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(Eds.)

Geospace Electromagnetic Waves and Radiation

 Springer

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Preface

The “Ringberg Workshop on High Frequency Waves in Geospace” convened at Ringberg Castle, Bavaria, from July 11 to 14, 2004. Approximately 30 attendees from 11 countries gathered at the castle for a program of invited talks and posters focussed on outstanding problems in high-frequency waves, defined broadly as waves exceeding a few kHz in frequency. Thirteen invited presentations comprise the contents of this volume. These articles provide introductions to current problems in geospace electromagnetic radiation, guides to the associated literature, and tutorial reviews of the relevant space physics. As such, this volume should be of value to students and researchers in electromagnetic wave propagation in the environment of the Earth at altitudes above the neutral atmosphere, extending from the ionosphere into outer space.

The contributions are broadly grouped into three parts. Part I, entitled “High-Frequency Radiation” focusses on radiation processes in near-Earth plasmas. Benson et al. present a tutorial review of *Z*-mode emissions, which so far have received relatively little attention and are the subject of few such reviews despite their abundant presence in geospace. Hashimoto et al. continue with another tutorial review on the terrestrial continuum radiation, the relatively weak radio emissions that fill the entire outer magnetosphere and provide information about the magnetospheric plasma boundaries and the state of the magnetospheric plasma density. Louarn reviews the ideas relevant to the generation of Auroral Kilometric Radiation (AKR), by far the most powerful and significant of the high-frequency radiations in the magnetosphere. Fleishman introduces the topic of diffusive synchrotron radiation, a mechanism not widely appreciated by geophysicists, but which may play a role in several magnetospheric, heliospheric, and even astrophysical settings. Pottellette and Treumann end this chapter with a discussion of the latest ideas about the relationship between auroral acceleration processes and radiation processes such as AKR, a subject which has been transformed in the last decade due to observations with the FAST and CLUSTER satellites.

Part II of this monograph, entitled “High-frequency waves,” focusses on wave physics. Sonwalkar presents a lengthy and comprehensive review of

whistler-mode propagation in the presence of density irregularities. James' paper deals with recent results from the OEDIPUS-C sounding rocket, combined with recent innovations in antenna theory, which lead to the provocative but significant conclusion that field strengths measured by many previous observations of auroral hiss using dipole antennas may need to be revised downward. Lee et al. present a novel theoretical method for analyzing mode-coupling and mode-conversion of high-frequency waves, with applications to geophysical plasmas. Yoon et al. treat the subject of mode-conversion radiations, which are replete in the Earth's environment, both in the ionosphere, magnetosphere, and solar wind. Vaivads et al. conclude this part with a review of high-frequency waves related to magnetic reconnection as the generator region of high-frequency waves and radiation in geospace, a very important and hot topic, especially in the light of recent CLUSTER satellite observations.

Part III of the monograph is devoted to new analysis techniques and instrumentation transforming research on high-frequency waves. Pécseli and Trulsen discuss novel ideas on the forefront of linking wave observations to theoretical models. Santolík and Parrot apply sophisticated wave propagation analysis tools to the study of AKR. Finally, Kletzing and Muschietti discuss wave particle correlators, describing the physics that can be investigated with them and including results from a recent state-of-the-art wave-particle correlator flown in the Earth's auroral ionosphere.

This monograph would not have been possible without the assistance of the many referees. Special thanks are due to M. André, R.E. Ergun, J.R. Johnson, E.V. Mishin, R. Pottelette, O. Santolík, V.S. Sonwalkar, and A.T. Weatherwax. We thank Dr. Axel Hörmann and his team for creating the gracious, welcoming environment at Ringberg Castle, which allowed a creative workshop to take place and thereby inspired this volume. We also thank the International Space Science Institute Bern for support. Finally, the editors at Springer, especially Dr. Christian Caron, deserve thanks for supporting the timely publication of this work and helping to assure its high quality.

Hanover, New Hampshire, and Munich
June 2005

James LaBelle
Rudolf Treumann

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