SOLAR AND SPACE WEATHER RADIOPHYSICS

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SOLAR AND SPACE WEATHER RADIOPHYSICS

Current Status and Future Developments

Edited by

DALE E. GARY

Center for Solar-Terrestrial Research,
New Jersey Institute of Technology, Newark, N.J., U.S.A.

and

CHRISTOPH U. KELLER

National Solar Observatory,
Tucson, AZ, U.S.A.

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Preface

This volume is the outgrowth of several international meetings to discuss a vision for the future of solar radio physics: the development of a new radio instrument. From these discussions, the concept for the Frequency Agile Solar Radiotelescope (FASR) was born. Most of the chapters of this book are based on invited talks at the FASR Science Workshop, held in Greenbank, WV in May 2002, and a special session on Solar and Space Weather Radiophysics held at the 200th American Astronomical Society meeting held in Albuquerque, NM in June 2002. Although many of the chapters deal with topics of interest in planning for FASR, other topics in Solar and Space Weather Radiophysics, such as solar radar and interplanetary scintillation, are covered to round out the discipline. The authors have been asked to write with a tutorial approach, to make the book useful to graduate students and scientists new to radio physics.

This book is more than a compilation of FASR science topics. The FASR instrument concept is so revolutionary—by extending capability by an order of magnitude in several dimensions at once (frequency coverage, spatial resolution, dynamic range, time resolution, polarization precision)—that it challenges scientists to think in new ways. The authors of the following chapters have been tasked not only with reviewing the current state of the field, but also with looking to the future and imagining what is possible.

Radio emission is extremely complex because it is generated so readily, and every imaginable plasma parameter affects it. This is both its great strength and its weakness. It offers tremendous diagnostic potential for the study of the quiet and disturbed solar atmosphere and heliosphere, but it also places great demands on the precision and quality of observations needed to interpret the information. FASR will be the first instrument to achieve the necessary precision with simultaneously excellent spatial, spectral, and temporal coverage. Together with observations in other wavelength regimes, both from the ground and from space, FASR will not only unleash the potential for radio diagnostics we are already familiar with—coronal magnetograms, electron acceleration, coronal mass ejections—but it will also allow new science to be addressed. Each author has thought about what will become possible when FASR and the other next-generation solar and heliospheric instruments are available, and has

attempted to describe the discoveries we can expect over the next two decades. To quote N. Gopalswamy (Chapter 15): solar radio astronomy, and solar and heliospheric physics in general, is "poised for a leap."

I would like to thank my wife, Kyle Gary, for her assistance in proof-reading the manuscript. Any errors that remain are mine. Thanks is also due to my co-editor, Christoph Keller, for helping to collect the chapters and for authoring the index terms. My special thanks goes to each of the chapter authors, in particular Tim Bastian, Gordon Hurford, and Stephen White, whose vision and enthusiasm not only made this book possible, but also helped to define FASR and will help to make it a reality.

DALE E. GARY