RECONNECTION OF MAGNETIC FIELDS

Magnetohydrodynamics and Collisionless Theory and Observations

The reconnection of magnetic fields is one of the most fascinating processes in plasma physics, responsible for phenomena such as solar flares and magnetospheric substorms. The concept of reconnection has developed through recent advances in exploring the environments of the Sun and Earth through theory, computer simulations, and spacecraft observations. The great challenge in understanding it stems from balancing the large volumes of plasma and magnetic fields involved in energy release with the physical mechanism which relies on the strongly localized behavior of charged particles. This book, edited by and with contributions from leading scientists in the field, provides a comprehensive overview of recent theoretical and observational findings concerning the physics of reconnection and the complex structures that may give rise to, or develop from, reconnection. It is intended for researchers and graduate students interested in the dynamics of plasmas.

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Magnetohydrodynamics and Collisionless Theory and Observations

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Preface

This book grew out of a month-long workshop on Magnetic Reconnection Theory held in 2004 at the Isaac Newton Institute, Cambridge, UK, organized by E. R. Priest, T. G. Forbes, and J. Birn. The focus of this workshop was on the most recent advances in understanding reconnection, particularly its three-dimensional aspects and the physics of collisionless reconnection. These are the two areas where the most rapid development beyond the classical theory of reconnection has taken place in recent years. In addition, it was found desirable to include new observational aspects from the two areas that have initiated the concept of reconnection as well as provided new, unprecedented details in remote and in situ observations, the Sun and the Earth’s magnetosphere.

This book highlights recent progress and thus it is not a comprehensive overview. Rather it is complementary to recent reviews by Priest and Forbes (2000) and Biskamp (2000), which cover more of the traditional approaches to reconnection. Due to the focus on new results, rather than the classical concepts, about one-third of the citations in this book are from the new millennium, years 2001 to 2005. This makes it plausible that the latest developments have not led to a settled, unified, well-accepted picture, and that some topics are still controversial, even between different authors contributing to this book. We did not try to hide those controversies. Also, we did not try to consolidate various discussions of related topics into single sections or subsections. We found that, at this stage of the research development, different views of the same topic by different authors might actually be helpful to the reader to gain deeper insights.
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