

Foreword

The book contains courses taught to a public of Ph.D. students, post-docs and confirmed researchers in all fields of heliospheric plasma physics. It aims at identifying physical issues which are common to two different fields of astronomy: solar and magnetospheric physics. Emphasis is given to basic processes of transport and conversion of energy: magnetic reconnection is discussed in detail from the viewpoints of MHD and kinetic physics. Processes of charged particle acceleration are reviewed and confronted with recent observations. The subject is introduced by a summary of MHD and the basic structures and parameters of the solar atmosphere, terrestrial ionosphere and magnetosphere are reviewed. The book combines a pedagogic and comprehensive presentation of physical issues and raises fully open questions, with the complementary and sometimes conflicting views of geophysicists and solar physicists. The book's focus, while basic, opens new avenues.

Observatory of Meudon, France
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The Editors

Preface

Following the great success of the first two CNRS Summer Schools on Solar Astrophysics held in Oléron (May 1996 and May 1997 – two schools devoted to the highlights of solar physics), I came to the conclusion that the initiative should be continued. A new programme committee, consisting of

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was set up and embarked on the organization of this third school. The basic idea was that, in view of the recent exciting developments in the physics of the solar corona, the magnetosphere, and boundary between the two, the solar wind, the committee decided it was important to unite the solar physics and magnetospheric communities, which had been separated for so long. Within this framework, people could effectively interact, exchange new scientific ideas and establish a common language to overcome the technical barriers between the two fields. At the same time they could try by analyzing recent breakthroughs, and so make progress in the two major areas of:

- magnetic reconnection;
- and the process of acceleration.

We wished to establish a general framework in which these highly specialized, but interdisciplinary fields could be furthered. It seemed to us essential that young researchers should be aware of underlying hypotheses and to acquire the necessary techniques and tools for calculation. Also equally important is that everyone understands the limits that are imposed by the instruments used for understanding the physical environments of the corona and magnetosphere.

This Workshop was thus devoted to “*Magnetic Reconnection*” and the courses covered:

- a general introduction (to MHD), recalling basic physics notions and establishing a common basis;

- a review of classical aspects of magnetic reconnection, which is an important mechanism that changes the topology of sheared magnetic fields and converts magnetic energy to both thermal energy and the acceleration of plasma;
- an overview of the role of the magnetic field in the solar atmosphere and how magnetic reconnection can be driven by the emergence of sheared magnetic field;
- a comprehensive introduction to the physics of magnetospheric plasmas, proposing the key approaches needed to gain new insight into the structure and some specific processes the magnetosphere;
- a new self consistent kinetic approach of collisionless plasmas.

In its “Lecture Notes”, Springer Verlag gives an excellent opportunity to voice the best of the scientific thought in this field. I am particularly grateful to all speakers, namely, *Giorgio Einaudi, Pascal Démoulin, Olivier Le Contel, Philippe Louarn, Clare Parnell and René Pellat*, for their formal or informal contributions. Moreover, the innumerable individual discussions appeared to fit well with the overall aim of the School. Nearly all the plenary lectures are collected in this volume. From that point, I wish to warmly thank the authors for the careful preparation of their manuscripts.

This monograph, one of the first comprehensive reviews available on the subject is intended for astrophysicists who are seeking an introduction to the physics of magnetic reconnection inside the heliosphere, and for students at graduate level.

Finally, this school would not have been possible without the financial support of the “*Formation Permanente du CNRS*”. This same institution also kindly sponsored the fourth CNRS Summer School, which was held from the 21st to the 25th of June, 1999, in Oléron on the *Data Analysis for Astrophysics and Geophysics*.

Grasse, France
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Jean-Pierre Rozelot

Transport and Energy Conversion in the Heliosphere
Lectures Given at the CNRS Summer School on Solar
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