolation of the photospheric surface field measurements.
The inversion code based on the effects mentioned above has been developed. The code is tested using simulated data of the longitudinal Zeeman and Hanle effects including some artificial noise. The magnetic field configuration is chosen to consist of two parts: a mean dipole field component and non-potential field component induced by a circular current in the corona. The tomographic inversion of the simulated data allows us to reconstruct the potential and the non-potential component of the field while a traditional potential field approximation reconstructs only the mean field component.

Presentation: Talk
Time: 10:30 - 10:45

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Chromospheric and Coronal Magnetic Fields II

Tuesday, 11:30 - 12:30 **Chair: Bernhard Fleck**

Measurement Methods of Chromospheric and Coronal Magnetic Fields

N.-E. Raouafi[1]

(1) National Solar Observatory

The observable structuring in the high layers of the solar atmosphere, i.e. chromosphere-corona, witnesses of the increasingly dominance of the energy density of the magnetic field over that of the gas. Hence, the magnetic field is at the origin of most of the solar phenomena observed in the Sun's atmosphere, i.e. sunspots, flares, coronal mass ejections, flows, etc. The magnetic field plays consequently a major role in the storage of the energy and its release which results from driven instabilities by the magnetic field leading to the heating of the plasma. The dynamic of the solar atmospheric gas is highly influenced by the magnetic field that controls the flows in particular in the corona. The role played by the magnetic field in the solar atmosphere makes development of measurement methods a highest priority in the solar physics and generally in the astrophysical research. The knowledge of the magnetic field is fundamentally indispensable for understanding the physical processes and mechanisms taking place in the solar atmosphere. The recent developments includes theoretical, computational and instrumental aspects. We present an overview of the techniques used to determine the magnetic field in the solar chromosphere and corona. The future needs to get better informations concerning the magnetic field will be also outlined.

Presentation: **Invited Talk**
Time: 11:30 - 12:00

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A Novel Diagnostic Window on Cosmic Magnetic Fields and its Application to the Magnetism of the Solar Atmosphere

Javier Trujillo-Bueno[1]

(1) Instituto de Astrofisica de Canarias

In our opinion, the greatest future challenge in cosmic physics is the empirical investigation of the magnetic field in a variety of astrophysical plasmas, including the solar outer atmosphere (chromosphere, transition region and corona). The chances of attaining this goal would be dramatically increased if we could carry out spectropolarimetric observations from space in order to measure the polarization signals that scattering processes induce in UV spectral lines, such as those of the Lyman series of hydrogen. The physical interpretation of this type of observations would allow us to infer the magnetic field vector via the Hanle effect, which consists in the modification of scattering polarization signals due to the presence of a magnetic field.
This contribution aims at illustrating the Hanle effect at work, demonstrating how the magnetic field vector can be retrieved. To this end, we present some examples of theoretical investigations, which have allowed us to extract the information encoded in the polarization signals of a few spectral lines that can be observed using high-sensitivity polarimeters on ground-based telescopes. Due to the limitations in the choice of spectral lines that can be observed from the ground, we will focus only on the following issues:
(1) The hidden magnetic fields of the "quiet" solar photosphere.
(2) The magnetic field that channels the dynamic jets that are called spicules.
(3) The magnetic field that confines the plasma of solar coronal filaments.
Our aim is to highlight the great diagnostic potential of spectropolarimetry and to argue that Europe would strengthen the leading role it already plays in this field if a development like a UV/EUV polarimeter in space is made.

Presentation: Talk
Time: 12:00 - 12:15

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UV Polarimetry of the Second Solar Spectrum

Achim Gandorfer[1]

(1) Max-Planck-Institut für Sonnensystemforschung

High sensitivity observations of scattering polarisation at the solar limb provide various insigths into the physics of the solar atmosphere, like temperature stratifications, electron densities, abundances, and - via the Hanle effect - also into its magnetic field structure. Detailed observations of this ”Second Solar Spectrum” have become possible during recent years, allowing for a systematic and rigorous exploration of the second solar spectrum from the visible down to the atmospheric cut-off around 310 nm. The complete data-set is available in the form of a spectral atlas to serve as a reference giude for future observations, as well as to guide theroretical efforts in this rapidly growing field of solar research.

Presentation: Talk
Time: 12:15 - 12:30

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Chromospheric and Coronal Magnetic Fields III

Tuesday, 14:00 - 15:15 **Chair: Franz Kneer**

Results from Chromospheric Magnetic Field Measurements

Andreas Lagg[1]

(1) MPS für Sonnensystemforschung

Hα observations revealed already in the early stages of solar observations the beauty and the huge variety of magnetic structures in the chromosphere. However, a comprehensive description of this important layer, coupling the photosphere to the corona, is still missing. The key for a deeper understanding of the chromosphere lies in the reliable determination of the vector magnetic field. The low magnetic field strengths combined with the complexity of non-LTE line formation requires a close interplay between advanced atomic physic modeling and sophisticated observational techniques and instrumentation. The progress in the development of such tools to measure these fields was enormous during the last decade. Especially the field of combined Zeeman and Hanle polarimetry has a great potential in determining the chromospheric magnetic field vector with high spatial and temporal resolution. In this talk I want to review the properties of selected chromospheric magnetic structures and also present some recent results on canopies, spicules and active regions.

Presentation: **Invited Talk**
Time: 14:00 - 14:30

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Magnetic loops: A comparison of extrapolations from the photosphere with chromospheric measurements

Thomas Wiegelmann[1], Andreas Lagg[1], Sami K. Solanki[1], Bernd Inhester[1], Joachim Woch[1]

(1) Max-Planck-Institut für Sonnensystemfosrschung

Direct observations of chromospheric and coronal magnetic fields are difficult and usually one has to reconstruct the 3D magnetic field from photospheric measurements. The extrapolation method depends on assumptions regarding the electric current flow in the coronal plasma. Due to the low plasma beta it is justified to assume that the currents are parallel or antiparallel to the magnetic field, the so called force-free assumption. Simplifications of the in general non-linear force-free magnetic model are linear force-free and potential fields.
We compare the different magnetic field models (potential, linear force-free, non-linear force-free) with the observationally inferred structure of magnetic loops in a newly developed active region. This is the first time that the reconstructed 3D-topology of the magnetic field is available to test the extrapolations. This comparison reveals that a potential field extrapolation is not suitable for a reconstruction of the magnetic field in this young, developing active region. The inclusion of field-line-parallel electric currents gives much better results. Furthermore, a non-linear force-free computation reproduces the observations better than the linear force-free approximation.

Presentation: Talk
Time: 14:30 - 14:45

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The vertical component of electric current densities in sunspots

Balthasar, H.[1]

(1) Astrophysikalisches Institut Potsdam

The vertical component of the electric current density is an important ingredient for extrapolations of the magnetic field from the photosphere to the corona. The ratio j_z/B_z determines the parameter alpha for the force-free case. In this contribution I present maps of several sunspots observed with the Tenerife Infrared Polarimeter (TIP). TIP delivers spectral line profiles in all four Stokes-parameters with a rather high spatial resolution. Using the SIR-code the magnetic field vector is obtained. In case that there is no temporally changing electric field, the vertical component of the current density is proportional to the vertical component of curl B. Vertical current densities in sunspots vary between a few and several dozen mA/m^2 (up and downward currents), both signs are present in one sunspot. Disturbances in the radial structure of the penumbra are related to enhanced current densities. The alpha-parameter varies over several orders of magnitude.
The presented results base on the assumptions that the magnetic field is continuous over at least three pixel (but Bellot Rubio et al. found two different atmospheric components interpreted as different magnetic flux tubes) and that the values of neighboring pixel correspond to the same geometrical height. The latter might be not the case at locations where we deal with strong variations of the local intensities.

Presentation: Talk
Time: 14:45 - 15:00

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Line formation in inhomogeneous magnetic fields and its implication for the magnetic flux in internetwork regions

Thorsten A. Carroll[1]

(1) Astrophysikalisches Institut Potsdam

Observations and recent numerical magneto-convection simulation pointing out that the nature of the internetwork magnetic field is highly intermittent and disorganized. How can we adequately describe the line formation in inhomogeneous and fluctuating atmospheric regimes with small scale embedded magnetic fields and how does the underlying structure of the atmosphere influence the outcome? Based on a stochastic formulation of the polarized radiative transfer - which not only accounts for a spatial variation of the atmospheric regimes perpendicular to the line-of-sight (LOS) but also for a variation along the LOS - I will present some investigations of Stokes profiles observed in the quiet solar photosphere. The results indicating that a meso-type structured magnetic atmosphere with mixed field strength and mixed size scales might be a more appropriate "adhoc" model for the magnetic internetwork than a conventional macroscopic flux tube model or a magnetic microstructured model (MISMA). Based on that mesostructured perspective I will also demonstrate, how the underlying correlation lengths (mean length scales) of the magnetic structures have a direct impact on the determination of the magnetic filling factor and the magnetic flux density.

Presentation: Talk
Time: 15:00 - 15:15

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Chromospheric and Coronal Magnetic Fields IV

Tuesday, 16:00 - 18:00 **Chair: Mats Carlsson**

Radio Measurements of Coronal Magnetic FIelds

Stephen White[1]

(1) University of Maryland

Coronal magnetic fields affect solar radio emission in several ways that lead directly to diagnostics. In active regions, the gyroresonance mechanism produces optically thick emission that dominates the radio images above frequencies of a few GHz, allowing the direct measurement of coronal magnetic field strengths above about 200 Gauss. Measurements of weaker fields outside active regions are more difficult, but there is information present in the radio polarization. We discuss the three-dimensional nature of coronal magnetic fields and the ways that radio data will be combined with data from other wavelengths and with extrapolations.

Presentation: **Invited Talk**
Time: 16:00 - 16:30

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Magnetic Fields in Coronal Dimming Regions

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Examination of the transient coronal holes that appear in conjunction with coronal mass ejections shows that some of these regions drop in intensity to a level that is consistent with the intensity of existing coronal holes. However, other so-called transient coronal holesmay dim dramatically, but only to a level close to the intensity level of the quiet sun. The variable timing of the commencement of the dimmings, together with the different intensities of the dimmings, points to the existence of different types of dimming. This study also examines the magnetic field in these dimming regions in order to search for a physical explanation for the different types of dimming that are observed.

Presentation: Talk
Time: 16:30 - 16:45

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Magnetic Field Extrapolation

Thomas Neukirch[1]

(1) University of St. Andrews

Detailed knowledge of the structure of the magnetic field is crucially important for gaining a better understanding of the physical phenomena occurring in the solar atmosphere, in particular the corona. Despite the progress made in developing methods for the direct measurement of the coronal magnetic field, magnetic field extrapolation methods are still indispensable for obtaining estimates of the coronal field structure. In this talk I will give an overview of the different magnetic field extrapolation methods, which have been proposed, focusing on theoretical aspects. I will also try to highlight some of the difficulties of magnetic field extrapolation.

Presentation: **Invited Talk**
Time: 16:45 - 17:15

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Describing Coronal Magnetic Fields by Successive Force-free Equilibria

Stephane Regnier[1], Richard C. Canfield[2]

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Solar flares are often related to photospheric motions such as moving magnetic features, sunspot rotation, cancelling magnetic features. In active region 8210 observed on May 1rst 1998, we have observed the clockwise rotation of the main sunspot. To understand the coronal response to this photospheric motion, we study the time evolution of the coronal magnetic field configuration near the sunspot where the flares have occured. We assume that the evolution of the magnetic field can be described by a series of nonlinear force-free equilibria reconstructed from photospheric vector magnetograms. The reconstructed magnetic structures involve field lines in a complex topology (e.g., null points, separatrix surfaces). The photospheric motion has moved the sunspot magnetic field lines towards the separatrix surface. As evidenced by the evolution of the reconstructed magnetic field, the above motion has led to reconnection process near the separatrix surface and associated with Hα blueshift events. We also study the evolution of the magnetic energy released during the process.

Presentation: Talk
Time: 17:15 - 17:30

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Solar wind origin in coronal funnels and correlation heights of the sources of solar ultraviolet emission

Eckart Marsch[1], Chuan-Yi Tu[2], Cheng Zhou[3], Li-Dong Xia[4], Liang Zhao[2], Jing-Xiu Wang[5], Klaus Wilhelm[1]

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Here we establish that the solar wind starts flowing out of the corona at heights above the photosphere between 5 Mm and 20 Mm in magnetic funnels. This result is obtained by a correlation of maps of the Doppler-velocity and radiance of spectral lines from various ions with the force-free coronal magnetic field as extrapolated from photospheric magnetograms to different altitudes. For maps in emission lines of Si II, C IV and Ne VIII it is found that, with increasing vertical height, each of the correlation coefficients initially increases, reaches a maximum and then decreases again. The height of this maximum is called correlation height. Thus we find that in coronal funnels Ne^{7+} ions mostly radiate around 20 Mm, where they have outflow speeds of about 10 km/s, whereas C^{3+} ions mainly radiate around 5 Mm, where they have no average flow speed. In contrast, in a quiet-Sun region the correlation heights of Si II and C IV are near 2 Mm, and for Ne VIII near 4 Mm. At these heights the averaged square root of the line radiance, which is considered as a proxy of the plasma density, depends linearly on the magnetic field Bz component. This empirical result indicates that the transition region may still be affected by frozen-in convection. A new model for the solar wind origin is suggested.

Presentation: Talk
Time: 17:30 - 17:45

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Coronal heating through braiding of magnetic field lines

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(2) Institute of Theoretical Astrophysics, University of Oslo, Norway

(3) Niels Bohr Institute, University of Copenhagen, Denmark

The lower corona and transition region of the Sun are highly structured through the magnetic field, and are very dynamic. To account for both the structure and the dynamics an 3D MHD model of a small active region in the corona is employed, with the heating being due to braiding of magnetic field lines. Based hereupon we derive the EUV emission line profiles from the transition region and corona, which can be directly compared to observations.
The flux-braiding heating results in the right differential emission measure (DEM) curve, i.e. we can reproduce the increase of DEM for low temperatures, without any spurious assumptions. Furthermore the Doppler shifts of the synthesized lines match the observed Doppler shifts strikingly well, and also the temporal variability described by the rms fluctuations of line intensity and shift compares very well with the observations.
To our knowledge this is the first coronal model to reproduce all these features qualitatively and quantitatively. It also provides a unique tool to explore stellar coronae and by this can be used to help defining new proposals for future instrumentation.

Presentation: Talk
Time: 17:45 - 18:00

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Coupling to the Photosphere I

Wednesday, 09:00 - 10:45 **Chair: Manfred Schuessler**

Magnetic Fields in the Solar Photosphere: Current Understanding and Future Prospects

H. Socas-Navarro[1], J. M. Borrero[1]

(1) HAO

The observational study of solar magnetic fields is rapidly evolving thanks to a suite of new (spectro-)polarimetric instruments. Increased angular resolution, polarimetric sensitivity and wavelength diversity, are providing exciting new insights into fundamental problems and a connected view of the photospheric/chromospheric coupling. In this talk, we review the most important advances made in our understanding of the photospheric field, both in the quiet Sun and in active regions. Finally, we present an overview of the next generation of instrumentation that will become operational during the next few years and could help resolve some of the current outstanding problems.

Presentation: **Invited Talk**
Time: 09:00 - 09:30

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Observations and simulations of bright points in the wing of Hα

J. Leenaarts[1], P. Sütterlin[1], M. Carlsson[2], H. Uitenbroek[3], R. J. Rutten[1]

(1) Sterrekundig Instituut Utrecht

(2) Institute for Theoretical Astrophysics, Oslo

(3) National Solar Observatory, Sacramento Peak

We present a comparison between Dutch Open Telescope observations of the sun at disk center in the blue wing of the Hα line and Hα images synthesized from 3D magneto-convection simulations. Small scale magnetic elements appear bright in the observations, which is quantitatively reproduced in the simulation. We show that the bright points are formed in LTE in the photosphere. The reason for the fluxtube brightening is the lower opacity in the fluxtubes combined with the smaller radial temperature gradient inside a fluxtube as compared to the surrounding granulation, similar to the G band bright point formation mechanism.

Presentation: Talk
Time: 09:30 - 09:45

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Magnetic flux losses from an active region and related coronal activity

Valentin Martinez Pillet[1], A. Sainz Dald[2]

(1) Instituto de Astrofisica de Canarias

(2) THEMIS/IAC

Sunspot decay has to be understood in the framework of the global evolution of the active region magnetic flux. While it has been traditionally considered in the context of the bipolar activity seen surrounding sunspots, we show that this activity is more linked to the penumbral dynamics. We then study an example of a decay process of a sunspot. This decay is put in the context of the disappearance of the active region flux as a whole. Active regions are seen to loose as much as 70 % of their flux "in-place". While this flux is being lost, the active region shows Coronal activity in the form of one filament eruption and several outward moving surges. This activity ceases at the same time as the active region flux losses stops. Only the remaining flux is left to participate in the diffusion processes that lead to the reversal of the polar fields.

Presentation: Talk
Time: 09:45 - 10:00

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Carbon monoxide in the magnetic chromosphere

Sven Wedemeyer-Böhm[1], Oskar Steiner[1], Werner Schaffenberger[1], Matthias Steffen[2], Bernd Freytag[3], Inga Kamp[4]

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(3) Los Alamos National Laboratory, USA

(4) Space Telescope Division of ESA, STScI, Baltimore, USA

We present the results of a first simulation of the formation of carbon monoxide in the solar atmosphere, including the low to middle chromosphere, in combination with magnetic fields. The radiation hydrodynamics code CO5BOLD has been extended to a magnetohydrodynamics version. Furthermore, the time-dependent treatment of chemical reaction networks has been added. Next to the time-dependent solution of the reaction network, the code accounts for the advection of the resulting particle number densities with the hydrodynamic flow field and also for the radiative cooling by carbon monoxide lines. The radiation transport is solved in two seperate bands, a continuum band with Rosseland mean opacity and an infrared band with additional CO opacity. The CO opacity is directly calculated from the time-dependent number densities. For the application presented here we use a chemical reaction network consisting of 27 reactions. It involves the chemical species H, H_2, C, O, CO, CH, OH and a representative metal.
Although the largest absolute amount of CO is located in the middle photosphere, CO is also abundant in the layers above and binds a large fraction of carbon. An exception are the hot propagating shock waves that frequently dissociate the carbon monoxide molecules. We address the distribution of CO in the dynamic and inhomogeneous atmosphere of the Sun and the role that magnetic fields play for it.

Presentation: Talk
Time: 10:00 - 10:15

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Magnetic Network and Canopy

Mei Zhang[1]

(1) National Astronomical Observatory, Chinese Academy of Sciences

Whereas it is generally believed that the magnetic field on the photosphere is concentrated into discrete flux tubes with kG field strengths, the situation is less clear in the upper atmosphere. The conventional canopy model predicts the magnetic structure in solar upper atmosphere by considering the force balance between the magnetic field and gas pressure inside the tube with the gas pressure outside. Since the external gas pressure declines upward rapidly, the flux tubes are considered to spread continuously until they cover almost the whole solar surface at a height of 1500 - 2500 km above the photosphere.
In this talk, we first present our observations on measuring the longitudinal photospheric (FeI 5324 line) and chromospheric (H_β line) magnetic fields in quiet-Sun regions. We find that the photospheric and chromospheric magnetic networks look quite similar to each other when observed in the disk center. There is only a limited expansion of the chromospheric magnetic element sizes compared to those on the photosphere. We then use polar magnetic field as a comparison to show that the longitudinal photospheric magnetic fields of quiet-Sun regions show little polarity reversal pairs when observed near equatorial limbs. This again implies little evidence of horizontal components and hence canopy structures. We further use TRACE 171A observations of thin fibril-like emissions whose roots are centered in simultaneous photospheric magnetic networks to show again that there is little expansion along each fibril from their roots to 40" (that is, 30Mm) higher up into the atmosphere. We end the talk with a discussion on possible implications of these observations.

Presentation: **Invited Talk**
Time: 10:15 - 10:45

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Coupling to the Photosphere II

Wednesday, 11:30 - 12:30 **Chair: Javier Trujillo Bueno**

Magnetic Structure of Solar Prominences

A. A. van Ballegooijen[1]

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Prominences (aka filaments) lie above polarity inversion lines (PIL) on the photosphere, and occur within filament channels, regions where the chromospheric fibrils are aligned with the PIL. This alignment indicates that the magnetic field in a channel has a strong äxialcomponent, i.e., the field deviates strongly from a potential field. Quiescent prominences often have barb-like extensions, and counter-streaming flows occur along the filament spine and barbs. Active region filaments are narrow and low-lying, indicating such filaments are embedded in untwisted magnetic structures. I will review observations and models related to filament magnetic structure and dynamics, including recent efforts to construct non-linear force-free fields (NLFFF) based on observed photospheric vector fields.

Presentation: **Invited Talk**
Time: 11:30 - 12:00

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Determination of the Magnetic Field Vector via the Hanle and Zeeman Effects in the He I 10830 Å Multiplet: Evidence for nearly vertical magnetic fields in a polar crown prominence.

Laura Merenda[1], Javier Trujillo Bueno[1], Egidio Landi Degl'Innocenti[2], Manuel Collados Vera[1]

(1) Instituto de Astrofísica de Canarias

(2) Dipartimento di Astronomia e Scienza dello Spazio, Università di Firenze

The magnetic field is the key physical quantity responsible of the formation, stability and evolution of solar prominences. Therefore, it is important to achieve a good empirical knowledge on the three-dimensional structure of prominence magnetic fields. Here we show how the magnetic field vector can be inferred via the physical interpretation of spectropolarimetric observations in the He I 10830 Å multiplet. To this end, we have developed an efficient inversion code based on the quantum theory of the Hanle and Zeeman effects and on a few (reasonable) modeling assumptions. We show an application to full Stokes-vector observations of a polar-crown prominence which in the slitjaw H_α image showed nearly vertical plasma structures, providing evidence for nearly vertical and relatively strong magnetic fields.
While these results provide new light on the geometry of the magnetic fields that confine the plasma of polar-crown prominences, they also urge us to develop improved solar prominence models and to pursue new diagnostic investigations, ideally via spectropolarimetry in several spectral lines simultaneously.

Presentation: Talk
Time: 12:00 - 12:15

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Evidence of photospheric magnetic dips in filament channel

Schmieder Brigitte[1], Lopez Arturo[2], Aulanier Guillaume[1], Mein Pierre[1]

(1) Observatoire de Paris

(2) THEMIS

We perform a fine analysis of a filament channel observed with THEMIS on October 16, 2004 in multi lines simultaneously (Halpha, Na D1 and Fe 6302A and Fe I 6303A).
We perform the inversion of the Stokes parameters by using the PCA method. A high sensitivity was achieved in the polarimetric observations. Weak parasitic polarities were detected in the filament channel. We deproject the observations in a local reference system. The 180 degree ambiguity is resolved by using the rules of the chirality. The magnetic vectors indicate a concave topology (magnetic dips) in the filament channel. Looking at the time evolution of the structures, the local changes of the Halpha filament is related to heating of the threads. We interprete these observations due to cancelling flux which transforms locally the dips in small arcades. The plasma is heated by dissipation of the magnetic energy reconnection. It is confirmed by a simple sequence of lfff models.

Presentation: Talk
Time: 12:15 - 12:30

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Coupling to the Photosphere III

Wednesday, 14:00 - 15:15 **Chair: Spiro Antiochos**

The size of small-scale solar magnetic structures.

Wiehr, Eberhard[1], Puschmann, Klaus[1]

(1) Institute for Astrophysics, Univ. Goettingen

Small-scale magnetic flux-concentrations are investigated from two-dimensional images taken in the CH 430 nm 'G-band' at the 1 m SST on La Palma. Image reconstruction by speckle masking, considering the variable correction of the adaptive optics over the field-of-view, yields a spatial resolution at the SST limit of 70 km on the solar surface. A particular pattern recognition algorithm is used to distinguish G-band bright points (BP) located in inter-granular lanes from others which are commonly assumed not to be of magnetic nature. Among a total of 2600 of such 'magnetic BP' 1100 (42%) show diameters in the range 150 km to 200 km; only 55 BP (2.5%) are smaller than 113 km and only 30 BP (1.3%) exceed 290 km. The lower histogram drop is near the 'optical scale height' $\Delta log\tau_{0.5} = 1.0$ which marks the transition to optically thin features. The upper limit yields for a flux density of 785 Mx/cm^2 a magnetic flux of 10^{17} Mx which is well below the lower limit of sunspots near 10^{19} Mx; that 'flux gap' might point to a fundamental difference between small bright and large dark magnetic features on the sun.

Presentation: Talk
Time: 14:00 - 14:15

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Magnetic fields measured in prominences and spicules

Arturo Lopez Ariste[1], Roberto Casini[2]

(1) THEMIS. CNRS UPS 853

(2) HAO. NCAR

We present measurements of the magnetic field vector in prominences and spicules inferred from full-Stokes spectropolarimetry of the He D3 line. Zeeman and Hanle effects combine to make of this line a powerful diagnostic tool for magnetism in these solar features. General prominence magnetic topology is confirmed. We observe however the presence of up to 60G fields in the body of the prominence. In spicules the field appears to be either transversal or aligned with the spicule (a 90 degrees ambiguity leaves the two options open) and with field strengths up to 40G but not much higher than that.

Presentation: Talk
Time: 14:15 - 14:30

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Magnetic topologies: where reconnection will occur ?

Demoulin Pascal[1]

(1) Paris Observatory

The energy needed to power flares is thought to come from the coronal magnetic field. However, such energy release is efficient only at very small scales.
Magnetic configurations with a complex topology, i.e. with separatrices, are the most obvious configurations where current layers can spontaneously form in 2-D configurations. This has been extended to 3-D configurations with a variety of magnetic topologies not suspected before. If the photospheric field is described by an ensemble of concentrated magnetic sources, separated by flux-free regions, one can deduce the coronal topology of the associated potential field. A complete topological description is provided by the skeleton formed by the null points, spines, fans and separators. In order to better match the observed photospheric magnetograms, the magnetic sources can be set below the photosphere. An extra topological element then can appear, so-called bald-patches.
In several flaring configurations the computed separatrices permit to understand the localization of the flare ribbons in the framework of magnetic reconnection. However, this view is too restrictive taking into account the variety of observed solar flaring configurations. Indeed 'quasi-separatrix layers' (QSLs), which are regions where there is a drastic change in field-line linkage, generalize the definition of separatrices for magnetic fields extending in the full volume (photosphere and corona). Also 'hyperbolic flux tube' (HFT) generalizes the concept of separator.
These studies indeed teach us that coronal magnetic reconnection occurs in a broader variety of magnetic configurations than traditionally thought, and this variety is reviewed.

Presentation: **Invited Talk**
Time: 14:30 - 15:00

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Solar coronal heating by forced magnetic reconnection:multi-pulse driving

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(1) Department of Applied Mathematics, University of sheffield, UK

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(3) Earth Simulator Center, Japan

Magnetic reconnection is a strong candidate for a coronal heating mechanism, and here we investigate heating by forced magnetic reconnection. Two dimensional, nonlinear magnetohydrodynamic simulations are used to investigate forced magnetic reconnection in a compressible plasma. The reconnection occurs when a sheared force-free field is perturbed by a slow disturbance (pulse) at the boundary which is representative of the solar corona where the reconnection is induced by the photospheric motions. The case of driving by successive pulses, which generate a series of heating events which may interact with each other, is considered. This is in order to model the heating of the corona by a series of *nanoflare* events. For small perturbations, the simulation results are consistent with the previous analytic theory based on linear approach where a current sheet is formed initially at the resonant surface followed by reconnection and then release of magnetic energy. For large amplitude perturbations, or close to the threshold for tearing instability, the system exhibits strong nonlinear aspects. Following the second driving pulse, the current sheet expands along the separatrix before relaxing to a reconnective equilibrium and releasing even more magnetic energy for the same amplitude perturbation.

Presentation: Talk
Time: 15:00 - 15:15

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Coupling to the Photosphere IV

Wednesday, 16:00 - 17:45 **Chair: Tetsuya Magara**

Formation and dynamics of current sheets

Hiroaki Isobe[1]

(1) Department of Earth and Planetary Science, University of Tokyo

Current sheets are believed to be essential for magnetic energy dissipation in the solar chromosphere and corona. They are formed by photospheric motions, instabilities or loss of equilibrium of magnetic arcades with/without flux rope, emergence of new flux system, etc. Observations suggest that magnetic reconnection and particle acceleration in the current sheets are highly intermittent and bursty, contrary to the classical view of laminar and steady reconnection. Such intermittency is attributed to various dynamic phenomena in the current sheet such as tearing instability and coalescence and ejection of magnetic islands.
After reviewing recent observations and numerical simulations that indicate the intermittent nature of the current sheet, I will present the results of our three-dimensional MHD simlation of emerging flux and its interaction with pre-existing coronal field, which was carried out on the Earth Simlator. The simulation shows that filamentary sturucuture similar to the well-know arch filament system sponteneously develops due to the magnetic Rayliegh-Taylor instability. As a result, many filamentary current sheets are formed in the emerging flux, and magnetic reconnection occurs between the interchanging emerging flux and coronal field in a spatially intermittent way. We also sugget that such intermittent reconnection can occur in various dynamically evolving system and may explain the origin of fine structures in solar flares and jets.

Presentation: **Invited Talk**
Time: 16:00 - 16:30

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MHD Shock wave structure in spontaneous supersonic fast magnetic reconnection

Tohru Shimizu[1], Masayuki Ugai[1], Kondo Kohji[1]

(1) Ehime University

Theoretical study of MHD shock waves in spontaneous supersonic fast magnetic reconnection is presented. According to MHD simulations, when the spontaneous reconnection process stays in a steady state and ejects a plasmoid in the downstream jet, a slow shock associated with the reconnection process is finally devided into two regions, i.e. jet and plasmoid regions, and then, a fast shock appears between those slow shocks. These shock waves intersect at a point in front of the plasmoid. With the Rankine Hugoniot relation, it is shown that these shock structure can be closely related to the plasmoid propagation speed and the compression ratio of plasmoid (i.e. fast shock). Then, the theoretical study of the Rankine Hugoniot relation is compared with the MHD simulation results. This study may be useful to specify whether a plasmoid observed in solar flares is formed by the Petschek or the Sweet-Parker reconnections.

Presentation: Talk
Time: 16:30 - 16:45

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Evolution of Twisted Magnetic Flux Ropes Emerging into the Corona

Yuhong Fan[1]

(1) NCAR

We present MHD simulations in spherical geometries of the evolution of the coronal magnetic field as a twisted magnetic flux rope emerges slowly into a pre-existing potential arcade field. We have considered both an idealized 2D axisymmetric toroidal flux rope circling around the sun, and also a 3D flux rope with its ends line-tied to the surface. In both cases, the simulations show two distinct stages of the evolution. The earlier evolution is quasistatic during which if the flux emergence is stopped, the flux rope settles to a neighboring equilibrium with stored free magnetic energy. Current sheets may develop along the "bald-patch" separatrix surfaces of these partially emerged flux ropes, explaining both the observed X-ray sigmoids and also the presence of a hot X-ray source at the prominence location in the cavity of a stable polar crown filament. Loss of equilibrium and eruption of the flux rope are found for both the 2D axisymmetric flux rope and the 3D line-tied flux rope, when too much twisted flux is transported into the corona. For the 3D line-tied flux rope, we find that with the build-up of a moderate amount of twist (< 2 full winds of field-line twist between the line-tied ends), the flux rope can erupt through the arcade at a localized area, with most of the arcade field remaining closed. The non-linear evolution of the kink instability facilitates the loss of confinement of the flux rope by changing its orientation at the apex such that it becomes easier for the flux rope to part and erupt through the arcade.

Presentation: **Invited Talk**
Time: 16:45 - 17:15

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Magnetic flux emergence and its 3D reconnection with the existing coronal field

Klaus Galsgaard[1], Archontis, V.[2], Moreno-Insertis, F.[2], Hood, A.[3]

(1) NBI Univesity of Copenhagen

(2) IAC

(3) University of St Andrews

As magnetic flux emerges through the photosphere it rapidly expands into the transition and coronal region. This volume is already filled with magnetic flux, so the emerging flux has to interact with the existing field to make it way into the corona. This happens either by pushing the overlaying field away or by cutting through it by the means of magnetic reconnection. In all off our numerical experiments it is found that, sooner or later, localised current concentrations form and eventually magnetic reconnection starts. This process has been observed by TRACE. Here we precent the result of numerical simulations of the emergence of a twisted flux robe into a laminar coronal magnetic field. The talk will emphases the dynamic interaction between the two flux systems and the deviations in the process that arises as the relative orientation between the two flux systems is changed. It is found that a 3D reconnection process drives the dynamics and that it shows clear deviations from simple textbook examples.

Presentation: Talk
Time: 17:15 - 17:30

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The initiation of solar eruptions by the kink instability

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We show that the ideal kink instability of line-tied, force-free magnetic flux ropes successfully models the onset and initial evolution of filament eruptions and fast coronal mass ejections (CMEs) and is therefore a very promising candidate for the mechanism of their initiation. MHD simulations of the instability yield full qualitative agreement with characteristic properties of such events, such as their rise profiles and the development of helical shape in the course of the eruption. The formation of post-ejection loops by magnetic reconnection in a vertical current sheet below the rising flux rope is also obtained. The instability evolves into a CME if the field initially overlying the flux rope decreases sufficiently fast with height; otherwise the ascent is stopped by the development of a current sheet and magnetic reconnection above the rope. Scaling two simulations with different overlying fields to such a confined event (on 2002 May 27) and to two well-observed CMEs (on 2001 May 15 and on 2004 November 10) yields very good quantitative agreement with the observed shapes and rise profiles, and plausible values of the released energy in all cases. We discuss the relationship between the ideal kink instability and the closely related magnetic reconnection in the formed vertical current sheet, i.e., between the "CME part" and the "flare part". This relationship indicates the dominance of the ideal MHD instability (the CME) in the closely coupled processes.

Presentation: Talk
Time: 17:30 - 17:45

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Magnetic Structures I

Thursday, 09:00 - 10:45 **Chair: Stephen White**

Time-dependent Response of the Large-Scale Solar Corona

Jon A. Linker[1], Roberto Lionello[1], Zoran Mikic[1], Pete Riley[1]

(1) SAIC

The solar magnetic field defines the structure of the solar corona and inner heliosphere, including the position of the heliospheric current sheet and the regions of fast and slow solar wind. It is difficult to measure the magnetic field in the corona, but the Sun's magnetic field has been measured in the photosphere for many years. Understanding the large-scale structure of the corona and heliosphere requires accurately mapping the photospheric magnetic field into the corona and outward. Typically, when the coronal magnetic field is modeled (either by potential field assumptions or MHD), steady-state solutions are sought for a given boundary condition based on photospheric magnetic fields. However, the magnetic flux on the Sun is constantly evolving, and the coronal magnetic field must respond to this evolution. In this talk, we describe MHD simulations of the response of the coronal magnetic field to different aspects of photospheric flux evolution, including differential rotation and emerging flux. We apply our results to current controversies regarding the evolution of open and closed magnetic flux (e.g, Fisk, JGR 108, 157, 2003; Wang & Sheeley, APJ 612, 1196, 2004).

Presentation: **Invited Talk**
Time: 09:00 - 09:30

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The Role of Magnetic Helicity in the Initiation of CMEs from Emerging Active Regions

A. Nindos[1]

(1) University of Ioannina

Recently Nindos & Andrews (2004, ApJ, 616, L175) found that in a statistical sense the preflare value of the coronal magnetic helicity of active regions producing CME-associated big flares is larger than the value of magnetic helicity of those producing big flares that do not have associated CMEs. The obvious question arising from the above result is whether CME initiation is controlled by the amount of magnetic helicity stored in the corona. We investigate this problem by studying several active regions that emerge on the visible side of the solar disk. For each active region, its magnetic helicity content is monitored from its emergence until the active region reaches a heliographic longitude of 45-50 degrees or until the occurrence of the first CME associated with it (whichever happens first). The main statistical result of our study suggests that when CMEs occur, the coronal magnetic helicity is larger than the coronal magnetic helicity of those active regions that do not produce any CMEs. This result is independent of the strength of CME-associated flares. We also study the relation of the occurrence of CMEs to the spatial distribution of the helicity injected into the corona.

Presentation: Talk
Time: 09:30 - 09:45

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Quantitative link between solar ejecta and interplanetary magnetic clouds: magnetic helicity

Cristina H. Mandrini[1], Sergio Dasso[2], Maria Luisa Luoni[1], Pascal Démoulin[3], Silja Pohjolainen[4], Lidia van Driel-Gesztelyi[5]

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We provide evidence for the link between coronal ejective events and their interplanetary manifestations. We combine multi-wavelength remote sensing and in situ observations with the computation of the coronal and interplanetary magnetic fields using a standard linear force-free approach. The analysis and computations are applied to one of the smallest and to a large ejecta, as well as to their related magnetic clouds.
The connection between the coronal and interplanetary events is shown by comparing the magnetic helicity variation (pre- to post-eruption) in the corona to the helicity content in the associated magnetic clouds, and through the compatibility of other observational characteristics (e.g. spatial orientation) and computed quantities (e.g. magnetic flux) in both environments.
Our results show that, within the uncertainties, the computed helicities are in good agreement. They also show that the magnetic orientation of the ejecta changed little from Sun to Earth. Such quantitative analyses help to unambiguously identify the solar source region and flare/CME event of magnetic clouds, and may help to forecast the magnetic impact of an ejecta at Earth.

Presentation: Talk
Time: 09:45 - 10:00

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Observations of Large-Scale Instabilities

Lyndsay Fletcher[1]

(1) University of Glasgow

Energy stored in the coronal magnetic field, when released, gives rise to the many forms of coronal activity that we observe. These include plasma mass motion, heating and particle acceleration. As this talk will show, observational data are being used to look at all stages of the coronal energy release process, from the magnetic configuration of the regions in which the energy is stored and released, to the energy partition of the resulting event deduced from observations in multiple wavelength ranges. Two main themes will be elaborated on - firstly the growing observational confirmation that topological structures such as separatrix structures are crucial in at least the early stages of the instability, and secondly that the description of the overall energetics is incomplete without consideration of the non-thermal particles budget, which turns out to be a ubiquitous feature of the active corona. I will also present some recent work from members of the RHESSI Multi-wavelength Observations Working Group, which bears strongly on the topic of instabilities, such as early-phase coronal hard X-ray sources and flare footpoint motions.

Presentation: **Invited Talk**
Time: 10:00 - 10:30

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Simulation Study on the Self-Organization of Sigmoidal Structure and the Onset of Solar Flares

Kanya Kusano[1], Satoshi Inoue[2], Tetsuya Yamamoto[3], Takaaki Yokoyama[3], Takashi Sakurai[4]

(1) The Earth Simulator Center, Japan Agency for Marine-Earth Science and Technology

(2) Graduate School of Advanced Sciences of Matter, Hiroshima University

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(4) National Astronomical Observatory of Japan

The onset mechanism of solar flares is a crucial subject not only in the solar physics but also for the general understanding of nonlinear plasma dynamics. Although the recent observations strongly support the reconnection scenario, in which magnetic reconnection plays a key role for the energy liberate in flare processes, how and why can magnetic reconnection be triggered suddenly in flare events still remains as fundamental open questions. In order to find the answer, we have to explain not only the dynamics in the main phase of flares, but also the transition mechanism from pre-flare to flare phase. It is an important test bench for the onset model to explain the causal relation between the formation of sigmoids and the onset of flares, because sigmoids are widely believed to be typical precursor phenomena of the eruptive events.
We present the new simulation results of the high-resolution 3D MHD model, in which the nonlinear evolution of a thin current sheet formed above the magnetic neutral line is investigated in detail, using the state-of-art technique of parallel computation. The results indicate that the tearing mode instability growing on the current sheet can drive the self-organization of sigmoidal structure, and that the reconnection between the sigmoidal field and the overlaying field leads to the collapse of magnetic arcade, which is followed by the large-scale eruption. Mutual excitation of double reconnections plays an important role for the transition from the collapsing to the eruption.
The results strongly suggest that the nonlinearity in the tearing instability growing on the current sheet can play a principal role both for the sigmoidal formation and the onset of flares. Based on the simulations, a new model of flare onset is proposed. The careful comparison of the simulations with the multiple wavelength observations is also discussed.

Presentation: Talk
Time: 10:30 - 10:45

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Magnetic Instabilities I

Thursday, 11:30 - 12:30 **Chair: Eric Priest**

Theory of Large-Scale Magnetic Activity

Spiro K. Antiochos[1]

(1) NRL

One of the most challenging problems in solar physics is understanding the processes responsible for giant magnetic disruptions such as the event of July 14, 2000, which consisted of a massive filament ejection, a fast coronal mass ejection (CME), prolonged X-class flaring, and an intense particle storm. These major events are of critical importance because they drive the most destructive forms of space weather and they provide a unique opportunity to study, in revealing detail, MHD instability and nonequilibrium – processes that are at the heart of plasma astrophysics. It is now widely accepted that CMEs/eruptive flares represent the explosive release of magnetic energy stored in the corona. Therefore, in order to understand the phenomenon, we must answer the following questions: What is the field structure responsible for the disruption and why is the energy released explosively? In this talk we address these two questions using the latest theories and numerical models for CMEs/eruptive flares.
This work was supported, in part, by NASA and ONR.

Presentation: **Invited Talk**
Time: 11:30 - 12:00

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Numerical Simulations of 3D Magnetic Reconnection

I. De Moortel[1], K. Galsgaard[2]

(1) University of St Andrews

(2) Niels Bohr Institute

We present the results of numerical simulations of 3D magnetic reconnection driven by photospheric footpoints. We investigate the location of the reconnection in relation to the evolving magnetic skeleton, as well as the rate and efficieny of the energy release. Different types of photospheric motions, such as rotation and twisting of the footpoints are studied and the results are compared with a recent analytical study into the formation of strong currents along coronal loops (Priest, Loncope and Heyvaerts, 2005). These authors compare energy storage and heating occuring at separatrices and separators and suggest that coronal heating is of comparable importance at both of these locations.

Presentation: Talk
Time: 12:00 - 12:15

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The torus instability in coronal mass ejections

Bernhard Kliem[1], Tibor Török[2]

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(2) Mullard Space Science Laboratory, University College London+

We model CMEs as expanding toroidal current rings. The ring is unstable against expansion if the external poloidal field $B_{\rm ex}$ decreases sufficiently rapidly with distance R from torus centre. For steep profiles of $B_{\rm ex}(R)$, representative of active regions, the expansion accelerates initially nearly exponentially, followed by a nearly linear further expansion. For only slightly supercritical profiles of $B_{\rm ex}(R)$, representative of the quiet Sun, the acceleration profile increases very slowly with R so that a nearly constant acceleration is observed during the expansion over many initial radii R_0. The two apparently disparate classes of fast and slow CMEs are thus described in a uniform manner by the model. While the photospheric line tying of flux ropes acts stabilizing with regard to the torus instability, it raises the acceleration and extends the radial range of significant acceleration in comparison to an untied, freely expanding ring if the instability occurs. It also enforces an overproportional expansion of the minor radius with the consequence that a cavity and hence the classical three-part structure of CMEs are formed. We discuss the relationship of the torus instability to the helical kink instability in CMEs. The two related ideal MHD instabilities can explain the onset of CMEs and their essential properties (rise profiles, helical shape, three-part structure), leaving the formation of unstable flux ropes as the main open question of a flux rope model for CMEs.

Presentation: Talk
Time: 12:15 - 12:30

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Magnetic Instabilities II

Thursday, 14:00 - 15:15 **Chair: Pascal Demoulin**

Small-scale magnetic activity

C.J. Schrijver[1]

(1) LMATC

Magnetic field emerges onto the solar surface in bipolar regions which range over at least six orders of magnetude in flux down to the smallest observable scales. In recent years, we have realized that the smallest end of this spectrum, from the so-called ephemeral regions downward, plays fundamental roles in sustaining the chromospheric network, in the surface dispersal properties of the global magnetic field, and as the foundation of much of the heliospheric field. What do we know of the origin and evolution of the smallest-scale field? What are the properties of the atmosphere above the magnetic carpet that is formed by the multitude of small-scale flux concentrations?

Presentation:	**Invited Talk**
Time:	14:00 - 14:30

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Correlations between spicules in the chromosphere and in the transition region

Alfred de Wijn[1], B. De Pontieu[2], R. Erdélyi[3]

(1) Sterrekundig Instituut, Utrecht University

(2) Lockheed Martin Solar and Astrophysics Laboratory

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Spicules and mottles provide a powerful diagnostic to study the structure and dynamics of the magnetic structure in the solar chromosphere and transition region. They are visible in the low chromosphere in Ca II, and in the middle and high chromosphere in Hα. They have been associated with dark structures in transition region "moss", seen in 171Å observations from the Transition Region And Coronal Explorer (TRACE). We compare spicules in the chromosphere, imaged in Hα line profiles with the SOUP filter installed at the Swedish 1-meter Solar Telescope, with emission from the transition region, observed in C IV constructed from 1550Å, 1600Å, and 1700Å UV images from TRACE. The broader investigation by De Pontieu et al. (2003) found that often these downflows are accompanied by brightenings in C IV, suggesting that some parts of spicular jets are heated to transition-region temperatures. We expand on this an anti-correlation between the red wing of Hα and C IV emission and the consequences for the relation between heating mechanisms and the energy balance in the chromosphere and in the transition region.

Presentation: Talk
Time: 14:30 - 14:45

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Observation of small scale reconnections during the emergence of undulated flux tubes

Pariat E.[1], Aulanier G.[1], Schmieder B.[1], Georgoulis M.K.[2], Rust D.M.[2], Bernasconi P.N.[2]

(1) Observatoire de Paris, LESIA

(2) Johns Hopkins University, Applied Physics Laboratory

With Flare Genesis Experiment (FGE), a balloon borne observatory launched in Antarctica on January 2000, series of high spatial resolution vector magnetograms, Dopplergrams, and Hα filtergrams have been obtained in an emerging active region (AR 8844). We performed a linear force-free field extrapolation of the field above the photosphere. The analysis of the chromospheric magnetic topology reveals the existence of undulated low-lying field lines, presenting a 'sea-serpent' shape. These field lines are passing through several "Bald Patches" regions (BPs are regions where the vector magnetic field is tangential to the photosphere). These separatrice field lines are thus connected to the photosphere. The undulation spectrum leads us to suppose that the undulations are due to the Parker instability. In addition, these undulated field lines are highly associated with many short-lived and small-scale Hα brightenings called 'Ellerman bombs', which are likely to be due to magnetic reconnections along the BP separatrices. This observation permits us to conjecture that reconnection plays a key role in the flux tube emergence process. Arch filament systems and active region coronal loops do not result from the smooth emergence of large scale Ω loops, but rather from the rise of flat undulated flux tubes which get released from their photospheric anchorage by reconnection at BPs.

Presentation: Talk
Time: 14:45 - 15:00

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Physically consistent simulation of chromospheric and coronal magnetic fields

Büchner, Jörg[1]

(1) Max-Planck-Institut für Sonnensystemforschung

A popular approach in solar physics is the force-free extrapolation of photospheric magnetic fields to the corona. By its very definition this approach excludes the consideration of forces which form and heat the solar corona and accelerate the solar wind. Contrary, real plasma simulations allow the investigation of the solar magnetic field taking into account the physical processes acting in the corona. In this 10-minute presentation we can give only a short overview of what has been achieved in our Lindau group to consistently simulate the chromospheric, transition layer and coronal magnetic fields based on the observed photospheric plasma motion and magnetic fields in order to trigger appropriate and extended discussions of the progress in simulating solar magnetic fields during this meeting.

Presentation: Talk
Time: 15:00 - 15:15

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Magnetic Instabilities III

Thursday, 16:00 - 16:45 **Chair: Adriaan van Ballegooijen**

Downflows along an off-limb loop structure seen both in 30.4nm and in Hα

Anik De Groof[1], Daniel A.N. Mueller[2], Stefaan Poedts[1]

(1) Centrum voor Plasma Astrofysica, K.U.Leuven

(2) Institute of Theoretical Astrophysics, University of Oslo, NORWAY

An EIT shutterless campaign was conducted on 11 July 2001 and provided 120 high-cadence (68s) 30.4 nm images of the north-eastern quarter of the Sun. Systematic intensity variations are seen which appear to propagate along an off-limb half loop structure. In this paper we study the nature of these intensity variations by confronting the EIT observations with simultaneous Hα images from Big Bear Solar Observatory.
The two image sets are carefully co-registred by means of a new technique designed to compare data of two different instruments, and later overplotted in order to visualize and compare the behaviour of the propagating disturbances in both data sets. Since the same intensity variations are seen in the EIT 30.4 nm and in the Hα images, we confirm the interpretation of De Groof et al. 2004 (A&A 415, p1141) that we are observing downflows of relatively cool plasma. The origin of the downflows is explained by numerical simulations of "catastrophic cooling" in a coronal loop which is heated predominantly at its footpoints.

Presentation: Talk
Time: 16:00 - 16:15

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A multi-wavelength view on coronal rain

Daniel Mueller[1], Bart De Pontieu[2], Viggo Hansteen[1]

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Observations of coronal loops at high temporal resolution reveal their highly dynamic nature. Bright features (”blobs”) suddenly appear in the upper corona and subsequently rain down along magnetic field lines towards the solar surface. The acceleration of these blobs is significantly smaller than free-fall, and some blobs brighten up before reaching the surface.
In order to explain these phenomena, we compare time-series of high-resolution images of coronal rain taken with the Swedish Vacuum Solar Telescope (Hα and Ca II K) and TRACE (160 nm passband) with detailed numerical simulations.
Our simulations show that any heating mechanism which dissipates energy predominantly at the footpoints of coronal loops is able to trigger a highly dynamic evolution due to a loss of thermal equilibrium at the loop apex. The resulting process of ”catastrophic cooling” gives rise to fast downflows of cool, dense plasma blobs which emit strongly in emission lines formed at transition region and chromospheric temperatures. Since we solve the non-equilibrium atomic rate equations self-consistently with the dynamic equations, we are able to calculate time-dependent emission and line-shifts for a large number of optically thin emission lines.
We study the evolution of the observed blobs in different wavelengths by tracking their paths, intensities and velocities. From this analysis, we find a good qualitative agreement with the catastrophic cooling model. This finding is supported by data from several other recent observing programs, e.g. an EIT shutterless campaign and a joint observing program (JOP 174) of SOHO and TRACE.

Presentation: Talk
Time: 16:15 - 16:30

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Transverse waves in a post-flare supra-arcade

E. Verwichte[1], V.M. Nakariakov[1], F.C. Cooper[1]

(1) University of Warwick

Observations of propagating transverse waves in an open magnetic field structure with TRACE are presented. Waves associated with dark tadpole-like sunward moving structures in the post-flare supra-arcade of NOAA AR 9906 on April 21, 2002 are analysed. They are seen as quasi-periodic transverse displacements of the dark tadpole tails, with periods in the range of 90-220 s and are interpreted as propagating fast magnetoacoustic kink waves guided by a vertical, evolving, open structure.

Presentation: Talk
Time: 16:30 - 16:45

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Chromospheric and Coronal Seismology I

Friday, 09:00 - 10:30 **Chair: Eckart Marsch**

Chromospheric Waves

Mats Carlsson[1], Bob Stein[2]

(1) Institute of Theoretical Astrophysics, Oslo

(2) Michigan State University, East Lansing, USA

There is a large volume of observations showing wave phenomena in the solar chromosphere. These waves affect the very structure of the chromosphere, may contribute to the heating of both the chromosphere and higher lying regions and may provide powerful diagnostics using seismological techniques. In this contribution we will review the observations of chromospheric waves and compare with simulations of wave excitation in the solar convection zone and of wave propagation and mode conversion in realistic magnetic field topologies. We will specifically address the effects of waves on the chromospheric structure and energetics and the prospects of chromospheric seismology.

Presentation: **Invited Talk**
Time: 09:00 - 09:30

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Simulations of magneto- acoustic waves in sunspots

Elena Khomenko[1], Manolo Collados[1]

(1) Instituto de Astrofisica de Canarias

We report the simulations of magneto-acoustic wave propagation in a sunspot-like structure of magnetic field. A code based on the finite difference discretization of the linear MHD equations written in the conservation form has been developed. The boundary conditions were improved in the way to let the outgoing waves coming out of the computational box almost without reflection. A sunspot-like structure in a agneto-static equilibrium is perturbed by a pressure or velocity pulse at the photospheric level giving rise to propagating waves. The propagation of waves is studied from the photosphere to the low chromosphere as a function of initial conditions (pulse location, period, perturbing quantity). The type of modes that develop depends on the ratio between the magnetic and gas pressure and a mode conversion is observed to occur effectively in the region were both values are similar. A wave refraction back to the photosphere appears at somewhat higher layers.

Presentation: Talk
Time: 09:30 - 09:45

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Detection of waves in the equatorial coronal holes

D. Banerjee[1], E. O'Shea[2], J.G. Doyle[3]

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(3) Armagh Observatory

We examine long spectral time series of coronal holes with the Coronal Diagnostic Spectrometer (CDS) on-board SoHO. The observations were obtained with several transition region and coronal lines. We compare the dynamics of equatorial coronal holes and the polar coronal holes. Presence of long period waves in the plumes and inter-plume regions have been reported earlier from CDS and SUMER observations. From a study of several transition region and coronal lines we will report on the presence of long period outwardly propagating waves in several locations on the disk part of the coronal holes. From a joint study of SUMER and MDI, recently it has been discovered that the fast solar wind originates from the coronal funnels in the polar regions. In this presentation we will focus on the equatorial coronal holes. We will also try to search for the origin of these long period waves and will report on the connection, if any, of network boundaries in the coronal holes. If we are able to identify and characterize these waves properly, they will provide additional tools in the study of coronal seismology.

Presentation: Talk
Time: 09:45 - 10:00

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Waves and Oscillations in coronal loops

T. J. Wang[1]

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In the past few years observations by high-resolution space imaging telescopes and spectrometers have confirmed that a great variety of MHD waves are supported in the solar corona of a low-beta plasma and fine structure. MHD waves are an important diagnostic tool for the determination of the physical parameters of coronal loops, dubbed coronal seismology. In this talk, I will review recent results of both propagating and standing waves observed with SOHO and TRACE, and discuss the wave damping and excitation mechanisms as well as some applications of coronal seismology based on recent numerical simulations and theories in relation to the observations.

Presentation: **Invited Talk**
Time: 10:00 - 10:30

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Chromospheric and Coronal Seismology II

Friday, 11:00 - 12:30 **Chair: Valery Nakariakov**

Impulsive generation of vertical oscillations of a solar coronal arcade loop

M. Selwa[1], K. Murawski[1], S. K. Solanki[2]

(1) Institute of Physics, UMCS, Lublin, Poland

(2) MPS Lindau

We consider impulsively generated oscillations of a solar coronal arcade loop. The two-dimensional ideal MHD numerical model we implement includes the effects of field line curvature and nonlinearity on the excitation and damping of standing fast magnetosonic waves. The results of the numerical simulations reveal wave signatures which are reminiscent of recent TRACE observational data. From our parametric studies we deduce that wave periods and attenuation times of the excited waves depend upon the position of the pulse below the loop summit, as well as its width and strength; wider pulses launched closer to a foot-point and to the loop apex trigger wave packets dominated by with longer period which are more strongly attenuated. We consider two kinds of damping mechanisms: wave leakage and geometric loop restructuring due to the initial pulse.

Presentation: Talk
Time: 11:00 - 11:15

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Dynamics of coronal loop oscillations

Tom Van Doorsselaere[1], Inigo Arregui[1], Jesse Andries[1], Stefaan Poedts[1], Marcel Goossens[1]

(1) Centre for Plasma Astrophysics, KULeuven, Belgium

We will discuss the observed transversal oscillations of coronal loops, which are strongly damped. Several features are added to the classical (straight) cylindrical coronal loop model. In our models we include vertical density stratification, highly inhomogeneous radial density profiles and footpoint leakage.
We investigate the effect of vertical density stratification both numerically and analytically. We can conclude that longitudinal stratification establishes a coupling between different longitudinal mode numbers. On the other hand, the observational parameter $\tau_{\text{damping}}/\text{Period}$ is not influenced.
However, since the ratio of periods of different longitudinal numbers is different from 2, we can estimate the density stratification in a loop if two longitudinal mode numbers are observed. We can conclude that the inclusion of vertical density stratification provides an excellent tool for coronal seismology.
We extend our investigation by performing 2D time-dependent simulations of coronal loops subject to footpoint leakage. As a result, an extra damping mechanism is introduced. The question still remains whether this leakage has a substantial effect on the damping times of the coronal loop oscillations.

Presentation: Talk
Time: 11:15 - 11:30

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First results from SECIS observations of the 2001 total Solar eclipse

A.C. Katsiyannis[1], F. P. Keenan[2]

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(2) Queen's University Belfast

SECIS observations of the June 2001 total solar eclipse were taken using an Fe XIV 5303A filter. Existing software was modified and new code was developed for the reduction and analysis of these data. The observations, data reduction, study of the atmospheric and instrumental effects, together with some preliminary results are discussed. Emphasis is given to the techniques used for the automated alignment of the 8000 images, the software developed for the automated detection of intensity oscillations using wavelet analysis and the application of the Monte Carlo randomization test as a means of checking the relability of those detections. In line with findings from the 1999 SECIS total eclipse observations, intensity oscillations with periods in the range of 7-8 s, lying outside coronal loops were also detected.

Presentation: Talk
Time: 11:30 - 11:45

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X-ray quasi-periodic pulsations in solar flares as magnetohydrodynamic oscillations

C. Foullon[1], E. Verwichte[1], V. M. Nakariakov[1], L. Fletcher[2]

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(2) University of Glasgow

We report the first observation at high spatial resolution of long-period (8-12 min) quasi-periodic pulsations (QPP) of X-ray radiation during solar flares, made possible with the Reuven Ramaty High Energy Solar Spectroscopic Imager (RHESSI), supported by complementary data at other wavelengths from space-based and ground-based telescopes. Evidence for the presence of a transequatorial loop possibly responsible for the detected periodicity is found. Our findings demonstrate that QPP can be interpreted as a periodic pumping of electrons in a compact flaring loop, modulated by oscillations in a magnetically linked and larger loop acting as a long-period magnetohydrodynamic resonator.

Presentation: Talk
Time: 11:45 - 12:00

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Poster Session

Foyer and seminar room

Poster Number: P.01

Multispacecraft observations of discontinuities in the solar wind.

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Present paper is dedicated to the analysis of data, which are obtained by simultaneous measurements carried out onboard five satellites (WIND, ACE, INTERBALL, Geotail, IMP8) in the solar wind. The attention is focused on geometrical structure and physical parameters of the discontinuities. Three different techniques are used to determine the discontinuity normals. It is shown that in overwhelming number of observations the tangential discontinuity is the best approximation to observations. The minimum variance technique has certain limitations in its application for analysis of solar wind disturbances, although in individual cases it still can be usable. Geometry of the fronts is found to be planar; discontinuities are frozenïn the solar wind. The angle between Sun-Earth line and surface normal constitutes, in average, 40 degrees.

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Poster Number: P.02

Supersonic Flows in the Solar Chromosphere

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We present an overview a large dataset of active regions obtained in the chromospheric He I 1083.0 nm triplet. Infrared spectropolarimetric observations were obtained with the Tenerife Infrared Polarimeter (TIP) at the German Vacuum Tower Telescope (VTT) of the Spanish observatory of Izaña, Tenerife. The observations taken in the chromospheric He I 1083.0 nm multiplet were used to create maps in the Stokes parameters I, Q, U and V. A technique to invert Stokes profiles of the He I 1083.0 nm multiplet lines was applied in order to obtain the full magnetic vector and the line-of-sight velocity. A number of active regions have been scanned and measurements of supersonic flows are reported. Supersonic flows with line-of-sight velocities of the order of $30\ \mathrm{km\ s^{-1}}$ (corresponding to Mach number $\approx M_a = 3$) turn out to quite common and are generally found in several locations of most observed active regions. Strongly supersonic downflow velocities up to $60\ \mathrm{km\ s^{-1}}$ are also observed in some cases. Quiet sun regions scanned close to disk centre reveal that, althought smaller than in active regions, downflows of the order of $30\ \mathrm{km\ s^{-1}}$ are also present.

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Poster Number: P.03

Study of asymmetries of stokes profiles from high spatial resolution spectropolarimetry on sunspot penumbrae

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We present here the continuation of our study on sunspot penumbrae after the last results obtained from the analysis of data observed with the 'Göttingen' Fabry-Pérot interferometer installed at the German VTT (Observatorio del Teide, Tenerife) on penumbral magnetic fields and line-of-sight velocities with a spatial resolution better than 0.5" (Bello González et al., 2005). We perform now the analysis of single Stokes-*I* and *V* profiles observed at $\lambda 6149.2$Å (Fe II) and $\lambda 6302$Å (Fe I) iron lines from different regions for both centre and limb penumbral sides of two sunspots located at $\mu \approx 0.93$. The profiles show strong asymmetries as an indication of the existence of gradients in the magnetic and the velocity fields. Sometimes, the profiles also show a 'kink' which might be related to a mixing of different flow and magnetic components. These features in the observed profiles are a clear evidence of the highly dynamic nature of the sunspot, strongly related to the magnetic field. Therefore, we synthesize Stokes profiles from a two-component-atmosphere model: a horizontal magnetic flow embedded in a more vertical magnetic environment (background) as proposed by the "uncombed penumbral model" (Solanki and Montavon, 1993). The background component model has been taken from del Toro Iniesta (1995) and the more horizontal magnetic flux tubes carrying the Evershed flow introducing a perturbation in the temperature, the magnetic field and the macroscopic velocity as proposed by Martínez Pillet (2000). We show results from the comparison of the observed and the synthesized profiles through forward modeling using a code developed at the Universitäts-Sternwarte Göttingen.

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Poster Number: P.04

Chromospheric signatures of photospheric magnetic flux cancellation

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We observe the cancellation of a Moving Magnetic Feature with a plage element at the outer edge of a sunspot moat. The cancellation event lasts for some 30 minutes until the smaller plage element completely disappears. The analysis of vector spectropolarimetric measurements of infrared and visible spectral lines reveals no drastic changes in the photospheric magnetic field during the cancellation; the magnetic flux is reduced gradually due to a reduction in the magnetic filling factor. However, photospheric upflows of about 1 km/s are observed near the polarity inversion line (PIL). At the position of the cancelling patches, chromospheric emission in the core of the Ca II H line is detected. The location of this emission is found to move from the center of the respective flux concentrations towards the PIL as the cancellation proceeds. Strongly enhanced chromospheric emission becomes visible at the PIL 18 minutes after the cancellation has started; it continues for several minutes afterwards. The chromospheric Ca II H line profiles at the PIL show two strong emission peaks at wavelengths significantly different from those of profiles emerging from the surroundings. We complete the chromospheric data with the time evolution of the Ca II H line core intensity in speckle-reconstructed filtergrams. In co-spatial TRACE observations we find no indications of new coronal loops or transient brightenings at the cancellation site up to one hour after the cancellation has ended. This suggests that the energy released in the photosphere is transported efficiently to the chromosphere but not to the corona, at least for the small-scale event studied here.

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Poster Number: P.05

Polar Faculae Study

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Thanks to a new Fabry-Pérot interferometer installed a few months ago in the ”Göttingen” two-dimensional spectrometer at the German Vacuum Tower Telescope (Observatorio del Teide, Tenerife), and with new CCD cameras, images of very high spatial and spectral resolution of polar faculae (PFe) at the south pole of the sun have been obtained in May this year, under very good seeing conditions. Speckle reconstruction will allow to achieve an unprecedented spatial resolution from these data. The number of PFe observed in this period, close to the maximum of their activity, is much higher than the before-adopted number present at one time. The PFe have been observed by scanning with the spectrometer through the FeI 6173 A line with a polarimeter, so magnetic and velocity fields will be obtained from Stokes I and V profiles. Also, observations in H-alpha were obtained, which will give us the opportunity to study PFe at different heights, from photosphere to chromosphere. Available data from SoHO and TRACE for the same dates of these observations will complement the data to study the influence of PFe on the solar corona.

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Poster Number: P.06

MHS equilibrium of thick penumbral filaments

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The magnetohydrostatic equilibrium of thick penumbral fibrils is investigated. We show that for typical penumbral conditions the fibril's magnetic field can not be completely aligned with its axis, but rather there must exist a non vanishing component on the plane of the fibril's cross section. Such configuration, although pausible within the constraints imposed by spectropolarimetric observations of Sunspots, leads us to conclude that penumbral fibrils are instrisically dynamical.

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Poster Number: P.07

High resolution full disk magnetic field vector observations with the Helioseismic and Magnetic Imager

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The Helioseismic Magnetic Imager (HMI), on board the Solar Dynamics Observatory (SDO), will begin data acquisition early in 2008. It will provide the first full disk, high temporal cadence observations of the full Stokes vector with a 0.5pixel size. Using appropriate inversion techniques, a continuous monitoring of the Solar vector magnetic field will be possible. HMI data will advances our understanding of small and large-scale magnetic field evolution, the photospheric fields relation to local and global dynamo processes, flux emergence, magnetic helicity and the nature of polar magnetic fields.
In this poster we will summarize the main properties of the HMI instrument as well as its expected operation modes. A ten minute average vector field data product will provide excellent input for coronal field extrapolations using the potential field method. In fastest observing mode, HMI would provide the full magnetic field vector every 90-120 sec. In this case we focus on the polarization cross talk induced by the solar oscillations and how this will affect the magnetic filed vector determination.

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Poster Number: P.08

Physical parameters of dark mottles observed in Hα

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In April 2002, Hα observations of the solar chromosphere with high spatial and high spectral resolution were obtained with the Göttingen Fabry-Perot Spectrometer mounted in Vacuum Tower Telescope at the Observatory del Teide/Tenerife. Intensity and velocity maps at different wavelenghts along the Hα profile were derived over two-dimensional field of view by applying Lambdameter method. Some physical parameters (like the optical thickness, doppler width, velocity and source function) of dark mottles were determined using Becker's cloud model (Becker 1964). In this work, the obtained results will be discussed.

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Poster Number: P.09

3D Magneto-convection and flux emergence in the photosphere

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To model the emergence of magnetic fields at the photosphere, we carried out 3D radiative magneto-hydrodynamics (MHD) simulations using the MURaM code. Our simulations take into account the effects of compressibility, energy exchange via radiative transfer and partial ionization in the equation of state. All these physical ingredients are essential for a proper treatment of the problem. In the simulations, an initially buoyant magnetic flux tube is implanted in the upper layers of the convection zone. The interaction between the flux tube and the external flow field has an important influence on the emergent morphology of the magnetic field. Depending on the initial properties of the flux tube (e.g. field strength, twist, entropy etc.), the emerging field can also modify the local granulation pattern. The inclusion of radiative transfer allows us to directly compare the simulation results with real observations of emerging flux.

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Poster Number: P.10

Two-component models of solar flare loops.

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The simultaneous modeling of the physical conditions in the chromosphere and photosphere for two H-alpha loops in a bright flare shows a shift of the boundary of the transition layer down into the atmosphere and a presence of a hot region in the photosphere. It is show that a different mechanisms can be efficient at the different stages of the flare development. The processes related to the appearance of a flux tube from the sub-photospheric layers are important before and at the beginning of the flares. At this stage, the faint reconnections at the photospheric leves are possible. The disturbance of the low-temperature layers propagates along the loops to the photosphere down at the impulsive phase. The latter can be a result of the reconnection in the upper atmosphere.

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Poster Number: P.11

Evidence for in situ heating in active region loops

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We report new observational results and insights in the energy release during transient events on sub-flare level, which seem to be a common feature of active region loops. Our work is based on multi-temperature observations obtained high above the limb by SOHO/SUMER. We conclude that the energy input into the loop system is initiated at one and only one foot point by an asymmetric impulsive mechanism. This trigger does not seem to be connected with any bulk flow and there is no indication that the plasma in the loop is replenished or replaced. These observational facts rule out some of the heating models under discussion. The electron density, Ne however, increases significantly during such events. If no new material is added to the local plasma, then the Ne increase can only be explained by a rapid volume decrease, i.e., by an in-situ pinch effect, compressing and heating the affected plasma.

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Poster Number: P.12

Evidence for Wave Mode Conversion in the Solar Chromosphere?

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In an effort to better understand how the chromospheric plasma and magnetic fields are guiding, converting and dissipating acoustic waves, we analyze high-cadence time series of Doppler- and intensitygrams of lines formed in the photosphere and lower solar chromosphere. We study time series from various sources: MOTH, Swedish Vacuum Solar Telescope, VTT Sac Peak, and TRACE. The travel time maps, power maps, and phase diagrams show some unexpected behaviour, in particular in and around active regions, indicating either mode conversion and/or wave reflection at the beta=1 surface.

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Poster Number: P.13

Ultra-long period oscillations in an EUV filament

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We present the first detection of long-period (8-27 hours) oscillatory intensity variations in a coronal filament. The filament is observed continuously as it crosses the solar disk in a 12-minute-cadence SoHO/EIT 195 A uninterrupted data set. Cyclic intensity variations are found to be correlated along the filament, while the most pronounced oscillations are detected at its southern end for nearly 6 days. The dominant period of these oscillations is 12.1 hours and the amplitude of the intensity variations reaches approximately 10% of the background intensity. The ultra-long-period oscillations may be interpreted in terms of slow string MHD modes or may be connected with thermal over-stability associated with peculiarities of the cooling/heating function and with the effect of neutrals. These theoretical predictions however do not explain the spatial structure of the oscillations along the filament.

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Poster Number: P.14

Magnetic flux emergence and its 3D reconnection with the existing coronal field

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As magnetic flux emerges through the photosphere it rapidly expands into the transition and coronal region. This volume is already filled with magnetic flux, so the emerging flux has to interact with the existing field to make it way into the corona. This happens either by pushing the overlaying field away or by cutting through it by the means of magnetic reconnection. In all off our numerical experiments it is found that, sooner or later, localised current concentrations form and eventually magnetic reconnection starts. This process has been observed by TRACE. Here we precent the result of numerical simulations of the emergence of a twisted flux robe into a laminar coronal magnetic field. The talk will emphases the dynamic interaction between the two flux systems and the deviations in the process that arises as the relative orientation between the two flux systems is changed. It is found that a 3D reconnection process drives the dynamics and that it shows clear deviations from simple textbook examples.

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Poster Number: P.15

Analysis of active region loops dynamics associated with a small C-class flare.

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Analysis of the magnetic loops dynamics before and during a C-class flare activity in NOAA AR 10646 is presented using data of the SOHO/CDS spectrometer. The sit-and-stare observational mode of the SOHO/CDS was used to measure the temporal evolution of the spectral line profiles of He I 584.33 A (chromosphere), O V 629.73 A (transition region) and Si XII 520.67 A (corona). Several precursor events and main impulsive phase of the flare were detected at different position along the CDS slit in all spectral lines. Analysis of two selected chromospheric precursors with clear relation to the main impulsive phase and the main impulsive phase of the flare itself has shown time delays between chromospheric/transition region and coronal occurrence of events, significant upflows during precursor events and peaks of downflow and upflow velocities during main impulsive phase. This findings lead to a conclusion that the chromospheric evaporation was probably the driving mechanism responsible for the observed flare emission. Further investigation of remaining (mainly coronal) precursors and also a detailed analysis of the co-observations obtained by TRACE instrument and the DOT/LaPalma telescope is necessary for confirmation of this conclusion.

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Poster Number: P.16

Full-Stokes Polarimetry of the Chromosphere in the H-alpha Line

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Chromospheric magnetic fields are essentially important to understand various active phenomena in the corona (and probably heating of the corona). However, polarization of the chromospheric absorption lines are weak, and therefore, it has been difficult to get magnetic maps of the chromosphere. We have developed a high-precision polarimeter with ferroelectric liquid crystals, and it enables us to get full-Stokes polarization data in the H-alpha line. Not only the Stokes V signals but also the Stokes Q/U signals, which correspond to the transverse magnetic field in the chromosphere, can be detected. The results of our full-Stokes measurements suggest that the Stokes signals at the different wavelength offsets from the H-alpha center correspond to the magnetic fields of the different atmospheric layers. This means that the H-alpha polarimetry data have a potential to show the three-dimensional structure of the solar magnetic field.

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Poster Number: P.17

Fractal Properties of Sunspot Magnetic Fields

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Some spatial properties of sunspot magnetic structure are described. For the analysis the results of the observations on IZMIRAN solar spectromagnetograph and magnetic data of MSFC vector magnetograph (FeI 5250.2 A) downloaded through Internet were used. The existence of two families of the self-similar magnetic field lines is shown, one is corresponded to the region of the sunspot umbra and the inner penumbra and the another to the region outer penumbra - ambient photosphere. The transition from one field line family to the other one reflects the variations of the field contours from relatively smooth to jagged. The peculiar properties of magnetic structure were also investigated in the frames of the fractal model of sunspot. In the interval 2200-200 G (with the 200 G step) the connections between field line lengths and the enclosed areas expressed in logarithmic scale were determined. The angular coefficient d of these characteristics approximated by linear dependence represents the so-called Hausdorff fractal number. It is shown that the greatest value d (close to 1.50) approximately corresponds to the umbra-penumbra interface (fields interval 1200-1400 G). The second (smaller) maximum corresponds to the interface between penumbra and photosphere. These particularities may either signify the existence of a current system at the umbra–penumbra interface or a transition from one current system to another. The similar procedure was also carried out with transversal component of sunspot magnetic field and its full value. The results are discussed.

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Poster Number: P.18

On the relationship between magnetic field strength and loop lengths in solar coronal active regions

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By assuming that coronal active regions are made up of many loops, we investigate the relationship between the average magnetic field strength and loop length for a sample of active regions observed by the Soft X-ray Telescope aboard Yohkoh. We use photospheric magnetic data from the Michelson Doppler Imager and compute extrapolated field lines that match the observed loops. We compare our findings with the previous study of Mandrini et al. (2000). Such studies have important implications for solar coronal heating models.

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Poster Number: P.19

An Observational Evidence for Solar Atmospheric G-Mode Oscillations from CaII H -Line and 1600 A Continuum Observations

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An identification and clarification of different modes of oscillations may eventually illuminate the solar neutrino problem. Particularly, the internal g-modes of the Sun are the most powerful tool for investigation of solar core, and a way to solve, for instance, the neutrino problem. We have used a high spatial and temporal resolution of long time sequence of spectra in CaII H-line obtained at the Vacuum Tower Telescope (VTT) of the Sacramento Peak Observatory on a quiet region at the center of the solar disk over a large number of bright points and network elements to search for atmospheric (chromospheric) g-mode oscillations.
An important parameter of the H-line profile, intensity at H_{2V} ($I_{H_{2V}}$), has been derived from a large number of line profiles at the locations of 29 bright points and 3 network elements. We derived the light curves of all the bright points and network elements for the total duration of our observations. The light curves represent the main pulse with large intensity amplitude and followed by several follower pulses with lower intensity amplitudes. The light curves of these bright points would give an impression that one can as well draw curves towards and away to the highest peak (main pulse) showing an exponential growth and decay of the amplitudes. The exponential functions have been fitted for all the light curves of the bright points and found that the slopes are more or less the same, and one value of the exponent can represent reasonably well the decay for all the cases.
We find an evidence for the existence of a longer period (around 80-90 min) of oscillations apart from a well known 3-minute oscillations in bright points and 5-7 minute oscillations in network elements. We suggest that the longer period of oscillations may be related to chromospheric g-mode oscillations. In order to confirm the results related to long-period of oscillations, we have also analyzed a long time sequence of images obtained under high spatial and temporal resolution with TRACE Space Mission in 1600 Å UV continuum. We derived the cumulative intensity values of the UV bright points.
The light curves of the UV bright points have been generated. We find an evidence of longer period, of the order of 2 hours, of oscillations associated with the UV bright points at the transition region. This confirms the results obtained from CaII H -line observations, and suggest that the longer period may be related to solar atmospheric g-mode oscillations.

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Poster Number: P.20

SWAP: An EUV imager for solar monitoring on board of Proba II micro-satellite

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Proba II is a ESA technology demonstration mission to be launched in early 2007. The prime instrument on board of Proba II is SWAP (Sun Watcher using Active Pixel System detector and Image Processing), a full disk solar imager with a narrow bandpass filter centred at 17.5 nm (Fe IX - XI) and a fast cadence of 1min. The telescope is based on an off-axis Ritchey Chretien design while an extreme ultraviolet (EUV) enchanted APS CMOS will be used as a detector. The field of view will be wider than EIT's by 30% allowing SWAP to observe a larger portion of the lower corona and bridge the gap between EIT and LASCO-C2.

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Poster Number: P.21

Manifestation of the coronal magnetic loop parameters and dynamic features in the low-frequency modulations of solar microwave radio emissions

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The spectral and temporal evolutions of the low-frequency (LF) pulsations modulating the microwave radiation (37 GHz) of solar flares recorded at the Metsaähovi Radio Observatory were studied by means of a ßliding windowFourier analysis.
Microwave radiation of solar flares is interpreted as an electron gyrosynchrotron radiation produced on harmonics of the gyrofrequency. In the case of a power-law distribution of electrons in energy the intensity of gyrosynchrotron radiation from the loop is proportional to a moderately high (1,5...6) power of the background magnetic field. Therefore, any slow variations of the magnetic field associated with disturbances of the electric current in a radiating source, will modulate the intensity of the microwave radiation.
Quite often the dynamic spectra of the LF pulsations contain several spectral tracks demonstrating a similar or slightly different temporal behaviour. We consider the multi-track features of the LF spectra as an indication that the microwave radiation is produced within a system consisting of several closely located magnetic loops having slightly different parameters, and involved in a common global dynamical process. Application of the equivalent electric circuit models of the loops with inclusion of the effects of electromagnetic inductive interaction in groups of slowly growing current-carrying magnetic loops allows to explain and reproduce the main dynamical features of the observed LF modulation dynamic spectra. Each loop is considered as an equivalent electric circuit with variable parameters (resistance, capacitance, and inductive coefficients) which depend on shape, scale, position of the loop with respect to other loops, as well as on the plasma parameters and value of the total longitudinal current in the magnetic tube.

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Poster Number: P.22

Magnetic structures in the solar photosphere observed with the new "Göttingen" 2D spectrometer on Tenerife

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The two-dimensional "Göttingen" spectropolarimeter, mounted in the Vacuum Tower Telescope at the Observatorio del Teide on Tenerife, has been upgraded early 2005. It is based on wavelength scanning Fabry-Perot interferometers (FPIs). A Burleigh Instruments FPI has been replaced by an etalon from IC Optical Systems (UK, former Queensgate) which has high throughput, high finesse (approximately 50) and high stability. New CCD detectors (Imager QE) have been purchased from LaVision (Göttingen). They possess, with the same pixel size (per arcsec) as in our old system, a four times larger field of view, have five times higher frame rate and are a factor 30 more sensitive. FPI settings and data acquisition are controlled by powerful hard- and software. First observations of quiet and active regions on the Sun were obtained in April/May 2005 using the Kiepenheuer Adaptive Optics System (KAOS). The data analysis includes speckle reconstruction, so we obtain high spatial resolution. We present first results of line intensities, velocities and magnetic fields.

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Poster Number: P.23

A comparative analysis of different methods for spectropolarimetric measurements.

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Spectropolarimetric methods for measuring magnetic field strengths used at the Sayan Solar Observatory are described. Spectropolarimeter consists of polarization splitter and electrooptical modulator (FLC). Such a scheme makes possible to realize several modes for measurement of the longitudinal H including stocks-meter and lambda-meter mode. The report discusses advantages and disadvantages of the modulation and modulationless measurements when using the ordinary slow CCD camera. In some cases combined variants appear to be preferable.

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Poster Number: P.24

Three dimensional analysis of shock structure around magnetic loop associated with spontaneous fast magnetic reconnection

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Three dimensional shock structure is studied by computer simulation of magnetic loop associated with magnetic reconnection. In out computer simulations, spontaneous fast reconnection model is adopted as magnetic reconnection model. In this model, petschek type fast reconnection is represented, so that a pair of slow shocks stands elongated from magnetic diffusion region and fast shock stands in front of magnetic loop top. In this paper, we present the results of detail analysis of these shock structure. In particularly, three dimensional structre of slow shock around magnetic loop and three dimensional fast shock structure in front of magnetic loop are studied in detail.

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Poster Number: P.25

Explosive events, blinkers or spicules as seen in shutterless EIT 304 Å?

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We present preliminary results of a study on transient phenomena in the solar atmosphere using unique EIT 304 Å datasets. The observations were obtained during EIT shutterless campaigns started in year 2001 and continuing until present. The data have a cadence of approximately 68 sec and a spatial resolution of 2.62 arcsec. They are obtained always simutaneously with TRACE 171 and various CDS observing programs. We hope this study to reveal the real image of phenomena named as explosive events, blinkers and spicules. We will try to establish the long disputed connection and/or differences between these solar features.

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Poster Number: P.26

A Mechanism for the Emergence of Magnetic U-loops and Flux Cancellation on the Sun

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Flux cancellation is one of the phenomena observed at the solar surface, in which opposite polarity regions come close together and disappear around the neutral line. There have been proposed several ideas to explain the origin of flux cancellation, including the emergence of magnetic U-loops, although the physical mechanism for this process is not obvious because the mass tends to accumulate at the dipped part of U-loops thereby reducing the buoyancy. Here we use three-dimensional MHD simulation with gravity to understand the dynamics of emerging U-loops and investigate their possible role in flux cancellation. Our flux emergence simulation reveals that a diverging flow appears around the dipped part of U-loops, which helps the U-loops emerge into the atmosphere by enhanced buoyancy. We discuss plasma motions on the field lines related to flux cancellation. We also infer a possible field-line configuration during flux cancellation.

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Poster Number: P.27

Observed Wave Propagation Along the Sunspot Magnetic Field Through the Chromosphere, Transition Region and Corona

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A sunspot active region is imaged with the Coronal Diagnostic Spectrometer (CDS) and Transition Region and Coronal Explorer (TRACE). We use the CDS wide slit to image the active region with high time resolution in He I , O V, Mg IX and also co-temporally in TRACE 171Å. 3-min oscillations are observed above the sunspot umbra in He I and O V. These oscillations are then observed to propagate along the active region loops observed in TRACE. The CDS oscillations and TRACE propagations both show resonance-like multiple frequencies. We suggest that the 3-min sunspot oscillations in CDS, and the propagations in TRACE are the same wave phenomena. The waves are observed as oscillations in the chromosphere/transition region and propagations in the corona due to line of sight effects of the magnetic field geometry, combined with the formation height of the different temperature lines. The energy flux of the waves is estimated in the different temperature regions of the atmosphere.

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Poster Number: P.28

Influence of Instrumental Effects on High Frequency Oscillations Observed with TRACE

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A sequence of TRACE 1600 Å images is used to search for high frequency (>10 mHz) oscillations in the solar chromosphere. The cadence of about 2.7 s allows in principle to find peaks in the power spectra up to about 190 mHz. We examine the role of instrumental and observational effects on the detection of high frequency oscillations. An electronic readout pattern and the jpeg compression algorithm are studied in detail. While the readout pattern seems to have very little effect, the use of a lossy jpeg compression compromises a reliable detection above 15 mHz due to additional power created by the algorithm.

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Poster Number: P.29

Investigation of a colour-colour method to determine solar atmospheric temperatures along plasma loops.

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Recently the interest to establish the heating mechanism in solar coronal loops has centred on determining the fundamental plasma properties within the loops, for example, temperature and density. This approach has so far prooved to be difficult. Aschwanden et al. (2000) used single filter ratio techniques and found evidence for heating weighted towards the loop base. Priest et al. (2000) used Yohkoh observations and a corresponding heating form and found that the heat was most likely uniformly distributed, whilst Reale (2002) found cases of apex dominated heating. This paper examines the double filter ratio method proposed by Chae et al. (2002). The Chae et al. (2002) method takes two filter ratios (TRACE 195/171Å and 284/195Å) which, when plotted against each other, provide a colour-colour curve for determining a wide range of unambiguous plasma temperatures. We used this method on SOHO/EIT data of a flare loop on the north east solar limb in order to obtain the temperature profile along the structure. In doing so, we find Chae's method to be troublesome with many data-points sitting off the colour-colour curve. We discuss how this may be due to a multithermal atmosphere with more than one loop along the observational line of sight. We have also reexamined two of the TRACE data sets initially analysed by Chae et al. (2002), testing three different background subtraction methods. We have then plotted our results against the revised TRACE response functions which now include the Fe VIII emission.

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Poster Number: P.30

Poster Number: P.31

The General Properties of 23th Solar Cycle

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The purpose of this work is to investigate various solar activity indexes which shows general properties of the 23th solar cycle. Besides we will compare the results with previous cycles. Here, following activity indexes are taken into account; such as Wolf number, total sunspot areas, average magnetic field, flare index, irradiance, and coronal mass ejection (CMEs). One more aim of the work is to investigate the influence of the CMEs to earth magnetic field.

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Poster Number: P.32

Granular and intergranular oscillations from the observations of BaII resonance line

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We study statistical properties of granular and intergranular oscillations by applying the so-called lambda-meter method (Stebbins & Goode, 1987) to the observations of BaII 4554A resonance line. Observations were taken during july, 2004 on the VTT, Observatorio del Teide, Tenerife, Spain. Through the analysis of time-sequences of line profile data we received velocity and intensity oscillations at several line depths for each position along the slit. Using realistic model of Ba atom and non-LTE solution of radiative transfer equations we calculate heights of formation of Ba II lines. This gives us possibility to link line depths to the real heights in the atmosphere. Area of formation of BaII 4554A line is approximately 200-800 km above the zero-level of $log(\tau_5)$. The aim of this work is to expand such study of Khomenko et al. for the FeI 5324A line (Khomenko, Kostik & Shchukina, 2001) to the chromosphere.

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Poster Number: P.33

On the electron and ion acceleration during the flare on 28.10.2003

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The question on the electron and ion acceleration during solar flares is investigated. The images obtained by RHESSI show a displacement of hard X-ray sources with respect to gamma-ray (2.2 MeV) centroids (G.J.Hurford et al, Apj, V.595, P.L77, 2003). Two explanations were offered. The first one argues that electrons and ions are accelerated in different places of the solar corona (G.Emslie et al, ApJ, V.602, P.L69, 2004). The second model insists that both kinds of particles can be accelerated in the same place (a reconnecting current layer on a separatorÇs top) but separated into different beams (V.Zharkova et al, ApJ, V.605, P.546, 2004). We investigate the question which model is in better agreement with the magnetic field topology of the Active Region. The topological model by Gorbachev-Somov (V.S.Gorbachev, B.V.Somov, Sol.Phys., V.117, P.77, 1988) is used for analysis of the gamma-ray flare which occured on 2003 October 28. It is shown that electrons and ions are accelerated in a common current layer.

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Poster Number: P.34

Photospheric and Chromospheric Magnetic Structure of a Sunspot

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The magnetic field of sunspots has been well studied in their photospheric layers, but is poorly known in the upper chromosphere. Radio observations provide maps of the field strength, but for many purposes the full magnetic vector at good spatial resolution is required. Here we present state-of-the-art inversions of the full stokes vectors of the He I triplet at 1083 nm and of highly Zeeman sensitive infrared photospheric lines which give us a map of the full magnetic vector in the upper chromosphere, as well as in the photosphere. These maps are analyzed to discuss the differences between the photospheric and the chromospheric magnetic structure.

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Poster Number: P.35

Numerical simulations in the Ca IR triplet

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The Ca IR triplet around 8500 Å is a possible candidate for observing chromospheric magnetism. Here results from combining a radiation hydrodynamic simulation with a Stokes synthesis code are presented. The simulation shows interesting time varying behavior of the Stokes V profiles as waves propagate through the lines' formation regions. Disappearing and reappearing Stokes V lobes as well as profile asymmetries are closely related to both the local fluid velocity and atmospheric velocity gradients. The simulated profiles are compared with recent SPINOR-observations of the Ca IR triplet to see if this relatively simple simulation is able to reproduce the shapes of the observed profiles.

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Poster Number: P.36

How strong is the dependence of the solar chromosphere on the convection zone?

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Numerical simulations of the chromosphere, especially such with wave induced shock heating, make much effort to use acoustic wave spectra which represent as best as possible the turbulence motion in the convection zone. But is this really necessary? To answer this question, we have made with our 1-D chromosphere simulation code WAVE a series of computations using quiet different frequency spectra for both pure acoustic and longitudinal MHD waves. It is found, that the chromospheric mean temperatures and time averaged line profiles (Ca II K+H, Ca II IRT, Mg II k+h, Ly alpha) show only a weak dependence on the used spectra. Only by study of time series of the line profiles it is possible to distinguish between the different used spectra. The solar chromosphere considered from the viewpoint the sun as a starïs therefore a problematic diagnostic tool for the underlying layers. This may be important for the interpretation of chromosphere observations of stars other than the sun.

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Poster Number: P.37

Evolution of the magnetic energy budget in AR 0486 from potential and nonlinear force-free models

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Over two weeks in October/November 2003, the Sun featured unusually strong activity, with three large sunspot groups (including the largest one of this solar cycle), twelve X-class flares (including the strongest ever recorded), numerous halo coronal mass ejections (two with near-recorded speeds) and two significant proton storms. Eight of the twelve X-class flares originated from active region AR 10486. To understand the reasons of this peculiar activity, we investigate the evolution of the coronal magnetic field configuration as well as the energetics of AR 10486 before and after the X17.2 flare on October 28. To determine the coronal magnetic fields, we use potential and nonlinear force-free reconstruction techniques using line-of-sight (SOHO/MDI) and vector (MSO/IVM, Huairou, BBSO) magnetograms on the photosphere as boundary conditions. We identify the source region of the flare as related to the existence of null point or separator field line evidenced in a reversed-Y magnetic configuration. From the 3D configurations we derive the magnetic energy budget which can be released during the impulsive phase of the flare. The estimated free magnetic energy is enough to trigger an X-class flare. The continuous evolution of the magnetic energy derived from the potential field extrapolations indicates that the flare does not modify the distribution of magnetic field on the photosphere. We also study the distribution of energy before and after the flare using different vector magnetic field measurements.

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Poster Number: P.38

Influence of the interplanetary magnetic filed on the 27-day modulation of galactic cosmic rays

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The amplitude of the 27-day variation of galactic cosmic rays is calculated for each Bartels solar rotation during the time interval 1965-2001. The cross correlation function (CCF) between the amplitude of the 27-day variation and the interplanetary magnetic field (IMF) is calculated for each solar rotation. The amplitude of the cosmic ray variation is better correlated to the IMF strength for negative ($A<0$) polarity than for positive ($A>0$) polarity. The CCF is steeper as the sunspot number increases for $A<0$ than for $A>0$. The cosmic ray particles drift slower during $A<0$ than during $A>0$.

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Poster Number: P.39

Analysis of a wide chromospheric active region

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The chromosphere, as an intermediate layer between hotosphere and corona, has interesting features like the chromospheric network of magnetic field elements, bright plages around sunspots, dark filaments across the disk and prominences above the limb.
We want to make a detailed study of the motions and structures in a large active area near disc center, so we planned the observation to construct a mosaic of aproximately 100"x100".
For the present work we used data taken with the "Goettingen" Fabry-Prot interferometer mounted at the Vacuum Tower Telescope at the Observatorio del Teide/Tenerife on May, 2004. Speckle reconstruction is used to achieve high spatial and spectral resolution in the Hα spectral line. In the poster we present velocity and intensity maps, as well as the temporal variation of certain fast evolving features. The velocity maps were obtained using the "lambdameter method" as described by Al et al. (2004).
References:
Al, N., Bendlin, C., Hirzberger, J., Kneer, F. and Trujillo Bueno, J., 2004 A&A 418, 1131-1139

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Poster Number: P.40

Derivation of plasma flow velocities using photospheric magnetic field measurements

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The dynamics of the chromospheric and coronal solar magnetic field and plasma dynamics is controlled by the magnetic fields in and the plasma flows through the photosphere. While photospheric magnetic fields are more or less directly accessible by polarimetry, plasma flows have to be derived. We derived plasma flow velocities utilizing photospheric magnetic field measurements by three different methods: The first, called Local Correlation Tracking - LCT - method is based on a local cross-correlation analysis between two magnetic field images using different displacements (e.g. November & Simon, 1988). The displacement that produces the best cross-correlation is used to calculate the velocity. The second method - ILCT - additionally requires that the velocity field satisfies the vertical component of the induction equation (see, e.g. Welsch et al., 2004). The third method, the so called Minimum Energy Fit - MEF - is completely independent on LCT, it solves the induction equation and selects the velocities which minimize an energy functional (see, e.g., Longcope, 2004).
We apply these three methods to derive the plasma flows in the active regions NOAA 8210 and NOAA 9077 using vector magnetic field data. We compare the resulting flow fields and discuss their consequences for flare activity and CME ejection.

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Poster Number: P.41

Influence of the Paschen-Back effect on the Stokes profiles of the He I 1083.0 nm triplet

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We evaluate the influence of the Paschen-Back effect on the Stokes profiles of the Zeeman sensitive He I 1083.0 nm multiplet lines. During the past years the determination of the magnetic field vector using spectropolarimetric data in the He I 1083.0 nm multiplet has always been done considering linear Zeeman splitting until Socas-Navarro et al. (Apj, 2004) demonstrated that it must be carried out considering the wavelength positions and the strengths of the Zeeman components in the incomplete Paschen-Back effect regime. We demonstrate the relevance of this effect using synthetic profiles and investigate its influence on the inversion of polarimetric data obtained with the Tenerife Infrared Polarimeter (TIP) at the German Vacuum Tower Telescope (VTT).

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Poster Number: P.43

First holistic magnetohydrodynamic simulation from the convection zone to the chromosphere

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We have carried out a three-dimensional magnetohydrodynamic simulation of the integral layers from the convection zone to the chromosphere. The simulation starts with a homogeneous vertical magnetic field of a flux density of 10 G superposed on a previously computed, relaxed model of thermal convection. This flux density ought to mimic magnetoconvection in a network-cell interior. The three-dimensional computational domain extends from 1400 km below the surface of optical depth unity to 1400 km above it and it has a horizontal dimension of 4800×4800 km. Thus, for the first time it became possible to extend simulations of magnetoconvection of the surface layers into the chromosphere.
The magnetic field concentrates in narrow sheets near the surface of optical depth unity with field strengths up to approximately 1 kG. Below the surface the field disperses again but partially remains concentrated in flux tubes with a strength of a few hundred Gauss. The chromospheric magnetic field is marked by strong dynamics with a continuous reshuffling of magnetic flux on a time scale much shorter than in the photosphere or in the convection zone. The formation of weak flux tubes prevails again but on a spatial scale much larger than the width of the sheets near the surface and with a slight tendency to be located in between the flux concentrations at the surface. Highly dynamic filaments of stronger than average magnetic field are a ubiquitous phenomenon in the chromosphere. They form in the compression zone behind and along propagating shock fronts, that continue to be an integral part of chromospheric dynamics as already seen in the hydrodynamic simulations of the chromosphere by Wedemeyer et al. (2004), A&A, 414, 1121. These magnetic filaments that have a field strength of not more than a few tens of Gauss, rapidly move with the shock fronts and quickly dissolve or form with them. Over all, the picture of flux concentrations that strongly expand through the photosphere into a more homogeneous chromospheric field remains valid. That field fills the entire chromosphere and leads to a surface of plasma $\beta = 1$ around a height of 1000 km. However, the chromospheric magnetic field experiences a much more vigorous dynamics than previously thought.

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Poster Number: P.44

The Dynamics and Structure of the Lower Transition Region as Inferred from Hydrogen Lyman Lines.

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Hydrogen Lyman lines dominate the Vacuum UltraViolet (VUV) radiance spectrum of the Sun and the resonance (alpha) line dominates the Solar radiative losses around 20,000 K. Although, these lines are optically thick, it was already shown 25 years ago by the Transition Region Camera (TRC: Bonnet et. al. 1980) Lyman alpha imager that structures are still not resolved at1" resolution. More recently, the Very High Advanced Ultraviolet Telescope (VAULT: Korendyke et al. 2001) Lyman alpha imager has shown structures as small as its 0.33" (240 km) resolution. Such images also show many structures evolving on time scales of few tens of seconds.
Past spectroscopic observations of the Lyman alpha and beta lines have been often characterised by a compromise between spatial and spectral resolution. However, they have shown the extreme variability of the Lyman profiles in different solar features.
Taking advantage of the rastering capabilities of the stigmatic SUMER spectrograph aboard SOHO, we have built simultaneous images in Lyman alpha and in the optically thin Si III 120.6 nm line (T 20,000 K). The images looks nearly identical at the 1.5" SUMER spatial resolution, showing the integrated Lyman alpha radiance to be a good diagnostic of the lower transition region. Furthermore, the Si III profiles also allows typical transition region transients such as explosive events to be identified and their spectral signature in Lyman alpha to be investigated.
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Poster Number: P.45

Eruption of a kink-unstable filament in Active Region NOAA 10696

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We present rapid-cadence Transition Region And Coronal Explorer (TRACE) observations which show evidence of a filament eruption from active region NOAA 10696, accompanied by an X2.5 flare, on 2004 November 10. The eruptive filament, which manifests as a very fast coronal mass ejection (CME) some minutes later, rises as a kinking structure with an apparently exponential growth of height within TRACE's field of view. We compare the characteristics of this filament eruption with MHD numerical simulations of a kink-unstable magnetic flux rope, finding excellent qualitative agreement. Immeadiately before the eruption, four brightenings in the vicinity of the filament (one of them approximately cospatial with a small emerging bipole) are observed, indicating the occurence of quadrupolar reconnection above the filament. We suggest that, while tether-weakening by breakout-like quadrupolar reconnection (triggered by the newly emerged flux) may be the release mechanism for the previously confined flux rope, the driver of the expansion is most likely the MHD helical kink instability. We conclude that the release of the accumulated magnetic stress in the corona can involve several mechanisms, three of them being present in the studied event.

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Poster Number: P.46

Analysis of Polarimetric Sunspot Data from TESTOS/VTT/Tenerife

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We report on the analysis of polarimetric sunspot observations taken with the Fabry-Perot Triple Etalon SOlar Spectrometer (TESOS) at the Vacuum Tower Telescope (VTT) on Tenerife. The data were obtained on August 22, 2004, from the large sunspot of active region NOAA 0663 at heliocentric angle 41.2°. The lines Fe I 6302.5 (Landé factor g = 2.5) and Fe II 6149.2 (g = 4/3) were scanned quasi-simultaneously in a new speckle mode. A lambda/4 plate with a Wollaston prism was used as a Stokes V polarimeter in the narrowband channel of TESOS. Short exposure (30ms) frames were taken in the narrowband channel simultaneously with broadband images. We demonstrate that the data analysis is very complex. It is a long way to arrive from observations at results for interpretation. Many preparatory reduction steps have to be performed with TESOS data. Apart from dark subtraction and flat fielding, one has to deal with rotation and rescaling of the polarised light images with respect to each other and with respect to the broadband image. The frames are to be co-aligned, the fields of view in the different images have to be cut to the same size, and noise filters are to be applied. Some of the frames exhibit artificial stripes to be removed. At TESOS, the Fabry-Perot etalons are located close to a focal plane in telecentric mounting. This results in an orange peel pattern which has to be removed keeping the information on solar structures.

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Poster Number: P.47

Multiwavelength study of a slow CME: rising X-ray source linked to exponentially accelerating erupting filament

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A slow CME linked to a long duration event (LDE) was observed on 16 April 2002 close to the NW limb. Multiwavelength observations show many aspects of a classical eruptive flare scenario: (i) The event starts with the lift-off of a filament seen by TRACE, for which helical flows observed with SOHO/CDS indicate a fluxrope-like structure. (ii) Under the rising filament cusped flare loops start forming (LDE). (iii) The rising filament/flux rope is followed by a hard X-ray source (v 60 km/s) observed by RHESSI, which shows no velocity signal measurable with CDS. The two features seem to be intimately linked, keeping a steady distance of about 20 Mm. We interpret the rising RHESSI source as a ”plasmoid” which forms where the upward directed reconnection outflow/shocks related to the LDE meet the closed magnetic structure of the erupting filament. (iv) The CDS slit, which is positioned about 50” above the limb, starts to observe a velocity signal in the hot Fe XIX line after the passage of the RHESSI source and the start of the flare. The redshift-blueshift pattern is broadening as the underlying cusped EUV flare loops are getting taller. These Doppler velocity observations combined with MDI magnetic field modeling indicate down-flow of material along hot, newly reconnected loops. (v) Using LASCO C2 observations we combine the height-time profiles of the rising filament and the WL CME. We find that the rising filament goes through an exponential acceleration indicating an instability (kink?) as the underlying cause of the eruption.

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Poster Number: P.48

Magnetic fields of the third type: what is their role on the Sun?

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There are three types of magnetic field lines according to I.E.Tamm classification: 1) closed; 2) going from infinity to infinity; 3) endless, but occupying a finite volume. In addition to this, skeleton of field lines connects zero points if they exist. Mathematical singularities are considered as physically removable. They have regular and continuous structures in the macroscopic field description. Theoretical arguments demonstrate that first two types are simple eroded special cases when the third type of magnetic fields represents more common and general situations, which are complicated. Hence, an 'exotic' case at first glance appears important in reality when internal structures are not neglected. Examples of field lines of three types are constructed analytically and presented for several axial and toroidal configurations. The magnetic flux concept is not defined for the fields of the third type. The magnetic tubes do not exist in such fields, but the local field strength can be arbitrary large. The whole volume of interest can be covered even by one field line (Peano curve) in some of these 'ergodic' cases. The third type could correspond to places on the Sun and in the corona, which are seen as structure-less or fuzzy features in the images. The questions exist about the role of such disordered and 'exotic' situations on the Sun and in the heliosphere. First of all, they are important for the energy, momentum and mass transport phenomena. Collision-less regimes are substituted by diffusive propagation along very long field lines. Confinement of particles across fields is also violated and diffusion occurs in these directions too. This leads to more collective and hydrodynamic behavior of the plasma medium even if the length scale of volume of interest is small in comparison with the mean free path of plasma particles against their collisions, similarly to the 'neo-classical' diffusion in tokomaks. We discuss experimental methods allowing to discriminate between an ergodic steady state and time-dependent turbulent states. Difficulties in observations are related to possible overlapping and space-time smearing of fine and middle grain patterns.

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Poster Number: P.49

Non-linear force-free magnetic fields

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The solar magnetic field is an important quantity which couples the solar interior with the photosphere and atmosphere. Knowledge regarding the coronal magnetic field plays a key role for eruptive phenomena, e.g. coronal mass ejection, flares and eruptive prominences. We describe a computer code for a non-linear force-free extrapolation of photospheric measurements into the corona based on an optimization principle.

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Poster Number: P.50

Dynamic properties of the EUV spicules and their relation to the disk events

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In this contribution we combine the time series data obtained by SUMER and EIT on SoHO to study the dynamic properties of the EUV spicules and the possible connection between them and the disk events. The data selected for this study were taken in the polar coronal holes, where a reduced effect of the solar rotation and the coverage of both on-disk and off-limb regions give us a good opportunity to analyse their temporal elovution and allow a comparison between them. Our data reveal that spicules occur repeatedly at the same location, sometimes, with an obvious period of 3-5 min for rising and falling/fading phase, respectively. The results show evidence that a long macrospicule seem to be comprised of a group of high spicules and could be driven by a series of bursts at their foot-sites, each with a short duration. The observational results of these transient events will further be discussed in connection with the magnetic field structures in the transition region.

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Poster Number: P.51

Coronal spectro-polarimetry in the Infrared: Proposal for Solar physics at Dome C

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The magnetic field vector in the solar corona is a key physical parameter for the understanding of the coronal structure and dynamics (CMEs, acceleration of the solar wind), and of coronal heating. Measuring the Zeeman effect on infrared emission lines seems to be the more promising approach to get a direct diagnostic of the magnetic field on a large domain in the low corona (Judge et al. 2001, Arnaud 2003). The sensitivity of spectral lines to Zeeman effect increases linearly with wavelength; in the infrared it allows to detect weak magnetic fields on the order of a few Gauss which is their expected range in the corona. Cold regions of the chromosphere can also be investigated through the emission lines of CO.
We propose to take advantage of the excellent qualities of the atmosphere at DomeC: seeing, transparency in the IR and low sky brightness, together with the good sensitivity of the Zeeman effect in the IR, to build an instrument dedicated to the direct measurement of the magnetic field vector in the Solar corona.

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Poster Number: P.52

The Solar Optical Telescope onboard the Solar-B

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The SOLAR-B mission is the third JAXA/NAO spacecraft dedicated to solar physics which will be launched in summer of 2006. The mission consists of a coordinated set of optical, EUV and X-ray instruments that will apply a systems approach to the interaction between the Sun's magnetic field and its high temperature, ionized atmosphere. The Solar Optical Telescope (SOT) is a diffraction limited magnetograph consisting of a 50cm aperture Gregorian telescope and a focal plane package, and provides the quantitative measurements of the full vector magnetic field of the photosphere with a spatial resolution of 0.2-0.3 arcsec. We will present the overview of the SOT instrument and its capability for diagnosing the solar magnetic fields in the photosphere and chromosphere.
The SOT is joint effort of Japan (JAXA/NAOJ) and the United States
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Poster Number: P.53

Spectropolarimetric measurements of prominences and spicules.

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A large set of high precision full-Stokes spectropolarimetric observations of the He-D3 line in prominences and spicules have been performed with the ZIMPOL polarimeter at the Gregory-Coudé Telescope in Locarno. The observational technique allow to obtain measurements free from seeing induced spurious effects. The instrumental polarization is well under control and taken into account in the data analysis. The observed Stokes-profiles are interpreted according to the quantum theory of the Hanle and Zeemann effects with the aim of obtaining information on the magnetic field vector. To this end, we make use of a suitable Stokes inversion strategy technique. The results are presented giving emphasis on a few particularly interesting Stokes-profiles. Finally, if time permits, we will also show some novel prominence observations in the H_α and H_β hydrogen lines.

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Poster Number: P.54

3D numerical experiments on magnetic flux emergence in the Sun

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Using three-dimensional MHD numerical experiments , we study the emergence of a bipolar magnetic region from the solar interior into a horizontal large-scale coronal magnetic field. The initial magnetic flux tube below the photosphere is twisted and has enough buoyancy to rise through the photosphere. A thin current sheet is formed at the interface between the rising magnetic tube and the ambient coronal field. Vigorous reconnection takes place in the current sheet which, following the intrinsic three-dimensionality of the field configuration across the sheet, does not conform to standard two-dimensional scenarios. As a result of the reconnection, the corona and the photosphere become magnetically connected, a process in agreement with observational evidence obtained through satellite missions in past years.

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