SOLAR ENCOUNTER
THE FIRST SOLAR ORBITER WORKSHOP

Puerto de la Cruz, Tenerife, Spain.

14-18 May, 2001

FINAL PROGRAMME AND ABSTRACTS BOOKLET

Sponsored by: **European Space Agency**
Instituto de Astrofísica de Canarias

Organized by: **Instituto de Astrofísica de Canarias (IAC)**

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1 General aim

The Solar Orbiter was selected three months ago as an ESA F-mission for the time frame 2008-2013 (for information see http://solarsystem.estec.esa.nl/projects/solar_orbiter.htm). It is now up to the solar/heliospheric community to exploit this excellent opportunity to the full. To that effect, the first Solar Orbiter workshop is now being organised.
The prime objectives of the Solar Orbiter workshop are to

- inform the community about the science opportunities of the Solar Orbiter mission,
- provide a forum for sharpening and focusing the science goals,
- allow the hardware groups and future instrument proposers to review critically the strawman payload,
- establish international contacts and collaborations.

2 General site information

2.1 The island

The Canarian Archipelago (Tenerife, Gran Canaria, Lanzarote, Fuerteventura, La Gomera, La Palma and El Hierro) is made up of seven volcanic islands located in a privileged part of the Atlantic. Tenerife is the largest island in the Archipelago and the one with the most impressive geography, just over 150 km off the coast of Africa.
Tenerife is an ideal island for a different holiday and has a wide range of hotels and outdoor facilities. Its nice climate and exuberant vegetation, including its landscapes so full of contrasts, together with the hospitality of its people make it yet more attractive to the visitor. The climate on the coast is mild during September-October and is often suitable for bathing, with temperatures in the range 20-25° C during the day and 15-17° C at night.
Modern and cosmopolitan, and at the same time steeped in its traditions, Tenerife is ideal for those seeking amusement, sport, light and nature, or simply relaxation and peace.
The Island's dramatic orography (Mount Teide, the highest point in Spain, reaches a height of 3,718 metres) and the north-easterly trade winds provide Tenerife with a variety of microclimates which are among its many attractions.

2.2 Puerto de la Cruz

Puerto de la Cruz is on the northern coast of the Island of Tenerife, a 25.000 pop. seaside resort, and about 42 km from the capital city, Santa Cruz de Tenerife. Located at a latitude = +28° and at a longitude = 15 W, the Spanish Islas Canarias consist of a volcanic archipelago (in the Atlantic Ocean) made up of 7 "large islands" and 6 islets, with 1.605.000 inhabitants. The nearest island is 108 km off the Northwest African mainland, in contrast with the maximum distance within the archipelago which is 485 km. Geographically, the islands are part of the African continent but from a historical, economical, political and sociocultural point of view, the Canaries are completely European. The town is the main tourist centre of the north of the island, catering for "quality tourism". The mild climate and international nature of the town make it a popular place for foreigners to settle and many people come to the area to retire. This gives Puerto de la Cruz a very international atmosphere with a very active night life. Restaurants can be found that cater for many types of international cuisine and it is easy to find places with their menus in many foreign languages apart from the ubiquitous Spanish, English and German; these include Swedish, Finnish, Danish, French, Dutch, Russian and Italian. A list recommended of restaurants will be provided in your conference folder. There are facilities of all kinds in the town for visitors and their families, including a small port (used by private vessels). Like in most of Tenerife, sandy beaches are in short supply (the islands are too young to have much natural sand), but there are a large complex of chlorinated and salt-water pools for swimming, the famous Lagos Martianez. Attractions include Loro Parque, a fascinating centre which combines a park, a zoo, a large bird collection and some spectacular aquaria; the XVIII century Botanic Garden; and the sea-front area. Close to Puerto is La Orotava with its special architecture and famous old Canarian-style houses. The town is connected to the two main airports by motorways. The easiest access is from the North Airport (TFN, or Los Rodeos) along the TF-5 motorway. This is an approximately 20 minute journey along the coast. The South Airport (TFS, or Reina Sofia) is more than an hour away along the TF-1 and then TF-5 motorways.

2.3 Health

There are two very good private clinics in Puerto de La Cruz: Hospiten Bellevue (phone: 922-383551) and Hospiten Tamaragua (phone: 922-380512).
There are two large hospitals, the General Hospital (Hospital Universitario de Canarias) (phone: 922-678000), which is under the control of the Cabildo Insular de Tenerife; and the Residence of the National Health Service (Nuestra Señora de la Candelaria) (phone: 922-602114). Both are amply equipped with the most sophisticated medical facilities. There are also Red Cross centres along the main motorways and roads of the island, which have emergency telephones at regular intervals.
In case of any kind of emergency directly dial **112**.

3 Publication of the proceedings

INSTRUCTIONS TO AUTHORS for preparing their papers

The Proceedings will be published by ESA's Publications Division (EPD) some 3 months after the meeting, as Special Publication SP-493. Authors should submit their hardcopy camera-ready papers to the ESA Editor at the Symposium; electronic input is NOT accepted. To allow this rapid publication and a homogeneous presentation, please prepare your paper as follows:
- Use any word-processing software, and preferably a laser printer
- Paper format: standard A4 (21 x 29.7 cm) or U.S. letter size (8 x 11 inches)
- Use only one side of the paper
- Vertical typing area is 24 cm (for A4 this means a top margin of 3 cm, bottom 2.7 cm)
- Horizontal typing area is 17 cm (for A4 this means left & right margins of 2 cm each)
- Text in two columns of 8 cm width each, separated by a centre interval of 1 cm
- Justified text, using Times Roman 10 points; single line space (11 points).

At the top of the first page, to be centred:
-the TITLE (in 11 pt bold CAPITAL letters)
- the Author's Name(s) (in mixed case)
- the Author's affiliation and professional address (with phone/fax numbers and email).
Start the text (in the left column) with an abstract of about 150 words.
Figures and photographs will be printed in black and white (NOT colour). Remember that detail and contrast are lost in printing, so please ensure the illustrations are of good quality and contrast.

Number of pages: About four for ten minutes of presentation
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(requires Adobe Acrobat Reader)

A LaTeX template is available at http://esapub.esrin.esa.it/conference/esapubzip.htm
Further electronic support is not available at this time.

4 Registration fee

A registration fee of 20.000 pesetas is requested. This fee includes coffee-breaks, a copy of the abstracts and the proceedings books and all social events. The current exchange rates are US 1 = 180 pesetas and 1 Euro= 166,4 pesetas.
The payments will be done at the the time of the Workshop. We will only accept cash (spanish pesetas) or credit cards (VISA or MASTER card). Please fill in the registration form before 30 March, 2001 to avoid a late registration fee of 25.000 pesetas.

5 Conference Centre

The sessions will take place at the modern Conference Centre (Centro de Congresos) of the Cabildo Insular de Tenerife (Island's local authority), within walking distance from the hotels and apartments where participants will be accommodated. The conference centre is modern and of recent construction and is set within the Parque Taoro on one of the hills overlooking the centre of Puerto de la Cruz. Apart from the conference centre, the park contains various hotels and the well known Casino Taoro.
Centro de Congresos (Conference Centre)
Parque Taoro, 22
E-38400 Puerto de la Cruz, Tenerife, Spain
Phone: (Int)-34-922-380550
Fax: (Int)-34-922-383744

This Conference Centre is provided with the necessary facilities for workshop participants including:

- A large conference hall.
- A small computing centre with high-speed links. This will be installed by the IAC for the workshop and will only be available during the workshop timetable.
- A room for poster presentations (panels 1mx1m).
- Slide and overhead projectors, video tape player and computer display facilities. Anyone requiring special facilities for presentation (e.g. a supplementary TV + video set for posters) must request this in advance to the LOC. The VTR at the conference centre is designed to play both PAL and NTSC systems.
- Morning and afternoon coffee-breaks will be held outside the conference centre in the open air. In the case of poor weather, there is enough space to move inside.
- Various coin-operated telephones outside the conference room.

Supplementary rooms will be available at an adjacent building (see map) for the splinter meetings)

6 Registration desk

The registration desk opens on Sunday at the Conference Centre for the Welcome reception at 18:00

7 Poster presentations

Individual poster panels will be available for participants to display their presentations. Each poster panel is 1 metre × 1 metre. They are located in an area close to the main entrance.
Material – drawing pins, scissors, etc – will be available at the conference desk if required. Each conference panel will display a number, coinciding with the order indicated in the conference book. Please choose the correct panel according the number assigned. Additional panels for late arrivals will also be provided.

8 Social events

The participants are invited to attend the following events:

- Sunday May 13 at 18:00 : Welcome cocktail at Casino Taoro (Please see the map in your folder for directions)
- Moday, May 14 at 20:30: Welcome dinner at El Monatserio (Buses leave at 20:00).
- Wednesday, May 16 at 18:30 Visit to a local winery (Buses leave at 18:00).
- Thursday May 17 at 20:30: Workshop dinner in Lagos Martianez, Puerto de la Cruz (offered by the Town Hall. Buses at leave at 19:50).

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10 Workshop Programme

10.1 SUNDAY, May 13

18:00 Opening of registration desk at Conference Center

18:00 Welcome cocktail

21:00 Closing of registration desk

10.2 MONDAY, May 14

10.2.1 Morning session

Chair: V. Martínez Pillet

08:30 Opening of registration desk (Conference Center) and Poster setting

09:00	**Welcome adress**	**E. Marsch** **V. Martínez Pillet**
09:15	**The Solar Orbiter- Mission Design and Results of the Assesemnt Study**	**E. Marsch** **R. Harrison**

THE FOUR GREAT THEMES OF SOLAR ORBITER

- The Sun's magnetized plasma-

Close-up observations of the solar atmosphere

10:00	**Visible-light observations and high-resolution polarimetry**	**B. W. Lites**
10:30	**High-resolution EUV imaging and spectroscopy of the corona**	**J.C. Vial**

11:00 Coffee break

- Linking the photosphere and corona to the heliosphere: Corotation observations -

Chair: E. Marsch

11:30	**Structure and dynamics of the solar corona and inner heliosphere**	**T. Zurbuchen**
12:00	**Heliospheric manifestations of solar activity at all scales**	**J.L. Bougeret**

12:30 Lunch

10.2.2 Afternoon session

Chair: R. Schwenn

14:30	**Plasma and fields**	**T. Horbury**
15:00	**Energetic charged particles, neutrals and neutrons**	**M.B. Kallenrode**

15:30 Coffee break

Chair: Bernhard Fleck

The Sun's polar regions and equatorial corona: Excursion out of the ecliptic

16:00	**The lower polar atmosphere and the solar dynamo**	**S. Solanki**
16:30	**The Sun's global corona in three dimensions**	**E. Antonucci**

Another fresh view on Solar Orbiter Science

17:00	**Key issues of heliospheric and coronal waves to be addressed by Solar Orbiter**	**Velli**

17:20	**Key issues of the solar transition region to be addressed by Solar Orbiter**	**V. Hansteen**

20:30 Welcome dinner at El Monasterio

10.3 TUESDAY, May 15

10.3.1 Morning session

OLD AND NEW OBJECTIVES FOR SOLAR ORBITER

Chair: Jean-Claude Vial

09:00	**On the best wavelength range for the EUV spectrometer**	**M. Landini**
09:20	**Scientific brainstorming**	
11:00	*Coffee break*	

THE SOLAR ORBITER PAYLOAD CRITICALLY REVIEWED

Chair: Peter Boschsler

11:30	**Solar remote-sensing instrumentation**	**Donald M. Hassler**
12:00	**Heliospheric in-situ instrumentation**	**D.J. Mc Comas**

THE SOLAR ORBITER PAYLOAD SCRUTINIZED

12:30	**General discussion and preparation of splinter groups**	**Peter Boschler** **V. Martínez Pillet**
13:00	*Lunch*	

10.3.2 Afternoon session

15:00 SPLINTER MEETINGS ON PAYLOAD I

SG1.- Chair: Peter Bochsler & Richard Marsden

Particle field instruments

SG2.- Chair: Rainer Schwenn & Ester Antonucci

Coronograph Instrumentation

The Dust Detector is included in SG1 and the Neutrals and Neutrons in SG1 as well

(**SG only for this session)** Chair: Richard Harrison

Spectral Line selection

16:30 Coffee break

17:00 SPLINTER MEETINGS ON PAYLOAD II

SG3.- Chair: Oskar von der Lühe & Bernhard Fleck

Visible-Light Imager and Magnetograph

SG4.- Chair: Richard Harrison and Jean-Claude Vial

EUV Spectrometer and EUV Imager

The Radiometer is included in SG3

10.4 WEDNESDAY, May 16

10.4.1 Morning session

09:00 SPLINTER MEETINGS continued **III**

SG1.- Chair:Peter Bochsler & Richard Marsden

Particle and field instruments

SG2.- Chair:Rainer Schwenn & Ester Antonucci

Coronograph Instrumentation

SG3.- Chair: Oskar von der Lühe & Bernhard Fleck

Visible-Light Imager and Magnetograph

SG4.- Chair: Richard Harrison & Jean-Claude Vial

EUV Spectrometer and EUV Imager

11:00 Coffee break

Chair: Giuseppe Tondello

11:30 Plenary discussion and statements on payload issues

13:30 Lunch

10.4.2 Afternoon session

HISTORICAL CONSIDERATIONS

Chair: Ester Antonucci

15:00	**ESA solar physics missions: from the early beginnings to SOHO**	**R. Bonnet**
15:30	**Roger Bonnet, the Scientist**	**M. Huber**
16:00	**Poster Session**	
18:30	*Visit to a local vinery*	*Bodegas Monje*

10.5 THURSDAY, May 17

10.5.1 Morning session

Chair:Eckart Marsch

Perspectives for international synergy and collaboration

09:00	**Solar Orbiter and ESA's solar-system-science programme (BepiColombo)**	**Southwood**
09:30	**Solar Orbiter and NASA's Living with a Star (LWS) programme**	**G. Withbroe**
10:00	**Solar Orbiter and Solar Probe**	**B. Tsuratani**
10:30	**Solar Orbiter and the Russian Space Agency (RSA) InterHelioProbe**	**V. Kuznetsov & V. Oraevsky**
11:00	*Coffee break*	
11:30	**Solar Orbiter, Solar-B and the ISAS solar physics programme**	**T. Kosugi**
11:50	**Solar Orbiter collaboration with the Indian Space Research Organisation (ISRO)**	**R. Jain**
12:10	**Using Solar Orbiter Data for Space Weather Predictions**	**E. Hildner**

12:30 **Solar Orbiter and ground-based observations - Lessons from SOHO** **B. De Pontieu**

12:50 **Solar Observations Out of the Sun-Earth Line: STEREO, Solar Polar, and Farside** **D. Moses**

13:05 *Lunch*

10.5.2 Afternoon session

PAYLOAD SPLINTER GROUP REPORTS

Chair: Jean-Louis Bougeret

15:00 Group SG1: Particle and field instruments

15:20 Group SG2: Coronograph Instrumentation

15:40 Group SG3: Visible-Light Imager & Magnetograph

16:00 Group SG4: EUV Spectrometer and EUV Imager

16:20 *Coffee break and Poster Session*

Chair: Rainer Schwenn

16:50 **Payload, mission and S/C issues such as: Orbit design, thermal problems, allocation of resources, telemetry, etc...**

20:30 *Dinner offered by the Mayor of Puerto de la Cruz in Lagos Martianez*

10.6 FRIDAY, May 18

10.6.1 Morning session

Perspectives for collaboration

09:00	**Self - organized small splinter meetings**	

Chair: Giuseppe Tondello

10:00	**A critical summary of the Solar Orbiter science**	**Eric Priest**
10:30	*Coffee break and Poster Session*	

Chair: Richard Harrison

11:00	**A critical review of the in-situ instrumentation**	**P. Boschsler**
11:20	**A critical review of the remote-sensing instrumentation**	**A. Gabriel**
11:40	**General discussion, summary, recommendations and conclusions**	
13:00	*End of the meeting*	

11 SCIENTIFIC PROGRAMME

Invited Reviews and Oral Contributions (in order of presentation)

Solar Orbiter - A High-Resolution Mission to the Sun and Inner Heliosphere

E. Marsch[1], R. Harrison [2] and G. Whitcomb [3]

[1] **Max Planck Institut für Aeronomie**
[2] **Rutherford Appleton Laboratory, United Kingdom**
[3]**ESA/ESTEC, Noordwijk, The Netherlands**

Abstract
The scientific rationale of the Solar Orbiter (SO) is to provide, at high spatial and temporal resolution, observations of the solar atmosphere and unexplored inner heliosphere. The most interesting observations will be made in the almost heliosynchronous segments of the orbits at heliocentric distances near 45 $R_{\odot}$ and out-of-ecliptic at the highest heliographic latitudes of 38 degrees. The SO will achieve its many and varied aims with relatively small instruments through a novel choice of orbits. The first near-Sun interplanetary measurements together with concurrent remote observations of the Sun will permit us to determine and understand, through correlative studies, the characteristics of the solar wind and energetic particles in close linkage with the plasma and radiation conditions in their source regions on the Sun. Over extended periods the SO will stay behind the Sun and deliver images and data from the side of the Sun invisible from the Earth. It will also provide the first optical solar observations from outside the ecliptic. The many original features of the SO will lead to new insights into how the Sun works. In addition to helping resolve major open questions in solar physics the SO possesses a potential for unexpected discoveries.

Visible-light observations and high-resolution polarimetry

Bruce W. Lites

High Altitude Observatory, National Center for Atmospheric Research, P.0. Box 3000, Boulder, CO 80307-3000, USA

Abstract
The polarimetric imager on Solar Orbiter will follow the realization of significant space- and ground-based programs for high resolution solar polarimetry. In this review I attempt to identify the scientific potential of Solar Orbiter within the context of anticipated observational capability and scientific understanding ten years from now. The unique contribution of Solar Orbiter is its high resolution imaging from a angular perspective well-removed from that of the Earth. When combined with simultaneous high resolution polarimetry from near the Earth, Solar Orbiter will provide stereoscopic observations of the fine structure in the solar photospheric magnetic field which will likely reveal the detailed structure *on a physical height scale, rather than an optical depth scale.* Furthermore, the observations will provide the velocity field components in a plane, rather than along just one line-of-sight. These advances promise tight observational constraints for fundamental processes such as convective collapse, generation and propagation of MHD waves in flux tubes, and ultra fine-scale magnetic structure. At some phases of its orbit, the Orbiter will also provide the unique capability to follow the development of solar activity through a large fraction of a complete solar rotation.

High-resolution EUV imaging and spectroscopy of the corona

Jean-Claude Vial

Institut d'Astrophysique Spatiale
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Abstract
The on-going successful space solar missions have evidenced a very fine structuring of the solar atmosphere and its role in various processes at work for coronal heating, wind acceleration, flaring activity,... This is especially true for magnetic reconnection which seems to proceed at many different scales. These results point at the need of observations both dramatically improving the spatial resolution and providing a multi-temperature (multi-wavelength) coverage. Solar Orbiter offers a unique opportunity to analyse this fine structure (e.g. the internal structure of the thin loops observed by TRACE) in closed and open fields. It will allow for a diagnostic of regions such as the magnetic network which seems to play a major role in the wind acceleration, in conjonction with in-situ observations of the ejected plasma. We will present a bunch of imagers and spectrometer which have been proposed as a strawman payload in order to meet the scientific requirements of the mission. We will discuss their pros and cons in terms of scientific return and technical characteristics, along with the constraints which led to their design.

Models of the magnetic structure of the heliosphere and the corona

Thomas H. Zurbuchen

University of Michigan, Space Physics Research Laboratory, Ann Arbor, MI, USA

Abstract
The heliospheric magnetic field configuration is largely determined in the solar atmosphere. The interplanetary magnetic field is therefore intimately linked with the coronal structure and evolution during the solar cycle. Traditionally, this interdependence has been studied using time-stationary models that usually manage to approximate the large-scale properties of the magnetic field configuration. However, the solar source is clearly time-dependent on many scales, for example, due to differential rotation effects. In1996 Fisk pointed out that such effects will lead to footpoint motions that significantly alter the heliospheric magnetic field configuration on a large scale.

We first summarize the basic properties of these models. We then derive qualitative predictions for the heliospheric magnetic field configuration and compare them with in situ measurements in the heliosphere. We conclude that many properties of coronal models are fundamentally inconsistent with heliospheric data. We will also address fundamental contributions to this research from the Solar Polar Orbiter.

Heliospheric manifestations of solar activity at all scales

J.L. Bougeret

Observavaotoire de Paris, DESPA, F-92195 Meudon Cedex, France

Abstract

Plasma and field measurements: challenges for Solar Orbiter

T. S. Horbury

Imperial College, London, U.K

Abstract
Previous inner heliosphere missions, most notably the dual Helios spacecraft, have provided in situ measurements of the solar wind and magnetic field at solar distances of 0.29 AU at above. We present an overview of the state of the heliosphere at these distances, and discuss key science questions which Solar Orbiter, with its unique orbit, will be able to address. Finally, we discuss the required capabilities of plasma and field instruments at these distances, with implications for the Solar Orbiter payload.

Energetic charged particles, neutrals and neutrons

M.B. Kallenrode

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Abstract

The lower polar atmosphere and the solar dynamo

Sami Solanki

Max Planck Institut für Aeronomie, Max Planck Str. 2, D-37191 Katlenburg-Lindau, Germany

Abstract

The Sun's global corona in three dimensions

Ester Antonucci

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Abstract
The Solar Orbiter will perform the first out-of-ecliptic and the first heliosynchronous observations of the solar corona, thus allowing unique science investigations. Co-rotation will freeze for many days the corona in the plane of the sky, and this will ensure the most favourable conditions to investigate the evolution of the coronal structures. For instance, the evolution of the magnetic configuration of coronal streamers is essential to determining the role of magnetic reconnection as one of the possible processes leading to the formation of the slow wind, and the evolution of elemental composition of streamers will provide insight in the processes of gravitational settling and dynamic stratification within a streamer. The out-of-ecliptic observations will allow for the first time a unique view of the low-latitude and equatorial distribution of the coronal plasma and of the solar wind. These observations are essential to measuring the longitudinal extent of coronal streamers and coronal mass ejections and to determining the flux carried by plasmoids and ejections in the heliosphere.

Key Theoretical Issues of heliospheric and coronal waves to be addressed by Solar Orbiter

M. Velli

Dipartimento di Astronomia e Scienze dello Spazio, Universitá di Firenze, Largo E Fermi 5, I-50125 Firenze,Italy

Abstract
Scenarios for wave generation, propagation, the development of MHD turbulence, coronal heating and solar wind acceleration will be reviewed with emphasis placed on the basic uncertainties which may be resolved by further continuous observation of fluctuations in the inner heliosphere. My main focus will be the Alfven wave generation and cascade and heating at the proton-cyclotron resonance versus other routes to the dissipation scale.

Key issues of the solar transition region to be addressed by Solar Orbiter

Viggo H. Hansteen

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Abstract

The transition region is the thermal contact between the dense and cold chromosphere and the hot and tenuous corona. As such, the spectral emission lines formed in the region potentially contain information on the phenomena occurring in both. This diagnostic potential is increased since the transition region is geometrically quite small and since the radiative transfer is relatively simple for these lines. The transition region thus presents us with the possibility of making observations that can elucidate the still not understood energetics and dynamics of the corona and the chromosphere.

On the other hand, the nearly discontinuous rise in temperature and the fact that plasma β passes through $\beta = 1$ close to the transition region practically ensure that wave phenomena such as reflection and refraction will occur. It is also certain that time-dependent phenomena and the topology of the magnetic field are factors that contribute to the complications in unraveling the nature of the dynamics of these regions.

There is a large contrast between network and internetwork emission throughout the outer layers of the Sun (indeed it is not certain that any material at coronal temperatures is in thermal contact with the internetwork at all), while at any given location the emission varies with time on several different time scales.

In the internetwork there is, perhaps, general agreement that acoustic waves play an important role in powering the emission stemming from the upper chromosphere. In the network the acoustic power seems suppressed and in the upper regions of the Solar atmosphere magnetic phenomena, such as rapid reconnection or the dissipation of high frequency Alfvn waves surely contribute to the heating.

We will discuss the various phenomena expected in the transition region in the context of observations possible with the Solar Orbiter.

On the best wavelength range for the EUV spectrometer

Massimo Landini

Department of Astronomy and Space Science, University of Florence
largo E. Fermi, 5 ,Firenze, Italy

Abstract
Using numerical simulations and available observations,the Extreme Ultraviolet region of the spectrum is investigared in order to select proper spectral bands for temperature and electron density evaluation.

Solar remote-sensing instrumentation

Donald M. Hassler

Southwest Research Institute, 1050 Walnut St., Suite 426, Boulder, CO 80302, USA

Abstract
I will critically review the Solar Orbiter Remote Sensing Instrument payload as decribed in the Assessment Study Report. The main aim of this talk is to stimulate discussions for the subsequent working groups focusing on payload issues.

Heliospheric in situ instrumentation

D.J. McComas

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Abstract
This talk critically reviews the in situ instrumentation payload planned for Solar Orbiter (from the Assessment Study Report). The in situ payload comprises a solar wind electron and ion plasma analyzer (including composition); a radio and plasma wave analyzer; a radio sounder; a magnetometer; an energetic particle detector; a dust detector, a neutral particle detector, and a neutron detector. With only 25.2 kg and 23.5 W allotted for this diverse and challenging set of measurements, new and innovative designs will be required for a number of the instruments. This talk reviews the completeness and optimization of the baseline in situ payload and examines potential connections between these measurements and observations expected from complimentary missions in NASAs ongoing Solar-Terrestrial Probes and Living with a Star programs. Hopefully, this talk will stimulate discussions in the subsequent working groups, which address payload issues.

ESA Solar Physics missions: from the early beginnings to SOHO

R. Bonnet

European Space Agency, 8-10, rue Mario Nikis, F-75738 Paris Cedex 15, France

Abstract

Roger Bonnet, The Scientist

Martin C.E. Huber

European Space Agency, 8-10 rue Mario-Nikis, F-75738 Paris Cdex 15, France

Abstract
Roger Bonnet started his career as a scientist in 1961, when solar physics from space was in its infancy in Europe. We trace his contributions to solar spectroscopy - through instrumentation and observations - by means of rockets and satellites, and also touch on his space observations of other stars. After starting the 'Laboratoire de Physique Stellaire et Planétaire' in 1969, he continued his research in collaboration with his students and with colleagues in France, Europe and overseas. He also began to influence broader science issues: he was instrumental, for example in stimulating the 'solar-stellar connection' by organising and editing the Château de Bonas meeting on 'Solar Phenomena in Stars and Stellar Systems'.

Roger Bonnet's work as a scientist also includes his efforts - when he was a member of the Solar Physics Board of EPS - to improve the situation of solar physics in Europe. As chairman of ESA's Science Advisory Committee, he addressed the much broader issue of space sciences in Europe by devising a long-term programme. This, however, became reality only after he took on directing ESA's Science Programme in May 1983. He then immediately initiated the 'Horizon 2000' programme. This gave an enormous boost to European space science: it helped European scientists to assert leadership in several fields - among them in solar and heliosperic physics, with SOHO and, in future, Solar Orbiter.

Solar Orbiter and ESA's solar system science programme (BepiColombo)

Southwood

Abstract

Solar Orbiter and NASA's Living with a Star (LWS) programme

G. Withbroe

NASA Headquarters, 300 E Street SW, Washington DC 20546, USA

Abstract

Solar Orbiter and Solar Probe

Bruce T. Tsurutani[1], **David Lehman** [1] **and Lika Guhathakurta** [2]

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Abstract
The Solar Probe mission will be reviewed. The science, payload and current status will be discussed. In particular, results of recent spacecraft studies will be highlighted. Total joint science goals of Solar Probe and the ESA Solar Orbiter mission will be explored.

Solar Orbiter and the Russian Space Agency (RSA) InterHelioProbe

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Abstract
The results of designing the Interhelioprobe (Interhelios) mission within the Solar Program of the Russian Aviation and Space Agency are presented. The mission's research program, scientific payload, and ballistic scheme are described, and the spacecraft design and launching facilities are analyzed. Approaches are drawn up to allow cooperation between the Solar Orbiter and Interhelioprobe in the frames of the RASA and ESA solar programs.

Solar Orbiter, Solar-B and the ISAS solar physics programme

T. Kosugi

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Abstract

Physical Research Laboratory/ISRO Collaboration with the Solar Orbiter Mission

Rajmal Jain, Hemant Dave and M. R. Deshpande

Physical Research Laboratory, (Dept. of Space, Govt. of India), Navrangpura, Ahmedabad - 380 009 India

Abstract

Physical Research Laboratory (PRL), an institute of Indian Space Research Organisation/Dept. of Space, Govt. of India, is a premier institute to pioneer space research programs in India. PRL has vast experience in designing and developing rocket, balloon and satellite-borne experiments. PRL has state-of-the-art observatories for conducting research in the fields of solar physics, astrophysics and aeronomy.

At present, we are developing a payload - "Solar X-ray Spectrometer (SoXS)" to be flown on GSAT-2 Indian mission to study the high spectral and temporal X-ray spectra from solar flares. This mission is expected to fly in early 2002. We will present our experience in participating in coordinated observations with various missions including SMM, SOHO and YOHKOH. A brief SoXS payload description will be presented along with a detail approach to extend simultaneous observations with SoXS experiment and ground-based observations in optical waveband.

PRL is in a unique position to contribute positively to Solar Orbiter Mission by participating in design and development of instrumentation for EUV imager, spectrometer payload, and energetic particle detector.

Using Solar Orbiter Data for Space Weather Predictions

E. Hildner

Abstract

Solar Orbiter and ground-based observations - Lessons from SOHO/TRACE

Bart De Pontieu

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Abstract
Due to the flexibility and/or superiority of ground-based observations in spectral coverage, cadence, spatial resolution, targeting, and bandwidth issues, they are often very complementary to space-based observations. Coordinating ground-based efforts with spacecraft data comes with specific operational issues, of which seeing conditions, cross-instrument coordination, and co-alignment or targeting are the most critical for success. Successful coordination has shown promise for a much improved understanding of the connectivity between the photosphere and the corona, because it allows the study of the highly dynamic and finely structured intermediate layers through which the energy transport from the photosphere to the corona takes place. We will demonstrate these issues by taking a close look at recent results obtained with the combination of SOHO, TRACE and the SVST (Swedish Vacuum Tower Telescope in La Palma). We will also discuss how new or future ground-based technologies and instruments will be able to complement Solar Orbiter.

A critical summary of the Solar Orbiter Science

E. Priest

Abstract

A critical review of the in-situ instrumentation for Solar Orbiter

Peter Bochsler

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Abstract
The purpose of this contribution is to update and, if necessary revise, the scientific priorities and allocated resources (Weight, volume, telemetry, power) in the light of discussions and presentations at this workshop as compared to the strawman in-situ package of the Solar Orbiter proposal. Criteria for selection of experiments and the allocation of resources remain the uniqueness of the flight opportunity and the likelihood of relevant scientific discoveries. Whereas it is difficult to predict the technological developments and the actual circumstances of scientific priorities in a decade from now, it seems rather simple to establish some general criteria for the allocation of resources, e.g. regarding diagnostic capabilities.
The author will also present some ideas concerning the responsibility of experimenter teams and funding for data management and data distribution of in-situ packages.

A critical review of the remote-sensing instrumentation

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Abstract

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POSTER ABSTRACTS

The L5 Mission for Space Weather

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Abstract
We studied an interplanetary space mission for research and forecasting experiment of space weather. The spacecraft will be deployed at 5 th Lagangian (L5) Point of the Sun - Earth system for remote sensing of the Sun and the interplanetary space and in situ measurement of the solar wind plasma and high energy solar particle event. L5 point is an appropriate position for side-view observation of geo-effective CMEs and interplanetary plasma cloud. Optical and radio remote sensing will be dedicated for detailed tracking of CME launched toward earth direction. The mission will provide an excellent opportunity for not only space weather but also solar physics and solar terrestrial physics. However, due to its large distance from earth, a communication link will be limited severely. A concept of highly intelligent telemetry based on autonomous onboard data analysis with high performance onboard computer will be suggested.
On March 1999, the House approved a start of conceptual design work including BBM development. In this paper, overview of mission concept and status of study are reported.

How to Get SEP Flux Profiles at 0.4 AU and 1.0 AU

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Abstract
We present a first version of an engineering model which provides proton flux profiles (at 0.5 MeV and 2 MeV) of Solar Energetic Particle (SEP) events. This code is based on the model by Lario et al. (1998), assuming a number of supplementary hypothesis. SEP flux profiles greatly vary depending on the characteristics of the associated CME-driven

shock (strength, velocity), the heliolongitude of the parent solar activity relative to the observer's position and on the solar wind and interplanetary magnetic field conditions for particle transport. According to these main features we have built up a data base for several scenarios containing synthetic particle flux profiles for spacecraft located at 0.4 AU and 1.0 AU. By interpolating among these simulated scenarios we obtain flux profiles for intermediate events. We improve this code and expand it in order to provide particle event fluences. It will be also necessary to validate it for Space Weather applications.
Lario D., Sanahuja, B. and Heras, A. M., 1998, Astrophys. J.,509,415

Plasma waves and turbulence in the inner heliosphere

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[(2)] DESPA, Observatoire de Paris, Section Meudon, France

Abstract
We discuss observations and expectations of electrostatic and electromagnetic waves and turbulence in the inner heliosphere. Helios observations in to 0.3 AU showed primarily ion acoustic-like and electron plasma waves, though without waveform observations. These plasma waves occur in both disturbed conditions (at shocks, discontinuities, IP type III and type II bursts, magnetic holes, etc) and in the ambient solar wind. We use WIND spacecraft observations of these phenomena at 1 AU to discuss briefly the science goals for a waves instrument on Solar Orbiter.

A Radio and Plasma Waves Experiment for Solar Orbiter

S. D. Bale [(1)], **K. Goetz** [(2)], **M. Maksimovic** [(3)], **J.-L. Bougeret** [(3)] **and R. E. Manning** [(3)]

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Abstract
We discuss science requirements and a strawman instrument design for the Radio and Plasma Waves Analyzer and antenna system on the Solar Orbiter spacecraft. This instrument is unique in the payload in that it supplies both in situ and remote measurements. Solar Orbiter will sample a wide range of plasma parameters and the characteristic wave frequencies (e.g. plasma and cyclotron frequency) will vary accordingly. Sensitive measurement of solar radio bursts, Langmuir, ion acoustic, and whistler waves and solitary waves drive the science requirements. Furthermore, this instrument measures the thermal noise spectrum near the electron plasma frequency, which provides an accurate

measurement of electron density and temperature. We discuss the frequency range, time resolution, and dynamic range necessary to carry out science objectives. The appropriate instrument will sample both spectral density and waveforms from electric antennas and magnetic sensors. These receiver subsystems will be integrated with an instrument DPU. We present a preliminary design based on heritage from Wind, Ulysses, ISEE, and STEREO. This instrument can provide burst triggers to other instruments and could share DPU capabilities as well. We give some preliminary estimates of mass, form factor, and data rate.

Magnetic fields in the high latitude heliosphere

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Abstract
Magnetic field observations are now available from the 3D heliosphere covering the past ten years from the Ulysses mission. These observations were first made at high heliolatitudes during 1993 to 1996, around solar minimum. Since 1998, Ulysses has explored the southern heliosphere, during a period of increasing solar activity. We shall provide a brief overview of the key results of the magnetic field observations, under both solar minimum and solar maximum conditions. In particular, we shall examine the relationship of the structure of the magnetic field to the heliospheric current sheet, as it evolved from a near equatorial orientation to a near polar one. From the relative simplicity of the relationship at solar minimum, the fast-evolving coronal conditions near solar maximum made the connection between coronal and heliospheric polarities more complex, although, the data are consistent with a highly inclined, topologically connected single current sheet. However, the observations may still be consistent with a more complex relationship between coronal and heliospheric structures.

The OAPA/DpSFA Contribution to SOLar Orbiter: “solar physics, instrumental expertise, and the XACT Facility”

M. Barbera (1), **A. Collura** (1), **G. Peres** (2), **F. Reale** (2), **S. Orlando** (1), **S. Serio** (2)

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Abstract
The potential contribution to OSL hardware, calibration and testing from the Palermo group (Osservatorio Astronomico di Palermo + Sez. di Astronomia Dip. Scienze Fisiche ed Astronomiche, univ Palermo) will be mostly based on the XACT facility and the related

expertise. The X-ray Astronomy Calibration and Testing (XACT) facility of Osservatorio Astronomico di Palermo "G.S. Vaiana" (OAPA) includes vacuum systems, sources, monochromators, detectors, mechanical manipulators, clean room, etc. that permits us to perform measurements in the spectrum ranging from visible light to soft X-rays (0.001 - 10 keV). The facility is currently used in the development and calibration of filters, detectors, and moderate angular resolution grazing incidence optics for X-ray astrophysics missions, as well as for other programs. A cryogenic system is under completion to study and calibrate low temperature X-ray microcalorimeters. Ongoing projects and future developments are presented in order to illustrate the wide potential of use for the Solar Orbiter coronal instruments development.

Analysis of High Resolution and Full Disk Solar Images

F. Berrilli (1), **B. Caccin** (1), **S. Cantarano** (1), **A.Egidi** (1), **V. Penza** (1), **I. Ermolli** (2) **and F. Zuccarello** (3)

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(3) Dipartimento di Fisica - Università di Catania

Abstract
In the last years, our solar group started to develop image processing procedures to analyze data coming from ground-based telescopes, both for high spatial and spectroscopic resolution observations (THEMIS, DST at NSO/SP) and full-disk observations (RISE/PSPT). The main procedures we developed to produce Advanced Calibrated Data (ACD) are the following:

1. Standard digital image corrections (flat-field, dark current, global motion, oscillation filtering)
2. Image segmentation (identification of granules, granular and super-granular cells, and solar network)
3. Non-linear fitting of spectral cubes derived from Fabry-Perot imagers
4. Image restoration (Wiener filter, Phase Diversity Technique)
5. Feature tracking (neural network, threshold method, CLT)

Thanks to that, we acquired a wealth of solar data processing and display routines. In this framework we are interested in collaboration for the Visible-Light Imager and Magnetograph (VIM) data processing system.
In particular we propose our participation in the realization of the analysis pipeline and graphical interface for the VIM instrument.

Helioseismology from Space - Lessons from the Michelson Doppler Imager Instrument on SOHO

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Abstract
The Michelson Doppler Imager (MDI) instrument on the Solar and Heliospheric Observatory spacecraft has been observing the Sun since December 1995. The dopplergrams and magnetograms obtained from MDI observations have made key contributions to helioseismology and the understanding of the Sun's magnetic cycle. There are three areas that the experience with the MDI instrument will contribute to the success of Solar Orbiter. The first is lessons from the development and testing of the MDI instrument which were critical to the observation quality and the durability over the last five years. Examples include an observing program that maintains an observing cadence to high precision and life testing of key mechanisms. The second is the understanding of critical measurement parameters and their importance in data analysis and scientific interpretation. In this case, details of the performance of the MDI tunable filter system and instrument optical distortion are significant in proper calibration of the measurements. The final topic is the aging of the MDI instrument and how these changes affect the quality of the observations and calibrations. For instance, environmental exposure has caused a 10window transmission, which in turn has caused a shift in prime focus due to changing temperature gradients. Aspects of these topics will be examined in light of similar instruments proposed for Solar Orbiter.
This work was supported by NASA grants NAG5-3077 and NAG5-8878.

Stokes Profiles measurements in each sodium D line using a Single and dual band Magneto-Optical filters on board Solar Orbiter

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(3) Istituto Ricerche Solari Locarno, CH-6605 Locarno Monti, Switzerland

Abstract
The main scientific aims are: 1) to obtain precisely calibrated line profile information with detailed center-to-limb variations of the scattering polarization in the Sodium lines, which is made possible by the exact and extensive Doppler scanning by the spacecraft orbital motion in combination with the stable and narrow MOF passband; 2) to obtain a sequence of precisely calibrated magnetograms through the Sodium D line profiles accessed

by the orbital Doppler scanning, thereby covering a wide range from the photosphere to the chromosphere; 3)to obtain simultaneous Stokes and Intensity images at the same line profile position to oibtain full disk, and possibly hogh resolution, Hanle-effect maps for complementary magnetic field diagnostics. The above measurements from the space will be assisted by ground based Doppler and polarimetric measurements with identical instruments.

Solar Flares, Turbulence, and Self-Organized Criticality

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Abstract
The statistics of Solar Flares have been investigated in the last years. Some authors claimed for a description in terms of Self-Organized Criticality, where flares are decribed by avalanches in the usual sand pile model. After a critical review, we point out the striking differences between SOC models and intermittency in turbulence. Finally we show that turbulence describes all statistical observed features of solar flares.

Proper Orthogonal Decomposition Analysis of the Vertical Photospheric Velocity Field

V. Carbone (1), F. Lepreti (1), L. Primavera (1), E. Pietropaolo (2), F. Berrilli (3), G. Consolini (4), G. Alfonsi (5), B. Bavassano (4), R. Bruno (4), A. Vecchio (1) and P. Veltri (1)

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Abstract
We propose the application of the Proper Orthogonal Decomposition analysis to the photospheric vertical velocity field, to recover a proper optimal basis of functions. We show the first results obtained through the data acquired by the THEMIS telescope. We found that four modes, energetically dominant, are nearly sufficient to reconstruct both the convective field and the field of the "5-minutes" solar oscillations.

An Analysis and Interpretation of Stokes Profiles with Artificial Neural Networks

T.A. Carroll and J. Staude

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Abstract
We present a fast analysis and interpretation of spectro-polarimetric data with artificial neural networks (ANNs). Modern spectro-polarimeters provide us with a hugh amount of polarimetric data which emphasizes the need for a fast and stable interpretation. We demonstrate that ANNs are an appropriate tool for a quick first analysis and interpretation of Stokes profiles. The pattern recognition capabilities of the ANN allow such an analysis in terms of identifying distinct features within the Stokes profiles, so for instance the identification of a specific signature of a multi-component atmosphere or an interlaced structure of the underlying atmosphere or the identification of pathological Stokes profiles. The approximation capabilities are used for a fast inversion of Stokes profiles to retrieve estimates of the magnetic field vector, the line-of-sight velocity, the micro- and macroturbulence. The amazing processing speed make them a good candidate for a quasi realtime and on-board analysis of Stokes profiles.

Role of Waves in Solar Wind Dynamics; Measurements on Solar Orbiter

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Abstract
Even beyond the orbit of Mercury, solar wind ions are heated. Given that collisions are rare, this heating can only be achieved via waves and/or turbulence. Due to the scarcity of wave measurements in the inner solar wind, we don't know yet what is the nature of this heating process. Particle and field measurements on Solar Orbiter should enable us to answer this question, and to extend the domain of investigation to regions much closer to the Sun, where the solar wind plasma is turbulent. It is therefore very important to be able to characterize the properties of waves/turbulence in the inner part of the solar wind, and to compare them with the particle distributions functions. Proper characterization of waves/turbulence, however, is a difficult problem, due to the Doppler shift. Given that we have no measurements in the inner region to be covered by SO, we use the Earth magnetosheath as a proxy and discuss recent observations carried out by Cluster. We show that very intense, electromagnetic fluctuations,are often observed in the magnetosheath, and we discuss their possible interpretation and their potential consequences on particle heating. We stress the importance of measuring the 3 magnetic

components of the waves (together electric), in order to be able to identify wave mode in spite of the Doppler shift.

Dynamical phenomena in sunspot chromospheres

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(2) High Altitude Observatory, National Center for Atmospheric Reserach, Boulder Co 80307-3000 (USA)

Abstract
A preliminary analysis of a temporal sequence of full polarimetric spectra taken in a sunspot are presented. The observed wavelength interval includes the photospheric SiI 10827 A and the chromospheric HeI 10830 A lines. The behaviour of the two spectral lines is completely different, the Helium line showing strong velocity fields which vary with a period of 3 minutes. Different nuclei within the spot can be clearly discerned with oscillate with different phases. The implications of this behaviour will be discussed.

Coronal Magnetic Field Configurations and the Likelihood of Coronal Mass Ejections

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Abstract
Considerable recent interest has focused on S-shaped or reverse S-shaped magnetic field configurations in Active Regions and their possible relationship to Coronal Mass Ejections (CMEs) and other eruptive phenomena. We comment on the difficulty of classifying S-shaped or sigmoidal structures and their relationship to CMEs in particular.
We have observed a large sigmoidal structure that formed on 8-May-00 between the dispersed remnants of two previously existing active regions. Studies of this structure and of the evolution of the related active region, AR 8906, during three solar rotations from 9-Mar-00 to 10-May-00 will be reported. The role of helicity in particular and its removal by continuing associated CME activity will be examined.
In contrast, the observation of a flare with classification X1.2 on 30-Sep-00 which showed no evidence of CME or other related eruptive activity will be discussed. The relevance of the pre-flare magnetic field configuration as an inhibitor of eruptive activity will be described.

EUV Windows of the Solar Atmosphere

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Abstract
In the SUMER spectral range from 500 Åto 1600 Åmore than 1200 solar emission lines are observed. The vast majority of these lines have been identified. In this colourful bunch we find the fingerprints of atoms and ions under various conditions: temperatures ranging from 5 10^3 to 10^7 K and densities ranging from 10^7 to 10^14 cm^{-3}.
These lines, which represent a powerful tool for the diagnostic of the emitting source can be classified according to their origin, chromosphere, transition region, quiet corona, or active corona. Some spectral windows allow the simultaneous observation of plasma in very different conditions. These are ideally suited for the observation of evolutionary processes or transient phenomena, a fact that should be taken into account for the design of future EUV spectroscopes.

Numerical Study of a Quasi 3D Top-hat Solar Wind Plasma Analyser

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Abstract
In this work we present preliminary results of numerical studies apt to simulate the response of a quasi 4π quadrispherical analyser for ions and electrons to study kinetic properties of space plasma. We discuss the performances of the instrument and provide considerations about the possibility that such a class of electrostatic analysers might fit the requirements imposed by the Solar Orbiter project.

Polar Magnetography: Limits of Observations from the Ecliptic

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Abstract
The need for polar viewing angles to resolve polar magnetic fields is a major driver for solar orbiter. It is worthwhile to consider the state of the art in Earth or near-Earth observing of small scale field at the pole: time-averaged magnetograms from SOHO/MDI. 30 minute

derotated, reprojected MDI magnetograms compensate for the low signal level at the pole by beating down uncorrelated noise in the individual magnetograms. They show a fair amount of small-scale structure in the polar regions with little or no "canopy effect", and hence provide a good simulation of the view from Solar Orbiter. They are also the best polar magnetic data that are currently available on spatial and temporal scales relevant to supergranulation and mid-scale flux transport.

High Resolution Observations of Quiet Sun Magnetic Elements

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Abstract
We present high-resolution observations of a quiet sun region, made on 23-May-1998 using the Swedish Vacuum Solar Telescope (SVST) and the Transition Region and Coronal Explorer (TRACE). We study the statistics and the effects on upper atmospheric layers of emergence and cancellation of magnetic elements on scales of 0.5" using Fe I 6302 magnetograms, co-temporal G-band, Ca II K-line and H-alpha filtergrams, and TRACE 1550, 1600, 1700, 171 and 195 Angstrom images. From our 3 hour long dataset, obtained under excellent seeing conditions, we calculate maps of the photospheric flowfield, and study its relationship to the dynamics of magnetic elements, the chromosphere (spicules), and the TR/corona. For example, our study reveals several cases in which flux concentrations that have recently emerged in the internetwork, are apparently rapidly (within 10 minutes) dispersed after emergence. Co-aligned G-band images show that the magnetic flux, initially quite concentrated (0.5"), seems to get spread out (to several arcseconds) and/or shredded due to granular action or convective flow, until it falls below the noise levels in our magnetograms and becomes undetectable. These magnetic flux concentrations do not seem to get cancelled by opposite polarity, and typically do not form G-band bright points or Ca II K-line brightenings. A significant fraction of the flux that we see emerge undergoes this process.

A High Energy Solar Particle and Cosmic Ray Telescope for the Solar Orbiter

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Abstract
Major goals of the Solar Orbiter include (i) the investigation of energetic particle acceleration, confinement and release associated with flares, (ii) studying particle acceleration

in connection with CMEs and shocks, (iii) utilising the energetic particles as probes for the coronal and heliospheric magnetic field, and (iv) analysing the propagation of solar particles and modulation of galactic cosmic rays. We propose a design for constructing a state-of-the-art energetic particle telescope which addresses the above issues, to fly on the Solar Orbiter. The instrument consists of a stack of solid state detectors and a CsI(Tl) scintillator, and is surrounded by active shielding. It will have a commandable, self-adaptive geometric factor to accommodate a large dynamic range in the particle flux, and will measure the differential energy spectra of electrons from ~ 0.1 to > 30 MeV, H and He isotopes from 4 to 130 MeV/nucleon. Additionally, the instrument will have some capabilities to measure positrons from ~ 0.2 to ~ 3 MeV, and gamma rays from ~ 0.1 to ~ 5 MeV, which are often produced associated with the acceleration of energetic solar particles.

Properties of minor ions in the solar wind and implications for the background solar wind plasma

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Abstract
Properties of the plasma in the source region of the solar wind are primarily determined using observations of spectral line emission from heavy ions and polarized Thompson scattered white light. The distance range covered by these observations is crucial for the formation of the charge states measured by in situ instruments. The coronal and in situ observations are connected through the ionization balance of the elements which is established in the corona and conserved into interplanetary space. Hence, the ions carry with them the history of their formation which can be used to determine information on the coronal source region not otherwise accessible to observations. For example, the formation of the ions in the corona is extremely sensitive to the details of the electron velocity distribution function and the flow speeds of the ions/elements. This paper discusses the constraints placed by in situ charge state measurements on the electron velocity distribution function and differential ion flow speeds.

Extended UV Corona Imaging from Solar Orbiter: The UV Visible-light Coronagraph

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Abstract
The global structure and kinematics of the extended corona is currently known only from 1-A.U., on-the-ecliptic, visible-light observations. These give the global density distributions of only the coronal electrons.
New information on the global coronal structure can be obtained from the imaging of resonantly scattered UV emission from the corona, as demonstrated by the pioneering observations of SOHO/UVCS. The novel concept is presented here for an Ultraviolet and Visible-light Coronagraph (UVC) for such imaging of the full extended corona in UV and visible light.
The UV line-emissions from neutral hydrogen and singly-ionized helium are among the strongest in corona. Imaging of these UV emissions would reveal the global kinematics and distribution of the most abundant coronal elements. The Solar Orbiter will provide with the unique opportunity of 0.2-A.U., out-of-the-ecliptic platform for a compact 1-m class UV coronagraph. Such an istrument has been included in the Solar Orbiter strawman payload.
The UVC is an externally-occulted reflecting coronagraph optimized for UV narrow-band imaging of HI 121.6 nm line and, for the first time, of the HeII, 30.4 nm. The UVC capabilities include also broad-band imaging of the polarized visible brightness. The optical design and expected performances are described.

Magnetic field diagnostics with the Na D lines

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Abstract
Vectorpolarimetric investigations in the Na D2-D1 lines allow insights in the magnetic field topology in a broad fieldstrength range. We present full vector polarimetric studies of the Na lines in the mixed Hanle-Zeeman regime, where scattering polarization and Zeeman polarization contribute to the measured polarization profiles. While the Zeeman

effect can be used for diagnostics of strong fields, the Hanle effect allows to give constrains on the magnetic field strength in a range of several Gauss. Exotic effects like lower level polarization may in future be used to extend the sensitivity range down to the milligauss regime.

Time-Distance Helioseismology: Travel-Time Sensitivity Kernels

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Abstract
The purpose of time-distance helioseismology is to obtain a three-dimensional view of the solar interior. We present a new and physically motivated general framework for calculations of the sensitivity of travel times to local perturbations. We employ two key elements from the geophysics approach: a clear definition of travel times and the single-scattering Born approximation. In addition we take account of the excitation of solar oscillations by distributed random sources. Our travel-time sensitivity kernels depend explicitly on the measurement procedure.

Recent Results in Time-Distance Helioseismology

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Abstract
Time-distance Helioseismology gives information about travel times for wave packets moving between any two points on the solar surface. This technique, which is an important complement to global mode helioseismology, has been employed to produce many exciting insights into the solar interior. We present the latest observational and theoretical results obtained by the Stanford Group.
The Solar Orbiter will offer a unique opportunity to learn about the 3D structure and dynamics of the near polar regions. We mention a few instrumental requirements for local helioseismology.

Velocity Observations of an active region during a CME onset phase

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Abstract
There has been recent interest in studying coronal mass ejections (CMEs) spectroscopically. In particular, it has been found that significant dimming occurs in million degree plasma (Harrison and Lyons, 2000). We expand the spectroscopic analysis of CMEs by studying an event which was observed by CDS both before, during and after the ejection. The event occurred on the 31st March 1998 at the NW limb. There was associated dimming observed in the EUV Imaging Telescope onboard SOHO, and the CME was well observed by LASCO. We observe velocities corresponding to the dimming regions in both the coronal and transition region emission. This is the first observation of the Doppler velocity of material leaving the Sun during a coronal mass ejection.

Neutral particle sensor: Goals, objectives and complications

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Abstract
Neutral atoms are closely coupled to the emerging solar wind plasma and give rise to the prominent solar Lyman-alpha corona. The ratio of the densities of neutral hydrogen and protons is small, some parts per million, and the neutral atoms are therefore a trace particle population in the solar wind plasma. Direct observation of the neutral atoms, their flight pass (imaging) and their density and velocity distribution will help to refine the understanding of the Lyman-alpha corona. Beyond 3 solar radii, the neutral atoms become more and more decoupled from the plasma. This neutral solar wind then constitutes an in-situ trace particle population of the solar wind plasma within a few solar radii being observable at 0.21 AU (Perihel of the Solar Orbiter). We will discuss the goals and objectives of a neutral particle sensor capable to detect 100-1000 atoms per second in an environment dominated by solar radiation and solar wind plasma.

BOLD : Wide Bandgap EUV and VUV Detectors For Solar Observations

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Abstract
BOLD (Blind to the Optical Light Detectors) is an international initiative dedicated to the development of novel imaging detectors for UV solar observations. It relies on the diamond and nitrides materials that have lately undergone key advances. The investigation is proposed in view of the Solar Orbiter UV instruments, for which the expected properties of the new sensors -visible blindness and radiation hardness- will be highly beneficial. Despite various improvements over the last decades, the present UV detectors exhibit limitations inherent to their actual technology. Yet, the utmost spatial resolution, temporal cadence, sensitivity, and photometric accuracy will be decisive for the forthcoming space solar missions. The advent of imagers made of a large bandgap semiconductor would surmount many weaknesses, thus opening up new prospects and making the instruments cheaper. As for the Solar Orbiter, the aspiration for wide bandgap semiconductor UV detectors is still more sensible for the spacecraft will approach very near to the Sun where the heat and the radiation fluxes are high. This triggered this original R&T programme. We depict motivations and present a plan for future activities.

A Heliospheric Imager for Solar Orbiter

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Abstract
We have developed a prototype instrument for use on a near-Sun, three-axis stabilized, solar-oriented platform such as Solar Orbiter. The imager we envision analyzes remotely-sensed observations of coronal and heliospheric brightness in order to provide context for in-situ plasma measurements. With this sensitive instrument, the analysis of these data will proceed much as it has from our recent use of Thomson-scattering observations from the Helios spacecraft together with a recently developed time-dependent tomographic technique for analyzing these observations.
We show a working model of our heliospheric imager for use on Solar Orbiter, scaled-down from the size required at 1 AU. We also show our most recent time-dependent

tomographic result with Helios photometer data that depicts CMEs as well as corotating structures in the heliosphere and gives correlations of these data with in-situ plasma density measurements at the spacecraft.
This work is supported by NASA grant NAG5-9423.

Simultaneous EUV Imaging and Spectroscopy

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Abstract
Multi-order slitless imaging spectroscopy is a newly proposed technique that allows simultaneous imaging and spectroscopy in a narrow EUV band. The instrument configuration is simple and robust, and there is no scanning slit. Unlike conventional imaging spectrographs, the data are gathered simultaneously in a single exposure. For the first time, the determination of EUV line intensities and doppler shifts over a simultaneous 2D field of view will be possible. A proof-of-concept sounding rocket payload, MOSES, has recently been funded by NASA and is planned for launch in early 2004. This presentation discusses some highlights of the MOSES mission, and illustrates a concept for a future compact, lightweight imaging spectrograph optimized for solar observations at closer than 1 AU.

Measurements of the magnetic field fluctuations in the Solar Orbiter project

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Abstract
Measurements performed by the Helios 1 and 2 satellites are used to point out the characteristic parameters (mainly amplitudes and frequencies) of waves observed in the Solar wind at characteristic distances of the order of 0.2 AU (the orbit of the Solar Orbiter). They are used to establish measurement requirements for the magnetic wave field components. Experimental constraints are discussed. The main characteristics of LPCE magnetic field sensors are presented. They include search coils and wide band magnetic loops.

Energetic charged particle instruments for space research

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Abstract
Energetic charged particle detectors with their signal conditioning and data handling electronics are expertice areas of Aboa Space Research Oy (ASRO). Experience gained, e.g., in the design, procurement, and operation of SOHO/ERNE covers also on-board data analysis software and instrument ground support equipment. Particularly in electronics design, test, and manufacturing ASRO is supported by the Laboratory of Electronics and Information Tech- nology of the University of Turku. Instrument developments carried out are for a large part driven by the scientific requirements of the research objectives of the Space Research Laboratory of the University of Turku. Recently, the conceptual design of a Charged Particle Telescope (CPT) for a detailed investigation of the Earth's radiation belts was carried out as an ESA contract. CPT employs multiple head telescopes with directional sensitivity, and relies on highly integrated state-of-the-art analog electronics, FPGA logic, and an advanced data processing system. The instrument is capable of measuring electrons in the range 0.1 - 18 MeV, protons between 1 MeV and 400 MeV, and heavy ions upto a few tens of MeV/nucleon. The feasibility of adapting the CPT design to fulfil the requirements of the Solar Orbiter are being studied.

Spectrometer for Neutron and Gamma-Ray Detection

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Abstract
Solar neutrons with energies < 5 MeV can't be detected in the near-Earth space due to the both its decay and decreasing of its fluxes with distance from the Sun. So solar neutron observations near the Sun compared with near-Earth ones allow studying ac-

celeration of ions up to significantly smaller energies, what happens considerably more often. Besides that near-Sun low energy neutron observations are important for search for non-flare ion acceleration on the Sun. For project InterHelioSound we have proposed spectrometer of neutrons with energies 0.05-5 MeV. LiI(Eu) crystal $4 * 3$ cm enriched in Li-6 (96 %), surrounded by a plastic scintillator 1-3 cm thick loaded with B-10 is used as a detector. Neutrons will undergo elastic scattering with the hydrogen in the plastic. A delayed coincidence within a window of 0.1 - 10 ms in either scintillator is a signature of a neutron, with the initial fast plastic signal pulse height being a direct measure of the incident neutron's energy. A fast charged particle will produce simultaneous signals in both scintillators and will be vetoed. Gamma's with energies 0.03-10 MeV will be identified too as signals in LiI alone. Neutrons with energies > 5 MeV interacting with nuclei of Li and I will be detected as signals in LiI alone too. Monte-Carlo simulation of the delayed coincidence mode of neutron detection by the instrument is performed. Response function, energy and angle dependencies of the effective area are calculated. Calculated effective area for normal neutron incidence varies from 5.6 sq. cm for 0.1 MeV to 0.3 sq. cm for 5 MeV. Estimated effective area for gamma detection is 3-12 sq. cm. Mass of the instrument is not more, than 1.5 kg. We believe that this proposal will be interesting for Solar Orbiter project too.

Application of an analytical MHD wind model with latitudinal dependences to the solar wind

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Abstract
The non-spherical character of the solar wind will be modelled using an analytical MHD wind model in which the latitudinal dependences were obtained via separation of the variables (Lima, Priest and Tsinganos 2001). Ulysses data will be used to constraint the parameters that control the various latitudinal profiles. The solution is then reconstructed all the way back to the base of the corona. The applicability of this model with open fieldlines will be compared to the applicability of another model which relaxes that assumption (Sauty et al. 1999).

References
Lima, J.J.G., Priest, E.R., Tsinganos, K. 2001, accepted for publication in A&A
Sauty, C., Tsinganos, K., Trussoni, E. 1999, A&A, 348, 327

Near Sun Observations of the Acceleration of Solar Energetic Particles

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Abstract
The Sun is the most powerful particle accelerator in the solar system, able to accelerate ions up to tens of GeV and electrons up to hundreds of MeV. The acceleration to energies $> \sim 10$ MeV by flares and fast CMEs appears to occur within ~ 15 solar radii. Hard X-/gamma-ray continuum and gamma-ray line/energetic neutron are the most direct signatures of energetic electrons and ions, respectively, near the Sun. Some of the energetic particles escape, but scattering and energy changes in prop- gagating to ~ 1 AU blur out our view of the acceleration process. Solar Orbiter located at ~ 0.2 AU, co-rotating with the active regions, could detect for the first time neutrons down to $\sim$ MeV energies, provide far more sensitive X-/gamma-ray measurements, unblurred energetic particle observations, and observations of fast CMEs and their shocks before they have evolved significantly. Also close to the Sun the Parker spi- ral field is nearly radial so the regions which produced the energetic particles are always well observed by the remote sensing instruments. A coordinated set of in situ and remote-sensing instruments, such as proposed for the Particle Acceleration Solar Orbiter (PASO) mission in the NASA Roadmap, could provide a great leap forward in our understan- ding of the fundamental process of particle acceleration in nature.

Temporal evolution of explosive events as observed in Lyman and S VI lines

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Abstract
High cadence observations obtained with the SUMER spectrometer on board SoHO in Ly 6 and S VI lines reveal new insight on the nature of explosive events. A dataset obtained in Ly 6 and S VI lines with 10 s exposure time permits us to analyse the dynamics of a several explosive events. Another temporal series obtained with 30 s exposure time and covering the entire Lyman series plus O I, S VI and N IV lines shows the response of some lines during an explosive event. Some particularities as well as common features

were found following the temporal evolution of both the blue and red wings of the lines during the phenomena. The possible region of formation and the way of propagation of the explosive events in the solar atmosphere is discussed. Using MDI data an association with the photospheric magnetic field evolution is made.

Solar wind electron temperature profile between 1 and 45 Rs : models and observational constraints

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Abstract
The measurement of the solar wind electron temperature (Te) radial profile in the unexplored region between 1 and 45 Rs is of prime importance for kinetic and thermally driven solar wind models. Solar Orbiter's location, combined with it's ability to observe the corona in co-rotation, will furnish strong observational constraints on solar wind models.

We will review briefly the observational constraints on solar wind modeling already given by a comparison between SOHO remote and Ulysses in-situ measurements of the electron temperature.

We will also discuss the interest of implementing plasma thermal noise analysis onboard in order (i) to get accurate measurements of the total electron density and core electron temperature and (ii) to allow direct determination of the spacecraft charging effects which affect the electron analyzers.

Scientific Objectives of the Radiospectrometer aboard Solar Orbiter

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Abstract
A radiospectrometer working in the range 100 kHz - 1 GHz is intended to include in the Radio and Plasma Wave Analyzer (RPW) aboard Solar Orbiter. Since the solar and interplanetary radio emission is assumed to be emitted near the local electron plasma

frequency the radio radiation of 1 GHz and 100 kHz is generated in the low corona near the transition region and at a distance of about 60 solar radii. Thus, the measurements of the solar and interplanetary radio radiation in the range 100 kHz - 1 GHz allows to study plasma processes associated with suprathermal electrons in the solar corona and near-sun interplanetary space. Especially, transient solar events like CMEs, electron beams and shock waves are presented as special examples of such processes.

Heating and acceleration of ions by cyclotron waves in the solar corona

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Abstract
It is observed in the solar wind and the corona that the heavy ions are strongly heated perpendicularly to the magnetic field and also preferentially accelerated parallel to the magnetic field. These observations can be explained by quasilinear theory if one assumes that the ions exchange resonantly energy and momentum with a broad spectrum of ion-cyclotron waves. This process must be calculated self-consistently, whereby the spectrum is allowed to change its slope and wave dissipation is accounted for in compliance with energy conservation between particles and waves. Some numerical results are presented, which are based on solutions of the multi-fluid equations for the ions and the spectral-transfer equations for the waves. The physical consequences for the heating of the coronal holes and the fast solar wind are discussed.

Pitch-angle diffusion of ions in the solar wind

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Abstract
Quasilinear theory predicts that ions in resonance with transverse ion-cyclotron waves undergo pitch-angle scattering, thereby conserving their energy in the wave frame of reference. For the first time evidence for this process to occur in the solar wind was found in the Helios plasma data. Parts of the isodensity contours in velocity space of the measured proton velocity distribution functions can well be represented by concentric circles (or segments of spheres in three dimensions), having their centers at about 60-100 percent of

the local Alfvenspeed, which comes close to the phase speed of the dispersive ion-cyclotron waves. The distribution functions exhibit plateaus in their pitch-angle gradients, where the wave absorption coefficient (damping rate) vanishes. The consequences of these result for the heating of the ions and the spectral transfer of wave energy are discussed in connection with the rate equations for ion heating and acceleration, which result from taking moments of the diffusion equation.

Science Objectives of the First Flight of MOSES

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Abstract
MSU's Multi-Order Solar EUV Spectrograph (*MOSES*) is the first of a new class of instruments that will provide high resolution, fast imaging EUV spectroscopy over a large field of view. In EUV solar imaging high spatial resolution must be accompanied by high temporal resolution since smaller physical features evolve more rapidly. Spectroscopy must have similar capabilities to be relevant to those studies. *MOSES* is the natural technology to develop for such observations.
For the first flight of *MOSES* we chose to observe the He II 303.8 Å and Si XI 303.3 Å line pair. We anticipate to measure the spectral features of individual He II surface elements in a snapshot 2D image, not a raster. This will allow to us to determine whether indeed the He II line spectrum has a Gaussian core for each surface element – which would confirm collisional excitation of the line. We will further ascertain whether the brightest He II elements exhibit upflows, as would be consistent with the velocity redistribution mechanism for He II intensity enhancement proposed by Andretta et al. (2000). Finally we will verify, with great accuracy, the anti-correlation between line width and He II surface brightness.
Together these relations will provide strong qualitative constraints on any proposed mechanism for the anomolous He II enhancement in the solar spectrum.

The Sources of Solar Ultraviolet Variability Between 276 and 288 nm: Mg I, Mg II, Si I, and Continuum

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Abstract
The variation of the solar spectrum between 200 and 400 nm is a major component of the total irradiance variability of the Sun. Recent analyses suggest that variations in the solar ultraviolet flux at these wavelengths accounts for about 30% of the total solar irradiance

variability. Most estimates of solar spectral irradiance variability in the ultraviolet are based on the ratio of the intensity of features such as solar plage and sunspots relative to intensity of the quiet Sun. There ratios are referred to as contrast factors. To a large degree, contrast factors at ultraviolet wavelengths have not been measured. We present measurements of the average intensities of plage, sunspot and quiet sun region in the spectral region between 276 and 288 nm derived from high spatial and spectral resolution spectra obtained during the HRTS-9 rocket flight in 1995. From these average spectra, plage and sunspot contrast factors are determined. To our knowledge, these are the first contrast factors at these wavelengths derived from measured solar intensities. These spectra show a large contrast in the Mg I, Mg II and Si I Fraunhofer lines and a much smaller contrast (1.01 +/- .015 to 1.04 $\pm$ .04) in the line-blanketed continuum. Contrast factors are also determined for 3 intensity levels of the quiet sun. Many small spectral features in the contrast factors can be attributed to weak Fraunhofer lines of Cr II, Fe I, Fe II, and Mg I.

Comparison of Solar Source Regions of LASCO Coronal Streamers and Solar Wind Sampled by ACE and Ulysses near Solar Maximum

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Abstract

The highly inclined and distorted current sheet seen during the current solar maximum leaves a strong imprint on the corona as seen by SOHO LASCO and the solar wind sector structure as seen by Ulysses and ACE. Here we present results of studies to determine the solar source regions of (1) solar wind streams sampled in situ by Ulysses and ACE near solar maximum and (2) coronal streamers seen by the LASCO C3 coronagraph. The solar source region of the Ulysses-sampled wind is determined using a two-step mapping of the data to the Sun: (1) a "ballistic" mapping (constant radial velocity using the velocity measured at Ulysses) is used to map the wind from Ulysses to the solar source surface, and (2) a source surface magnetic field model is used to complete the mapping to the solar surface. For the coronal streamers, multiple view points provided by solar rotation are used to determine the streamer's location at the source surface and, again, the magnetic model is used to map t! he field lines to the solar surface. We will report results for analysis of Carrington Rotations 1953 and 1957 when Ulysses was at about -30 deg latitude. It has been shown previously that coronal streamers lie along the current

sheet. Here we compare the current sheet location as determined by the streamers and the magnetic models to observed heliospheric current sheet crossings.

A Study of the Plasma and Magnetic Field Topology of Magnetic Clouds

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Abstract
We present an extension of a previous model for the study of magnetic clouds which now incorporates the behaviour of the pressure of plasma inside the cloud. The parameters of the fitting are the current density components, the attitude of the cloud and the maximum approach of the satellite to the cloud axis. The model fits simultaneously the three components of the magnetic field and the pressure measured by the satellite, all of them expressed in the GSE coordinate system

Russian payload for InterHelioProbe Mission

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Abstract
The composition and specifications of the scientific payload proposed by Russian designers for the Interhelioprobe mission are presented, as well as the prospective cooperation in designing and manufacturing the necessary equipment. The equipment for remote observations of the Sun comprises an optical complex consisting of an optical telescope and Fourier-magnetograph, a coronograph, and an X-ray imager spectrometer. The complex for in-situ measurements comprises the solar wind ion and electron analyzers, the solar wind dust and plasma analyzers, a magnetic and wave complex, a magnetometer, a charged particle telescope, a neutron detector, a radio spectrometer, and an electron gun. The total weight of the scientific payload is about 50 kg, the telemetry transmission rate is 50 kbit/s, and the consumed energy is 60 W

The Sun Observed as a Star: Contribution of Different Coronal Structures to the EM(T) Distribution and X-ray Spectrum of the Whole Solar Corona

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Abstract
The Sun offers us a unique opportunity to study in great detail a late-type star and to examine the spatial structure of the source regions of its X-ray emission. Solar X-ray data are very useful as a guide and a template to interpret data from stellar coronae, and to explore the so-called "solar–stellar" connection.
In this perspective, we analyze a sample of full-disk solar observations of the Soft X-ray Telescope (SXT) on board Yohkoh spanning the solar cycle 22. We apply a method developed by Peres et al. (2000) to put the solar data into the same format and context of the stellar data. For each observation, we derive the distribution of emission measure vs. temperature, EM(T), of the whole solar corona and separately of its components: more specifically of regions of low brightness, of active regions, and of cores of active regions. From the EM(T) distributions we synthesize the X–ray spectra of the Sun and of the single classes of solar coronal regions as they would be observed by non-solar X-ray instruments, such as CHANDRA/ACIS.
We discuss the contribution of the different regions in determining the whole corona's EM(T) and X-ray spectrum at various phases of the solar cycle.
Peres, G., Orlando, S., Reale, F., Rosner, R., Hudson, H., 2000, ApJ 528, 537

Self-Organized Critical (SOC) : Solar flares modeling based on observations

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Abstract
A new self - organized critical (soc) model of solar flares is proposed. Due to diversity and complex interconnection of process in the solar photosphere one need to find the "main" process driving other processes. The reconnection of the magnetic field in the Sun atmosphere was usually treated as the main process in the soc models. But we guess that it is the annihilation of opposite charged magnetic elements on the sun surface. Theses

elements are intersections of the magnetic tubes with the sun surface. The energy released in the annihilation causes the mechanical motion of the plasma, which in turn ignite annihilations in the adjacent regions giving a chain reaction of annihilations. Computer simulations of a cellular automaton for this process show that the system organizes itself into critical state with power law distributions of energies, areas, duration's and peaks of flares. However the exponents of distribution are somewhat lower than the values observed in nature.
We believe that the increased values are given by the inertia effects. Annihilations cause macroscopic outward flows extruding activity to periphery of the flare and thus extending size of the flare if it was big enough to initiate such flows. The stronger inertia the steeper probability distributions. Preliminary simulations confirms this presumption.

CMOS-based VUV detectors for the Solar Orbiter

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Abstract
The aim of this paper is to present the project to develop vacuum UV detectors based on the flip-chip technology on CMOS imagers. The objective of the project is to propose a new detector for the UVCI experiment, but it can be applied to every EUV experiments on Solar Orbiter. The technological background is based on the well-established expertise on innovative materials (such as diamond and nitrides) as photosensitive substrate for UV photons at wavelengths below 200 nm and the currently available technology of (bump-) bonding material layers on CMOS devices. We propose an innovative detector based on such technologies. This detector has been already developed for IR imagers and particle detectors and the application to VUV photon detection will be discussed. The advantages of such a device are in term of sensitivity, radiation hardness, solar blindness, mechanical and thermal properties, and very low dark currents as well as the on-chip read-out electronics that is typical of CMOS imagers, allowing a compact detector system. In addition, the present availability of all the related technologies for fabricating such devices is another important feature to address the objective of a quick development of 4096 x 4096 frame formats with a 15 ?m pixel size. A technique implementing photon counting capability is described as well.

The Dust Detector for the Solar Orbiter

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Abstract
The composition, size, abundance and dynamical evolution of the Interplanetary dust (IDP) complex is driven by its sources and a range of physical processes. In particular, measuring these parameters in the inner Solar System could significantly improve our understanding of the processes active on IDPs and their origin. Also, an interstellar dust component has been confirmed in the circum-solar environment at least at 1 AU. Solar Orbiter gives a unique opportunity to address these topics, mainly regarding the Solar System environment (with contributions from both local and external dust components) inside the Earth's orbit. In particular it can address:
- identification of new dust sources in the inner Solar System
- determination of the relative contribution of interstellar and interplanetary dust and other dust sources
- characterisation of the interstellar and interplanetary dust flow through the planetary system, including a direct observation of the dust free zone around the Sun
- determination of mass, size, speed and electrical charge distributions from measurements of individual particles

The importance and technical solutions for such an instrument will be discussed, depending also on mission plans and available resources.

Searching the Source Regions of the Fast Solar Wind in Polar Coronal Holes : Some recent SOHO/eclipse results and the potential of Solar Orbiter

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Abstract

Our understanding of the source regions of the fast solar wind in polar coronal holes has been dramatically enhanced since the launch of SOHO. However, still more remains to be done and possible observations by the SO will hopefully provide much more insight.
We present results of a SOHO/eclipse study in an interplume inside a Polar Coronal Hole. They concern the determination of the radial flow velocity of the solar wind in this region at the base of the corona. We discuss the implications of our result in terms of the genuine source regions of the fast solar wind in polar coronal holes. We outline possible polar coronal hole observations to be conducted by foreseeable instrumentation onboard the SO.

Multi-component structure of the solar transition region

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Abstract
Observations with the SUMER spectrograph onboard SOHO allowed to deconvolve the emission from small coronal loops in the network and coronal funnels that form the base of the large scale corona and the solar wind. This was done by fitting the observed line profiles by two Gaussians. As it turned out, one of the Gaussians is much broader than the other one and the relation of line shift and width to line intensity is very different for the two components. The latter result indicates that the two source regions are heated by different mechanisms. The variation of the line width of the emission from the coronal funnels is increasing with line formation (or electron) temperature. This might be interpreted either as a strong non-linear wave passing the transition region or it might indicate that the ions are much hotter that the electrons, even deep in the transition region. The latter interpretation would be along the lines of the UVCS observations above the limb giving several hundred million K for the ions. Further support for high ion temperatures deep in the transition region is provided by recent kinetic models for the transition region and solar wind. This new spectral technique to deconvolve emission from different atmospheric regions holds promise to be valuable for future EUV spectroscopic observations, like onboard the Solar Orbiter.

Telescope-spectrometer for EUV solar imaging spectroscopy in the grazing-incidence region

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Abstract

The optical design of a stigmatic telescope-spectrometer for imaging spectroscopy on SOLO in the spectral region below $\sim$ 35-40 nm is presented. This spectral region is particularly reach in spectral lines for measurements of density, temperature, abundance and flows in the solar atmosphere. Generally speaking, an instrument for imaging spectroscopy consists of a telescope, an entrance slit and a spectrometer. Unfortunately, metallic coatings at normal incidence (such as Pt, Au, Ir) have negligible reflectivity below 35 nm, so a normal-incidence telescope-spectrometer with conventional coatings has an useful effective area only for wavelengths higher than $\sim$ 40 nm. The normal-incidence reflectivity can be enhanced by multilayer coatings. Unfortunately, the severe thermal environment of SOLO makes it impossible to use such coatings on optics looking directly at the solar disk. Then, a telescope looking at the solar disk from 0.2 AU below 35 nm must use optics at grazing incidence with conventional coatings. A grating spectrometer, even in the ideal aberration-free case, has spatial resolution capability only in the plane perpendicular to the spectral dispersion one.
In the case of an astigmatic configuration, only spectral aberrations are corrected, so a point-like source placed on the entrance slit plane is imaged on the focal plane on a narrow and slightly curve line parallel to the slit itself. Such a configuration is not able of providing imaging spectroscopy: images of the Sun can be built scanning over the whole region to be observed point by point. Instead, in a stigmatic spectrometer the aberrations are fully corrected, so a point-like source placed on the entrance slit plane and on the optical axis is imaged as a point on the focal plane. Monochromatic images of extended regions are then obtained by moving the spectrometer only in the direction perpendicular to the slit: this simplifies the mechanical complexity and minimizes the acquisition time.
Unfortunately, the image aberrations for points far from the optical axis increase quickly, causing a degrading of both spectral and spatial resolutions. The off-axis aberrations become severe particularly in grazing-incidence configurations, so it is an impressive task to design a grazing-incidence stigmatic spectrometer with an useful field-of-view for extended regions. In the stigmatic designs proposed up to now, the image of an on-axis emitting point is stigmatic, but it broadens for off-axis points, so spectral and spatial resolutions are not preserved in an extended field-of-view. We propose an innovative configuration for a stigmatic grazing-incidence telescope-spectrometer for space applications to imaging spectroscopy on SOLO. The telescope is divided into two sections: telescope I consists of a single grazing-incidence mirror focusing the radiation on the entrance slit of the spectrometer only in the spectral dispersion plane; telescope II consists of two grazing-incidence mirrors in Wolter configuration focusing the radiation on the spectrometer focal plane only in the direction perpendicular to the spectral dispersion plane. The spectrometer consists of a grazing-incidence variable-line-spaced cylindrical grating with flat-field properties. The spectrum is acquired by a detector mounted at near normal incidence with respect to the direction of the exit beam. The telescope II is crossed with respect to the grating and to the telescope I, i.e. its mirrors are mounted with their tangential planes coincident with the grating equatorial plane. The image of an extended source

has negligible spectral broadening even far from the optical axis and a spatial broadening depending only on the performance of telescope II: a relatively large field-of-view is obtained in the direction parallel to the slit with constant spectral resolution and slightly degrading spatial resolution.
Such unique configuration gives imaging spectroscopy of extended sources even in the grazing incidence region. As an example of an instrument working in a region of particular scientific interest, the performance of a telescope-spectrometer optimized in the 17-23 nm range are presented.

Observations of Oscillations Above Sunspots

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Abstract
Oscillations of intensity and velocity in bright EUV plumes above sunspots have been observed with the SUMER spectrograph onboard SoHO during two campaigns. All oscillations point at rapidly changing conditions in the emitting volumes. Generally, we find oscillations in the 5 min range dominating in the chromosphere, while the transition region lines show oscillations at shorter periods (2 to 3 min). At two occasions we find a drift in the period of Doppler velocity from 5 min to 2.5 min within 30 minutes. This can be explained by a strongly non-stationary behaviour of the transition region, probably related to downstream of material into the plume region.

Energetic Particles inside Interplanetary Magnetic Clouds

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Abstract
In this work, we have tried to stress the relevance of directional information when studying energetic particles "trapped" inside Magnetic Clouds. During solar activity cycle 21st maximum, the instrumentation aboard ISEE-3 spacecraft observed many energetic particles events, several of them associated with Magnetic Clouds (MCs). In this paper, we focus our study on the December 19th 1980 event, which was related with an MC that showed one of the most intense magnetic field strength ever observed. We have studied the energetic particle (36 keV - 1,6 MeV) spectra and directional distribution evolutions just before, inside and after the MC passage, with the aim of finding the origin and evolution of the energetic particles detected inside the MC.

Antenna System Considerations for Solar Orbiter

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Abstract
The perihelion distance of the Solar Orbiter trajectory lies between 0.2 and 0.3 AU and at those distances the solar disc appears under angles of 2.7° and 1.8°, respectively, suitable conditions for the study of solar radio emissions. In principle two kinds of objectives must be distinguished as they pose different requirements to receivers and antennas: Studies of the spectral distribution concentrate on the relative intensity of radiation and how they vary with frequency. In order to get more information of received radio waves, the method of direction finding is applied, which yields the direction of incidence and the polarization of radio waves. This method also opens the door to the determination of radio source locations.
Studies performed at the Cassini RPWS experiment, in particular rheometry experiments, numerical computer simulations based on wire-grid modelling, and antenna system calibration by known radio sources have shown that a reasonable error of direction finding is about 2○. All these studies are only suitable for the low frequency range (below 30 MHz), where the wavelength exceeds the dimension of the spacecraft. For such a radio source direction finding three non-coplanar antennas are necessary. On the other hand to study the spectral characteristics a simple antenna boom is sufficient to provide relative intensity measurements. In this case the optimum length of a monopole antenna is given by a quarter of the wavelength. Nevertheless, also for spectral analysis there are spacecraft attitudes, for which the quality of received signals is poor. So care must be taken to prevent such positions where the effective antenna axis is directed straight towards or away from the radio source. Technical and geometrical constraints will be discussed in the context of optimized scientific profit.

The European Solar Magnetometry Network

R.J. Rutten

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Abstract
The ESMN is an EC-TMR funded collaboration between eight European solar physics groups to study solar magnetism, combining Canary-Island groundbased observing with spacebased observing, development of numerical interpretation techniques, and theoretical

simulations. I will review the ESMN approach, efforts and accomplishments with emphasis on future endeavours

SO support from DOT

R.J. Rutten and R.H. Hammerschlag

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Abstract
The Dutch Open Telescope on La Palma combines a superior-quality site with excellent image quality and stability and with large-volume speckle restoration to provide long-duration image sequences in multiple wavelengths simultaneously at 0.2 arcsec resolution that cover a much larger field than can be restored with adaptive optics. This capability is of obvious value for high-resolution context mapping to Stokes polarimetry and other SO science applications

Spectral Synthesis of the G-band in Small Magnetic Concentrations

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Abstract
Narrow band imaging in the CH G-band is routinely used to trace small magnetic field concentrations on the Sun. This band-pass may be one of the obvious candidates to furnish the imaging package of the Solar Orbiter. Despite a widespread use, the mechanism that makes magnetic concentrations bright in the G-band has remained unclear. In order explore the simplest possibility, we carry out LTE syntheses of the G-band in an assorted set of semi-empirical model magnetic concentrations. The syntheses include all CH lines as well as the main atomic lines within the band-pass. The model atmospheres produce bright G-band spectra having many properties in common with the observed G-band bright points. In particular, the contrast referred to the quiet Sun is about twice the contrast in continuum wavelengths. The agreement with observations does not depend on the specificities of the model atmosphere, rather it holds from single fluxtubes to MISMAs. However, the agreement requires that the real G-band bright points are not spatially resolved, even in the best observations. Since the predicted G-band intensities exceed by far the observed values, we foresee a notable increase of contrast of the G-band images upon improvement of the angular resolution. According to the LTE modeling, the

G-band spectrum emerges from the deep photosphere that produces the continuum. Our syntheses also predict solar magnetic concentrations showing up in continuum images but not in the G-band . Finally, we have examined the importance of the CH photo-dissociation in setting the amount of G-band absorption. It turns out to play a minor role since the abundance of CH is controlled by collisions with atomic and molecular H.

A Close Look to Sunspots

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Abstract
Plasma motions in strong magnetic fields with wide range of inclinations can be studied in sunspots. Although several large solar telescopes equipped with adaptive optics will be in operation when the Solar Orbiter will fly, the absence of disturbing terrestrial atmosphere and the possibility of uninterrupted long-period observations are clear advantages of the close-up remote sensing from space. Visible-light imaging and 2D spectroscopy with resolution of 80 km on the solar surface can answer many questions about fine structures in sunspots, giving better constraints to physical models of the umbra and the penumbra:

• Real size, brightness, magnetic field, line-of-sight velocities, horizontal motions, and lifetimes of umbral dots.
• Structure, magnetic field, and velocities of umbral diffuse background
• Magnetic field and velocities in penumbral filaments.
• Photometry, magnetic field, velocities, horizontal motions, mutual interactions, and lifetimes of penumbral grains
• Interactions and relations of fine structures at the boundaries umbra - penumbra, umbra - photosphere, and penumbra - photosphere.

Hydrodynamics of Coronal Loops Subjected to Transient Heating

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Abstract

We investigate the hydrodynamic behaviour of coronal loops undergoing transient heating. We adopt a 1-D loop model with space- and time-dependent heating, concentrated near the chromospheric footpoints. The timescale of heating variations is comparable with the radiative cooling time of the coronal plasma ($\sim 10^3$ s). We use a new numerical code that has a fully adaptive grid (MacNeice et al. 2000), in order to properly resolve the chromospheric-coronal transition region sections of the loop. We simulate the hydrodynamics of loops with different effective gravity (i.e., different loop geometry) and heating terms. We describe the temporal behaviour of the various physical quantities along the loop (plasma density, temperature, flow velocity), showing that the increase in heating produces a chromospheric evaporation with characteristic velocities of ~ 10 km s^{-1}, followed by long-lasting downflows with velocities of $\sim 1-2$ km s^{-1} during the quiescent phases in between the episodic heatings.

MacNeice P.J., Olson K., Mobarry C., de Fainchtein R., Packer C., 2000, Comput. Phys. Commun., 126, 329

A Solid-State Detector as the EPD aboard the SOLar Orbiter

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Abstract
The scientific program of the RIM Collaboration aims to study cosmic rays in a broad energy spectrum using a series of space missions. This Collaboration is composed by the Italian National Institute of Nuclear Physics (INFN) and the Moscow State Engineering and Physics Institute (MEPhI), and was established in 1994. INFN team consists of several Italian Institutions (WiZard group) who have carried out, together with international partners, balloon-borne experiments since 1989. The first steps of the RIM program have been already moved with the two missions NINA and NINA-2, whose goal was to detect cosmic rays of galactic and solar origin at 1 AU, between 10 and 200 MeV/n. The experiments have been carried out respectively aboard the satellite Resurs-01-N4, launched in July 1998, and MITA, launched in July 2000 and still taking data. Previous to these missions the Sil-Eye experiments, performed on board the MIR Space Station, had started already the exploration of space. The RIM missions will then continue with the deployment of the PAMELA instrument, which will be put in orbit at the end of the year 2002. The SOLO Mission proposed to ESA can give the RIM Collaboration the possibility to

continue the studies about Solar Energetic Particles started with the NINA and NINA-2 experiments, but in an orbit much closer to the Sun (0.21 AU) anf for a longer period of observation.

Solar Wind Ion Anisotropy in Stream Trailing Edges: ACE Measurements

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Abstract
Remote observations of the solar corona with SOHO have indicated that heavy ion species may have very large $T_{perp}/T_{||}$ anisotropy. Understanding that anisotropy and understanding the ion temperature evolution as the solar wind propagates away from the sun are two fundamental aspects of solar wind research. As solar wind propagates, the ion anisotropy evolves through a tension between the cooling effects of adiabatic expansion and other processes acting to increase the ion thermal energy. These other processes are not well understood (cascading turbulence or kinetic instability may be contributors). The adiabatic contribution will vary with the effective expansion. Flows within the trailing edges of coronal-hole related high speed streams may have larger expansion factors than those in the center of a stream. We have recently begun a study to look for variations in the ion temperature anisotropy across the trailing edges of high speed streams using ACE SWEPAM measurements. We will show preliminary results which include examples where $T_{perp}/T_{||}$ decreases across the trailing edge for both protons and alpha particles. Near-sun measurements from Solar Orbiter will provide opportunity to identity the remnant of coronal source anisotropy with measurements less affected by propagation evolution.

Ultraviolet Spectroscopic Diagnostics of the Extended Solar Corona

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Abstract
We summarize how UV spectroscopy can be used to determine the nature of the physical processes that occur in the extended solar corona. Spectroscopic measurements can characterize the coronal source regions of the high- and low-speed solar wind as well as coronal mass ejections (CMEs). Such detailed descriptions are necessary for identifying the physical processes responsible for driving solar wind and CME plasmas into the heliosphere. For example, UVCS/SOHO has already revealed the importance of ion cyclotron

resonant absorption, magnetic reconnection, and shock formation in various coronal structures like coronal holes, streamers, and CMEs. In general, the detailed analysis of the intensities and profiles of coronal lines can be used to determine velocity distributions, temperatures, and densities of coronal ions and electrons. Intensity ratios can be used to determine elemental abundances and ion outflow velocities of coronal plasmas under a variety of conditions. These measurements, taken together with measurements of Doppler shifts and proper motions, can provide the 3-D bulk velocities of solar wind and CME plasmas and determine twisting or untwisting rates of helical magnetic fields. Such powerful diagnostics can enhance the in situ and remote sensing measurements planned for the Solar Orbiter.

Experience of Wroclaw Team in Construction of Solar Bragg Spectrometers

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Abstract
For 30 years now, experimental investigations of solar short-wavelength radiation have been undertaken by a group of several people working at Solar Physics Division of Polish Academy of Sciences Space Research Centre. On four sounding rockets and the Coronas-F satellite, Bragg scanning flat crystal spectrometers have been flown. At present, the two, new design, flat and bent crystal spectrometers (Diogeness and RESIK) are awaiting for launch aboard the Coronas-F Mission led by IZMIRAN Russia. The bent Crystal spectrometer has been constructed by a consortium including MSSL and RAL from UK, NRL form USA and our lab (acting as PI). In the paper we will describe the know-how, we gained during construction of the spectrometers, stressing the aspects which may be of interest for the Solar-Orbiter Mission.

The Evolution of Interplanetary Shocks Driven by Magnetic Clouds

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Abstract
As fast moving magnetic clouds travel through the variable inner heliospheric medium, the driven shocks have to adjust their characteristics and shape to reflect the local ambient solar wind conditions. Current, near-Earth, multi-point observations give as a limited insight into the final shape and characteristics of these driven shocks just before they

impinge on the Earth's magnetosphere. Results derived from ACE, WIND, IMP 8 and Geotail solar wind observations will be presented to illustrate the complexity of the shock surface structures. Furthermore, it will be exemplified how Solar Orbiter observations in conjunction with the LWS pre-formulation Inner Heliospheric Sentinels could significantly improve our understanding of the evolution of these driven shocks, and hence, that of magnetic clouds in the inner solar system.

Temperature and Density Structure of Hot and Cool Loops Derived from the Analysis of TRACE Data

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Abstract
In this work we analyse the filamentation of two relatively isolated loops on the disk, observed on August 1998 by TRACE in the passbands 171Å and 195Å, as well as the density stratification and thermal structuring of the plasma along the filaments.
The narrow band spectral response of the instrument requires special attention in the analysis and interpretation of the observations: we derive temperature and density values simultaneously through filter ratio diagnostic (195Å/171Å) and by modeling intensity profiles along the filaments with hydrostatic models; in both methods we take into account the removal of background flux. For the coronal structures selected, we find consistent values of temperature and density with both methods.
The data analysis shows evidence of loops with different characteristics: very warm loops ($T \sim 5 \cdot 10^6$ K) and rather cold ones ($T \sim 10^5$ K) whereas standard analysis would yield $T \sim 10^6$ K in both cases. Also the hot loop appears to have a thermal structure with a maximum at the apex compatible with temperature and density stratification dictated by detailed energy balance of a non-isothermal hydrostatic model (Serio et al.,1981). The cold filaments appear more isothermal and probably in dynamical conditions.
Serio,S.,Peres,G.,Vaiana,G.S.,Golub,L.,Rosner,R., 1981, ApJ 243, 288

EUNIS: An Extreme-Ultraviolet Normal-Incidence Spectrometer

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Abstract

GSFC is in the process of assembling an Extreme-Ultraviolet Normal-Incidence Spectrometer called EUNIS, to be flown as a sounding rocket payload. This instrument builds on the many technical innovations pioneered by our highly successful SERTS experiment over its past ten flights. The new design will have somewhat improved spatial and spectral resolutions, as well as 100 times greater sensitivity, permitting EUV spectroscopy with a temporal resolution near 1 $\sim$second for the first time ever. To achieve such high time cadence, a novel Active-Pixel-Sensor detector is being developed as a key component of our design. The high sensitivity of EUNIS will allow entirely new studies of transient coronal phenomena, such as the rapid loop dynamics seen by TRACE, and searches for non-thermal motions indicative of magnetic reconnection or wave heating. The increased sensitivity will also permit useful EUV spectra at heights of 2–3 $R_\odot$ above the limb, where the transition between the static corona and the solar wind might occur. In addition, the new design features two independent optical systems, more than doubling the spectral bandwidth covered on each flight. Its 300–370Å bandpass includes He II 304Å and strong lines from Fe XI–XVI, extending the current SERTS range of 300–355Å to further improve our ongoing series of calibration under-flights for SOHO/CDS and EIT. The second bandpass of 170–230Å has a sequence of very strong Fe IX–XIV lines, and will allow under-flight support for two more channels on SOHO/EIT, two channels on TRACE, one on Solar-B/EIS, and all four channels on the STEREO/EUVI instrument. First flight of the new EUNIS payload is scheduled for 2002 October.

Slow magnetoacoustic waves in coronal loops

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Abstract
Simultaneous, high-cadence observations with the EIT/SOHO and TRACE instruments reveal slow magnetoacoustic waves propagating in hot coronal loops. We present the wave signatures and the derived information about the coronal structures they travel in.

Geometry and Kinematic Scaling of Heliospheric Structures

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Abstract
The dynamical geometry of the heliospheric structures is very complicated and poorly known. Existing morphological classifications are often not based on definite quantitative

criteria. Corresponding descriptions of structures are sometimes confusing and even contradictory as in the case of coronal transients and mass ejections. The kinematic force free approximation can be used for their analysis because of the supermagnetosonic solar wind flow. In this approximation, heliospheric patterns are projected from the rotating Sun along the radial solar wind stream lines. The quantitative theoretical classification scheme is presented of the different heliospheric structures which is complementary to the traditional morphology and based on the evaluation of standard dimensionless parameters like the Strouhal numbers and others taking into account the rotation of the Sun, the inhomogeneous solar wind expansion, durations, latitudinal and longitudinal spans of the parent coronal inhomogeneities. The extended sets of dimensionless parameters are used for the evaluation of the dynamical MHD and kinetic effects. Several new independent parameters are introduced for this purpose in addition to the known in the literature. The Solar Orbiter measurements could bring the needed information about the geometry of corotating and transient structures in the inner heliosphere and reveal their new evolutionary characteristics. The suggested dimensionless approach gives an objective framework for the interpretation and classification of the dynamical and multi-scale structures in the heliosphere.

Ion Acceleration in solar Flares: low energy neutron measurements

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Abstract
The spectrum of neutrons produced by interaction of energetic ions with the solar atmosphere is large (from MeV to GeV). Due to their mean life time, only neutrons above 100 MeV can be and have been directly detected at the earth's orbit. Neutrons between 10 and 100 MeV have been detected for a few events through their proton decay. So far, less than ten neutron events have been reported compared to many more X-ray/gamma-ray events. Near-Sun measurements of neutrons on Solar Orbitor would allow to probe the MeV neutrons which are produced by the nuclear reactions of energetic protons with energy thresholds of a few MeV. High energy neutrons such as the ones detectable at the earth's level result from the nuclear fragmentation of ambient protons and helium with threshold energies of the incident particles of a few 100 MeV/nuc. Neutrons with energies of a few MeV are thus expected to be observed more frequently than higher energy neutrons. We shall summarize here our present knowledge about solar flare neutron measurements and discuss the new constraints on the spectrum of accelerated ions that could be brought from MeV neutron measurements.When combined with near-Sun in-situ ion measurements, neutron observations will bring information on the link between escaping

and interacting ions getting rid of part of transport effects.

On the role of ion-cyclotron kinetic Alfvén waves in the solar wind: results from Helios and expectations for Solar Orbiter

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Abstract
Double-peaked velocity distribution of protons and alpha particle beams have been often observed in the fast solar wind by Helios in close correlation with the temperature anisotropy of the main proton component. We propose a mechanism for the energy exchange between the parallel energy of the ion beam distributions and the perpendicular energy of the core protons by means of ion-cyclotron kinetic Alfvén waves (IC KAWs) which are very sensitive to both the parallel Landau resonance and the perpendicular ion-cyclotron resonance. Initial IC KAWs are excited at Landau resonance by the ion beam. They propagate anti-sunward and nonlinearly excite the secondary, sunward-propagating IC KAWs. We suggest that quasilinear diffusion of core protons due to cyclotron interaction with both the sunward and the anti-sunward IC KAWs can be an important mechanism for the shaping of velocity distribution and for the perpendicular heating of protons. The short-scale IC KAWs should be seen in the satellite reference frame at frequencies (dominated by Doppler shifts) in the range 10-100 local proton-cyclotron frequency.

GREGOR: high resolution solar observations from 1 AU

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Abstract
GREGOR will be a 1.5m telescope which replaces the 45cm Gregory Coude Telescope at the Teide Observatory on Izana, Tenerife. It will provide observations with high po-

larimetric precision at visible and infra-red wavelengths from Earth with a resolution that is comparable to that of the proposed SO Visible Imager / Magnetograph (VIM) at perihelion. We describe recent advances in the definition of GREGOR.

A Solar Orbiter magnetograph conceptual design

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Abstract
The Visible-Light Imaging Magnetograph (VIM) on-board the Solar Orbiter will provide magnetic field and velocity maps with resolutions better than the reference length scale of 100 km. These observations of the photospheric magnetism, from the equator to the poles, can provide direct access to the physics of magnetic elements and important clues about the solar dynamo. The scientific case for VIM is presented and an instrumental definition proposed. A 25 cm aperture telescope will collect the light for high resolution studies. A smaller telescope for full disk images will be available. They both use a polarization modulator that produces vector magnetograms in a selected photospheric/chromospheric spectral line. Wavelength selection can be obtained by means of a system of fixed Fabry-Perot etalons, which allow to use any line in the visible range. These devices provide an easy compensation for the spacecraft velocities and tuning at two wavelengths on either side of a spectral line. Different observing modes focused on different scientific programs (magnetic field evolution, local helioseismology...) can be accommodated in such an instrument.

Diagnosing Dynamic Coronal Heating : Lessons from Yohkoh, SOHO and TRACE

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Abstract
Recently it has been pointed out that any variation in the thermal structure along a coronal loop could be used as a possible coronal heating diagnostic (Priest et al, 1998,; Ashwanden et al, 2000). The investigations suggest that the the location of the dominant energy release within the loop can be implied by comparing the observed temperature profile with a hydrostatic or hydrosteady loop model for different spatially varying heating functions. However, an important aspect is that the corona is very dynamic. TRACE

EUV movies in particular reveal coronal structures evolving and brightening on timescales down to the instrument resolution (approximately ten seconds).
This study considers a spatially and temporally dependent heat input to a hydrodynamic loop model and deduces what current instrumentation would observe if a "perfect temperature" could be calculated. The imposed energy release is dynamic joule dissipation generated from three dimensional numerical experiments of magnetic flux braiding. The produced energy profile is reduced to a one dimensional average along the coronal loop. This spatio-temporal heating is then introduced as the time-dependent heat input into a hydrodynamic simulation along coronal magnetic fieldlines. The resultant evolution of the plasma will be described in detail. Implications of this dynamic energy source upon the observation of coronal loops by SOHO and TRACE will be presented along with a "wish list" for EUV spectroscopic amd imaging abilities that might be available on the Solar Orbiter.

Magnetic turbulence in the heliosphere and magnetic connection from the Sun to the Earth

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Abstract
Magnetic fluctuations in the heliosphere are the result of photospheric motions, magnetic activity in the solar corona, and solar wind evolution and convection. Nonlinear interactions lead to the formation of a power law spectrum which extends over several decades. Understanding the formation and evolution of magnetic turbulence, including features like the spectral index, the fluctuation level, the degree of anisotropy, as a function of heliographic distance, latitude, and stream structure, is a basic issue for magnetohydrodynamic turbulence studies. The Solar Orbiter can give a fundamental contribution to this field. In this paper we discuss the evolution of magnetic turbulence in the heliosphere, and show how knowledge of the above mentioned parameters allows to trace the magnetic field lines from the Sun to the Earth, a problem of interest to Space Weather predictions of solar energetic particle events.

Coordinated space and ground-based observations of rapidly evolving active regions

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Abstract
Physical processes taking place during the energy storage phase prior to flares are not yet completely understood despite the great improvements in flare mechanisms comprehension recently achieved. In this context, coordinated space and ground-based observations, have demonstrated to be an important tool to better understand rapidly evolving phenomena. Therefore, the systematic observational program carried out at the Catania Astrophysical Observatory and its possible upgrade with the installation of a Magneto-Optical Filter could provide a valid contribution to this research field, also in the perspective of the future ESA Mission, Solar Orbiter. In fact, SOLO, with a new view of the Sun directly from a solar orbiting platform and with high resolution imaging and spectroscopy, together with full-disk ground-based network observations, could give significant contributions to the study of the driving mechanisms of solar transients, besides than providing information on other important physical processes occurring in loops. Moreover, the use of the MOF onboard Solar Orbiter, which orbits out of the ecliptic, together with the same instrument installed on the solar spar at the OAC, will give us the opportunity to combine ground-based magnetograms with measurements of the Stokes parameters taken from space along the Na line profile.