PULSAR ASTRONOMY

Fourth Edition

Over the past 40 years, an astonishing range of astrophysics has become accessible through pulsar astronomy. The body of literature on this rapidly growing research area is vast and observational techniques now cover the whole of the electromagnetic spectrum.

Now in its Fourth Edition, this authoritative volume gives a thorough introduction to the field. It is extensively revised throughout and new material includes: astrometry of binary pulsars and relativity theory; millisecond pulsars; the origin and Galactic population of pulsars and magnetars; and the pulsed emission from radio to gamma-rays. Within each topic, the authors concentrate on the fundamental physics and list extensive references, spanning from first discoveries to the most recent advances. Websites for catalogues of known pulsars are also recommended, providing a basis for new research work.

The rapid pace of progress in pulsar astronomy makes this essential reading both for advanced students entering the field and established researchers.

Andrew Lyne is Emeritus Professor of Radio Astronomy at the University of Manchester, a former Director of Jodrell Bank Observatory and a Fellow of the Royal Society. His research has focussed on finding radio pulsars and understanding the physics of neutron stars. He has been at the forefront of pulsar research for over 40 years and his discovery of two-thirds of the known pulsars has resulted in several awards, including the Herschel Medal of the Royal Astronomical Society and the Descartes Prize of the European Union.

Francis Graham-Smith is Emeritus Professor of Radio Astronomy at the University of Manchester. He is a pioneer of radio astronomy and was involved in the discovery and accurate location of discrete radio sources. He has been Director of the Royal Greenwich Observatory, Physical Secretary of the Royal Society, Director of the Jodrell Bank Observatory and Astronomer Royal 1982–1990. The Fourth Edition of Pulsar Astronomy is the product of over 40 years of close collaboration in research at Jodrell Bank Observatory.

From previous editions

'For anyone starting research, or preparing a graduate lecture course, this comprehensive, authoritative and readable introduction to pulsars, with some interesting historical asides, is strongly recommended.'
The Observatory

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FOURTH EDITION

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Preface

The stream of research and publications in pulsar astronomy has spread to a flood tide, encompassing a wide range of observations and astrophysics. In 1967, when the first pulsar was discovered, digital techniques, wide bandwidth radio receivers, space-based X-ray and gamma-ray telescopes were all unheard of. Observations are now expanding as fast as technical developments allow, and we are already looking forward to another major step forward, the building of the international Square Kilometre Array. Recent years have seen the outstanding success of X-ray and gamma-ray astronomy, extending to energies in the GeV and TeV regions. We have seen spectacular advances in pulsar timing and astrometry, leading to the most stringent tests of relativity theory, while an astonishing range of astrophysics has become accessible through pulsar astronomy, from the cold condensed matter of the neutron star interior and the extremely high energy of the surrounding magnetosphere, to the detailed structure of the interstellar medium.

Our intention in this new edition is to provide a guide rather than an encyclopaedia. Both of us are physicists and hands-on observers rather than theorists, and we naturally concentrate on techniques and discoveries, and on the interpretation of observations. Nevertheless we present the basic astrophysics, supplemented by references to papers which will lead to more complete explanations and into the more abstruse physics of, for example, condensed matter and relativity. We have in fact quoted many more references than previously throughout this edition, with the intention of spanning each topic from the first discoveries through to the most recent research paper. Many important references have doubtless been omitted, but those which have been included should lead to the whole of the literature; for such pursuits we trust that every reader has access to the excellent archive provided by the SAO/NASA Astrophysics Data System. In the same spirit, we have omitted the catalogue of pulsars, and recommend the use of the ATNF Pulsar Catalogue at http://www.atnf.csiro.au/research/pulsar/psrcat. We also recommend *Handbook of Radio Astronomy* (D. Lorimer & M. Kramer, Cambridge University Press, 2005) for a more detailed account of observing techniques and methods of data analysis, and *Neutron Stars and Pulsars* (W. Becker, Springer, 2009) for neutron star physics and high-energy observations.

Finally, and not least, we record our gratitude to the research team at Jodrell Bank Observatory, who have provided many of the discoveries in this book, and who have spent many hours scrutinising the text. The errors remaining are our own responsibility.