Index

Oral presentations

Session 1 - Transients and dynamics in the lower solar atmosphere

S1-T16 Coronal 'Waves': Magnetic Footprints of large-scale CMEs?
G. D. R. Attrill ; L. K. Harra ; L. van Driel-Gesztelyi ; P. Demoulin ; J. P. Wuelser

S1-T17 A non-wave MHD model for stationary and propagating EIT waves
C. Delannée ; G. Aulanier ; T. Török ; J.F. Hochedez

S1-T18 Multi-wavelength study of coronal waves associated with a CME-flare event
J. Magdalenic , B.Vrsnak , S. Pohjolainen , M.Temmer , H. Aurass

S1-T19 X-ray global waves observed with Hinode X-ray telescope
N. Narukage; T. Sakao; R. Kano; H. Hara; A. Asai

S1-T20 Global Coronal Mass Ejections
A. N. Zhukov ; I. S. Veselovsky

Session 2 - CME's: Why and how do they erupt?

S2-T01 On Some Problems Related to Coronal Mass Ejections initiation
Tahar Amari

S2-T02 About the role of reconnection in solar eruptions
J. Buechner

S2-T03 3D MHD Simulations of the Interplay of Flows and reconnection in the Solar Corona
Giovanni Lapenta

S2-T04 Reconnection along a streamer current sheet induced by a CME expansion
A. Bemporad , G. Poletto , M. Romoli , F. Landini

S2-T05 Numerical simulations of CME initiation and evolution
C. Jacobs, B. van der Holst, S. Poedts

S2-T06 A first look at the propagation of CMEs through the Heliosphere with SECCHI/STEREO
F. Auchere & the SECCHI team

S2-T07 The use of combined STEREO-A/B EUVI data in CME related studies
L. Rodriguez, A. N. Zhukov, S. Gissot, C. Marque

S2-T08 Study of the electron density distribution and its temporal evolution in flux-rope CMEs using forward modeling techniques
A. Thernisien , R.A. Howard , A. Vourlidas

S2-T09 Application of Stereoscopy to STEREO/SECCHI Data
P. C. Liewer, S. Braswell, E. M. DeJong, J. R. Hall, W. Thompson and the SECCHI Team

S2-T10 Coronal filament cavities: why there is a there there and what to do about it
Sarah Gibson, Jim Fuller, Joan Burkepile, Giuliana de Toma, Therese Kucera, Steve Tomczyk

S2-T11 On Causal Relationships between Eruptive Prominences and Coronal Mass Ejections
Boris Filippov and Serge Koutchmy

S2-T12 The CME Link to Filaments and Filament Channels
S.F. Martin, O. Engvold, O. Panasenco and Y. Lin

S2-T13 Processes and mechanisms governing initiation and propagation of CMEs
B. Vrsnak

S2-T14 Simulation of a breakout CME in the solar wind

Session 3 - Heliospheric transients

S3-T11 A Panoramic View of CMEs with the STEREO/SECCHI Heliospheric Imagers
S.P. Plunkett and the SECCHI Team

S3-T12 First Results from STEREO's Heliospheric Imager
D. Bewsher ; R.A. Harrison ; C. J. Davis ; C.J. Eyles

S3-T13 The Plasma and Suprathermal Ion Composition Experiment on STEREO - Early Results
A. Galvin , L. Kistler , M. Popecki , C. Farrugia , K. Simunac , A. Gustafson , J. Barry , L. Blush , B. Klecker , R. Wimmer , B. Thompson and the STEREO TEAM

S3-T14 Modeling Coronal Mass Ejections from the Sun into Interplanetary Space*
J. A. Linker ; Z. Mikic ; R. Lionello ; P. Riley ; V. Titov; D. Odstrcil

Session 4 - Solar and Heliospheric science in the next decade and beyond

S4-T01 The new plans of the European SPS Board
Stefaan Poedts

S4-T02 Solar Physics and Solar Image Processing
J. Ireland

S4-T03 Hybrid Computer Platform for the Automated Prediction of Solar Flares
T. Colak and R. Qahwaji

S4-T04 Data Assimilation Opportunities and Challenges for Investigating Transient Phenomena
FarzaFarzad Kamalabadi, Mark Butala, Richard Frazin, Yuguo Chen

S4-T05 Can the total solar irradiance be reconstructed from solar activity proxies ?
T. Dudok de Wit , M. Kretzschmar , J. Lilensten , P.-O. Amblard , S. Moussaoui , J. Aboudarham , F. Auchère

S4-T06 Radio instruments, past results and future prospects
Karl-Ludwig Klein

S4-T07 Solar Imaging Science Fiction - Lessons learned and not learned with the PROBA2 experiment
David Berghmans and Jean-Francois Hochedez

S4-T08 SDO's Contribution to the Study of Solar Transients → Talk is canceled
W. Dean Pesnell

S4-T09 The combined science program of the Solar Orbiter and Sentinels missions for exploration of the Sun-Heliosphere connections
Eckart Marsch and Robert P. Lin

Poster presentations

Session 1 - Transients and dynamics in the lower solar atmosphere

S1-P01 Lyman alpha and Beta line profiles in prominences(SUMER/SOHO Observations)
A. Ajabshirizadeh and H. Ebadi

S1-P02 Hinode/EIS and XRT Observations of Hot Jets - A Failed Escape Attempt?
D. Baker ; J.L.Culhane ; L. van Driel-Gesztelyi ; L. Harra ; J. Sun ; G. Doschek ; D. Brooks ; L. Lundquist ; S. Kamio ; P. Young ; V. Hansteen

S1-P03 Tearing-triggered instabilities and reconnection mechanisms in the solar environment
Lapo Bettarini ; Simone Landi ; Marco Velli

S1-P04 Energy transport by large-scale Alfvenic wave pulses in the flare impulsive phase, and the electron acceleration problem
Lyndsay Fletcher and Hugh S. Hudson

S1-P05 Turbulent heating and cooling of coronal loops
E. Buchlin ; P. Cargill ; S. Bradshaw ; M. Velli

S1-P06 Ellerman bombs and surges in the sunspot moat
Lokesh Bharti, Rajmal Jain and S.N.A. Jaaffrey

S1-P07 Torsional Alfven Waves in Small Scale Density Threads of the Solar Corona
Paula Copil, Yuriy Voitenko and Marcel Goossens

S1-P08 SUMER observations of redshifted emission at footpoints of coronal loops
I.E. Dammasch, B.N. Dwivedi, W. Curdt, S. Parenti

S1-P09 SOHO and TRACE coordinated observations of the polar coronal jets
D. Dobrzycka

S1-P10 Characteristics of Small-Scale Transient Brightenings in the Transition Region
A. Fludra and D. Haigh

S1-P11 MHD turbulence in the solar flares
G. Gogoberidze and S. Poedts

S1-P12 A possible scenario of energy release and transport in the 16 August 2004 flare
L.K. Kashapova; V.V. Zharkova; V.V. Grechnev ; S.S. Ipson

S1-P13 Non-thermal particle effects on the H-alpha, H-beta and CaII 8542 A line profiles in the 18 August 2002 solar flare
L.K. Kashapova; P. Kotrc; Yu.A.Kupryakov

S1-P14 On the Acoustic Oscillations Below Solar Magnetic Canopy: Uniform Atmosphere
D.Kuridze ; T.Zaqarashvili ; B. Shergelashvili ; S Poedts

S1-P15 Spectroscopic diagnostics of filaments and prominences and their surroundings
N. Labrosse, B. Schmieder, P. Heinzel, T. Watanabe, S. Gunar, P. Schwartz

S1-P16 Particles acceleration in the footpoints of stressed coronal loops including collisional losses
R. Turkmani ; J. Brown , E. Kontar , P. Cargill , K. Galsgaard

S1-P17 Transition Region Explosive Events and their Relation to the Solar Magnetic Field
K. Muglachand K. Dere

S1-P18 Fine thermal structure of a coronal active region from Hinode/XRT
F. Reale, S. Parenti et al.

S1-P19 Fine thermal structure of a flare with Hinode/XRT
S. Parenti, F. Reale et al.

S1-P20 Coronal seismology: wave leakage at the lower layers
R. Pinto, R. Grappin and J. Léorat

S1-P21 Coronal heating and the turbulent dynamo: a simplified model.
O. Podladchikova, B. Lefebvre, B. V. Krasnoselskikh

S1-P22 Novel EIT wave Machine observing (NEMO):10 years EIT/SOHO EIT wave catalogue and its properties.
O. Podladchikova, D.Berghmans, V.Krasnoselskikh and SECCHI/STEREO team.

S1-P23 Investigation of the flaring kernels' sizes and intensities in various parts of the H-alpha line profile
K. Radziszewski, P. Rudawy

S1-P24 MHD waves in the viscous shear flows: recent applications for the solar atmosphere
B.M. Shergelashvili, S. Poedts and A.D. Pataraya

S1-P25 Measurements of Significant Plasma Flows in the Regions of Blinkers with SOHO/CDS
K. Steed and G. Del Zanna

S1-P26 Evolution and dissipation of Alfvénic turbulence in the polar solar wind: implications on the plasma heating and on the wind acceleration in coronal holes.
A. Verdini, M. Velli, E. Buchlin

S1-P27 Magnetic interfaces and triggering of transient events in the solar atmosphere
Y. Voitenko, T. Siversky, and M. Goossens

S1-P28 Low-Latitude Coronal Holes observed by SOHO EIT and MDI
Jun Zhang

S1-P29 Diagnostic of Temperature and Differential Emission Measure (DEM) based on Hinode/XRT data
Robert Falewicz; Pawel Rudawy; Marek Siarkowski; Anna Kepa

S1-P30 Interaction Between Non-thermal Electrons and Plasma In the Chromosphere and Transition Region During Solar Flares. Energetic Balance of Solar Flares.
Robert Falewicz; Pawel Rudawy; Marek Siarkowski

S1-P31 Spectral anisotropy of MHD turbulence with large mean field: recent numerical results
R.Grappin ; W.-C. Mueller ; J.Leorat

Session 2 - CME's: Why and how do they erupt?

S2-P01 Statistical properties of LASCO CMEs over solar cycle 23 based on the ARTEMIS catalog.
Yannick Boursier, Philippe Lamy, François Goudail, Antoine Llebaria

S2-P02 Analysis and interpretation of a fast limb CME with eruptive prominence, C-flare and EUV dimming
S. Koutchmy, V. Slemzin, B. Filippov, J.-C. Noens and D. Romeuf

S2-P03 Contribution of solar radio physics to the understanding of CME development
M. Pick, D. Maia

S2-P04 Repetitive ejections from the same source region
A. Bemporad, G. Poletto, M. Romoli, F. Landini

S2-P05 Filament eruption related to large-scale horizontal flows in the
B. Schmieder, T.Roudier, M. Svanda M., N.Meunier, J. Dudik, G. Aulanier, G. Molodij, J.M. Malherbe

S2-P06 Coronal Mass Ejections identified by manual and automatic methods
S. Yashiro and N. Gopalswamy

S2-P07 Evolution of Trans-equatorial Loops and the acceleration of CMEs
Yuzong Zhang, Jingxiu Wang, Jun Zhang, Guiping Zhou

Session 3 - Heliospheric transients

S3-P01 Interplanetary coronal mass ejections (ICMEs) in the near earth solar wind and their geospace impact
Badruddin and Y.P. Singh

S3-P02 On the relation of interplanetary shocks and slow CMEs
C. Becerril, G. Muñoz, R. Schwenn

S3-P03 Transient electron acceleration by electrostatic waves in the solar atmosphere
Joerg Buechner

S3-P04 3He-rich solar energetic particle events and type II radio-bursts: SOHO/EPHIN observations
R. Gómez-Herrero, A. Klassen, R. Müller-Mellin, B. Heber and R. Wimmer-Schweingruber

S3-P05 Homologous proton events of 15-20 January 2005 and 13-14 December 2006
V.V.Grechnev , I.M.Chertok , A.M.Uralov , L.K.Kashapova , Y.Hanaoka , K. Shibasaki

S3-P06 Finite instrumental resolution scale and statistical modeling of the solar wind
N.R.Minkova

S3-P07 Two-spacecraft reconstruction of a magnetic cloud and comparison to its solar source
C. Möstl, C.J. Farrugia , C. Miklenic, A. Veronig , M. Temmer, A. Galvin, M. Leitner, H.K. Biernat

S3-P08 Tracking back to the Sun the January 18, 2002 Ulysses? Event
Adrian Oncica, Nedelia Antonia Popescu, Cristiana Dumitrache

S3-P09 Ionospheric Height changes due to Space Weather phenomena
Alexander Soenen, Stefaan Poedts, Martin Füllekrug

S3-P10 Magnetic Field Disturbances Around a Super-Sonic Interplanetary Magnetic Cloud
E. Romashets , M. Vandas and S. Poedts

S3-P11 High-energetic storm particle events during the first seven years of SOHO
K. Huttunen-Heikinmaa and E. Valtonen

Session 4 - Solar and Heliospheric science in the next decade and beyond

S4-P01 Solar chromospheric and coronal stereoscopy
Guy Artzner

S4-P02 The 3D distribution of EUV flux in the heliosphere. Insights from STEREO.
F. Auchere, D. McMullin, J. Newmark, J. Cook, M. Witte, R. VonSteiger, E. Quemerais

S4-P03 FESTIVAL: A Multiscale Vizualisation Tool for Solar Data
E. Soubrie , F. Auchere , K. Bocchialini

S4-P04 Super-resolution of EUV images using small scale offpoints
E. Bordes ; V. Delouille ; A. Eudes ; J.-F. Hochedez

S4-P05 HiRISE, a new generation ultrahigh resolution, interferometric and coronagraphic, Solar Physics mission
L. Damé

S4-P06 The SWAP EUV imager: preflight calibration
A. De Groof , D. Berghmans , B. Nicula , J.P. Halain , J.M. Defise , T. Thibert , U. Shuehle , V. Slemzin

S4-P07 Quantifying and containing the curse on high resolution coronal imaging
V. Delouille ; P. Chainais ; J.-F. Hochedez

S4-P08 Development of new technologies for solar observation
M. Dominique, A. BenMoussa, J.-F. Hochedez

S4-P09 Multispectral analysis of EIT images: linking temperature to morphology
T. Dudok de Wit and F. Auchère

S4-P10 A new proposed effort: SOTERIA (SOlar-TERrestrial Investigations and Archives)
SOTERIA Consortium (Coordinator: Giovanni Lapenta)

S4-P11 Optimisation of the instantaneous noise level of the total Solar irradiance measurements
S. Mekaoui & S. Dewitte

S4-P12 Investigating the Association among Active Regions, Flares And CMEs using Machine Learning
R. Qahwaji, T. Colak, M. Al-Omari and S. Ipson

S4-P13 Large-Scale Numerical Analysis for the Prediction of Flares using Support Vector Machines and Neural Networks
R. Qahwaji and T. Colak

List of participants p. 101

Oral presentations

Oral presentations

Session 1

Transients and dynamics in the lower solar atmosphere

S1-T01

Transient phenomena in the low solar atmosphere

David Alexander

Rice University

Observations have shown that the chromosphere and corona are in constant motion and that the nature of the plasma dynamics plays a critical role in the development and evolution of transient activity. New results from Hinode and STEREO, coupled to ground-based velocity and intensity observations, are highlighting the range and impact of this dynamic activity and its relationship to large-scale transients like CMEs and flares. In this talk, we will briefly review some of the salient phenomena and recent results, leaving the details to the other, more specific, invited talks. We will focus particularly on recent observational results on filament/prominence dynamics and their impact on our understanding of the physics of transient solar phenomena.

S1-T02

The magnetic evolution of x-ray bright points

D. Brown

University of Wales Aberystwyth

X-ray bright points are supposedly simple, small-scale loops structures in the solar corona. They are typically associated with bipoles in the network field and live for an average of 8 hours, sometimes ending in eruption.
Simple theories about the evolution of bright points have been around for up to 35 years, for example, the theory that x-ray bright points are due to cancelling magnetic features. However, modern hi-resolution observations show that the actual evolution of x-ray bright points is usually much more complicated than these models suggest.
This paper will present high-resolution observations of x-ray bright points from SOHO/MDI and TRACE, and illustrate the intricate behaviour of the magnetic field in a bright point. It will show that the actual behaviour is more involved than traditional theories would have us believe, and that often a bright point is composed of more than a simple bipole.
Understanding the magnetic evolution of 'simple' magnetic features is an important step in understanding the magnetic processes that can occur in complex, large-scale structures (such as active regions). Studying the processes that can lead to simple eruption in x-ray bright point will provide important clues for understanding how solar flares occur.

S1-T03

Automatic tracking of photospheric Magnetic Bright Points and application to Hinode data: First Results

D. Utz [1], C. Möstl [1,2], A. Hanslmeier [1], R. Muller [3], H.J. Muthsam [4]

[1]University of Graz, Austria;[2]Space Research Institute, Graz, Austria;[3]Laboratoire d'Astrophysique de Toulouse et Tarbes, France;[4]University of Vienna, A-1090,Austria;

We discuss the dynamics of small-scale footpoints of magnetic field lines in the photosphere, also known as Magnetic Bright Points (MBPs), with data from the Solar Optical Telescope (SOT) aboard the recently launched Hinode spacecraft. Brightness enhancements in the G-band are used as a proxy for the magnetic flux. Using an algorithm for automatic detection and tracking of MBPs, we analyze a seeing-free time series of G-band images from a network region obtained by Hinode. We derive the horizontal velocity distribution as well as sizes, lifetimes and number densities. These results are discussed in the view of theoretical studies predicting the generation of MHD waves through rapid footpoint motions. We also estimate the resulting energy flux propagating upwards along the field lines into the corona. Future applications using multi-wavelength data are outlined.

→ will be presented as poster (S1-P32) instead of a talk

S1-T04

Hinode and the dynamic chromosphere: Spicules and Alfven waves

B. De Pontieu [1], S.W. McIntosh [2], V.H. Hansteen [3], M. Carlsson [3], SOT Team

[1] Lockheed Martin Solar & Astrophysics Lab, Palo Alto, USA
[2] HAO & Southwest Research Institute, Boulder, USA
[3] Institute of Theoretical Astrophysics, University of Oslo, Norway

High-resolution, high-cadence Ca II and H-alpha observations of the solar chromosphere obtained with the Solar Optical Telescope (SOT) onboard Hinode provide an unprecedented view of the dynamics of the chromosphere. We find that there are at least two types of spicules with very different dynamic properties. We show that the first type is driven by the same mechanism that forms dynamic fibrils: shock waves that form when global oscillations and convective flows leak into the chromosphere along magnetic field lines on 3-7 minute timescales. The second type of spicules is much more dynamic: they form rapidly (in ~10s), are very thin (<200km wide), have lifetimes of 10-150s (at any one height) and seem to be rapidly heated to (at least) transition region temperatures, sending material through the chromosphere at apparent speeds of order 50-150 km/s. The properties of Type II spicules suggest a formation process that is a consequence of magnetic reconnection.
Our analysis of chromospheric Hinode data also indicates that the chromosphere is permeated by strong Alfven waves. Both types of spicules are observed to carry these Alfven waves, which have significant amplitudes of order 20 km/s, transverse displacements of order 500-1,000 km and periods of 150-400 s. Estimates of the energy flux carried by these strong Alfven waves and comparisons to advanced radiative MHD simulations indicate that these waves most likely play a significant role in the acceleration of the solar wind, and possibly the heating of the quiet Sun corona. We will discuss the implications of these waves on the energy balance of the lower atmosphere.

S1-T05

Is the chromospheric transition region stable?

R. Grappin [1]; J. Leorat [1]; R. Pinto [1]; Y.-M. Wang [2]

[1] Observatoire de Paris; [2] NRL

The chromospheric transition region plays the role of a (partially) reflecting boundary. In fact, it has its own dynamics, which is essential to understand coronal sismology, and more generally coronal heating and wind. To progress, numerical modeling of the transition region must include the transition region not as a numerical boundary, but well within the simulation domain.
Published numerical simulations on the coronal dynamics including the transition region belong to two classes: either the transition region is given (or computed), but its oscillations are limited (relaxation models); or, in the rare self-consistent simulations in which the corona is heated by either viscous or ohmic heating (Gudiksen and Nordlund 2005; Suzuki and Inutsuka 2005), the transition region is free, and in the latter case, it is observed to be unstationary.
The present work explores as a preliminary step the issue in the 1D, hydrodynamic case (with some MHD cases), including chromosphere, corona and solar wind; we demonstrate that using relaxation models for the transition region leads to artificial stability, since when when this constraint is relaxed, the transition region shows unstable behaviour, by accumulating the energy of oscillations propagating upwards from the photospheric basis.

S1-T06

Transients in the coronal hole and their implication in heating

Banerjee, D.[1], Gupta, G[1], Popescu, M. D.[2] and Doyle J.G.[2]

[1]Indian INstitute of Astrophysics, Koramangala, Bangalore 560034, INDIA; [2]Armagh Observatory, Armagh, BT 61 9DG, N.Irealnd

We study the time series data of spectral lines originating from a wide range of temperatures in the solar transition region and corona, within coronal hole, with SUMER (Solar Ultraviolet Measurements of Emitted Radiation) on SoHO (Solar and Heliospheric Observatory). We will report on the dynamics and properties of these small scale transients as observed from the spectral line diagnostics. We will address on the question, if the the observed intensity and velocity changes are due to waves and/or are linked with recurrent magnetic reconnection process. Our data also reveal long periodicities (10-90 min), previously observed with different SoHO instruments. The implication to solar wind acceleration and coronal heating will be also addressed.

S1-T07

Transients in RHESSI and chromospheric flares

Hugh S. Hudson

SSL/UC Berkeley

Solar flares have a strongly nonthermal character, which means that the RHESSI hard X-ray and gamma-ray observations must play a decisive role in our understanding of the significant mechanisms involved. The major energy release, as confirmed by the recently detected stepwise changes of the photosphereic field, occurs during the impulsive phase when these hard radiations appear. Other radiations, such as soft X-rays, mainly reflect secondary effects and flare-altered magnetic structures, but the UV and white-light continuum strongly correlates with the energy release. The energy for the flare and for the particle acceleration must come from the solar corona. At the same time (the impulsive phase of the flare, or the acceleration phase of the CME) there are drastic effects in the chromosphere. We review the RHESSI observations of flares and discuss their relationships with the chromospheric effects.

S1-T08

First Results from Hinode Mission - Flare Observations

Taro Sakao

Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency (ISAS/JAXA)

We report initial results from Hinode mission with emphasis on observations of flares. A suite of three state-of-the-art imaging/spectroscopy instruments, namely, Solar Optical Telescope (SOT), X-Ray Telescope (XRT), and EUV Imaging Spectrometer (EIS), has enabled us to investigate, in an unprecedented detail, a wide variety of magnetic activities that take place in the solar atmosphere ranging from the photosphere to the corona. Observations with Hinode have even been providing us with totally-new findings about the Sun.
As exemplified by the events commenced in December last year, even with the present minimum phase of solar activity, there are several major, as well as numbers of smaller, flares well observed with Hinode which are of significant interest for understanding physical processes that take place in solar flares.
Highlights of flare observations made with Hinode in its initial 10 months, including new aspects of flares thus far revealed, will be presented and their implications to the field of solar flare study discussed.

S1-T09

The response of total solar irradiance to flares

M. Kretzschmar [1]; T. Dudok de Wit [2]; S. Mekaoui [3]; W. Schmutz [4]; J.F. Hochedez [1]; S. Dewitte [3]

[1] SIDC- Royal Observatory of Belgium; [2] LPCE / CNRS, Université d'Orléans, France; [3] Royal Meteorological Institute of Belgium; [4] PMOD/WRC, Switzerland

Solar flares are best seen in the EUV and X-ray spectral bands that usually characterize the corona; however they also affect the lower solar atmosphere and produce emission at longer wavelengths. Here we investigate the flare signatures at these longer wavelengths by using the total solar irradiance (TSI) measurements at high temporal resolution from the PMO and DIARAD sensors of the VIRGO experiment onboard SOHO. Using a conditional average that allows us to remove the fluctuations associated to p-modes, we show for the first time that there is a systematic increase of the TSI during flares belonging from x-ray class C to X. A systematic increase of visible irradiance is also found, demonstrating thus that white light flares are an intense and common feature of flares. We analyze the contribution of different spectral bands to the TSI increase and discuss the implications for flare energetics. These results are also of interests for Solar-Terrestrial relationships.

S1-T10

Off-limb EUV observations of the diffuse and structured solar corona and transient phenomena at 1-5 Rsun with the CORONAS-F/SPIRIT telescope-coronagraph

V. Slemzin[1], O. Bougaenko [2], A. Ignatiev [1], S. Kuzin [1], A. Mitrofanov [1], A. Pertsov [1], I. Zhitnik [1]

[1] P.N. Lebedev Physical Institute, Moscow, Russia; [2]Sternberg Astronomical Institute, Moscow State University, Moscow, Russia

During the flight of the CORONAS-F satellite (August 2001- December 2005), the SPIRIT telescope observed the solar corona in 175 and 304 Å bands in the off-limb coronagraphic mode. In this mode the central part of the aperture was closed by the external occulter and the focusing mirrors were tilted to observe the selected sector of the solar corona at the distance of 1.1-5 Rsun from the Sun center with spatial resolution of 5". This range is intermediate between fields of view of EIT (0-1.3 Rsun), UVCS (1.5-12 Rsun), LASCO C2 (2-7 Rsun) and is very important for forming the streamer belt and emergence of slow solar wind. The images of the corona in 175 and 304 Å bands were taken simultaneously with 150 or 300 s exposure times and with enhanced sensitivity of the detector (in 25-53 times more than in the disk mode). Observations were made during the periods from 1 day to several weeks with a cadence of 0.5-1 h. In the 175 Å band corresponding to T~ 1 MK the corona at the solar maximum (2001-2002) consisted of diffuse part and a distinct system of quasi-radial diverging loops and rays observed to the distances up to 2-2.5 Rsun. Most of these features were not seen in the 304 Å band. Both components showed short-term (hours) and long-term (days) variations with the activity of underlying regions. In the coronagraphic mode we detected also several transient phenomena such as prominence eruptions and jets. We analyze the results and compare them with the corresponding data of EIT, UVCS, CDS and LASCO.

S1-T11

Eruption precursors

Peter Gallagher

School of Physics, Trinity College Dublin, Dublin 2, Ireland

Accurate forecasting of solar eruptions is one of the primary goals of solar and space weather forecasters. Although it is now known that solar eruptions occur due to the destabilisation of magnetic fields in the complex topologies of active regions and filaments, it is still unclear how energy is stored and released in these features. In this talk, I will review the observational insights we have gained from instruments such as EIT and MDI onboard SOHO, and how advances in data-analysis and modelling have enhanced our understanding of the fundamental physics involved in triggering solar eruptions.

S1-T12

Diagnostics of active or eruptive prominences through Hydrogen and Helium lines modelling

N. Labrosse[1], J.-C. Vial[2], P. Gouttebroze[2]

[1]Institute of Mathematical and Physical Sciences, University of Wales Aberystwyth; [2]Institut d'Astrophysique Spatiale, CNRS - Université Paris XI

In this work we investigate the effects of radial motions of the plasma in active or eruptive prominences on hydrogen and helium lines. Doppler dimming / brightening is particularly effective for the EUV resonance lines observed by the SOHO spectrometers. However, because of the different formation mechanisms of each line, these intensity decreases / increases will be most effective for different values of the radial speed of the prominence plasma. We study these effects for several prominence models representative of the physical conditions in active and eruptive prominences. The possibility of identifying radiative signatures of activation and eruption of solar prominences in the strong H and He lines is discussed, with the implications for current and future missions.

S1-T13

Pre-flare X-ray brightenings as pre-cursors to prominence and CME eruptions

D. Tripathi [1], C. Chifor [1], H.E.Mason [1], B. R. Dennis [2]

[1]Department of Applied Mathematics and Theoretical Physics, University of Cambridge, UK; [2]NASA Goddard Space Flight Center, USA

We study the potential role of X-ray pre-flare brightenings in destabilisation of flare associated prominence eruptions for 8 events. For this study we combined observations taken from the Extreme-ultraviolet Imaging Telescope (EIT) aboard the Solar and Heliospheric Imager (SOHO), Transition Regions and Coronal Explorer (TRACE) and Reuvan Ramaty High Energy Solar Spectroscopic Images (RHESSI). We found that the pre-flare activity occurs prior to the impulsive phase of the flare and filament eruption and is observed in form of localized brightenings. These brightenings are located on or near the polarity inversion line. These brightenigns show both thermal and non-thermal hard X-ray emission during the pre-flare enhancement. This is suggestive of plasma heating and electron aceleration. This precursor activity provides strong evidence in favour of a form of tether-cutting mechanism responsible for common trigger for flare and prominence eruptions.

S1-T14

Slip-running reconnection : MHD theory and Hinode/XRT observations

G. Aulanier [1]; E. Pariat [2]; P. Démoulin [1]; C.R. DeVore [2]; L. Golub [3]; E.E. DeLuca [3]

[1] Observatoire de Paris, France; [2] NRL, USA; [3] Smithsonian Astrophysics Observatory, USA

Many solar transients have been conjectured to be due to magnetic reconnection in quasi-separatrix layers (QSLs) instead of at null points or separators. But the nature and the existence of reconnection in QSLs remain controversial. Using 3D MHD simulations, we have shown that thin current sheets naturally form all along the pre-existing QSLs in simple magnetic configurations driven by any line-tied motions. We then revealed that when the driving is suppressed, magnetic reconnection occurs as a result of the self-pinching and dissipation of the current sheet located where QSLs intersect. We highlighted that during this process, field lines continuously slip along each other at phase velocities that can be super-Alfvenic when the QSLs are thin enough. This peculiar behavior for reconnection can be attributed to the gradual resistively-driven de-rotation of the magnetic field locally in the current sheet, which naturally leads to successive rearrangements of field line connections with their neighbors. This regime was named "slip-running reconnection". Using Hinode/XRT observations, we recently found the first direct observational evidence of the sub-Alfvenic regime of this process occurring in the Sun's corona, as revealed by 100 km/s bi-directional motions of coronal loops observed in soft X-rays. We also propose that this process could also be responsible for the fast motion of HXR footpoint sources along flare ribbons.

S1-T15

A Mechanism for Coronal Hole Jets

D. Müeller [1], S. K. Antiochos [2]

[1]European Space Agency; [2]Naval Research Laboratory, Washington, DC

Bald patches are magnetic topologies in which the magnetic field is concave up over part of a photospheric polarity inversion line. A bald patch topology is believed to be the essential ingredient for filament channels and is often found in extrapolations of the observed photospheric field. We demonstrate that although common in closed field regions, bald patches are unlikely to occur in the open field topology of a coronal hole. We use an analytic source-surface model to calculate the magnetic topology of a small "active region" dipole embedded in a central magnetic dipole field. While bald patches readily occur in closed-field regions, we show that there is only a highly limited parameter range for them to form in open-field regions. Furthermore, the inclusion of a finite gas pressure and solar wind is likely to destroy even this limited parameter range for the existence of bald patches in coronal holes. Our results give rise to the following question: What happens to a bald patch topology when the surrounding field lines open up? This would be the case when a bald patch moves into a coronal hole, or when a coronal hole forms in an area that encompasses a bald patch. Our magnetostatic models show that, in this case, the bald patch topology almost invariably transforms into a null point topology with a spine and a fan. We argue that the time-dependent evolution of this scenario will be very dynamic since the change from a bald patch to null point topology cannot occur via a simple ideal evolution in the corona. We discuss the implications of these findings for recent Hinode XRT observations of coronal hole jets and give an outline of planned time-dependent 3D MHD simulations to fully assess this scenario.

S1-T16

Coronal 'Waves': Magnetic Footprints of large-scale CMEs?

G. D. R. Attrill [1]; L. K. Harra [1]; L. van Driel-Gesztelyi [1,2,3]; P. Démoulin [2]; J. P. Wuelser [4]

[1] UCL, Mullard Space Science Laboratory; [2] Observatoire de Paris, Meudon; [3] Konkoly Observatory, Budapest; [4] Lockheed Martin Solar & Astrophysics Laboratory, Palo Alto.

We propose a new mechanism for the generation of the "EUV coronal wave" phenomenon. This work is based on new analysis of data from SOHO/EIT, SOHO/MDI & STEREO/EUVI. Although first observed in 1997, the interpretation of coronal waves as flare-induced or CME-driven remains a debated topic. We investigate the properties of two "classical" SOHO/EIT coronal waves in detail. The source regions of the associated CMEs possess opposite helicities & the coronal waves display rotations in opposite senses. We observe deep dimmings near the flare site & also widespread diffuse dimming, accompanying the expansion of the EIT wave. We report a new property of these EIT waves, namely, that they display dual brightenings: persistent ones at the outermost edge of the core dimming regions & simultaneously diffuse brightenings constituting the leading edge of the coronal wave, surrounding the expanding diffuse dimmings. We show that such behaviour is consistent with a diffuse EIT wave being the magnetic footprint of a CME. We propose a new mechanism where driven magnetic reconnections between the skirt of the expanding CME & quiet-Sun magnetic loops generate the observed bright diffuse front. The dual brightenings & widespread diffuse dimming are identified as innate characteristics of this process. In addition we present some of the first analysis of a STEREO/EUVI limb coronal wave. We show how the evolution of the diffuse bright front & dimmings can be understood in terms of the model described above. We show that an apparently stationary part of the bright front can be understood in terms of magnetic interchange reconnections between the expanding CME & the "open" magnetic field of a low-latitude coronal hole. We use both the SOHO/EIT & STEREO/EUVI events to demonstrate that through successive reconnections, this new model provides a natural mechanism via which CMEs can become large-scale in the lower corona.

S1-T17

A non-wave MHD model for stationary and propagating EIT waves

C. Delannée [1]; G. Aulanier [2]; T. Török [3]; J.F. Hochedez [1]

[1] ROB, Belgium; [2] Paris Observatory, France; [3] MSSL, UK

Coronal waves are subject of an intense debate. They are observed simultanously in Halpha, in FeXII and in soft X-rays. They are always observed conjointly with a CME-associated flare from wich they seem to originate. They are often interpreted as magnetosonic waves due to the flare-related thermal or the CME-related dynamical pulse. We first present observational evidences against this wave interpretation. We further analyze two types of events, which show stationary and propagating "wave" brightenings. For some events, we calculate the 3D coronal potential field topology using the online Potential Field Source Surface package. For others, we calculate the electric currents in 3D MHD numerical simulations of a line-tied twisted flux rope embedded within potential bipolar arcades. Our first combined observational and modeling analyzis shows that the stationary brightenings in these waves are related to layers of drastic jumps of magnetic field connectivity (separatrices and QSLs) where current sheets are well known to be easily generated by any perturbation (such as a CME). We show that this approach also very naturally explains how large inter-connecting (and trans-equatorial) loops can become the front of CMEs originated from smaller active regions. Our second analyzis reveals that the propagating brightenings correspond to the over-dense shell-shaped interface between erupting twisted fields and their surrounding arcades, in which narrow and intense current sheets are dynamically formed. We also report on a very good correspondance between the shape and development of these calculated shells and that of two halo-CMEs, which we therefore naturally interprete as the signature of these over-dense shells. Both approaches lead us to conjecture a unified mechanism for the interpretation of stationary and propagating coronal "so-called" waves, as Joule heating in current sheets.

S1-T18

Multi-wavelength study of coronal waves associated with a CME-flare event

J. Magdalenic [1], B.Vrsnak [1], S. Pohjolainen [2], M.Temmer [1], H. Aurass [3]

[1]Hvar Observatory, Faculty of Geodesy, Croatia; [2]Tourla Observatory, University of Turku, Finland; [3]Astrophysical Institute Potsdam, Germany

We present the multi-wavelength study of the CME-flare event recorded on 24 December 1996. The kinematics and evolution of the shock wave signatures - type II radio burst, and the EIT-wave are analysed and compared with the CME evolution and kinematics.

In the study we employ dynamic spectra, position of the NRH radio sources and LASCO-C1 observations, which altogether represents an outstanding set of observations for a detailed analysis of this limb CME-flare event.

The obtained velocity of the shock wave is significantly higher than the CME velocity (1100 and 230 km/s, respectively). Moreover, since CME kinematics shows that the main acceleration phase of the CME happens 10-20 min after the shock wave was lunched, we conclude that the shock wave on 24 December 1996 is not CME-driven. On the other hand, the shock wave was probably ignited by the flare since it was closely associated with the flare impulsive phase.

However, the second shock wave that occurred 9 min after the first shock might have been driven by the CME.

S1-T19

X-ray global waves observed with Hinode X-ray telescope

N. Narukage[1]; T. Sakao[1]; R. Kano[2]; H. Hara[2]; A. Asai[2]

[1] Institute of Space and Astronautical Science, JAXA; [2] National Astronomical Observatory of Japan

When solar flares occur, wave-like disturbances and shock waves are sometimes observed in several kinds of wavelengths. Last December, the X-ray telescope (XRT) on board Hinode detected the wavelike disturbance associated with a large flare. The speed of this wavelike disturbance is about 630 km/s. In this flare, a type II radio burst, which shows the existence of a shock wave, was also observed with the Hiraiso Radio Spectrograph (HiRAS). Moreover, EUV Imaging Spectrometer (EIS) on board Hinode scanned the region where the X-ray wavelike disturbance was propagated. We analyzed these data and examine whether the wavelike disturbance is shock wave or not.
On the other hand, in this May, the XRT detected a slowly and widely propagating wave, just like the EIT waves. In this meeting, we will show the analysis results.

S1-T20

Global Coronal Mass Ejections

A. N. Zhukov [1,2]; I. S. Veselovsky [2,3]

[1] Royal Observatory of Belgium; [2] Skobeltsyn Institute of Nuclear Physics, Moscow State University, Russia; [3] Space Research Institute, Russian Academy of Sciences

Observations of the low solar corona in the extreme-ultraviolet and in soft X-rays evidence a close relationship of coronal dimmings and coronal mass ejections (CMEs). Dimmings are usually interpreted as places of plasma evacuation during a CME. We characterize a CME by the apparent angular extent of associated dimmings above the solar limb, and define a global CME as a CME with the total apparent extent of limb dimmings of more than 180 degrees. Several examples of global CMEs are discussed. All the global CMEs identified up to now are fast full halo CMEs associated with X-class flares (if they originate on the front side of the Sun). We demonstrate that global CMEs involve an eruption of several magnetic flux systems distributed on a large spatial scale comparable to a half of the solar disc (true angular width around 180 degrees). We discuss possible interpretations of the global CME phenomenon and challenges it presents to CME modeling. Our results suggest a non-local nature of the CME eruption mechanism.

Oral presentations

Session 2

CME's: Why and how do they erupt?

S2-T01

On Some Problems Related to Coronal Mass Ejections initiation

Tahar Amari

Centre de Physique Theorique. Ecole Polytechnique. France.

The low corona is dominated by its magnetic field, which is therefore reasonably assumed to be in a force-free state prior to the large scale eruptive events that represent Coronal Mass Ejections (CMEs). We will present several physical boundary value problems characterised by a quasi-static evolution driven by slow changes (such as footpoints motions by the dense photospheric plasma, or flux emergence/submergence) and their properties. Those have been considered by solar physicists for understanding some aspects of CMEs initiation such as: magnetic energy and helicity contents, topological complexity, twisted flux rope presence, trigger and role of reconnection

S2-T02

About the role of reconnection in solar eruptions

J. Buechner

Max-Planck-Institut fuer Sonnensystemforschung

We investigate the situation preceeding solar eruptions by means of numerical simulations based on the observation of photospheric magnetic fields prior to the moment of eruptions. This way we identify regions of enhanced currents in the corona. The regions of enhanced current flows appear to coincide with those of strong changes in the connectivity between the magnetically conjugate photospheric ends of the flux tubes, along which the disruptions occur. We discuss the role of reconnection in the course of the eruption and compare the simulation results with the observed signatures of the eruptions.

S2-T03

3D MHD Simulations of the Interplay of Flows and reconnection in the Solar Corona

Giovanni Lapenta

Centrum voor Plasma-Astrofysica, Katholieke Universiteit Leuven, Belgium

Reconnection is a fundamental process believed to play a significant part in the collective phenomena involved in many coronal processes. We consider here specifically two. First, the regions of formation of the slow solar wind, near the cusps of the helmet streamers. Second, the processes involved in the formation of coronal mass ejections (CME). In both cases reconnection can be an important processes enabling a change in the topological connection of magnetic field lines.
Reconnection develops in a constant interplay of large-scale changes of the system and small-scale dissipations. Two crucial mediators of small-large scale couplings are flows and electric fields. We report here a simulation study using the 3D-MHD code FLIP. We focus on three examples of specific coronal processes are used to illustrate the phenomena: i) the Kelvin-Helmholtz instability and its role in CME [1]; ii) the compressional action of bent field lines near the cusp of helmet streamers to lead to reconnection and the formation and ejection of the blobs [2] observed by LASCO in relation to the origin of the slow solar wind; and iii) the kink instability of open lines anchored at only one end to the photosphere [3].
[1]G. Lapenta, D.A. Knoll, Solar Phys., 214, 107-129 (2003); [2]G. Lapenta, D.A. Knoll, Astrophys. J., 624, 1049-1056 (2005); [3]G. Lapenta, I. Furno, T. Intrator, J. Geophys. Res., 111, A12S06, doi:10.1029/2006JA011932 (2006)

S2-T04

Reconnection along a streamer current sheet induced by a CME expansion

A. Bemporad [1], G. Poletto [1], M. Romoli [2], F. Landini [2]

[1]INAF - Arcetri Astrophysical Observatory, Firenze, Italy; [2]Dept. of Astronomy and Space Science, University of Firenze, Italy

On December 11, 2005 a slow CME occurred in the Western hemisphere in between two coronal streamers. SOHO/MDI magnetograms show a multipolar magnetic configuration at the photosphere: a complex of active regions located at the CME source and two bipoles at the base of the lateral coronal streamers. White light observations reveal that the CME expansion affects both of them and induces the release of plasma along the streamer axes. These transient phenomena are possibly due to magnetic reconnection occurring along the streamer current sheets and induced by the CME.
These events have been observed by the SOHO/UVCS with the spectrometer slit centered at 1.78 solar radii over about a full day. In this work we focus on the interaction between the CME and the streamer: the UVCS spectral interval included UV lines from ions at different temperatures of maximum formation such as O VI, Fe XII, Si XII and Al XI. These data gave us the opportunity to infer the plasma temperature and other physical parameters at the reconnection site and adjacent regions. These are relevant to characterize secondary reconnection processes occurring during a CME development.

S2-T05

Numerical simulations of CME initiation and evolution

C. Jacobs, B. van der Holst, S. Poedts

Centrum voor Plasma-Astrofysica, K.U.Leuven, Belgium

It is well known that Coronal Mass Ejections (CMEs) are one of the most important drivers of the space weather. Mathematical modelling of these violent solar events, might help us to get a better understanding of the evolution and impact of CMEs and is essential for a deeper insight into space weather physics. Due to the complexity of the problem, numerical modelling of solar transients is a challenging task and asks for a large amount of computational power and the continuous improvement of numerical techniques and physical models. During the last couple of years significant progress has been made in the field of computational magneto-fluid-dynamics applied to solar related phenomena. This progress is due to the improved computer facilities and also to the inclusion of more realistic, data-driven boundary conditions in the models.
We present recent results from numerical simulations of the initiation and interplanetary evolution of CMEs performed in the framework of ideal magnetohydrodynamics (MHD). As a first step the stationairy background solar wind has to be reconstructed. Both axi-symmetric (2.5D) solar wind models for the quiet Sun as more complicated 3D models are created. In a second step, fast CME events are mimicked by superposing high-density plasma blobs on the background wind. Both 2.5D and 3D models, including a magnetic flux rope are available. In this way, the evolution of the CME can be modelled and its effects on the coronal field and background solar wind studied. In addition, more realistic CME onset models have been developed to investigate the possible role of magnetic foot point shearing and magnetic flux emergence/disappearance as triggering mechanism of the instability.

S2-T06

A first look at the propagation of CMEs through the Heliosphere with SECCHI/STEREO

F. Auchère & the SECCHI team

Institut d'Astrophysique Spatiale

The SECCHI instrument suite on board the STEREO probes give us unprecedented views of our Sun. Especially, SECCHI offers the possibility to track CMEs from their initiation site to their propagation in the heliosphere. We present preliminary results combining observations from the 5 SECCHJI instruments.

S2-T07

The use of combined STEREO-A/B EUVI data in CME related studies

L. Rodriguez, A. N. Zhukov, S. Gissot, C. Marqué

SIDC - Royal Observatory of Belgium

The main goal of the STEREO mission is to address the three-dimensional structure of the Sun's corona, with emphasis in the origin and development of coronal mass ejections (CMEs). SECCHI/EUVI, the extreme ultraviolet imager onboard STEREO, provides full Sun coverage with improved cadence and spatial resolution with respect to SOHO/EIT. This fact, plus the new stereo information that can be now retrieved, allows an improved study of CME signatures in EUV.
The present work provides an insight analysis of CME related phenomena in the EUV. We combine the images of the EUVI instruments on board STEREO-A and STEREO-B in order to obtain information on the 3D configuration of solar structures. The method includes the identification and matching of corresponding structures in both images, together with the calculation of their height. We use it to investigate dynamics and morphology of some of the CME-related events observed by STEREO so far.

S2-T08

Study of the electron density distribution and its temporal evolution in flux-rope CMEs using forward modeling techniques

A. Thernisien [1], R.A. Howard [2], A. Vourlidas [2]

[1] USRA - NRL, Washington DC, USA; [2] NRL, Washington DC, USA

We study the electron density distribution in the leading edge and prominent material of different flux rope CME events. In an attempt to demonstrate a pile up effect in the leading edge of the CMEs, we also study the evolution of the density and mass distribution along time by following and fitting events through LASCO-C2 and C3 fields of view. To achieve that study, we used a simple flux rope model called GCS (Graduated Cylindrical Shell) that we fit to the different observations.

S2-T09

Application of Stereoscopy to STEREO/SECCHI Data

P. C. Liewer, S. Braswell, E. M. DeJong, J. R. Hall, W. Thompson and the SECCHI Team

JPL, GSFC, NRL

The spacecraft of NASA's Solar TErrestrial RElations Observatory (STEREO) Mission have reached sufficient angular separation for stereoscopic analysis of simultaneous images from the two spacecraft. In this talk, we will report results of 3D reconstruction of coronal loops and prominences using "tiepointing" and stereoscopy (aka triangulation). To validate the stereoscopy method, results will be compared for triangulation of coronal loops using different software algorithms and by comparison with the same loops seen at the limb. From the early May to late August, the separation of the two spacecraft increases from 6 to nearly 30 degrees, significantly decreasing the expected errors in the 3D reconstruction calculation. We will compare the observed scaling of the reconstruction errors with the theoretical predictions. We will use the technique on both "steady" loops and pre-eruptive-event loops.

S2-T10

Coronal filament cavities: why there is a there there and what to do about it

Sarah Gibson, Jim Fuller, Joan Burkepile, Giuliana de Toma, Therese Kucera, Steve Tomczyk

NCAR/HAO, Whitman College, NCAR/HAO, NCAR/HAO, NASA GSFC, NCAR/HAO

Recent observations confirm that coronal filament cavities are ubiquitous and visible over a wide spectral range. They also come in all sizes. When they are large enough (e.g., extending to heights 1.2 - 1.7 Rsun) they are often dramatic features in eclipse and low-coronagraph observations (both white light and infrared). When they are smaller (with upper heights < 1.3 Rsun) they can be distinctly visible in soft X-ray and EUV observations of the corona (particularly as seen in recent Hinode XRT data). Determining how much plasma is in the cavity and how hot it is relative to the surrounding arcade/helmet streamer is of critical importance to modeling the magnetohydrodynamics of CMEs and their precursors. Using geometric arguments, we will place limits on cavity size above which plane-of-the-sky observations of cavities are not significantly affected by the line-of-sight projection of non-cavity material, e.g., from an overlying helmet streamer or arcade. In such cases, white light and emission observations can be used in conjunction to estimate cavity plasma density and temperature. We will demonstrate that cavities are not generally "empty" relative to the surrounding corona, and discuss how best to obtain and interpret temperature diagnostics of cavity plasma.

S2-T11

On Causal Relationships between Eruptive Prominences and Coronal Mass Ejections

Boris Filippov [1] and Serge Koutchmy [2]

[1]Pushkov Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation; [2]Institut d'Astrophysique de Paris, CNRS and Univ. P. & M. Curie

Many studies revealed a very close association between eruptive prominences and CMEs, both slow and fast CMEs. Sometimes it is possible to follow the material motion starting from the prominence (filament) activation to the CME in the high corona. Remnants of the prominence are found in the bright core of the CME. However, detailed comparisons of the two phenomena reveal problems in explaining CMEs as a continuation of filament eruptions in the upper corona. For example, the heliolatitudes of the disappeared filaments and subsequent coronal ejections sometimes differ by tens of degrees. We discuss this and some other problems of EP-CME association and try to resolve them in the frame of a magnetic flux rope model. In such a situation, the considerable heliographic separation of the observed manifestations of eruption in its initial and final stages may result from non-radial and non-rectilinear motions of flux ropes in the corona due to their interaction with the large-scale magnetic field. Prominences and filaments are the best tracers of the flux ropes in the corona long before the beginning of the eruption. A twisted flux rope is held by the tension of field lines of photospheric sources until parameters of the system reach critical values and a catastrophe happens. The flux rope height above the photosphere is one of these parameters and it is revealed by the height of the filament. We analysed 70 filaments and found that eruptive prominences were near the so-called limit of stability a few days before their eruptions. We believe that a comparison of the real heights of prominences with the calculated critical heights from magnetograms could be a basis for predicting filament eruptions and following CMEs.

S2-T12

The CME Link to Filaments and Filament Channels

S.F. Martin[1], O. Engvold[2], O. Panasenco[1] and Y. Lin[2]

[1]Helio Research; [2]Institute for Theoretical Research, University of Oslo

We present a conceptual scenario for why CMEs occur. Observational evidence exists that coronal loop systems, that become CMEs, are in a state of dynamic equilibrium between magnetic forces that push coronal loop systems outward and the resistence of the coronal loop systems to being altered. We make the hypothesis that the magnetic fields of the filament channel, filament and cavity act together as a strongly non-potential magnetic field system that provides the outward magnetic pressure. As previously observed, loss of dynamic equilibrium can occur either because of (1) excess magnetic pressure from below, or (2) the removal of some of the coronal field by magnetic reconnection with newly emerging active regions. (1) plays the more important role because (2) does not occur in all cases. Also CMEs only occur in coronal loop systems lying over filament channels. Chromospheric structure within filament channels provides evidence that the fields, in both the chromospheric and coronal parts of the channel, deviate from potential fields more than anywhere else on the Sun. The single common property among all filament channels is their cancelling magnetic fields. Following Litvinenko and colleagues, we interpret cancelling magnetic fields as magnetic reconnection at the photosphere. The unique result of reconnection at the photosphere is the extraction of magnetic flux from the photosphere and its storage in the chromosphere and low corona. Continuous maintenance of channel magnetic fields and the continuous building of filament magnetic fields are evidence that storage of magnetic flux in the corona takes place concurrently with flux cancellation. The slow building of filament structure and the slow outward ascent of filaments and their overlying coronal loop systems, prior to CMEs, are the evidence that the channel magnetic field system continuously exerts ever increasing outward magnetic pressure on the overlying corona until loss of equilibrium occurs.

S2-T13

Processes and mechanisms governing initiation and propagation of CMEs

B. Vrsnak

Hvar Observatory, Faculty of Geodesy, Zagreb, Croatia

Basic observational characteristics of CMEs (kinematics, morphology) are presented, emphasizing those aspects which are most relevant for testing physical concepts used to explain their launch and propagation. Signatures of various processes taking part during the formation of the pre-eruptive magnetic structure, its development to the acceleration stage, and the evolution in the propagation phase are described. In particular, the emerging flux process, pre-eruptive magnetic field restructuring, evolution of the eruption-associated flare and the growth of the post-eruption loop system are addressed. Special attention is paid to 3-dimensional (3-D) topology, particularly to aspects related to the concept of the semi-toroidal flux rope anchored at both ends in the inert photosphere and embedded in the coronal magnetic arcade. Basic differences between models founded on this concept and those based on 2-D or 2.5-D geometry are emphasized. In the former case the primary driver of the eruption are ideal MHD processes related to the kink instability and the torus (self-force) instability, whereas resistive processes (reconnection) take active part in driving the eruption only after the CME take-off. The role of reconnection, which takes place in the current sheet that forms below the flux rope, is essentially in supplying the "fresh" poloidal magnetic flux to the rope, thus sustaining the electric current flowing along the flux rope, and consequently, reinforcing and prolonging the CME acceleration. On the other hand, in 2-D and 2.5-D models the reconnection itself is the essential ingredient from the very beginning of the eruption, since the overlying magnetic field cannot "slip aside" the erupting structure.
Finally, eruption scenarios based on the mentioned concepts and signatures predicted by various models (analytical and numerical) are confronted with observations.

S2-T14

Simulation of a breakout CME in the solar wind

B. van der Holst, S. Poedts, and R. Keppens

Centre for Plasma Astrophysics, Celestijnenlaan 200B, 3001 Leuven, Belgium

The initiation and evolution of a breakout model for Coronal Mass Ejections (CMEs) is studied in the framework of numerical magnetohydrodynamics. The initial breakout topology is embedded in a solar wind model. This pre-eruptive region is a octupolar structure with three neutral lines on the photosphere. The overlying closed magnetic field keeps this triple arcade in place. The initial system is located below a helmet streamer. Next, a triggering mechanism is used to make this equilibrium configuration unstable. A CME is triggered by the overlying magnetic breakout reconnection. The calculations are performed with a newly developed parallel adaptive mesh refinement code based on the finite volume codes VAC and AMRVAC. The numerical results are compared with observational data.

S2-T15

A Secondary CME Driver?: Solving the "Missing Momentum" Problem

M. J. Wills-Davey[1], S. W. McIntosh[1], A. R. Davey[1], A. A. Reinard[2]

[1] Southwest Research Institute, Boulder, CO, USA; [2]University of Colorado, Boulder, CO, USA

Coronal mass ejections (CMEs) have been well-documented for many years, and multiple theories exist to explain their initiation and propagation. However, these theories continue to have difficulty explaining these several aspects of CME kinematics:
1. CME core masses increase as they travel away from the Sun.
2. Evidence suggests CMEs do not decelerate quickly enough in the solar wind.
3. Long-duration stationary or moving Type-IV radio bursts are observed with CMEs, requiring a steady source of electrons.
The afore-mentioned problems can be explained if one assumes a secondary contributing driver. We postulate that CME sources--coronal dimming regions--function like transient coronal holes, driven by solar-wind-like open flux produced by spicules. Because this open flux is confined within the closed structure of the CME, the mass flux produced by the spicules builds up. This leads to an increase in total core mass, and forcing by the spicular flux can lead to residual CME acceleration. The constant spicular flux can also result in Type-IV radio bursts.

S2-T16

The propagation of shocks in the solar corona

A. Nindos[1]; C.E. Alissandrakis[1]; A. Hilaris[2]; C. Caroubalos[3]; A. Kerdraon[4]

[1] University of Ioannina, Greece; [2] Physics Department, University of Athens, Greece; [3] Department of Informatics, University of Athens, Greece; [4] Observatory of Paris, France

Type II bursts represent the passage of a shock wave through the tenuous plasma of the solar corona. Their exact origin has not been unambiguously determined, although they are associated with eruptive phenomena and are identified either with a flare blast wave or with a CME forward shock or with a shock driven by the flanks of a CME. We investigate the location of the shock formation and its association with flares and/or CMEs by studying the properties of four Type II radio bursts identified in 110-687 MHz range observations of the ARTEMIS-IV Solar Radio spectrograph and observed simultaneously with the Nancay Radioheliograph (NRH). The NRH makes images of the Sun at several fixed frequencies between 150 and 432 MHz, and our events could be mapped at two or three of its frequencies, allowing us to measure the motion of the Type II sources on the sky. Such measurements are quite rare because at a fixed frequency emission comes from a fixed electron density level, and because usually most Type II bursts occur at low frequencies where mapping is not possible. In all events the Type II-associated radio sources are quite small and show clear motion both radially and tangetially to the solar limb. The combined information provided by the radio data and observations of the associated flares and CMEs by EIT and LASCO, respectively, has been checked against realistic models of the Alfven speed in the corona in an attempt to derive constrains about the development and propagation of shocks in the corona.

S2-T17

Nature or nurture ? Thoughts on why CMEs are large-scale coronal events

Lidia van Driel-Gesztelyi, Gemma D.R. Attrill, Pascal Démoulin, Cristina Mandrini and Louise Harra

MSSL/UCL, UK; Observatoire de Paris, France; IAFE, Buenos Aires, Argentina

The apparent contradiction between small-scale source regions of and large-scale coronal response to CMEs has been a long-standing puzzle. By some, CMEs are considered to be (i) inherently large-scale events - eruptions in which a number of flux systems participate in an unspecified manner; while others consider (ii) the role of shock waves or (iii) magnetic reconnection in special global topologies (i.e. bald-patch or huge overlying loops) to be responsible for the large-scale response of the lower corona to CME events. Some of these ideas may indeed be correct in specific cases. However, what is the key element which makes CMEs large-scale? Observations show that the extent of the coronal disturbance matches the angular width of the CME -- an important clue, which does not feature strongly in any of the above suggestions. Furthermore, given the surface's curvature, it is not trivial how a fast-rising expanding CME structure can reach and interact with distant magnetic structures, unless CMEs have a steep lateral expansion in the low corona. We will compare the different ideas and outline a new CME evolution model and its implications.

S2-T18

New perspective on CME rates and their distributions

E. Robbrecht; D. Berghmans; R. Van der Linden

SIDC - Royal Observatory of Belgium

We report new results on CME rates during solar cycle 23. Our results are based on observations from LASCO, the first instrument in space observing the white light corona nearly continuously over an entire solar cycle (cycle 23). While the classical CME picture is a white light structure having a typical angular width of 45 degr in the coronagraphic field of view, statistics based on the CACTus CME catalog demonstrate that the CME process is scale invariant, i.e. that no typical CME size exists. We present the first 'objective' LASCO CME catalog, a result of the application of the CACTus software on the LASCO archive during the interval September 1997 - January 2007. We have studied the CME characteristics and have compared them with similar results obtained by manual detection (CDAW catalog). Summarized, our findings are that (1) there is a great discrepancy between CACTus and CDAW CME rates, both in shape and in amplitude; (2) the CME rate follows the solar cycle and increases from 2 CMEs per day during solar minimum to 8 CMEs during maximum, nearly half of them are narrow events (< 20 degr); (3) during the ascending phase of cycle 23, the CME rate increases less steeply as compared to the cycle 22, this is consistent with the lower sunspot maximum of cycle 23; (4) the CME cycle lags behind the sunspot cycle with a delay of 6 to 12 months. Our different CME statistics shed new light on the composition of CME (and other) catalogs and highlights the need for caution in the usage of catalogs. Perhaps the most revealing conclusion of this paper is that at present, no 'ground truth' CME catalog exists, since no consensus exists about the nature and origin of marginal coronal eruptions.

S2-T19

Modelling CMEs' Speed

G. Munoz

[1] Escuela Superior de Ingenieri-a Mecinica y El²ctrica, IPN, M²xico, [2] Instituto de Geofi-sica, UNAM, M²xico.

From 1996 to 2006 more than 11000 Coronal Mass Ejections (CMEs) have been registered with The Solar and Heliospheric Observatory (SoHO). The diversity and sensitivity of the instruments in SoHO have provided huge quantity of data for CMEs and related phenomena. Dynamical parameters of CMEs are evaluated and published in the SoHO/LASCO CME Catalogue. A broad range of values for the plane of the sky speed of CMEs results from these observations, extremely slow events seem to be possible (~ 40 km/s) as well as fast CMEs (> 2000 km/s). In this work we study the distribution of speed for all the CMEs detected by LASCO from 1996 to 2006 and compare with previous analysis reported for SMM and MK3 missions. From the analysis of speeds we show that the speed of fast events (speeds greater than 400 km/s) can be considered as a multifractal phenomenon with fractal dimension 3.31. On the other hand, we show that low speed values can be attributed to geometrical projection effects by modelling a constant velocity vector located on the solar sphere. From this model can be inferred that the actual low values for slow CMEs are close to the ambient solar wind speed.

S2-T20

Coronal Mass Ejection accelerations

J. T. Burkepile [1], O.C. St.Cyr [2], A. L. Stanger [3], L. Sitongia [1], G. deToma [1], H. Gilbert [4]

[1]High Altitude Observatory, National Center for Atmospheric Research; [2]NASA Goddard Space Flight Center; [3]SIDC - Royal Observatory of Belgium; [4]Rice University

In order to understand the nature and magnitude of the forces acting of Coronal Mass Ejections (CMEs), we determine the acceleration of many CMEs over a wide range of scale heights in the corona using observations from the Mauna Loa Solar Observatory, the LASCO coronagraphs onboard SOHO and the SECCHI COR1 coronagraphs onboard STEREO. We examine the acceleration as a function of height and find that the largest accelerations occur low in the corona (< 3 solar radii). In addition, we find that low coronal measurements are needed to determine the most accurate CME onset times. Accurate onset times are critical for understanding the relationship between CMEs and other associated forms of solar activity.

S2-T21

Coronal Mass Ejections with and without type II radio bursts

N. Gopalswamy & M. L. Kaiser [1]; H. Xie, S. Yashiro, S. Akiyama , & P.Makela [2]; R. A. Howard [3]; J.-L. Bougeret [4]

[1] NASA Goddard Space Flight Center; [2] The Catholic University of America; [3] Naval Research Laboratory; [4] Observatoire de Paris, Meudon

Fast (>900 km/s) and wide (>60 deg) coronal mass ejections drive shocks that accelerate electrons and protons. Therefore, CMEs producing type II bursts (radio-loud CMEs) are considered good indicators of solar energetic particle (SEP) events. However, about a third of the fast and wide CMEs observed by SOHO/LASCO are not associated with type II bursts (radio quiet) when searched in the dynamic spectra obtained by Wind/WAVES experiment. For the present study we consider all the fast and wide CMEs observed by SOHO from 1996 to 2005 and separate them into radio-quiet and Radio-loud ones. We examine the kinematics and source locations of the radio quiet CMEs and compare them with those of radio loud CMEs. The investigation has led us to the following conclusions: (i) Radio-quiet CMEs are slower the average. (ii) The fraction of full halos is much smaller for the radio-quiet CMEs indicating that they are narrower on the average. Since narrower CMEs are less massive, the radio-quiet CMEs seem to be inherently less energetic. (iii) In addition to being weak, the radio-quiet CMEs may be propagating through an ambient medium that has a higher Alfven speed. (iv) The radio-quiet CMEs are launched at large angles to the Sun-Observer line (mostly back-sided or limb events). (v) The source locations of radio-loud CMEs are in the active region belt, while those of radio-quiet CMEs are mostly outside. (vi) The soft X-ray flare size is slightly smaller for the radio-quiet CMEs consistent with the fact that most of them originate away from the active region belt. (vii) None of the radio-quiet CMEs was associated with large SEP events. (viii) Some (a few percent) radio-quiet CMEs were associated with minor SEP enhancements, suggesting that weak shocks may be present in these cases. This also indicates there may be subtle difference in the requirement for electron and ion acceleration by the shock.

Oral presentations

Session 3

Heliospheric transients

S3-T01

CMEs and Their Role in SEP Acceleration and Transport

R.A. Leske

California Institute of Technology, Pasadena, CA USA

Observations of solar energetic particles (SEPs) indirectly probe the effects of the transit of coronal mass ejections (CMEs) through the inner heliosphere. Timing studies have shown that the highest energy SEPs are accelerated within a few solar radii of the Sun, while at lower energies CME-driven shocks are observed to accelerate particles at 1 AU and beyond. Recent studies have shown that a substantial fraction (~10%) of the CME kinetic energy goes into the acceleration of SEPs, making SEPs a significant part of the CME phenomenon. The geometry of the CME, both in terms of the solar longitude of its source and the orientation of its shock relative to the ambient field, plays a critical role in determining the time profiles and possibly composition of the resulting SEPs. Transport of SEPs can be affected by CMEs, as SEPs from source regions that nominally would not be magnetically connected to the observer have been observed during the passage of ICMEs and magnetic clouds.
Recent observational studies relating to SEP acceleration and transport and the role of CMEs in these processes are reviewed, and new observations that will be possible from STEREO relating SEP and CME observations are discussed.

S3-T02

Energetic particle observations in the three-dimentional heliosphere

O. E. Malandraki[1,2]; R. G. Marsden[3]; C. Tranquille[3]; R. J. Forsyth[4]; H. A. Elliott[5]; A. Geranios[6]; E. T. Sarris[2]; B. Heber[7]; R. Müeller-Mellin[7]

[1]National Observatory of Athens, Greece; [2]DUTH, Greece; [3]ESA, The Netherlands; [4]Imperial College, England; [5]SRI, USA; [6]UOA, Greece; [7]Universität Kiel, Germany

Ulysses, the first spacecraft ever to fly over the poles of the Sun, plays a central role in the Heliospheric Network, the international fleet of spacecraft to explore the Sun and Heliosphere. In November 2006, Ulysses, began its passage over the Sun's south pole for the third time. Although like during the first polar passes in 1994/1995 the Sun is again close to its activity minimum, an unexpected rise of solar activity occurred in December 2006. Active Region 0930 produced a series of major solar flares with the strongest one (X9.0) recorded on December 5 after it rotated into view on the solar east limb. We present energetic particle observations by Ulysses located at >70 deg south heliolatitude during this period and discuss their implications for particle propagation to solar polar regions. The observed events are also compared with previous Ulysses high latitude measurements obtained close to solar maximum. Furthermore, comparisons with data acquired from ACE -another spacecraft of the Heliospheric Network- near the ecliptic plane are discussed.

S3-T03

Halo coronal mass ejections and proton events during solar cycle 23

P. Makela[1,2]; N. Gopalswamy[2]; S. Yashiro[1,2]; S. Akiyama[1,2]; E. Valtonen [3]

[1] The Catholic University of America, Washington, DC, USA; [2] NASA Goddard Space Flight Center, Greenbelt, MD, USA; [3] Space Research Laboratory, University of Turku, Turku, Finland

We have studied the production and properties of solar energetic particles (SEPs) in association with halo coronal mass ejections (CMEs) during 1996-2005. A set of 378 halo CMEs observed by LASCO were compared with observations of the 1.8-80 MeV proton flux by ERNE, both instruments on board the SOHO spacecraft. The CME list included both frontside and backside halo CMEs. In general, particle production was observed to follow the known dependence on the position of solar source and the speed of the associated CME. Only a few of the backside CMEs were observed to coincided with proton events. In the case of frontside CMEs, a few CMEs with a speed less than 500 km/s produced detectable increase of interplanetary proton flux. There were fewer eastern hemisphere CMEs than western hemisphere CMEs associated with proton events. Similar kind of dependence for the geoeffectiveness of the same set of halo CMEs has been reported by Gopalswamy et al. 2007. We compare the source regions of geoeffective and SEPeffective halo CMEs. We finally discuss the properties of halos that were both geoeffective and SEPeffective.

S3-T04

Implementation of radiation storm forecasting with SOHO/COSTEP and adjustments to the solar minimum

A. Posner [1]; B. Heber [2]; R. Müeller-Mellin [2]

[1] Southwest Research Institute, San Antonio, TX, USA; [2] University of Kiel, Kiel, Germany

A method of forecasting the intensity of prompt solar energetic protons with relativistic electrons has been developed and successfully tested for 2003. It has been shown that such forecasting is urgently needed for radiation protection of humans and technology in space. The method utilizes the speed advantage of relativistic electrons over 30-50 MeV protons and newly discovered correlations of inverse rise time and intensity between the two particle species. The main strength of this method over all other forecasting attempts is that electrons and ions move along near-identical transport conditions in the ever-changing inner heliosphere. The purpose of this presentation is to inform of forecasting attempts in the 2004-2007 solar minimum period with its unusually high occurrence frequency of major radiation storms, and to give an update on the implementation of the method with the SOHO/COSTEP team and the SOHO project.

S3-T05

First results from STEREO/IMPACT

Volker Bothmer[1]; Axel Korth[2]; Janet Luhmann[3] and The IMPACT Team

[1] Institut für Astrophysik, Universität Göttingen, Göttingen, Germany; [2] Max-Planck-Institut für Sonnensystemforschung, Katlenburg-Lindau, Germany; [3] Space Sciences Laboratory, University of California, Berkeley, CA, USA

We present an overview of heliospheric transients detected with the IMPACT (In-Situ Measurements of Particles And Coronal Mass Ejection Transients) instrument suite aboard the NASA STEREO mission since launch in October 25, 2006. and an outlook on the potential of IMPACT for unravelling the science of transients at times of higher solar activity levels.

S3-T06

Quantitative links between CMEs and magnetic clouds

P. Démoulin

Paris Observatory, LESIA

Magnetic clouds, and more generally ICMEs, are believed to be the interplanetary counterparts of CMEs. The link has usually been shown by taking into account the CME launch position on the Sun, the expected time delay and by comparing the orientation of the coronal and interplanetary magnetic field.
Making such a link more quantitative is challenging since it requires the relation of very different kinds of magnetic field measurements: (i) photospheric magnetic maps, which are observed from a distant vantage point (remote sensing) and (ii) in-situ measurements of magnetic clouds, which provide precise, directly measured, magnetic field data merely from one-dimensional linear samples.
The association between events in these different domains can be made using adequate coronal and MC models. Then, global quantities like magnetic fluxes and helicity can be derived and compared. This approach is rewarding since it brings new constraints on the CME process.

S3-T07

The Structure of Magnetic Clouds During Solar Cycle 23

Emilia Huttunen

Space Sciences Laboratory, University of California, Berkeley

Magnetic clouds are a subset of interplanetary coronal mass ejections that are often associated with strong geomagnetic storms. The intensity and the duration of the southward component of the interplanetary magnetic field is the most critical factor in determining the geoeffectivity of a magnetic cloud. The magnetic topology of a magnetic cloud depends on its helicity, inclination of the axis with respect to the ecliptic plane and polarity, i.e. whether the field rotates from south at the leading edge to the north at the trailing edge (SN-polarity) or vice verse (NS-polarity). I will discuss the categorization of magnetic clouds and how their magnetic structure varies with the phases of the solar 22-year magnetic activity cycle. I will show the results of the survey of 73 magnetic clouds detected by the WIND and ACE satellites near 1 AU from 1997 to 2003 and compare the statistics to the solar cycle variations in the magnetic cloud structure found earlier for solar cycles 21-22.

S3-T08

Measuring the temperature of CME plasma near the Sun: Flare heating?

Thomas H. Zurbuchen, Katherine Baldwin, and Jim Raines

University of Michigan

We use in-situ ionic composition measurements together with a CME expansion model to measure the electron temperature in CME plasma during their ejection and expansion into space. The combined ionic composition from seven elements is used to address the temporal behavior of these CMEs in the near corona and their temperature history.

The results from this study are two-fold. First, we summarize the overall ionic charge states of CME-associated plasmas. We find important deviations from local thermal equilibrium in all ionic distributions. Most importantly, He and Ne-like charge states are found to be enhanced over the other states. Second, we discuss different scenarios to explain this behavior, such as flare-heating and CME expansion effects. Both, heating and expansion models are constrained using remote-sensing data.

This analysis provides important insights into the thermal state and evolution of CME-associated plasmas near the Sun. The heating of the plasma can be estimated, as can the cooling speed. This calculation is also crucial in the context of particle acceleration. We find highly non-thermal charge distributions in CME plasma, in contradiction to assumptions of models of heavy ions in SEP events.

S3-T09

Observations of transient decreases by SOHO EPHIN and Ulysses COSPIN/KET over the last two solar cycles

Heber, B., Müller-Mellin, R., Dunzlaff, P., Gómez-Herrero, R., Klassen, A., Wimmer-Schweingruber, R.

Institut für Experimentelle und Angewandte Physik, Christian-Albrechts-Universität Kiel, Germany

On board of the Ulysses spacecraft, launched in October 1990, and the SOHO spacecraft, launched in December 1995, particle sensors are measuring electrons, protons and helium nuclei in the MeV to GeV range. The counting rates of galactic cosmic rays are modulated by the 11-year solar cycle variation but also by recurrent and transient decreases. While the recurrent decreases are correlated with the occurrence of Corotating Interaction Regions caused by fast wind streams from coronal holes, transient decreases can be attributed to Coronal Mass Ejections. In this paper we investigate the amplitudes of these short term decreases during the last two solar cycles using Ulysses COSPIN/KET and SOHO/EPHIN data.

S3-T10

Interplanetary Evolution of 10 April 2006 CME and its Associated Magnetic Cloud

K. Steed [1]; C. J. Owen [1]; L. K. Harra [1]

[1] *UCL, Mullard Space Science Laboratory*

Magnetic clouds, which are currently widely modelled as force-free, large-scale, cylindrical magnetic flux ropes, are a subset of ICMEs. Using ACE and WIND observations at 1 AU, we have characterised the magnetic cloud associated with the 10 April 2006 CME eruption of active region AR10869. Using a comparison of these findings and observations from SOHO of the CME source region, both prior to and post eruption, we report on the interplanetary evolution of a CME from cradle to grave.

S3-T11

A Panoramic View of CMEs with the STEREO/SECCHI Heliospheric Imagers

S.P. Plunkett[1] and the SECCHI Team

[1]Code 7662, Naval Research Laboratory, Washington, DC 20375, USA

The Sun Earth Connection Coronal and Heliospheric Investigation (SECCHI) on the NASA Solar Terrestrial Relations Observatory (STEREO) mission is a suite of remote sensing instruments consisting of an extreme ultraviolet (EUV) imager, two white light coronagraphs, and two telescopes that comprise the Heliospheric Imager (HI). The main objective of SECCHI is to observe coronal mass ejections (CMEs) from their birth at the sun, through the corona and into the heliosphere. A complete instrument suite is being carried on each of the two STEREO spacecraft, which will provide the first sampling of a CME from two vantage points as the spacecraft separate from each other at the rate of about 45 degrees per year. The HIs in particular provide a unique panoramic view of a largely unexplored region of the heliosphere. We will present some initial observations of CMEs with the HIs, and we will discuss how these observations can be used to answer some of the key outstanding questions about the evolution and propagation of CMEs in the heliosphere.

S3-T12

First Results from STEREO's Heliospheric Imager

D. Bewsher [1]; R.A. Harrison [1]; C. J. Davis [1]; C.J. Eyles [1,2]

[1] STFC Rutherford Appleton Laboratory, Chilton, Didcot, Oxfordshire, OX11 0QX, UK; [2] University of Birmingham, Birmingham, B15 2TT, UK

NASA's STEREO mission was launched on 25th October 2006. The Heliospheric Imager (HI) is part of SECCHI, the imaging suite of instruments on STEREO. HI provides wide angle images of the heliosphere - and can view coronal mass ejections (CMEs) travelling along the Sun-Earth line.
Data from HI will be shown and examples of where HI data is being used in conjuction with SOHO data will be given.

S3-T13

The Plasma and Suprathermal Ion Composition Experiment on STEREO - Early Results

A. Galvin [1], L. Kistler [1], M. Popecki [1], C. Farrugia [1], K. Simunac [1], A. Gustafson [1], J. Barry [1], L. Blush [2], B. Klecker [3], R. Wimmer [4], B. Thompson [5] and the STEREO TEAM

[1]EOS UNH,USA; [2]U Bern; Switzerland[3]; MPE, Germany; [4]U Kiel, Germany; [5]NASA/GSFC, USA

Two identical Plasma and Suprathermal Ion Composition (PLASTIC) instruments are now flying on the STEREO A and B observatories, which launched in October 2006. PLASTIC together with the IMPACT suite provides the in-situ measurements for the STEREO mission, while the SECCHI suite and S/WAVES provide remote sensing.
PLASTIC is an ion mass spectrometer with measurements in the energy-per-charge range of 0.3-80 keV/e. The PLASTIC solar wind sector measures solar wind proton bulk parameters (speed, flow direction, density, kinetic temperature) and also measures the more dominant solar wind minor (Z>2) ions. The suprathermal section of the instrument measuresions accelerated under local shock conditions, pickup ions, and the suprathermal tails of solar wind distributions.
Thus far, the dominant solar wind features since launch have been a series of recurrent high and low speed solar wind streams and their interaction regions. In this poster we provide an overview of the initial observations of solar wind and suprathermal ions (including pickup ions), particularly in the CIR-related compression regions, other transient phenomena that may occur, and discuss possibilities for correlation studies.

S3-T14

Modeling Coronal Mass Ejections from the Sun into Interplanetary Space*

J. A. Linker [1]; Z. Mikic [1]; R. Lionello [1]; P. Riley [1]; V. Titov; D. Odstrcil [2]

[1] Science Applications International Corporation
[2] University of Colorado/CIRES and NOAA/SEC

How do the structures that we observe in white light and describe as coronal mass ejection (CMEs) evolve to produce the signatures that we identify in interplanetary space as ICMEs? What do the associated signatures of CMEs seen in EUV and X-rays tell us about the structure of CMEs as they leave the Sun? Many aspects of these basic questions remain unanswered. In this talk I will describe how more realistic simulations of CMEs, coupled with new observations from STEREO, may help to answer these questions.
*Work supported by NASA and NSF.

Oral presentations

Session 4
Solar and Heliospheric science in the next decade and beyond

S4-T01

The new plans of the European SPS Board

Stefaan Poedts

CPA, K.U.Leuven

The SPS Board has ambitious plans and submitted a FP7 Coordination Action proposal concerning "Solar and Space Environment" sciences. This proposal is aimed at complementing the related efforts in this respect by other key players, including ESA. The contribution of ESSENCE in this field would be the coordination of integrated and coherent activities, avoiding duplications and maximizing interoperability, and the identification of common objectives and the most optimal opportunities for EU funding. European industry will also be involved through the foreseen collaboration with NAVOBS+.
The project integrates the coordination entities JOSO and CESRA and the experts team SWWT to establish a more coherent and clearer structure. In this way, we want to keep the overview and to re-structure, re-organize and develop the solar and space environment science community. This new organization structure will thus create a European equivalent of the American SPD that can and will collaborate with the SPD as an independent equal partner.
The new structure will enable us also to identify the areas that are most suitable for collaborations with the SPD and likewise organizations, to specify areas in which the EU should proceed independently, and to identify the areas best suited for EU funding complementary to the ESA science programme

S4-T02

Solar Physics and Solar Image Processing

J. Ireland

ADNET Systems, Inc., NASA's GSFC, MC 671.1, Greenbelt MD 20771, USA.

Data analysis often requires some form of processing in order to make it ready for scientific discovery. Recently, solar physicists have turned to more advanced tools in an attempt to maximize the scientific return of the data. The desire to extract as much physically relevant information in the data as it will allow has led to the emergence of the growing, cross-disciplinary field of solar image processing.
This talk begins by examining the needs that are driving this burgeoning trend to more sophisticated and (hopefully) better approaches to solar data analysis. An overview of recent advances in solar image processing is given, highlighting both the techniques used in the service of finding and describing physically interesting features in the data, as well as the underlying solar physics question. The study of solar transient phenomena using advanced solar image processing techniques is particularly active, and some examples are described. Finally, some speculation is offered with regard to future trends in solar image processing.

S4-T03

Hybrid Computer Platform for the Automated Prediction of Solar Flares

T. Colak and R. Qahwaji

University of Bradford

The importance of real-time processing of solar data especially for space weather applications is increasing continuously. In this work, we will be presenting our real-time automated model for the short-term prediction of significant solar flares using SOHO/MDI images. This model integrates image processing and machine learning to deliver these predictions. A machine learning-based system is designed to study years of sunspots and flares data to extract knowledge and create associations that can be represented using learning rules, which can be applied using computers. An imaging-based real time system that provides automated detection, grouping and then classification of recent sunspots based on the McIntosh classification is also created and integrated within this system. The automated classifications created by the imaging system are processed using the learning rules to create real-time predictions. This system is currently under testing and is publicly available at http://spaceweather.inf.brad.ac.uk/.

S4-T04

Data Assimilation Opportunities and Challenges for Investigating Transient Phenomena

Farzad Kamalabadi, Mark Butala, Richard Frazin, Yuguo Chen

University of Illinois

Knowledge of the corona's three-dimensional (3D) structure is important for modeling the propagation of solar disturbances out to the near-Earth space environment. The current generation of Sun-observing spacecraft give the scientific community a historical opportunity to unravel unprecedented information about the 3D structure of the Sun's corona. However, full advantage of these sensing capabilities demands the concurrent development of next generation multi-sensor data processing strategies and algorithms.

Examples of such data include white-light and extreme ultraviolet (EUV) images of the solar corona, as measured routinely by a variety of dedicated space-based and ground instruments. Although Bayesian tomographic analysis of these data have produced reliable 3D reconstructions of persistent, large-scale structures, characterization of transient disturbances responsible for space weather phenomena requires developments in data assimilation, statistical estimation theory, and efficient algorithm design.

In this talk, I will describe a state-space framework through which one can estimate the state of the corona as a function of time. Since the 3D, time-dependent nature of the estimation scheme demands new algorithms that scale well with the problem size, I will describe new Monte Carlo filtering techniques which make use of recursive estimation and optimal filtering, in conjunction with new spatial localization concepts for line-integral measurement operators, that dramatically reduce computational complexity and enable global assimilative models of the solar corona.

S4-T05

Can the total solar irradiance be reconstructed from solar activity proxies ?

T. Dudok de Wit [1], M. Kretzschmar [2], J. Lilensten [3], P.-O. Amblard [4], S. Moussaoui [5], J. Aboudarham [6], F. Auchère [7]

[1] LPCE, Orléans, [2] ROB, Brssels, [3] LPG, Grenoble, [4] GIPSAlab, Grenoble, [5] IRCCYN, Nantes, [6] LESIA, Paris, [7] IAS, Orsay

Understanding how the Total Solar Irradiance (TSI) is related to solar activity is not only important for predicting its value in the past, but also for understanding what causes its variability. It is today widely accepted that the variability of the TSI is mainly governed by the presence of thermal regions (plages and faculae) and a deficit caused by sunspots. Attempts in modelling the TSI from these two contributions have been quite succesful, but significant discrepancies persist.
Instead of answering the usual question of how the TSI can be reconstructed from solar proxies, we want to know if and to what degree the TSI can actually be reconstructed from solar proxies. Using concepts from infomation theory, we estimate how much information the TSI shares with 29 years of various proxies such as the sunspot number, the MgII, CaK and HeI indices, the daily sunspot area and more. From this, we determine: 1) which quantities are best for reconstructing the TSI, and 2) if there are (linear or nonlinear) combinations of proxies from which the TSI can be reconstructed.
The results first show that no single combination of proxies can fully reproduce the variability of the TSI, whose dynamics contains a contribution that isn't contained in any of the proxies. Secondly, they clearly reveal the importance of regions of intense magnetic field (e.g. Mount Wilson Sunspot Index, and Optical Flare Index) for fitting short time scales and of more thermal regions (Lyman-a, CaK, coronal index) for reproducing long (>> 27 days) scales.

S4-T06

Radio instruments, past results and future prospects

Karl-Ludwig Klein

Observatoire de Paris

Radio waves provide unique or complementary diagnostics of the solar atmosphere, comprising parameters of the plasma and of energetic particle populations. We'll illustrate this with a few examples of recent research and then address topics where future radio instrumentation can provide significant new insight : the measurement of coronal magnetic fields especially in active regions through spectral imaging at cm-waves, the localisation of sites of particle acceleration in flares through spectral imaging at decimetre-metre waves, and the investigation of relativistic particles and thermal plasma from the chromosphere, through novel measurements at sub-millimetre and far infra red wavelengths.

S4-T07

Solar Imaging Science Fiction - Lessons learned and not learned with the PROBA2 experiment

David Berghmans and Jean-François Hochedez

SIDC - Royal Observatory of Belgium

Scientific instruments in space are expensive and scarce equipment. As a consequence, their design and operations tends to be conservative as to minimize the risk for damage or loss. On the ground technology advances with giant leaps, but the proper space qualification of this new technology proceeds only with little steps. Technology demonstration satellites, such as PROBA2, give us the rare opportunity to be more daring in innovation. This innovation is driven by the ever-increasing scientific requirements that conflict with the input bottleneck of a space instrument (lack of photons) as well as with the output bottleneck (lack of telemetry).
In this talk we will visit some ideas for technology innovations that have been considered for PROBA2, of which only some have been implemented. We will concentrate on the aspect of detectors and software. Detectors in solar physics are today typically based on silicon CCDs. Using other materials besides silicon could however allow to design the semi-conductors such that only desired photons are detectable. More advanced electronic circuitry to read-out the detector, as in CMOS detectors, would allow to have a variable exposure time over the FOV or to remove cosmic ray hits on the fly. Improved software can help bridging the telemetry gap. Why bringing down uninteresting data if onboard software can detect events? Even at times of major events, most of the solar disc remains essentially invariant suggesting unexplored possibilities for video compression.

S4-T08

SDO's Contribution to the Study of Solar Transients

W. Dean Pesnell

NASA, Goddard Space Flight Center

Flares and other transients on the Sun are not isolated events. The Sun's magnetic field acts as the source of the transients as well as the source of the nonlocality. The Solar Dynamics Observatory (SDO) is the first Space Weather Mission in NASA's Living With a Star Program. SDO's goal is to understand, driving towards a predictive capability, those solar variations that influence life on Earth and humanity's technological systems. The SDO science investigations will determine how the Sun's magnetic field is generated and structured, how this stored magnetic energy is released into the heliosphere and geospace as the solar wind, energetic particles, and variations in the solar irradiance. One scientific investigation (AIA) will make full-disk images of the Sun in ten wavelengths with a 10-second cadence and a spatial resolution similar to the Trace satellite. These images will be combined to give temperature maps of the lower corona, allowing us to study how coronal loops form, evolve, and dissipate. The full-disk images will allow a chosen active region to be tracked while giving a global context to the changes in that region. SDO is scheduled to launch on an Atlas V rocket from the Kennedy Space Center in Florida. The satellite will fly in a 28 degree inclined geosynchronous orbit about the longitude of New Mexico for its five-year mission life. The science teams at LMSAL, LASP, and Stanford are responsible for processing, analyzing, distributing, and archiving the science data. We will talk about the data SDO will provide and the science it will enable for NASA and solar research.

→ Talk is canceled

S4-T09

The combined science program of the Solar Orbiter and Sentinels missions for exploration of the Sun-Heliosphere connections

Eckart Marsch[1] and Robert P. Lin[2]

[1]Max-Planck-Institute for Solar System Research, Lindau, Germany; [2]University of California, Berkeley, USA

In a new synergistic approach, ESA's Solar Orbiter (launch 2015) and NASA's Sentinels (2017) have been combined to perform a joint science program with the strategy to explore and study together the Sun-Heliosphere connections. The joint scientific objectives of the combined program, as well as the genuine science goals of the individual missions, will be described and discussed. In particular the novel research perspectives, which are offered by the unique spacecraft orbits that permit multi-point in-situ measurements of solar wind, energetic particles and electromagnetic fields be made on several spacecraft together with remote-sensing optical observations of the Sun (also on its far side), will be presented and illustrated. The combined payloads of both missions have been optimized for synergies and thus will complement each other well, especially during the overlapping phases of the two missions. Special emphasis in the talk will be put on the future opportunities for studying the origins and geoeffectiveness of CMEs, flare particles and radiation, and solar wind streams, and to the scrutinize the solar and interplanetary manifestations of solar magnetic activity with the ultimate goal to understand how the Sun globally governs the solar system environment and locally affects geospace.

Poster presentations

Poster presentations

Session 1

Transients and dynamics in the lower solar atmosphere

S1-P01

Lyman alpha and Beta line profiles in prominences(SUMER/SOHO Observations)

[1,2] A. Ajabshirizadeh and [1,2] H. Ebadi

[1] Tabriz University, Faculty of Physics, Dept. of Theoretical & Astrophysics, Tabriz Iran. [2] Research Institut for Astronomy&Astrophysics of Maragha, 55134-441 Maragha Iran.

There are fine structures in solar prominences which emission radiation. Of them depends to their physical and geometrical properties. We treated line formation in prominences with different fine structuring issue. Some physical properties of such structures were derived and compared with observations.
Lyman alpha and Lyman beta line profiles in a solar prominence were observed with high spatial and spectral resolution with SUMER/SOHO. Within a 60 arcsec. scan, we measure a very large variety of profiles: not only reversed and non-reversed profiles but also red-peaked and blue-peaked ones in both lines. Such a spatial variability is probably related to both the fine structure in prominences and the different orientations of mass motions. Using integrated-intensity cuts along the SUMER slit, allowed us to categorize the prominence in three regions. We computed average profiles and integrated intensities in these lines.

S1-P02

Hinode/EIS and XRT Observations of Hot Jets - A Failed Escape Attempt?

D. Baker [1]; J.L.Culhane [1]; L. van Driel-Gesztelyi [1]; L. Harra [1]; J. Sun [1]; G. Doschek [2]; D. Brooks [2]; L. Lundquist [3]; S. Kamio [4]; P. Young [5]; V. Hansteen [6]

[1]Mullard Space Science Laboratory/UCL, UK;[2]NRL, USA;[3]SAO,Cambridge, USA; [4]National Astronomical Observatory of Japan;[5]STFC, RAL, UK;[6]Institute of Astrophysics, U. of Oslo

It is generally accepted that X-ray jets (discovered in Yohkoh/SXT Data) in coronal holes are caused by magnetic reconnection between emerging flux and ambient 'open' magnetic field lines. In this work, we use Hinode EIS and XRT Instruments to present the first multi-wavelength study of 3 such X-ray jets and their associated bright points seen during a southern polar observing campaign. Light curves in 14 different emission lines were compared to those of Hinode/XRT. The light curves show bright points containing hotter lines than those of the associated jets. The evolution of emission by the jets and bright points is well correlated in time. In addition, the three jets show post-jet increases in their light curves, which, based on the temperature of the spectral lines in which they appear, look systematically cooler than the jets. We interpret this feature to be due to hot plasma of the jet, having been propelled upwards and failing to reach escape speed from the Sun, falling back in a cooler state along the jet's trajectory.

S1-P03

Tearing-triggered instabilities and reconnection mechanisms in the solar environment

Lapo Bettarini [1]; Simone Landi [1]; Marco Velli [1,3]

[1] Dipartimento di Astronomia, Università di Firenze; [3] JPL, California Institute of Technology

Magnetic shear driven instabilities play a major role both in the dynamics of astrophysical objects and, in particular, in the evolution of several structures in the solar atmosphere. Although magnetic energy conversion by reconnection in two dimensions is relatively well understood, in three dimensions the magnetic topology and the MHD dynamics can be highly complex and also the related reconnection mechanism. Moreover, the presence of a sheared flow, and so the resulting stream + current sheet interaction, introduces a further degree of complexity.A detailed analysis of this class of problems has urged us to develop new premising numerical schemes.Considering two different perturbed current-sheet equilibrium configurations, a pressure-balanced and a force-free configuration, we present the three dimensional evolution of a tearing-driven current-sheet in the framework of compressible and resistive Magnetohydrodynamics. Furthermore, the first results on the 3D problem of combined magnetic and velocity shear driven instabilities are shown considering also a variable geometry of the basic fields. In order to understand resistive instabilities, secondary instabilities (in presence even of a guide field) and magnetic reconnection with the requirement of a detailed description of dissipation driven instabilities in the linear phase, several ingredients are needed. In addition, magnetic reconnection in the coronal and heliospheric plasma is often controlled by kinetic effects, such as the Hall term, which introduce dispersion and add to the number of different wave-modes carried by the plasma. These terms are important as they decrease the dependence of the growth rate on the Reynolds numbers, but have not been used universally for coronal and heliospheric physics until today.

S1-P04

Energy transport by large-scale Alfvenic wave pulses in the flare impulsive phase, and the electron acceleration problem

Lyndsay Fletcher and Hugh S. Hudson

Department of Physics and Astronomy, University of Glasgow, Glasgow G12 8QQ, UK

The impulsive phase of a solar flare marks the epoch of rapid conversion of energy stored in the pre-flare coronal magnetic field. Hard X-ray observations imply that a substantial fraction of flare energy released during the impulsive phase is converted to the kinetic energy of mildly relativistic electrons (10-100 keV). The liberation of the magnetic free energy occurs as the coronal magnetic field reconfigures and relaxes following reconnection. Therefore, we investigate a scenario in which the electron acceleration is caused by the agents of this reconfiguration -- large-scale Alfven wave pulses which propagate the field changes throughout the atmosphere. In a coronal plasma with beta less than the electron to proton mass ratio, these waves propagate as inertial Alfven waves which, in the presence of strong spatial gradients, generate field-aligned electric fields that can accelerate electrons to energies on the order of 10 keV and above (bearing in mind the strong magnetic fields and high Alfven speeds that pertain in the low corona in the core of an active region). Once they arrive at the chromosphere, the generation of a turbulent fast-mode spectrum and consequent wave damping offers an additional acceleration channel, as well as a source of lower-atmosphere heating. This novel view also provides an interpretation of the recently-observed rapid variations of the line-of-sight component of the photospheric magnetic field during the flare impulsive phase, and offers solutions to some perplexing flare problems, such as the flare "number problem" of finding sufficient and resupplying sufficient electrons to explain the impulsive-phase hard X-ray emission.

S1-P05

Turbulent heating and cooling of coronal loops

E. Buchlin [1]; P. Cargill [1]; S. Bradshaw [1]; M. Velli [2,3]

[1] Imperial College, London; [2] Jet Propulsion Laboratory; [3] Università di Firenze

We consider the coupling of both heating and cooling processes in coronal loops, including for the first time a feedback of the cooling on the heating. The heating is computed by a set of shell-models representing MHD turbulence; they are coupled by Alfvén waves traveling along the loop from the footpoints, where the energy is introduced by motions of the photosphere. The shell-models display properties of anisotropic turbulence and intermittency. The heating computed by this model is then used as an input of a hydrodynamic model of a loop with thermal conduction and a self-consistent treatment of radiation (including non-equilibrium ion populations). The dynamic density profiles computed by this model are then in turn used as an input for the heating model.
This coupled model provides new results on the profiles of heating along loops, and we discuss the importance of the feedback of cooling processes on the heating. Forward-modelled spectroscopic variables can be compared to SOHO, STEREO and Hinode observations.

S1-P06

Ellerman bombs and surges in the sunspot moat

Lokesh Bharti[1], Rajmal Jain[2] and S.N.A. Jaaffrey[1]

1.University Science College, MLSU, Udaipur, India, 2.Physical Research Laboratory, Dept. of Space, Govt. of India, Ahemdabad, India

We analyzed multiwavelength observations of moving magnetic features in the moat of decaying sunspot. Active Region NOAA 8350 was observed on 1998 October 8. The data consist of a 180 min time series of 2D spectral scans of the lines FeI 5576 A, H-alpha 6563 A, FeI 6302.5 A, continuum images at 5571 A, and simultaneous G-band images. We also recorded line-of-sight (LOS) magnetograms in 6302.5 A. The observations were taken at the Dunn Solar Telescope (DST) at NSO/SP. The observations reveals dark surges followed by Ellerman bombs. These surges were closely associated with flux cancellation of MMF of opposite polarities. These facts support the notion that low altitude magnetic reconnection can result in the magnetic cancellation as observed in the photosphere.

S1-P07

Torsional Alfven Waves in Small Scale Density Threads of the Solar Corona

Paula Copil, Yuriy Voitenko and Marcel Goossens

Centre for Plasma Astrophysics, K.U. Leuven, Belgium

The density structuring of the solar corona is observed at large scales (loops and funnels), but also at small scales (sub-structures of loops and funnels). Coronal loops consist of thin density threads with sizes down to (and most probably below) the resolution limit. We study the properties of torsional Alfven waves in inhomogeneous cylindrical density threads using the two-fluid MHD equations. The eigenmode solutions supported by such a structure are obtained and analyzed. It is shown that the dispersive and dissipative effects become important for the waves localized in thin threads. This mathematical model is applied to waves propagating in coronal structures. In particular, we consider ~ 1 Hz Alfven waves propagating along density threads with a relatively smooth radial profile, where a density contrast of about 1.1 is attained at radial distances of about 0.1 km. We found that the dissipation distance of these waves is less than the typical length of hot coronal loops, 50 Mm. Therefore, the torsional Alfven waves localized in thin density threads can be responsible for coronal heating and for maintenance of the small-scale coronal structuring.

S1-P08

SUMER observations of redshifted emission at footpoints of coronal loops

I.E. Dammasch[1], B.N. Dwivedi[2,3], W. Curdt[2], S. Parenti[1]

[1] ROB Brussels, Belgium
[2] MPS Katlenburg-Lindau, Germany
[3] Department of Applied Physics, Institute of Technology, Banaras Hindu University, Varanasi-221005, India.

The ubiqitious coronal loops are dynamic magnetic structures in the solar atmosphere. Their physics holds the key to understanding the coronal heating and the flow of mass and energy in the region. However, the energy source, structure maintenance and mass balance in coronal loops are not yet fully understood. Observations of blue and redshifted emissions have been widely used in the construction of viable loop models. But observations and interpretations of line shifts have been widely debated. In this paper, we will present detailed SUMER observations which clearly show a steady downflow in both footpoints of coronal loops in all the emission lines, emanating from the chromosphere, transition region and the lower corona. We will present their interpretations and implications in the light of a viable coronal loop model.

S1-P09

SOHO and TRACE coordinated observations of the polar coronal jets

D. Dobrzycka

ESO

The polar coronal jets were first observed by SOHO instruments (EIT,LASCO, UVCS) during the solar minimum in 1996. They were small, fast coronal eruptions originating from the flaring UV bright points within large polar coronal holes. Data analysis and modeling provided estimates for jet plasma conditions, dynamics, evolution of the electron temperature and heating rate. As the polar coronal holes disappeared at solar maximum and then developed again towards minimum of the Sun's activity a special SOHO Joint Observing Program (JOP 155) was designed with the aim to study the jets throughout the solar cycle. The program involved several SOHO instruments (EIT, CDS, UVCS, LASCO) and TRACE. The coordinated observations have been carried out on several occasions since April 2002. They enabled identification of new events and comparison of the current solar minimum jets with their counterparts from 1996-1998.
I will present the SOHO/TRACE coordinated observations of two particular examples of the polar coronal jets - obtained September 10, 2002 and February 27, 2005.

S1-P10

Characteristics of Small-Scale Transient Brightenings in the Transition Region

A. Fludra and D. Haigh

Space Science and Technology Department, Rutherford Appleton Laboratory, UK

We have developed a numerical method of detecting small-scale transient events in long, high-cadence time series. We use data recorded by the Coronal Diagnostic Spectrometer in the transition region line O V 629.7 A (~220,000 K) and analyse hundreds of hours of sit-and-stare time series obtained with a 15-s cadence in the quiet sun and active region areas. We derive event durations, rise and decay time, peak and total intensity, and obtain a continuous spectrum of their distributions for thousands of events, spanning a range from nanoflares to large brightenings (linear extent 2" - 10"), with durations between 60 s and 10 minutes, and the total intensity varying by two orders of magnitude. We discuss the implications of the derived parameter distributions for the understanding of the mechanism of the energy release in these events. This analysis uses a different method and a vastly larger amount of data than a previous CDS study, and offers better time resolution than other studies using EIT and TRACE images.

S1-P11

MHD turbulence in the solar flares

G. Gogoberidze and S. Poedts

Centre for Plasma Astrophysics, K.U.Leuven

The study of MHD turbulence is performed in the framework of the direct interaction approximation. Exact condition of realizability of weak turbulence regime is obtained. It is shown that both for weak and strong turbulence regimes there are two possible stationary inertial range solutions. Applications of the obtained results to the MHD turbulence in solar flares are discussed.

S1-P12

A possible scenario of energy release and transport in the 16 August 2004 flare

L.K. Kashapova[1]; V.V. Zharkova[2]; V.V. Grechnev [1]; S.S. Ipson[2]

[1] Institute of Solar-Terrestrial Physics, Irkutsk;[2] School of Informatics,University of Bradford, Bradford, UK

Results of the analysis of the solar event of August 16, 2004 are presented. In order to reconstruct the event scenario we tried to use the all nowadays available multi-wave observations by RHESSI, MDI/SOHO, Large Solar Vacuum Telescope (LSVT), Hiraiso Solar observatory, Nobeyama Radioheliograph (NoRH, 17 and 34 GHz), Siberian Solar Radio Telescope (SSRT, 5.7 GHz) and TRACE. The main phase of the flare was preceded by a short energy release event. This initial energy release event showed a close temporal correlation between the H-alpha intensity, hard and soft X-ray (HXR and SXR) emissions observed as well as microwave fluxes. However, the H-alpha kernel did not spatially coincide with HXR sources. The images of Nobeyama radioheliograph and SSRT showed two microwave sources, but only one of them was co-spatial with the HXR-source while the second one had only H-alpha emission source appearing nearly simultaneously with HXR source. Then, after less than 10 minutes the flare originated. The HXR sources moved to the western part of active region and again the same H-alpha kernel showed the intensity rise coinciding with HXR sources in time but not in position. In terms of the multi-wave data we studied the role of energetic particles in the energy transport during the pre-flare and flare events. A possible scenario is discussed.

S1-P13

Non-thermal particle effects on the H-alpha, H-beta and CaII 8542 A line profiles in the 18 August 2002 solar flare

L.K. Kashapova[1]; P. Kotrc[2]; Yu.A.Kupryakov[3]

[1] Institute of Solar-Terrestrial Physics, Irkutsk, Russia; [2] Astronomical Institute AS CR, Ondrejov, Czech Republic; [3] GAISH, MGU, Moscow, Russia

Understanding of the energy release/transport mechanisms in solar flares is closely connected with the lower atmosphere response to the high energy particle effect. We present results of the 18 August 2002 flare analysis as an example for developing a diagnostic tool for thermal and non-thermal processes in chromospheric lines. Taking into account the hard X-rays (HXR) and radio emission, we tried to derive properties the Balmer series and CaII 8542 A lines which arose from a non-thermal electron influence and could be useful for diagnostic purposes in the future.

The flare itself was a sequence of harder and softer bursts in HXR. We analyzed the chromospheric lines during the rise phase of HXR burst with energy up to 100 keV which was connected to a powerful H-alpha emission with extended chromospheric line wings. For analysis we used the parameters examined in our previous publications [1,2]. When RHESSI ceased observations, a subsequent HXR peak was registered by the HXR Spectrometer (HXRS) and its spectrum was even harder then the studied one. Thus, we took into account a possible influence of the two preceding harder HXR peaks and an effect of subsequent HXR flux peak on evolution of chromospheric emission. Coming to conclusions, we tried to reconstruct the possible scenario of the flare energy release/transport based on UV and microwave observations and information about magnetic field. Results are discussed both from their observational and theoretical aspects.

1. L. K. Kashapova, P. Kotrc, Yu. A. Kupryakov: 2007, ASP Conf. Series, 368, 431.

2. P. Kotrc and L. Kashapova: 2007, Modern Solar Facilities - Advanced Solar Science, F.Kneer, K.G.Pushmann, A.d.Wittmann (eds.), Universitaetsverlag Goettingen, 277.

S1-P14

On the Acoustic Oscillations Below Solar Magnetic Canopy: Uniform Atmosphere

D.Kuridze [1]; T.Zaqarashvili [1 2]; B. Shergelashvili [1 2]; S Poedts [3]

[1]Georgian National Astrophysical Observatory; [2] Institute for Theoretical, K. U. Leuven; [3] Centre for Plazma Astrophysics, K. U. Leuven

Observations show the increase of acoustic wave power in the field-free region of the solar lower atmosphere below the magnetic canopy. It is generally believed that this effect may be explained by the interaction of acoustic waves with the magnetic canopy. The aim of the work is to study the spectrum of acoustic oscillations in these regions and compare them to observations. The simplest of uniform atmosphere is considered.

S1-P15

Spectroscopic diagnostics of filaments and prominences and their surroundings

N. Labrosse[1], B. Schmieder[2], P. Heinzel[3], T. Watanabe[4], S. Gunar[3], P. Schwartz[3]

[1] University of Wales Aberystwyth, UK
[2] LESIA, Observatoire de Paris Meudon, FR
[3] Astronomical Institute, Academy of Sciences, Ondrejov, CZ
[4] National Astronomical Observatory of Japan, JP

We present coordinated observations between SUMER/SOHO and EIS/Hinode of filaments and prominences performed for JOP 178 during the first SUMER-Hinode observing campaign. We also present CDS/SOHO data obtained simultaneously. The combination of the three spectrometers brings us a detailed view of the physical conditions within and around these structures, thanks to the large number of line profiles obtained across a range of temperatures. A preliminary spectroscopic diagnostic of the plasma is presented, together with comparisons with non-LTE computations of the hydrogen and helium lines.

S1-P16

Particles acceleration in the footpoints of stressed coronal loops including collisional losses

R. Turkmani [1]; J. Brown [2], E. Kontar [2], P. Cargill [1], K. Galsgaard [3]

[1] Imperial College, [2] University of Glasgow, [3] University of Copenhagen

We perform an analysis of the electron energy gain arising from the competition between DC electric fields and collisional energy losses in the footpoint region of a coronal loop. The structure of the footpoint model is obtained from a 3-D MHD model of a stressed coronal loop in which fragmented current sheets are distributed throughout the entire loop. The electric and magnetic fields in the footpoint are used as an input for test particle experiments.
It is found that, since the Dreicer field in the footpoints is high, many electrons do not undergo any acceleration. However, a considerable number of particles do experience electric fields which exceed the Dreicer field and get accelerated in a short time. While some of these electrons will leave the footpoints after being accelerated, others get trapped there in regions where the electric field changes sign. These electrons get successively accelerated and decelerated repeatedly, bouncing back and forth in these regions, the amplitude of their oscillations decreasing with time due to collisional losses. This "driven-trapping" mechanism extends the life time of the particle in the footpoints.
Because the microscopic fields drive and trap the electrons, and so sustain their energies over many collisional loss times ("electron recycling"), the hard X-Ray photon yield per electron is greatly increased over the value for injection into the "Standard" collisional thick target model. Such local trapping and reacceleration may solve growing problems in the thick target with its high beam density and anisotropy.

S1-P17

Transition Region Explosive Events and their Relation to the Solar Magnetic Field

K. Muglach and K. Dere

Naval Research Laboratory/Artep, Inc., George Mason University

Magnetic field restructuring by reconnection is pervasive in in solar physics. It can potentially provide the energy to heat and accelerate the plasma in the solar atmosphere. We will investigate the role of small-scale magnetic reconnection in the formation of transition region explosive events.
These events are defined by strong transient enhancements of the wings of spectral lines that form at transition region temperatures (between 2 x 10^4 - 2 x 10^5 K).
Using SUMER data we are able to identify EEs by their spectral signature. With MDI we can continuously map the photospheric magnetic field and search for a manifestation of the reconnection in the lower solar atmosphere.
We have analysed several dozens of explosive events and will show how the underlying magnetic field evolves during these events.

S1-P18

Fine thermal structure of a coronal active region from Hinode/XRT

F. Reale[1], S. Parenti[2] et al.

[1] Univ. of Palermo, Italy; [2] Royal Observatory of Belgium

The determination of the fine thermal structure of the solar corona is important to constrain the mechanisms which heat the corona. Hinode/XRT is able to collect images of the solar corona in different filters and to provide temperature diagnostics. We have devised a particular hardness ratio of the signal in the different filters which optimizes the quality of the signal and is good for diagnostics of the coronal thermal structure. The application to a coronal active region observed with the XRT on November 2006 in five filters shows a finely-resolved highly thermally structured corona. We also find evidence of interacting structures, and signatures of varying thermal structuring along the light of sight.

S1-P19

Fine thermal structure of a flare with Hinode/XRT

S. Parenti[1], F. Reale[2] et al.

[1] Royal Observatory of Belgium; [2] Univ. of Palermo, Italy

In this work we investigate the thermal structure of a flare observed in November 2006 by Hinode/XRT. For this analysis we adopted a new technique which optimizes the use of five different filters, resulting in a good diagnostic of temperature and emission measure.

S1-P20

Coronal seismology: wave leakage at the lower layers

R. Pinto, R. Grappin and J. Léorat

LUTh - Observatoire de Paris

Observed coronal loop oscillations are often interpreted as standing kink modes of magnetic flux tubes with both footpoints line-tied to the photosphere. These have been observed to decay very fast (approx. 1-3 wave periods; Nakariakov et al. 1999, Aschwanden et al. 2002), much too fast for the expected viscous damping. Alternative damping mechanisms were proposed, such as dissipation by phase mixing and/or resonant absorption at the flux tube's lateral boundaries, but were unsuccessful at reproducing the correct damping times. It's relevant, however, to consider propagative (rather than standing) modes and the possibility of footpoint leakage (Ofman 2002, del Zanna et al. 2005).
We perform 2.5D MHD numerical simulations of the response of coronal loops to localized perturbations in a domain including a realistic (and consistently maintained) transition region.

S1-P21

Coronal heating and the turbulent dynamo: a simplified model.

O. Podladchikova[1], B. Lefebvre[2], B. V. Krasnoselskikh[3]

[1] Royal Observatory of Belgium; [2] Imperial College, London; [3] LPCE/CNRS-Université d'Orléans, France

Solar coronal heating is a complex problem due to the variety of scales and physical phenomena involved. It is therefore very difficult via numerical simulations to produce reliable statistics and study large-scale phenomena that can be compared with observations while including some of the essential microphysics.
Parker's hypothesis assumes that nanoflares and small-scale impulsive phenomena participate effectively in the heating of the solar corona. The so-called cellular automata models thanks to their relative simplicity allow to produce eruption statistics that can be compared (sometimes successfully) to observational ones. In the framework of such a model developed by (Krasnoselskikh et al. 2002, Podladchikova et al. 2002), which includes magnetic driving and dissipation of small-scale current sheets, we include a simplified dynamo based on the alpha-effect. This is found to have important effects on the large-scale organization of the magnetic fields and on the nanoflare statistics.
Experimental indications about the nature and location of the solar dynamo remains relatively rare, and new missions such as Solar Dynamic Observatory offers new opportunities to study this problem. However, observational indications on the dynamo may be indirect and therefore require to be complemented by numerical modeling.

S1-P22

Novel EIT wave Machine observing (NEMO):10 years EIT/SOHO EIT wave catalogue and its properties.

O. Podladchikova[1], D.Berghmans[1], V.Krasnoselskikh[2] and SECCHI/STEREO team[3].

[1] Royal Observatory of Belgium; [2]LPCE/CNRS-Université d'Orléeans, France; [3] Naval Research Laboratory, USA

We review the major properties of 1997-2007 EIT waves as detected and extracted by the NEMO software, developed for EIT wave analysis with SECCHI from the EIT/SOHO EUV telescope. This presentation will give a special attention to the attempt of the experimental validation of the recent developed models of EIT waves (Delanne et al, 2000-2007, piston driven shocks (Chen et al. 2006, 2007), MHD fast waves (Ofman & Thompson 2002, Wills-Davey 2007), blast waves (Krasnoselkikh et al. 2006, Uchida, 1968, Wu et al 2001), loop opening (Zhukov & Auchere, 2004), the Multiple Small-Scale reconnection model (Attrill et al. 2007). The same techniques applied the first high cadence multiwavelength EUV measurements from STEREO/SECHHI can help to identify unambiguously the mode type characteristics.

S1-P23

Investigation of the flaring kernels' sizes and intensities in various parts of the H-alpha line profile

K. Radziszewski, P. Rudawy

Astronomical Institute of the University of Wroclaw, Poland

In this paper we present some results of investigation of the flaring kernels' sizes and intensities measured in various parts of the H-alpha line profile. Our investigation was based on the high temporal resolution spectral-imaging data collected with Multi-Channel Subtractive Double Pass Spectrograph and Solar Eclipse Coronal Imaging System (MSDP-SECIS) at Bialkow Observatory (University of Wroclaw, Poland) during the observational seasons 2003-2005.
We have found that the intensities and areas of the kernels heated by non-thermal particles varies in time and in wavelengths. For some less intense flaring kernels the intensities and areas of the H-alpha emission decreases systematically toward the wings of the H-alpha line (it means toward the dipper layers of the chromosphere). Our result could be explained as an effect of the cone-shaped lower parts of the magnetic loops channelling the particle beams.

S1-P24

MHD waves in the viscous shear flows: recent applications for the solar atmosphere

B.M. Shergelashvili[1], S. Poedts[2] and A.D. Pataraya[3]

[1] Institute of Theoretical Physics, K.U. Leuven, Belgium; [2] Centre for Plasma Astrophysics, K.U. Leuven, Belgium; [3] Georgian National Astrophysical Observatory, Georgia

The recently proposed non-modal self-heating mechanism is applied to the medium of solar coronal holes with an inhomogeneous plasma flow along the magnetic field lines. The viscosity force is assumed to be anisotropic. The efficiency of the non-modal cascade process is examined for different sets of environment parameters and for different wave parameters. It is concluded that the proposed mechanism can serve as an alternative mechanism for a significant enhancement of the heat production in the lower corona, even when only laminar values of the viscosity coefficients are taken into account.
Besides, the rapid amplification of large-scale (long period) disturbances in shear flows is studied by means of a non-modal analysis. Typical solar coronal parameter values were considered in the calculations. The temporal evolution of the disturbances is studied.

S1-P25

Measurements of Significant Plasma Flows in the Regions of Blinkers with SOHO/CDS

K. Steed and G. Del Zanna

UCL/Mullard Space Science Laboratory

Blinkers are small explosive events located in the transition region and observed as brightenings everywhere on the Sun.
A number of blinkers were identified using SOHO/CDS and the ratios of the intensities of the O IV lines plotted, allowing us to obtain several values for the electron density of each blinker. A comparison of these values indicates that the electron density is constant in a blinker, lending strength to the theory that blinkers are caused by changes in transition region filling factor, rather than by density enhancements.
Using SOHO/CDS and rastering enabled us to do 2-dimensional imaging of the velocities of blinkers. This is the first time research has been done into blinker velocities in this way, and the results tell us that there is a flow of plasma within the blinkers, with velocities in the region of 50 km/s observed.
These results show plasma flows in the regions of blinkers to be very dynamic, and this may be significant for furthering our understanding of these events.

S1-P26

Evolution and dissipation of Alfvénic turbulence in the polar solar wind: implications on the plasma heating and on the wind acceleration in coronal holes.

A. Verdini[1], M. Velli[1,2], E. Buchlin[3]

[1]Dep. of Astronomy and Space Scienze, Unif. of Florence; [2]JPL; [3]Imperial College

Alfvén waves are a dominant component of the fluctuations observed in the fast streams of the solar wind, at least at the solar minimum. Measurements of non-thermal line width in polar regions show the presence of Alfvénic fluctuations close to the solar surface, suggesting their solar origin. During their propagation in the stratified atmosphere, waves are partially reflected by the density gradients in the chromosphere, at the transition region and in the low corona. Nonlinear interactions, occurring among counter-propagating waves, are hence triggered and driven by reflection, which in turn lead to the formation of a turbulent spectrum in planes perpendicular to that of the wave propagation.
Using a low dimensional model for turbulence (2D shell model) coupled radially through propagation, we study the evolution of the reflection driven spectrum formed, according to the above mechanism, from Alfvén waves injected at the base of the chromosphere and propagating upward, beyond the Alfvénic critical point of the specified solar wind.
Most of the turbulent dissipation occurs just above the transition region as requested by current solar wind models. Here the perpendicular spectral slope changes substantially because of the steep density gradient: the coupling among the large scale fields (gradients of the equilibrium fields) and the small scale fluctuations (turbulent dissipation) may provide a viable mechanism for the acceleration of solar wind and the plasma heating in coronal holes.

S1-P27

Magnetic interfaces and triggering of transient events in the solar atmosphere

Y. Voitenko, T. Siversky, and M. Goossens

Centre for Plasma Astrophysics, K.U.Leuven, Belgium

Numerous Yohkoh and SOHO observations suggest that the transient events in the solar atmosphere (flares, microflares, blinkers, etc.) are produced by magnetic reconnection. Magnetic reconnection occurs in magnetic interfaces (current sheets) between interacting magnetic fluxes. Classical transport coefficients cannot explain the observed rates of energy release. The difficulty of models based on the anomalous resistivity is that the threshold currents for responsible instabilities are rather high and require very thin interfaces that are subject to quick disruption. In this situation the fast Petschek regime of magnetic reconnection can hardly be obtained. In our study we take into account that inhomogeneous currents (and very likely shear plasma flows) are typical for magnetic interfaces. We find that the current inhomogeneity, as well as shear flows, drastically decreases the threshold currents for kinetic Alfven and ion-acoustic instabilities. Therefore, these instabilities develop between approaching magnetic fluxes much earlier and trigger anomalous resistivity in relatively wide and stable interfaces, which make the fast magnetic reconnection more realistic for the solar atmosphere.

S1-P28

Low-Latitude Coronal Holes observed by SOHO EIT and MDI

Jun Zhang

National Astronomical Observatories, Chinese Academy of Sciences

In order to explore the properties of low-latitude coronal holes (LLCHs) which correlates solar cycles, 521 LLCHs, observed by SOHO EIT and MDI during solar cycle 23 from 1996 January 19 to 2007 April 2, are studied. Each LLCH is selected as it locates close to the disk center, while it traverse solar disk from East to West. The following results have been obtained: 1. Magnetic flux density in LLCHs changes with the phase of the solar cycle.
At solar maximum, the flux density is about 9 G, which is twice as that at solar minimum. 2. LLCH area at solar maximum is 0.6 % of the solar surface area, three times as that at solar minimum. changes with the phase of the solar cycle. 3. The coronal temperatures in LLCHs also change with the phase of the solar cycle. At solar maximun the mean temperature is 1.12 Mk, which is 6 % higher than that at solar minimum.

S1-P29

Diagnostic of Temperature and Differential Emission Measure (DEM) based on Hinode/XRT data

Robert Falewicz[1]; Pawel Rudawy[1]; Marek Siarkowski[2]; Anna Kepa[2]

[1]Astronomical Institute of the University of Wroclaw, Poland; [2]Space Research Center, Polish Academy of Sciences, Poland

In our paper we discuss the methodology and optimal strategy of the diagnostic of the temperature and emission measure based on Hinode XRT data. As an example of the applied methodology we present determination of the temperature using two and three filter ratios. We also tested some methods for determination of the differential emission distribution based on Hinode XRT data.

S1-P30

Interaction Between Non-thermal Electrons and Plasma In the Chromosphere and Transition Region During Solar Flares. Energetic Balance of Solar Flares.

Robert Falewicz[1]; Pawel Rudawy[1]; Marek Siarkowski[2]

[1]Astronomical Institute of the University of Wroclaw, Poland; [2]Space Research Center, Polish Academy of Sciences, Poland

In our paper we present theoretical assumptions and methodology of our investigations of interactions occurring between non-thermal electrons and plasma in flaring loops as well as the energetic balance of the solar flares. Taking into account an influence of the energy distribution of the non-thermal electrons speeding down the flaring loops, geometry of the loops and properties of the plasma (density, temperature), radiative losses of the material and other processes, we intend to explain the processes of the plasma evaporation and formation of the observed chromospheric emission in strong Fraunhofer lines (like H-alpha, calcium lines etc.).
In our investigation we using two approaches: semi-analytical considerations of the observational data and hydrodynamic modeling of the flaring loops. As an example of the applied methodology, we present preliminary results of an investigation of the energy balance of some solar flares of a moderate C class. Our analysis was based on observations collected with Yohkoh SXT and HXT telescopes.

S1-P31

Spectral anisotropy of MHD turbulence with large mean field: recent numerical results

R.Grappin [1]; W.-C. Mueller [2]; J.Leorat [1]

[1] Observatoire de Paris, LUTH; [2] Max-Planck Institute, Garching

A well-known property of plasmas with a strong magnetic field is that small scales form preferentially with wave vectors perpendicular to the mean field, the weakness of small scale generation along the mean field being due to Alfvén waves decorrelation.
Dimensional arguments have been proposed, which lead to definite relations between the parallel and perpendicular slopes (Goldreich Shridhar, 1997).
To check such relations via direct simulations is not so simple. An important difficulty in this respect is that, while high resolutions such as 1024^3 are sufficient for an inertial range (hence also a slope) to show up in the perpendicular direction, this is not the case for the parallel direction, where the effective Reynolds number remains miserable.
One expects on the one hand that the so-called extended similarity, which holds in isotropic MHD turbulence (with zero mean field), also holds for the case of a strong mean field, which would lead to a definite relation between the perpendicular and parallel spectra valid over the whole spectral range, not limited to the inertial range. On the other hand, one also expects isotropy to hold in the dissipative range.
One answers here this dilemna by analysing results of 512 x 1024 x 1024 direct simulations of incompressible MHD. The implications for the coronal and solar wind plasmas are discussed.

Poster presentations

Session 2

CME's: Why and how do they erupt?

S2-P01

Statistical properties of LASCO CMEs over solar cycle 23 based on the ARTEMIS catalog.

Yannick Boursier[1], Philippe Lamy[1], François Goudail[2], Antoine Llebaria[1]

[1]Laboratoire d'Astrophysique de Marseille; [2]Institut d'Optique

A new method of detection of CMEs from the LASCO-C2 synoptic maps has been developed at the Laboratoire d'Astrophysique de Marseille. The fully automatic process has resulted in the creation of the ARTEMIS (Automatic Recognition of Transient Events and Marseille Inventory from Synoptic maps) online catalog which lists 21500 CMEs detected over the whole 23th solar cycle (June, 1996 to November, 2006). Such a large data set is suitable for statistical analysis which includes
(i) an analysis of the statistical distribution of main parameters (position angle, angular width, velocity),
(ii) a time dependant analysis of the same parameters over the solar cycle,
(iv) an analysis of occurences of CMEs,
(iii) a correlation analysis between the rate of detected CMEs and solar activity, and
(iv) a correlation analysis between the location of source regions of CMEs and largescale regions on the photosphere (neutral line, polar filaments).
When possible, the statistical properties have been compared with those coming from reliable catalogs : the CDAW catalog, a visual detection that may be considered as ground truth for most energetic CMEs, and the CACTus catalog, an automatic detection that also presents a high sensitivity to small, faint and numerous events.

S2-P02

Analysis and interpretation of a fast limb CME with eruptive prominence, C-flare and EUV dimming

S. Koutchmy[1], V. Slemzin[2], B. Filippov[3], J.-C. Noens[4] and D. Romeuf[5]

[1]Institut d'Astrophysique de Paris, CNRS and UPMC; [2]P.N. Lebedev Physical Institute; [3]IZMIRAN; [4]OMP and Pic du Midi Observatory; [5]C.R.I. Claude Bernard Lyon I University

We selected the fast W-limb CME event of December 2, 2003 to fully analyze its erupting phase, taking into account what is seen on disk and off disk. The corresponding erupting prominence was observed at high cadence well above the limb with the Pic du Midi full H-alpha line-flux imaging coronagraph. EUV images with the SOHO/EIT and with the Coronas/SPIRIT space instruments are also used. The eruption started with a fast bright expanding coronal loop registered slightly after by GOES as a C7.2 flare, followed by a brightening and an acceleration phase of the erupting material. Attention is paid to the details at time of the onset and to variations in the fine structure of the prominence, including a possible increase of turbulence inside with heating at its periphery. Difference imaging made using the EUV channels before and after revealed a large dimming at and above the limb, over a 2 hours interval. The total solar corona radiation flux dropped by ~7% in the 19.5 nm channel and by 4% in the 17.5 nm channel. One hour later the CME was observed by the LASCO C2 and C3 coronagraphs. The typical 3-part structure shows a core shaped similarly to the erupted filament/prominence. The total evaluated mass of the escaping CME (~ 1.5.1016 g from C2 LASCO observations) definitely overpasses the estimated mass of the escaping prominence material, reaching a factor of order of 10. Assumptions made to analyze the H-alpha prominence during the erupting phase, as well as the corresponding EUV darkening of the filament observed several days before, made this evaluation uncertain by a factor of at least 2. We quantitatively discuss the observational data set relevant to the mass budget. Based on an extrapolated from photospheric measurements coronal magnetic field, a possible scenario of the event leading to an instability is also proposed, including the heating processes associated to the small scale dynamics inside and around the filament.

S2-P03

Contribution of solar radio physics to the understanding of CME development

M. Pick[1], D. Maia[2]

[1]LESIA, Observatoire de Paris, France; [2]Observatorio Astronomico, Porto, Portugal

A brief synthesis is provided of what has been learnt about the initial phase of CME development, and the association with EUV waves, from coordinated spectral and imaging radio data, EUV and white light observations obtained by SOHO. The accent is made on the contribution to these studies of the radio observations. We first focus on the relationship between EIT waves and Moreton H-aplha waves, and on the process generating these waves. Radio imaging observations bring some constraints to the different interpretations which have been proposed. Thus we summarize how the various coronal sites of electron acceleration are generated during the initiation and development of CMEs. We discuss the origin of the energetic electrons illuminating the radio CMEs, discovered by Bastian et al. (2001), and their relationship with the electrons detected in-situ near 1AU.

S2-P04

Repetitive ejections from the same source region

A. Bemporad[1], G. Poletto[1], M. Romoli[2], F. Landini[2]

[1]INAF - Arcetry Astrophysical Observatory, Firenze, Italy; [2]Dept. of Astronomy and Space Science, University of Firenze, Italy

On May 28, 2004, the LASCO CME catalog lists five CMEs, two of them originating at the east limb of the Sun at a south latitude of ~ 20 degrees. Ulysses, at the time, was at 5.4 AU at a southern latitude of ~ 5 degrees, off the East limb of the Sun: i.e., at a position where its in situ experiments may possibly detect the CME ejecta. This prompted our interest in the events, which have been observed also by EIT, UVCS and LASCO on SOHO.
Analysis of data from these instruments allowed us to identify the source region of the CMEs in an active region (AR) crossing the solar limb on that day. Spectra taken by UVCS at an altitude of 1.55 solar radii show that at least one further, smaller,ejection originated from the same AR. In spite of their common origin, however, the ejections have different characteristics and different outward speeds. We give here their physical parameters, illustrate the scenario we propose for their origin and comment on the reconnection phenomena associated with the events.

S2-P05

Filament eruption related to large-scale horizontal flows in the

B. Schmieder[1], T.Roudier[2], M. Svanda M.[3], N.Meunier[2], J. Dudik[4], G. Aulanier[1], G. Molodij[1], J.M. Malherbe

[1]Observatoire de Paris, France; [2]Observatoire Midi Pyrénnees, France; [3]Ondrejov, Czech Rep.; [4]University of Bratislava

The influence of large-scale photospheric motions on the destabilization of an eruptive filament, observed on October 6, 7, and 8, 2004 is analysed by using local correlation tracking (LCT) technique in MDI Dopplergrams and magnetograms. The magnetic onfiguration of the filament consists of two flux tubes as shown the lfff extrapolation of the photospheric magnetic field observed with THEMIS. One of the flux tube escapes during the eruption leading to a CME.
Before the filament's eruptive phase, we observe both parasitic and normal polarities being swept by a continuously diverging horizontal flow located in the filament gap. The disappearance of the filament initiates in this gap. Such purely horizontal motions could lead to destabilization of the filament and could trigger the sudden filament disappearance. The topology of the flow field changed significantly during the filament eruptive phase, suggesting a coupling between the surface flow field and the coronal magnetic field. We measured an increase of the shear below the point where the eruption starts and a decrease in shear after the eruption. We find a pattern in the large scale horizontal flows at the solar surface which interacts with differential rotation.

S2-P06

Coronal Mass Ejections identified by manual and automatic methods

S. Yashiro[1,2] and N. Gopalswamy[2]

[1] Catholic University of America; [2] NASA Goddard Space Flight Center

Coronal mass ejections (CMEs) are related to many phenomena (e.g. flares, solar energetic particles, magnetic storms), thus the compiling of event catalogs is important for understanding these phenomena. CMEs have been identified manually for a long time, but in the SOHO era, automatic identification methods are being developed. In order to compare the manual and automatic CME catalogs, we examine the distributions of the CMEs listed in the CDAW Catalog (manual) and in the CACTus (automatic). Using (width*speed^2) as a proxy for the CME kinetic energy, we find that distributions of CDAW and CACTus CMEs result in almost identical distributions. Both distributions obey a power law with an index of 1.69 (CDAW) and 1.71 (CACTus). However there are significant discrepancies in the speed and width distributions; e.g. CACTus has a large number of narrow CMEs than CDAW. We discuss the advantages and disadvantages of the both methods.

S2-P07

Evolution of Trans-equatorial Loops and the acceleration of CMEs

Yuzong Zhang, Jingxiu Wang, Jun Zhang, Guiping Zhou

National Astronomical Observatories, Chinese Academy of Science, Beijing 100012, China

The activity of the trans-equatorial loops can be considered to be a type of disk signature of front-side coronal mass ejections (CMEs). Based on the data observed by the Large Angle and Spectrometric Coronagraph (LASCO) and the Extreme ultraviolet Imaging Telescope (EIT) on board the Solar and Heliospheric Observatory (SOHO) from January 1996 to May 2007, we selected 54 CME-associated TELs which appeared close to the central meridian and their detailed activity could be clearly traced in SOHO/EIT observations. Accelerated and decelerated CMEs in the sample occupy equal portions. During the process of CMEs, some of TELs totally or partially erupted, while others brightened in response to the flares in an AR. We identified 26 erupted and 28 brightened CME-associated TELs. It has been found that about 92% erupted TELs are associated with decelerated CMEs, while near 86% brightened TELs are related to accelerated CMEs. Most of the fast CMEs with the velocity greater than 1500 km/s are associated with erupted TELs and decelerated CMEs.

Poster presentations

Session 3

Heliospheric transients

S3-P01

Interplanetary coronal mass ejections (ICMEs) in the near earth solar wind and their geospace impact

Badruddin and Y.P. Singh

Department of Physics,

Space-borne detectors onboard SOHO are monitoring coronal mass ejections (CMEs) launched from the sun into the heliosphere. Field structures of a subset of ICMEs, called magnetic clouds, are high field regions with a systematic rotation (from northward-to-southward or southward-to-northward) in their fields. As observed, (a) magnetic clouds are isolated structures moving with the ambient solar wind, (b) faster magnetic clouds form shock/sheath preceding them, (c) slow moving magnetic clouds, when pushed from behind by fast solar wind from coronal holes, form thin interaction region in its backside, and (d) some shock-associated magnetic cloud are also pushed by high speed streams forming an interaction regions behind the magnetic cloud by the following streams. Additional features/structures associated with magnetic clouds during their propagation in the interplanetary space, together with field rotations, provide unique opportunity to study the geo-effectiveness of magnetic cloud itself, shock/sheath region, interaction region, high speed solar wind stream, and their combined occurrence. We have used such identified structures to study their geo-effectiveness using gamogenetic indices Dst and Kp. Plasma/field parameters have also been utilized to understand the physical mechanism(s) during passage of these structures with distinct properties. We interpret the differences in the effectiveness among individual structures (as well as among various combined structures) and their relative importance, both in intensity and duration of geomagnetic disturbances. We also discuss the significance of our results for space weather prediction.

S3-P02

On the relation of interplanetary shocks and slow CMEs

C. Becerril[1], G. Muñoz[1,2], R. Schwenn[3]

[1] Escuela Superior de Ingeniería Mecánica y Eléctrica, IPN, México; [2]Instituto de Geofísica, UNAM, México;
[3]Max-Planck Institute fur Sonnensystemforschung, Germany

Interplanetary shocks are related to different types of solar wind flows. It is generally accepted that fast CMEs lead shocks but some cases of slow CMEs associated to interplanetary shocks have been identified. In this work, we found temporal associations between slow LASCO CMEs from 1996 to 2006 and interplanetary shocks detected in situ. We analyzed the main dynamical parameters of "slow" CMEs (speed < 400 km/s) and the structure of the wind around the shock in order to characterize them.

S3-P03

Transient electron acceleration by electrostatic waves in the solar atmosphere

Joerg Buechner

Max-Planck-Institut für Sonnensystemforschung

The solar atmosphere is a strong accelerator of electrons interplanetary space - spacecraft observations like by RHESSI and in situ measurements have shown that solar electrons can be accelerated at the Sun in large numbers to high energies. Possible mechanisms are DC electric fields of three-dimensional reconnection as well as electrostatic plasma waves. Since collisions are rare in the solar corona the interaction of particles with plasma waves (or turbulence) has to be taken into account. We discuss ion-acoustic and lower hybrid wave modes which most probably are excited in regions of high current densities as well as in regions of strong return current flows. Their most effective interaction with electrons and acceleration to high electron energies will take place at the non-linear stage of the wave evolution. We will discuss possible nonlinear wave saturation mechanisms as well as the consequent electron acceleration.

S3-P04

3He-rich solar energetic particle events and type II radio-bursts: SOHO/EPHIN observations

R. Gómez-Herrero, A. Klassen, R. Müller-Mellin, B. Heber and R. Wimmer-Schweingruber

Institut für Experimentelle und Angewandte Physik, Christian-Albrechts-Universität zu Kiel, 24118 Kiel, Germany

Pure impulsive solar energetic particle events are characterized by dramatic enhancements in the abundance of 3He and heavy elements which are believed to arise from preferential acceleration due to resonant wave-particle interactions. These events have long been associated with solar flares and type III radio-bursts (Reames, von Rosenvinge, & Lin 1985). However, some 3He-rich events can be found which are accompanied also by coronal mass ejections and type II radio bursts, signature of a shock propagating in the corona or the interplanetary medium. A survey of 3He-rich events associated with type II radio-bursts observed between 1996 and 2006 by the Electron Proton and Helium Instrument (EPHIN) onboard SOHO is presented. The distribution of source heliolongitudes, energy spectra and electron and ion onset delays relative to the flare and type II/III radio emission are examined in order to clarify the relative importance of the flare and the shock for particle acceleration and injection during this kind of events.

S3-P05

Homologous proton events of 15-20 January 2005 and 13-14 December 2006

V.V.Grechnev [1], I.M.Chertok [2], A.M.Uralov [1], L.K.Kashapova [1], Y.Hanaoka [3], K. Shibasaki [4]

[1]Institute of Solar-Terrestrial Physics, Irkutsk, Russia; [2]IZMIRAN, Troitsk, Russia; [3]National Astronomical Observatory of Japan, Tokyo, Japan; [4]Nobeyama Radio Observatory, Nobeyama, Japan

Two homologous sets of major flare/CME/SEP events occurred during 15-20 January 2005 and on 13-14 December 2006. Several aspects of the January 2005 events exhibited homology; high-speed halo CMEs were among them. However, the major reason for the extremely strong and hard proton flux in the 20 January SEP/GLE event was found to be not in CME parameters, but in the flaring in strong magnetic fields just above sunspot?s umbrae. This clearly showed up in a huge microwave/millimeter burst (up to about 100,000 sfu) with its frequency maximum at about 30 GHz. Similar factors also determined intense, hard proton flux, which originated in the 13 December 2006 flare, unlike a homologous proton-soft 14 December 2006 event. This regularity revealed by the two sets of flares is also typical of many other proton events that is an important argument in favor of initial acceleration of SEP/GLE particles just in flares, rather than in CME-driven shocks. A probable reason for homology was continuous development of an active region towards strengthening a flare-productive configuration under persistence of main structural components for both the active region and its large-scale environment.

S3-P06

Finite instrumental resolution scale and statistical modeling of the solar wind

N.R.Minkova

Tomsk State University

The classical statistical approach to solar plasma modeling is revised from the viewpoint of finiteness of instrumental resolution scale and the multiparticle statistical approach [1] is presented. The latter one produces under some assumptions the two-particle kinetic model [2] which results are consistent with observational data for density and speed of the in-ecliptic solar wind. The observed acceleration of the solar plasma flow is provided according to the model by energy of thermal motion of plasma particles at the exobase. At the same time one-particle kinetic and fluid models require additional energy sources for achieving the measured terminal speed of the solar wind.

References

[1] Minkova N.R. Izvestija vuzof. Physics.-2004. V.47, No.10 (Special issue). P. 73-80.

[2] Y.M.Vasenin, N.R.Minkova, A.V.Shamin AIP Conference Proceedings. - 2003.
V.669, series Plasma Physics: ICPP2002. P. 516-519.

S3-P07

Two-spacecraft reconstruction of a magnetic cloud and comparison to its solar source

C. Möstl[1,2], C.J. Farrugia [3], C. Miklenic[2], A. Veronig [2], M. Temmer[4], A. Galvin[3], M. Leitner[1,2], H.K. Biernat[1,2]

[1]Space Research Institute, Graz, Austria; [2]University of Graz, Austria; [3]Space Science Center, University of New Hampshire, USA; [4]University of Zagreb, Croatia;

Numerical solution of the Grad-Shafranov equation is a powerful and versatile technique for reconstructing the magnetic field structures of systems with an invariant direction. Here we show its potential in distant two-spacecraft observations of magnetic clouds and adapt an extension of the Grad-Shafranov technique to a true multi-spacecraft method for the first time in the interplanetary context. To illustrate this, we take as an example the fast magnetic cloud which reached Earth on November 20, 2003, giving rise to the strongest geomagnetic storm of solar cycle 23. It was observed by spacecraft ACE and, about 1.2 hours later, by WIND when the spacecraft were separated by about 460 RE, the largest separation in these missions so far. By ingesting data from both observations into the analysis, we produce a single optimal field map, showing almost elliptical field lines, with an invariant axis which is oriented almost along the east-west direction and inclined about -50 degree to the ecliptic. We then compare the results with those from linear force-free fitting and minimum variance analysis, affording an excellent opportunity to study the coherence of the structure and the robustness of the results obtained, and offering valuable clues on the connection between the cloud and its corresponding flare/CME. The method opens new vistas in probing of the spatial structure of magnetic clouds in STEREO-STEREO or STEREO-WIND/ACE coordinated studies. Further, the in situ results are compared to the solar source, an M4 flare/CME event from November 18, 2003. In particular, we derive the CME source region/filament orientation, the magnetic flux reconnected during the flare, and the event location with respect to solar coronal holes which are the sources of high speed solar wind streams possibly modulating the magnetic cloud shape and orientation during its propagation in interplanetary space.

S3-P08

Tracking back to the Sun the January 18, 2002 Ulysses? Event

Adrian Oncica, Nedelia Antonia Popescu, Cristiana Dumitrache

Astronomical Institute of Romanian Academy

We studied the ICME registered by Ulysses on January 18, 2002. We gathered space and ground based observations in an attempt to track this event back to the Sun. Our analysis focused on the correlations between various plasma and radiation parameters that allow the identification of the correspondent event registered by SOHO and also the Sun?s region producing this CME. We have used data from Ulysses, SOHO, ACE, Wind and ground based radio registrations.

S3-P09

Ionospheric Height changes due to Space Weather phenomena

Alexander Soenen[1], Stefaan Poedts[1], Martin Füllekrug[2]

[1] Centrum voor Plasma-Astrofysica, K.U.Leuven; [2]University of Bath, UK

This project looked at how the ionospheric height varied over the period of a solar cycle and found that the ionospheric height varies by as much as 2km between solar minimum and solar maximum. The project also found that a diurnal variation can be observed in the intensity of Very Low Frequency radio waves. The intensity decreased soon after sunrise, due to the increased interaction with the ionosphere, and increased again soon after sunset. The final stages of this project involved trying to detect the difference between electrons accelerated directly by the Sun and those accelerated by mechanisms within the solar wind. No conclusive evidence was found to support this idea but the detailed analysis used lead to some interesting observations on particle effects. The particle effect on the ionospheric height with regards to the solar rotational period was therefore studied; a subject not yet covered in any major scientific research papers. A solar rotational effect of ± 28 days was observed in the particle data with a substantial decrease in ionospheric height detected. Further research is required to determine whether this can be attributed to either protons or electrons.

S3-P10

Magnetic Field Disturbances Around a Super-Sonic Interplanetary Magnetic Cloud

E. Romashets [1], M. Vandas [2] and S. Poedts [3]

[1] Prairie View A & M University, TX 77446 USA
[2] Astronomical Institute, Academy of Sciences of the Czech Republic
[3] CPA, K.U.Leuven, Leuven, Belgium

It is widely accepted that interplanetary magnetic clouds can cause strong geomagnetic storms due to the high magnetic field magnitude in their interior, especially if the magnetic field has a large negative B_z component. Also, disturbances around such objects can play an important role. The magnetic and flow fields in the sheath region in front of the body and in the rear of the cloud are important for understanding the dynamics and evolution of the interplanetary cloud, but also for the geo-efficiency of the cloud impact.
The aim of the present contribution is to calculate magnetic field in this sheath region in order to evaluate the possible geo-efficiency of this region in terms of the maximum B_z-component in this region. To describe the magnetic field between the bow shock surface and the cloud's boundary, we consider the disturbed field around the body as given by a vector potential. All three components of the vector potential are expressed as analytical functions. We present the magnetic field distribution in the sheath region in front of the body and in the rear of the cloud for two sample cases, viz. one case with a uniform ambient magnetic field and another case with an ambient spiral field similar to the Parker spiral field in the inner heliosphere.

S3-P11

High-energetic storm particle events during the first seven years of SOHO

K. Huttunen-Heikinmaa and E. Valtonen

Space Research Laboratory, Department of Physics, University of Turku, FI-20014 Turku University, Finland

We have statistically studied Energetic Storm Particle (ESP) events observed by SOHO/ERNE between May 1996 and April 2003. We first compiled a comprehensive database of interplanetary shock candidates (606 entries) from published lists and lists available in the internet. We then deduced the magnetohydrodynamic modes of the shock candidates by using solar wind data from WIND, ACE, and SOHO spacecraft, and ranked them according to the quality of the plasma signatures. A majority of the shock candidates was found to be fast forward shocks (54 %), but also a notable fraction of the candidates (22 %) was judged not to be shocks at all. As for the shock candidates, the observed ESP events were classified according to the quality of the signatures: intensity enhancements in several energy channels temporally close to the shock passage with no velocity dispersion. It was found that 29 % of the fast forward shocks were "clearly" associated and 13 % "probably" associated with high-energy (1.5-130 MeV/n proton and helium) ESP events. Very weak signals were found for 12 % of the cases and 46 % of the fast forward shocks had no associated high-energy ESPs. A more detailed analysis showed that roughly 40 % of the interplanetary fast forward shocks accelerate ESPs to energies greater than 1.5 MeV. A clear solar cycle variation was seen in the yearly occurrence frequency of fast forward shocks as well as in the high-energy ESP effectiveness of these shocks. We further studied the proton energy spectra at the time of fast forward shock passage (286 events) and their solar cycle dependence during the seven-year study period. The ESP spectra were compared with reference spectra calculated every day at 12:00 UT in the same manner as the ESP spectra. It was found that the standard power law well fits the spectra and that while ESP spectra are statistically significantly steeper than the reference spectra, the power law factors are larger for the ESP events.

Poster presentations

Session 4
Solar and Heliospheric science in the next decade and beyond

S4-P01

Solar chromospheric and coronal stereoscopy

Guy Artzner

Institut d'Astrophysique Spatiale, Orsay

We use the MEDICIS correlation program in order, firstly to validate the geometrical parameters given in the headers of the STEREO-Secchi-Euvi A (ahead) and B (behind) images, and secondly to present comfortable stereo pairs.
The relative centering between A and B is obtained within half a pixel by integer X and Y shifts. The relative magnification between A and B is determined within 0.0002, i. e. 0.14 pixel at the solar limb. At any time, up to mid June, 2007, the relative roll angle between A and B is adjusted within 0.01°, i. e. 0.12 pixel at the solar limb. On May 1st, 2007, at a six degrees separation between A and B, the epipolar angle is determined within 0.05°.
Static stereo pairs prepared according to the above prescription are viewed from computer screens by different methods. On small (800x1200, or 1200x1600) screens, anaglyphs have the advantage of displaying a large field of view. On high quality (IBM 2400x3840) screens, left/right or up/down stereo pairs viewed with the adequate convenient left/right or up/down Viewmagic TM devices allow simultaneously for a high quality and a large field of view. The amount of disparities, such as cosmic ray impacts, between the A and B images, is very small.
As a results of the MEDICIS correlation program, we obtain the apparent altitude of solar chromospheric or coronal structures above the solar hemisphere. We also obtain some quality index for the local correlation between A and B views of the same structures. We determine how this quality index grows worse from low to high compression data, and from static to dynamic structures. We also investigate the time evolution of the altitudes of solar structures.

S4-P02

The 3D distribution of EUV flux in the heliosphere. Insights from STEREO.

F. Auchère[1], D. McMullin[2], J. Newmark[2], J. Cook[2], M. Witte[3], R. VonSteiger[4], E. Quemerais[1]

[1] *Institut d'Astrophysique Spatiale*
[2] *Naval Research Laboratory*
[3] *MaxPlanck Institute*
[4] *International Space Science Institute*

Using in-ecliptic data from EIT/SOHO, the authors have shown that the distribution of the EUV flux is significantly anisotropic, the flux being lower at high heliographic latitutdes. However, the prediction of the EUV flux at any position in the heliosphere is limited by the fact that generally only one hemisphere of the Sun is observed. This situation has changed since the launch of the STEREO probes. Indeed, with the increasing separation of the spacecraft, a larger fraction of the Sun is being observed simultaneously. We investigate the new solar flux forecasting capabilities offered by the unique position of the STEREO probes.

S4-P03

FESTIVAL: A Multiscale Vizualisation Tool for Solar Data

E. Soubrie [1], F. Auchère [1], K. Bocchialini [2]

[1] *Institut d'Astrophsyique Spatiale*

Since 4 December 2006, the SECCHI instrument suites onboard the STEREO A and B probes have been imaging the solar corona and the heliosphere on a very large range of angular scales. The EUVI telescopes have a plate scale of 1.7 arcsec/pixel, while that of the HI2 wide-angle cameras is 2.15 arcmin/pixel, almost two orders of magnitude larger, with the COR1 and COR2 coronagraphs having intermediate plate scales. These very different instruments aimed at studying Coronal Mass Ejections from their initiation to their propagation in the heliosphere, represent a data visualization challenge. We present here FESTIVAL, a SolarSoftware package that is able to dynamically map the SECCHI data into composite images of the sky as seen by the STEREO and SOHO probes. The user can quickly and easily zoom in and out and pan through these composite images to explore all scales from EUVI to HI2 while keeping the native resolution of the original data. A large variety of filters can be applied to the data. This new tool has proven to be very convenient in tracking CME fronts across the fields of view of the various instruments. FESTIVAL will soon be able to manage data from several other instruments.

S4-P04

Super-resolution of EUV images using small scale offpoints

E. Bordes [1]; V. Delouille [2]; A. Eudes [1]; J.-F. Hochedez [2]

[1] *ISIMA, Université Blaise Pascal, Clermont-Ferrand II;* [2] *SIDC, Royal Observatory of Belgium*

The quality of the images recorded by space telescopes is always limited by the instrument's resolution. However, post-processing techniques exist that allow to reconstruct a higher resolution (HR) image from a set of low resolution images. Such 'super-resolution' methods present the advantages of being low-cost and easily applicable to any telescope images. Several algorithms have been proposed in the literature, and we choose for our application the inverse problem formulation proposed by Daubechies, Defrise, Demol (2004). Its solution is based on registration and l1-penalization, and assumes sparsity of the high resolution image in an appropriate wavelet basis.

In this presentation, a set of EUVI/STEREO images obtained with small scale artificial offpoints is used as input of the super-resolution algorithm. The shift between the images is first estimated to subpixel precision with an optical flow procedure. We compare our results with two other methods proposed in the literature. This shows that subpixel resolution can be achieved on a regular basis provided that small scale offpoints, spread and known appropriately, are available.

S4-P05

HiRISE, a new generation ultrahigh resolution, interferometric and coronagraphic, Solar Physics mission

L. Damé [1,2]

[1] Service d'Aéronomie du CNRS, BP 3, 91370 Verrières-le-Buisson, FRANCE
[2] LESIA Observatoire de Paris-Meudon, 5 place Jules Janssen, 92195 Meudon, FRANCE

There is growing evidence that the innermost 0.5 solar radii of the solar atmosphere is dominated by different physics than the extended corona at larger heliocentric distances. The chromosphere, transition region, and coronal base are strongly collisional and exhibit a complex magnetic topology, whereas the extended corona is relatively collisionless and uniform, with expansion of field lines into interplanetary space. Despite these local differences, the extended corona must be driven by energy that has made its way out through the lower layers. The lower solar atmosphere and corona are indeed efficiently coupled by the transport of nonthermal energy from the convection zone and by downward thermal conduction of heat from the corona. The nature of the outward energy flux is not known, but tangled magnetic fields associated with MHD waves and electric currents are believed to play a dominant role (Klimchuk, 2006; Klimchuk & Lopez Fuentes, 2006; Erdélyi et al., 2003, 2006; Peter, Gudiksen & Nordlund, 2005). Dissipation of this energy, from tangled fields, foot points convective motions or waves - the 3 "theoretical paradigms" of heating to disentangle by direct observations - heats the coronal plasma, drives the solar wind and propulses CMEs. Understanding this complex system requires the full characterization of the corona, particularly in the acceleration region of the wind: measuring its plasma parameters and its magnetic field. The HiRISE (High Resolution Imaging and Spectroscopy Explorer) mission, at the L1 Lagrangian point, proposed to ESA for Cosmic Vision provides meter class FUV imaging and spectro-imaging, spectroscopy and, ultimate coronagraphy by an external occulter (main satellite in formation flying at 250 m) allowing to characterize the transition zone and inner corona with direct magnetic field measurement: a unique set of tools to understand the onset of coronal heating.

S4-P06

The SWAP EUV imager: preflight calibration

A. De Groof [1], D. Berghmans [2], B. Nicula [2], J.P. Halain [3], J.M. Defise [3], T. Thibert [3], U. Shuehle [4], V. Slemzin [5]

[1]Centrum voor Plasma Astrofysica (B);
[2]SIDC - Royal Observatory of Belgium;
[3]Centre Spatial de Liège (B);
[4]Max Planck Institute, Lindau (D);
[5]Lebedev Physical Institute, Russia;

SWAP (Sun Watcher with APS detectors and image Processing) is a small EUV imager which is scheduled for launch in mid 2008 on board of the European Space Agency (ESA) PROBA2 satellite. As a technology demonstration mission, it brings the first APS detector with an EUV sensitive scintillator coating in orbit. SWAP is designed as a space weather monitor with a bandpass centred around 17.4nm, a FOV of 54 arcmin and an image cadence of 1 min. In addition to the innovative detector, SWAP will make heavy use of on-board data processing and autonomous operations. These will range from automatic off-pointing and tracking of appropriate solar events, to pre-downlink data prioritisation, and feature and event recognition procedures.
In this paper we discuss the preflight calibration of February 2007. The spectral bandpass is measured and seems ideal for monitoring most CME associated phenomena on the solar disk and close to the limb. A first estimate is made of the detector's flatfield and the filter grid. Noise characteristics are summarized at different temperatures and straylight is measured. In addition, the effects of and solutions for 'image lag', a typical phenomenon which is inherent in this type of CMOS detectors, are analysed.

S4-P07

Quantifying and containing the curse on high resolution coronal imaging

V. Delouille [1]; P. Chainais [2]; J.-F. Hochedez [1]

[1] SIDC, Royal Observatory of Belgium; [2] LIMOS, Université Blaise Pascal

Observing the Sun at a always higher resolution is one important incentive for future missions. For example, the high resolution imager proposed for the Solar Orbiter mission is expected to have a pixel resolution around $(80\text{km})^2$. In such extreme conditions, it becomes vital to evaluate if the available photon counts will provide a sufficiently high signal-to-noise ratio. To answer this question, a multiscale analysis is used to study how the contrast (defined as the difference between local maxima and background) evolves as the resolution becomes finer. In some particular situations, an increase in contrast as the resolution becomes higher might indeed balance the effect of a decrease in the photon counts due to the higher spatial resolution and cadence. In order to study the statistical behavior of quiet corona at resolutions unavailable with today's instrument, we use a stochastic modeling. Having computed the multifractal spectrum of a set of EIT 19.5nm quiet corona images, we identify a family of models (the Infinitely Divisible Cascades) that can reproduce artificial quiet sun-like images. It is the self similarity across scales that allows next to simulate images extrapolated at any finer resolution. With these extrapolations, we study how an increase in contrast can compensate (or not) for the decrease in photon counts as resolution increases and the scene observed becomes smaller. We propose a general criterion based on signal-to-noise ratio as well as the presence of sub-pixel structure in order to determine which areas are worth focusing on.

S4-P08

Development of new technologies for solar observation

M. Dominique, A. BenMoussa, J.-F. Hochedez

Royal Observatory of Belgium

New techniques for EUV sensing are emerging in an attempt to improve over the silicon detectors performance, their complexity and lifetime.Space solar instruments (e.g. LYRA, PREMOS) are already taking advantage of diamond and nitride (AlGaN, AlN) photodetectors. Porous track membranes are also applicable to EUV astronomy as optical filters. They have been successfully used onboard CORONAS-I and CORONAS-F. The purpose of this paper is to demonstrate their benefit in combination to wide-bandgap detectors for EUV radiometers.

The bandgap energy in diamond or nitride materials is wide, making sensors based on them blind to visible light. This is of interest for EUV observations, which usually require the addition of several optical filters to reject the visible and infrared parts of the spectrum but also the near UV part. Diamond and nitrides (PIN, MSM) single pixel photodiodes have been fabricated and a set of measurements campaigns was carried out to obtain their XUV-to-VIS characterization (1-1000nm).

Porous filters use the diffraction properties of a membrane covered by nanoscaled pores in order to reject the visible-IR range. The optical characteristics of porous filters (e.g bandpass, energy cut off) can be adjusted by changing its geometrical parameters (e.g pores diameter, thickness). A simple model to fit the optical transmission is introduced.

The performance of a possible EUV radiometer associating porous filters and diamond detectors is discussed and compared to an alternative more standard design.

S4-P09

Multispectral analysis of EIT images: linking temperature to morphology

T. Dudok de Wit [1] and F. Auchère [2]

[1] LPCE, CNRS and University of Orléans, Orléans; [2] IAS, CNRS and Paris Sud University, Orsay

EIT images in different wavelengths have frequently been studied with the aim of inferring information about emission temperatures and thereby distinguish different solar structures. We consider a more empirical approach to this problem, using blind source separation methods.
The morphology of solar structures changes with the wavelength of observation; we explore the possibility of using this property to separate different solar structures from a linear combination of EIT images. A set of statistically independent ``source'' images is built from the original EIT images, using independent component analysis. These source images show more contrast than the original ones and ease the characterisation of morphological structures. A comparison with the differential emission measure shows that each source image also isolates structures with specific emission temperatures. Such a decomposition is well suited for scanning through multispectral solar images and identifying structures of interest.

S4-P10

A new proposed effort: SOTERIA (SOlar-TERrestrial Investigations and Archives)

SOTERIA Consortium (Coordinator: Giovanni Lapenta)

SOTERIA Consortium

The proposed project realizes a wide synergy in the fields of solar- space- and geophysics to achieve a higher level of processed data and better understanding of solar and space events having terrestrial impact. The study of these events has an increasing importance with the increasing amount of technical equipment (e.g. power lines and telecommunication satellites) that can be damaged during these events. The project mobilizes more than 50 experts and significant resources from EU (including new EU member states) for the process, analysis, and interpretation of a large set of relevant data of more than 20 satellites (including 5 ESA missions) and the complementing ground-based data. It aims at providing better data bases and new methods to access and analyze them. The new databases go beyond the present state-of-the-art in details, and their on-line publication facilitates fast access to the open data acquired during these missions. The data will be further connected with new theoretical and simulation models and their usage will provide the expected impact of improvement of the scientific results that can be obtained from collected space data. The outputs will provide a long-term dissemination contributing to a higher level space monitoring system, and more reliable space weather forecast ability.
In the proposal all the aspects are related to the effective exploitation of scientific data from space missions. The project fulfills the expectations of EU Work Program on space science by "developing tools to archive, access and process the data", and realizing research as "downstream R&D activities complementing space missions". The set of deliverables "enhances the effectiveness and productivity of the European scientific community in terms of usage of this data". The research work will be accompanied with educational and SME-related activities as well as public events.

S4-P11

Optimisation of the instantaneous noise level of the total Solar irradiance measurements

S. Mekaoui & S. Dewitte

Royal Meteorological Institute of Belgium

Total solar irradiance measurements from DIARAD/VIRGO onboard SOHO are made since 1996 with a continuous 3 minute sampling. Long term stability of measurements is of the order of 100 ppm i.e. 0.13 W/m² over 11 years. In the current operational processing the instantaneous noise level is 40 ppm. We present a method to minimise this level to the order of 30 ppm i.e 0.04 W/m². A minimisation of the noise level is important for the study of short term transient, e.g. to study the contribution of flares to TSI variability presented in another abstract in this conference.

S4-P12

Investigating the Association among Active Regions, Flares And CMEs using Machine Learning

R. Qahwaji, T. Colak, M. Al-Omari and S. Ipson

University of Bradford

In this work, machine learning algorithms are applied to explore the characteristics of some active regions that are associated with significant flares and CMEs. The NGDC flares and sunspots catalogues and the SOHO/LASCO CMEs catalogue are processed automatically to extract the active regions that are highly associated with Flares and CMEs and to represent the characteristics of their sunspots in numerical training vectors. The sunspots characteristics include numerical representations for the McIntosh and Mt Wilson classifications, timing information, evolution features, etc. These training vectors are fed later to machine learning algorithms to extract the embedded knowledge and provide learning rules that can be used for enhancing the existing prediction models.

S4-P13

Large-Scale Numerical Analysis for the Prediction of Flares using Support Vector Machines and Neural Networks

R. Qahwaji and T. Colak

University of Bradford

In this work a computer platform that integrates neural networks and support vector machines for the large scale analysis of sunspots and flares data is introduced. This work represents the ongoing improvements to our recent work reported in (Qahwaji and Colak 2007, Solar Physics). We aim to design more robust prediction models with better generalisation capabilities by considering additional sunspots features and more flares classes (i.e. C-class flares will be considered this time with the X and M-classes).

S4-P14

Development of new information resource for radio diagnostics of the solar plasma, and forecasting of powerful solar flares

Tokhchukova Susanna [1]

[1] *St.Petersburg Department of the Special Astrophysical Observatory of Russia*

The Solar group of the SAO RAS represents the solar data obtained with the facilities of the world largest reflector type radio telescope RATAN-600 since 1997 on the web site http: // www.sao.ru/hq/sun. The facilities of the site satisfied needs in such a web resource over a whole decade. An implementation of a new spectral-polarization complex in 2005 at RATAN-600 with a multiply increased spectral resolution , the volume of the data obtained has increased as an order of magnitude. Data analysis, and their comparison with other data become considerably more complicated. At the same time, the techniques and technologies for serving such quantities of data, including the data transfer, computer power, data storage, become accessible to a wide community during the last years. This stimulates the development of a new , more advanced web resource for the RATAN-600 data on-line analysis . The development of the web resource was motivated by recent researches which schowed the unique plasma diagnostics possibilities of the high flux sensitivity (several Jy) and high spectral polarization (order of 1 % in the microwave range) observations. Several spectral polarization features were revealed during multi-azimuth observations at RATAN-600 in 2000-2005 which are associated with the preflare state of solar active regions. The web site mission is solar plasma diagnostics and activity forecast based primarily on RATAN-600 radio observations, but also using the data from other large radio telescopes Nobeyama, SSRT, and the SOHO MDI magnetograms. Data acquisition, their transfer, primary data processing, vizualization, and comparison with the data from the other telescopes are performed without human assistance now. Many routine operations for the data analysis for common tasks of plasma parameters diagnostics will be authomated on this web site, or are already authomated there.

S4-P15

Mkit: An IDL multiscale toolbox

C. A. Young

NASA/GSFC (ADNET System, Inc.)

In order to make wavelets and other multiscale transforms more accessible to the solar and astrophysics community, I have begun the development of a free IDL toolbox called Mkit. The goal of Mkit is to provide the community with a documented, user-friendly toolbox for multiscale analysis of time series, images and data cubes. In this presentation I present examples from the first release of this toolkit, a set of tools for wavelet analysis of image data. I will also discuss future additions to the toolbox. Wavelets and other multiscale transforms have been increasingly used in astronomy and solar physics over the last ten years. In fact, the first practical applications of wavelets included the study of transient phenomena. In spite of this, these transforms have not yet become a standard part of analysis tools. One main reason is that most of the world's experts in multiscale transforms are mathematians and electrical engineers. These groups have made code freely available but it is almost exclusively written for MATLAB. Another reason is that the two main multiscale toolboxes for IDL are not free and can cost upwards of $2000. Mkit will help to address these needs of the solar and astrophysics community.

S4-P16

The DynaMICCS perspective

S. Turck-Chièze, P. Lamy, C . Carr, P. H. Carton, I. Dandouras, S. Dewitte, T. Dudok de Wit, J-F. Hochedez, T. Horbury, N. Murphy, P. L. Pallé and the DynaMICCS team

SAp/CEA France; LAM France; Imperial college, England; CESR, France; RMIB, Belgium; LPCE, France; ROB, Belgium; IC, England; JPL, USA; IAC, Spain; CSL, Belgium; PMOD/WRC, Switzerland; SA France

Understanding the internal structure of the Sun contributes to answering questions of importance for fundamental physics (neutrino properties, atomic physics, fundamental constants, general relativity, fusion processes ...). Helioseismic studies are also unique in making progress in the origin of the solar system and the study of stellar evolution. The Sun's irradiance and magnetic behaviour is strongly linked to the Earth's environment through its interaction with the magnetosphere, producing auroras, and affecting ozone and temperature. The Sun's role in determining Space Weather and Space Climate becomes increasingly important the more life on the Earth depends on sophisticated technology, space travel and human influence on climate. Solar variability is mainly determined by three regions of the Sun: the inner core, the interface layer between photosphere and chromosphere, and the low corona, the DynaMICCS mission is designed to probe and understand dynamics of these crucial regions. It will deliver the knowledge not provided by any other known missions by an uninterrupted observation of the Sun around the Lagrangian L1 point, and will also pursue the Space Weather goals.

List of participants