SUN AND HELIOSPHERE

CHALLENGES FOR SOLAR-TERRESTRIAL PHYSICS, MAGNETO- AND HYDRODYNAMICS

Chairperson and Editor: **M.C.E. HUBER**

https://doi.org/10.1017/S1539299600011230 Published online by Cambridge University Press

JOINT DISCUSSION 6: SUN AND HELIOSPHERE - CHALLENGES FOR SOLAR-TERRESTRIAL PHYSICS, MAGNETO- AND HYDRODYNAMICS

MARTIN C.E. HUBER, ARNE PEDERSEN
ESA, Space Science Department, ESTEC, Postbus 299, NL-2200 AG Noordwijk, The Netherlands

AND

CLAUS FRÖHLICH
Physikalisch-Meteorologisches Observatorium Davos, World Radiation Centre, Dorfstrasse 33, CH-7260 Davos-Dorf, Switzerland

1. Introduction

There is one astrophysical system, where the sites of a star's mass loss can be localised and observed in detail, and where the behaviour of the resulting stellar wind in the star's environment and around orbiting obstacles can be investigated in situ: it is the Sun, the heliosphere and the surroundings of planets — among the latter most prominently the terrestrial magnetosphere. Indeed, within a year or so a fleet of satellites equipped with sophisticated remote-sensing and in-situ instruments will make this astronomical paradigm, or more precisely, the solar-terrestrial system accessible to intensive, multi-disciplinary study.

Four identical CLUSTER spacecraft, orbiting the Earth within the magnetosphere, the surrounding space and the particularly interesting plasma boundary layers will perform a three-dimensional in-situ study of plasma-heating, particl e-acceleration and other small-scale plasma processes (Schmidt and Goldstein,1988). A number of other missions — some of them already in orbit, like GEOTAIL and WIND, some to be launched within one or two years, like INTERBALL and POLAR — will provide information about the Earth's magnetosphere and the solar wind on larger spatial scales. These missions are described in a Brochure issued jointly by the European Space Agency, NASA, the Japanese Institute of Space and As-

I. Appenzeller (ed.), Highlights of Astronomy, Vol. 10, 291–293.

tronautical Science and the Russian Space Agency, which can be obtained from A. Pedersen at the above address.

The Solar and Heliospheric Observatory (SOHO) will be placed in a halo orbit around the first Lagrange point, L1, along the Earth-Sun line, where it will be exposed to the solar wind and where it will be able to perform uninterrupted observations of the solar hemisphere turned toward the Earth (Domingo and Poland, 1988). SOHO will investigate similar plasma processes as CLUSTER, albeit in another plasma domain (namely the solar chromosphere, transition region and corona) and with remote spectroscopic diagnostics (rather than in-situ measurements). In addition, SOHO will measure — by mass spectrometry — the composition of the solar wind and solar energetic particles and, perhaps most fundamentally (although only partially pertaining to our topic), the structure and dynamics of the interior of the Sun by the method of helio- seismology. High-resolution soft X-ray images of the solar corona have now been obtained by the YOHKOH satellite for over three years and have thus enabled extensive investigations of the magnetodynamic processes taking place in the corona (Culhane, 1994). YOHKOH and the Russian CORONAS missions will hopefully be operational in parallel with SOHO.

An out-of-ecliptic spacecraft - ULYSSES - is probing the space over the poles of the Sun. Ulysses' in-situ measurements have led to deeper insights into the physical properties and the composition (fractionation!) of fast and slow solar-wind streams (Marsden, 1994). A number of additional spacecraft in the heliosphere, e.g. the Voyagers and Galileo, will provide further opportunities for studying the Sun and the heliosphere.

Joint Discussion 6 was convened in order to take stock of the situation in the many disciplines relevant for the comprehensive investigations mentioned above, to familiarise researchers coming from different fields (and using fundamentally different techniques, like remote sensing and in-situ measurements) and to present an outlook onto the problems that can, and will be tackled.

The Discussion was organised in three main topics and abstracts of invited presentations are given on the following pages. The topics and corresponding authors are:

I. Global Effects of the Solar Magnetic Field (Foukal, Hood, Uchida)
II. Plasma Heating and Acceleration of Particles, including atomic data required (Haerendel, Mason, Venkatakrishnan, Vlahos, von Steiger) and
III. Heliosphere and Earth as Cosmic Sensor (Beer).

Contributed papers, predominantly in poster form, were also presented (cf. van Woerden, 1994). Several posters dealt with advances in solar observations from space (Yohkoh) and from ground observations; they were

nicely complemented by a number of theory and modelling presentations. The generation of the solar wind - still not fully understood - was also covered. A few posters addressed possible connections between solar activity and the Earth's climate.

This Joint Discussion was rounded off by a general discussion, led by P. Foukal, on the question: 'Is the cosmogenic isotope variation connected to solar irradiance variations, and if so how?' This highlighted gaps in our understanding of the connection between the magnetic field in the photosphere determining the solar irradiance variability and the magnetic field in the heliosphere and close to Earth determining the production of cosmogenic isotopes. In spite of considerable activity and steady progress made in these fields, a lack of insight and untested assumptions persists in such fundamental topics as, for example, the C14/solar-activity/climate connection.

References

Culhane, J.L. 1994, pp. 17-28 in Marsden (1994).

Domingo, V. and Poland, A. (eds.) 1988, The SOHO Mission - Scientific and Technical Aspects of the Instruments, ESA SP-1104 (Paris: European Space Agency).

Marsden, R.M. (ed.) 1994, The High-Latitutude Heliosphere (Proc. of the 27th ESLAB Symposium, Friedrichshafen, 19 - 21 April 1994), (Dordrecht: Kluwer); also reprinted in Space Sci. Rev. 72, Nos. 1-2, 1995.

Schmidt, R. and Goldstein, M.L. (eds.) 1988, The Cluster Mission - Scientific and Technical Aspects of the Instruments, ESA SP-1103 (Paris: European Space Agency).

Woerden, van, H. (ed.) 1994, Astronomy Posters - Abstracts (Sliedrecht/NL: Twin Press), pp. 206-213.