Preface to the Sixth Edition

This book introduces the tools needed to pursue research in radio astronomy. These consist of:

1. The basic principles in Chaps. 1–4 and 6
2. The properties and uses of various types of receivers and antennas in Chaps. 5, 7, 8, and 9
3. The analysis of mechanisms responsible for broadband continuum and spectral line radiation in Chaps. 10–16

Our aim is to help users to understand and apply well-established results. In addition, this book uses relations and expressions in the form normally encountered in radio astronomy publications so that the reader can connect these with concepts found in basic physics and chemistry texts.

There have been many major new instrumental developments since the appearance of the fifth edition. One example is the practical use of Focal Plane Arrays of receivers. Another is the Expanded Very Large Array (now the Jansky-VLA) and, more generally, interferometry at frequencies below $\nu = 1\,\mathrm{GHz}$ and above $\nu = 200\,\mathrm{GHz}$. For this reason, Chap. 9 has been expanded relative to the 5th edition. Over the past 30 years, the most dramatic improvements in interferometric aperture synthesis imaging arise from the use of faster computers and sophisticated image correction algorithms. In modern systems, computer soft- and firmware has become more and more integrated with receiver hardware, so are an integral part of radio astronomical systems. Other additions are the inclusion of the conventional derivations of receiver noise (Appendix C for Chap. 4) and the radiation field of a filled aperture (Appendix E for Chap. 6). Our descriptions of a specific topic are dispersed because some aspects are related to the theory of receivers (Chap. 4), actual receiver systems (Chap. 5), measurements with such systems (Chaps. 7 and 8), and the interpretation of results (Chap. 10 and following). To mitigate this, we have indexed terms extensively, so aspects of a device or concept can be found.

It is assumed that the readers have a thorough knowledge of physics. However, difficulties have often arisen when the instrumental topics were discussed. Often there is a difference between how a subject is treated in basic physics books and

the way it is presented using the language of radio astronomy. Our presentation is meant to bridge this gap, but in all cases, we try to use concepts familiar to physicists. A challenge encountered when writing a textbook is that of consistent designations, symbols, and units. Since the astronomical community prefers their traditional mixed set of units, we use the *Gaussian CGS system*, augmented when necessary with SI or MKS units. Where needed, we give the relations in their respective units in the equations. As to nomenclature, in the text and index, we refer to single radio telescopes as "antennas" and arrays of antennas with coupled outputs as "interferometers"; the more specialized instruments, such as those used to study the cosmic microwave background, are referred to as "facilities."

For each chapter, a list of references is given. Usually this list has two parts: (1) general references that are review articles and books that cover the general aspects and which often give an overview of the subjects covered and (2) special references for specific topics. We favor more recent and more general references in which citations to earlier work can be found. Finally, many of the most recent descriptions of facilities are to be found in the Internet. Since the exact locations may change with time, we have tried to give unique names for facilities, so the web sites can be found using search engines. In a number of cases, results are given to illustrate aspects of the theories or to make the approach plausible. The book is intended to aid in applying the principles of radio astronomy, but it is not intended to be a review of the entire field of radio astronomy.

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