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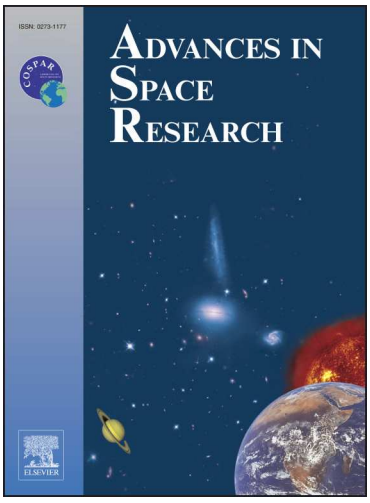

Preface

MHD Wave Phenomena in the Solar Interior and Atmosphere

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MHD Wave Phenomena in the Solar Interior and Atmosphere

Preface

The Sun is our nearest star and this star produces various plasma wave processes and energetic events. These phenomena strongly influence interplanetary plasma dynamics and contribute to space-weather. The understanding of solar atmospheric dynamics requires hi-resolution modern observations which, in turn, further advances theoretical models of physical processes in the solar interior and atmosphere. In particular, it is essential to connect the magnetohydrodynamic (MHD) wave processes with the small and large-scale solar phenomena vis-a-vis transport of energy and mass. With the advent of currently available and upcoming high-resolution space (e.g., IRIS, SDO, Hinode, Aditya-L1, Solar-C, Solar Orbiter), and ground-based (e.g., SST, ROSA, NLST, Hi-C, DKIST, EST, COSMO) observations, solar physicists are able to explore exclusive wave processes in various solar magnetic structures at different spatio-temporal scales.

With regards to MHD wave studies, solar physicists have now identified ubiquitous MHD waves propagating through the Sun's atmosphere, from the photosphere through the chromosphere up into the solar corona, identified their specific mode characteristics, and estimated their associated energy flux. Furthermore, there have been substantial gains from magneto-seismological studies, including, estimating magnetic field strengths and determining sub-resolution cross-field and parallel plasma inhomogeneity length scales that would not be possible by other means. However, it has become increasingly apparent that plasma dynamics, e.g., flows, instabilities and condensations, occur simultaneously with these observed waves. This fundamentally questions the widespread use of static background equilibria models which have been the staple of solar atmospheric wave studies since the launch of the Transition Region and Coronal Explorer (TRACE) in 1998.

The MHD waves, which are omnipresent in the Sun's atmosphere, have the potential to be exploited for unprecedented fine-scale and dynamic plasma diagnostics if the appropriate inversion tools are developed. Since it is expected that DKIST, NLST and COSMO will be fully operational in the next 3-5 years, it is extremely timely for theorists and observers to summarize and discuss the current achievements to be prepare for this most promising era in solar atmospheric waves research.

This thematic special issue of Advances in Space Research is focused on the novel studies of the various MHD wave processes in the solar interior and exterior and contains a number of research papers from the top international experts in MHD wave theory, numerical simulation of solar plasmas and observations. These papers all discuss the nature of solar phenomena mentioned above.

This set of outstanding state-of-the-art and original scientific articles provide new insight on the mechanisms of excitation of MHD waves in the solar atmosphere, their role in triggering localized energetic events and in the energy and momentum transport from photosphere to chromosphere and further to the solar corona. The inclusion of articles on magnetic fields

modeling, current development of the models to replicate the impulsive heating of the solar chromosphere, repetitive magnetic reconnections processes all fall in the regime of understanding the MHD plasma system. We are convinced that the articles of this special issue of Advances in Space Research provide a coherent view on the advancement of MHD waves in the solar interior and atmosphere and signify the recent developments in the understanding of the multi-scale solar energetic events.

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