was Moore's most important source, and so he uses her own words to tell much of her story, almost as if he wrote from a series of extended interviews with his late subject. *What Stars Are Made Of* flows like a historical novel, and Moore has a particular gift for weaving details about the cultural richness of early-20th-century Cambridge, Massachusetts, into his prose. Moore explains both the scientific details and the overall significance of Payne-Gaposchkin's work clearly, and he does so without jargon. His descriptions of Payne-Gaposchkin's Forrest Gump–like habit of running into some of the greatest physicists of the 20th century adds to the readers' fun; her mentors and teachers included such luminaries as Niels Bohr and Ernest Rutherford.

But reading about the sacrifices Payne-Gaposchkin made, and the burdens under which she suffered, was often painful. How could my predecessors have worked so hard to undermine the work of one of the greatest minds in 20th-century astrophysics? The book also prompts uncomfortable questions about the modern scientific community. In the year 2020, women have softened most of the barriers for participation in astrophysics, but that progress is recent, and it is far from complete. Who is our modern Payne-Gaposchkin? Is that person undervalued and denied opportunities because of their gender or gender identity? Their skin color or country of birth? A disability?

Most of us in science can probably relate to one part of Payne-Gaposchkin's story: She became a scientist because she was encouraged and inspired to do so by dedicated teachers. At age 12 her path led her to Dorothy Daglish's science classroom at St Mary's Catholic school. Next, at St Paul's School for Girls, she had the good fortune of finding another inspiring and caring teacher, Ivy Pendlebury. Most, or perhaps all, of us chose a path into science because we had similar experiences. We should pause and say thank-you to all of the Miss Daglishes and Miss Pendleburys we've been lucky enough to meet. This, then, is my chance to say thank-you to Chris Tellefson, my high school physics teacher in State College, Pennsylvania, in the early 1970s, who has no idea how important her teaching, guidance, and advice were to me.

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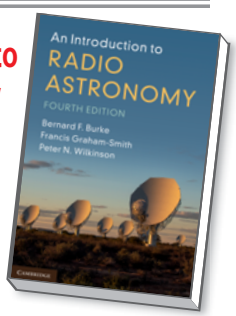
A radio astronomy classic, updated

Radio astronomy has a reputation in the scientific community as a mature field, given that nearly nine decades have passed since Karl Jansky and Grote Reber made the first measurements of the sky outside the optical regime. But that description is hardly appropriate today, as the field is enjoying a remarkable period of discovery driven by an impressive range of technical innovations. The Event Horizon Telescope's imaging of the black hole shadow in M87 and the discovery of mysterious fast radio bursts are just two recent examples.

The publication of a fourth edition of the classic text *An Introduction to Radio Astronomy*, therefore, could not be timelier. Lead author Bernard Burke sadly passed away in 2018; Burke's coauthor Francis Graham-Smith is joined in this edition by new coauthor Peter Wilkinson, an expert in radio interferometry and a longtime participant in the Square Kilometre Array project. The book has been significantly revised and reorganized following input from the astronomical community. However, the fourth edition remains true to its original audience: graduate students and astronomical researchers who seek a comprehensive introduction to the field.



An Introduction to Radio Astronomy

Bernard F. Burke, Francis Graham-Smith, and Peter N. Wilkinson
Cambridge U. Press, 2019 (4th ed.). $79.99

The first part of the book is devoted to the basic physics of radio wave emission, how radio waves are affected by the interstellar medium and our atmosphere, and how they are detected using modern receivers. In the second part the authors delve into the theory and operation of single-dish radio telescopes and interferometers; they have added considerable new material on observational techniques. The third and final section covers the large variety of phenomena studied by radio astronomers, starting with our solar system, the Milky Way, and other galaxies out to very distant quasars. The book concludes with a primer on cosmology and covers how radio observations of the cosmic microwave background and gravitational

lenses are vital to our understanding of the structure and evolution of our universe.

Authors attempting to cover in a single volume a field as vast as radio astronomy will have to make choices between depth and scope; Burke and coauthors have clearly opted for the latter. *An Introduction to Radio Astronomy* is impressively comprehensive in addressing the basic theory, techniques, telescopes, and astrophysics in the radio regime—no small feat in 500 pages. The only important areas that need more in-depth treatment are astrometry and geodesy, molecular cloud and star formation, and radio transients, all of which have significant research communities.

The authors adopt a lecture-like writing style that is easy to read, and the text is interspersed with relatively clean, simple figures. Students looking for detailed derivations of equations may be disappointed, however, as many equations are not presented from first principles. The authors do include numerous references to more in-depth works. Professors interested in adopting the textbook for a graduate course should be aware that it has no end-of-chapter problems and very few worked examples or calculations involving actual astronomical data, omissions that are atypical among popular astrophysics textbooks.

Other texts published in the past few years fill different niches from *An Introduction to Radio Astronomy*. James Condon and Scott Ransom's *Essential Radio Astronomy* (2016) places more emphasis on equations and worked examples but omits detailed material on observer techniques and individual radio telescope facilities. Those looking for an undergraduate-level text appropriate for students who don't have an astronomy background will want to check out *Fundamentals of Radio Astronomy* (2015) by Ronald Snell, Stanley Kurtz, and Jonathan Marr.

Overall, the fourth edition of *An Introduction to Radio Astronomy* is a pleasure to read and has only a few flaws. Given that the field straddles both astronomy and electrical engineering, it is not surprising that no uniform system of units is used throughout, although nonexperts will likely be baffled when mks and cgs units sometimes appear in the same equation.

The publishers also make an odd choice to use a footnote-size font for all text that involves a list, even when such a list takes up a whole page. The index uses an even smaller font and is incomplete: It omits many italicized terms in the text such as scattering, starburst galaxy, and photodissociation region. Some of the figures, such as that showing the Milky Way's rotation curve, could be replaced with more recent data, and very few of the spectacular images recently obtained by the Atacama Large Millimeter/Submillimeter Array are included. The authors appear to have recognized some of those shortcomings, and they provide continuously updated supplementary material on the publisher's website.

The relatively minor issues aside, I highly recommend the book for graduate students and other astronomers looking for an up-to-date, comprehensive introduction to the exciting and rapidly advancing field of radio astronomy. As a reference work it merits a prominent place on the bookshelf of every radio astronomer.

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