

# Preface

Astrophysical plasmas are magnetized and turbulent and this presents a serious challenge for studying such a media. For decades turbulent astrophysical magnetic fields were completely enigmatic and this was constraining the progress in understanding key astrophysical processes. In particular, in diffuse media, the processes of cosmic ray propagation, heat transport, formation of a variety of density structures, filaments, molecular clouds, etc. were treated using poorly constrained values of magnetic fields and somewhat ad hoc models of magnetic turbulence. The essential processes related to magnetic fields, for instance, the ability of magnetic fields to change their topology, i.e. magnetic reconnection, were hotly debated with the estimates of the rates used by different researchers varying by many orders of magnitude.

A substantial progress has been made in the field of magnetic fields in diffuse media in the last decade. The new observations allowed to map magnetic fields with higher precision, which affected substantially our understanding of the role of magnetic fields in the interstellar medium and intracluster medium. With better computational abilities it became possible to test and reject theories of key processes in magnetized media. In particular, essential progress has been achieved in understanding the origin and evolution of magnetic fields, in the theory of magnetic field generation, in the physics of magnetic reconnection, acceleration and propagation of cosmic rays in turbulent magnetized media.

Recent research reveals strong synergy between different branches of research of magnetized media. For instance, in some cases, high resolution observation available for interstellar medium makes it an important testing ground for theories related to magnetic fields. These theories can then be applied to a wide variety of magnetic phenomena related to physics of magnetic phenomena in compact sources, gamma ray bursts, stellar activity, galaxies, galaxy clusters, etc.

This volume presents the current knowledge of magnetic fields in diffuse astrophysical media. Starting with an overview of twenty-first century instrumentation to observe astrophysical magnetic fields, the chapters cover observational techniques, origin of magnetic fields, magnetic turbulence, basic processes in magnetized fluids, the role of magnetic fields for cosmic rays, in the interstellar medium and for star

formation. Written by a group of leading experts the book represents an excellent overview of the field. Non-specialists will find sufficient background to enter the field and to be able to appreciate the state of the art.

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