Planetary Ring Systems

Properties, Structure, and Evolution

Planetary rings are among the most intriguing structures of our solar system and have fascinated generations of astronomers. Collating emerging knowledge in the field, this volume reviews our current understanding of ring systems with reference to the rings of Saturn, Uranus, Neptune, and more. Written by leading experts, the history of ring research and the basics of ring-particle orbits is followed by a review of the known planetary ring systems. All aspects of ring system science are described in detail, including specific dynamical processes, types of structures, thermal properties, their origins, and investigations using computer simulations and laboratory experiments. The concluding chapters discuss the prospects of future missions to planetary rings, the ways in which ring science informs and is informed by the study of other astrophysical disks, and a perspective on the field's future. Researchers of all levels benefit from this thorough and engaging presentation.

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The field of research on planetary ring systems has progressed tremendously since the magisterial 1984 book *Planetary Rings,* edited by Rick Greenberg and André Brahic, was published by the University of Arizona Press. That book was based primarily on the then-recent flybys of Jupiter and Saturn by four spacecraft, first Pioneer 10 and 11 and then the blockbusters Voyager 1 and 2, which brought the first sophisticated scientific equipment to those planets and revolutionized our understanding of ring systems. Since that time, not only did Voyager 2 proceed on from Jupiter and Saturn to also visit Uranus and Neptune, but the Galileo mission spent nearly 8 years at Jupiter (1995–2003), several other spacecraft flew past targets in the outer solar system, and the capabilities of Earth-based telescopes, laboratory experiments, and computer simulations dramatically increased. Most spectacularly, the Cassini spacecraft arrived at Saturn in 2004 and continues its work of revolutionizing our understanding of ringed planets for a second time.

Despite the volumes of new data and the marked advances in understanding over the past 30 years, the 1984 Greenberg and Brahic book remains a classic, such that nearly every planetary rings researcher has it on her or his bookshelf and consults it periodically. We gladly take this opportunity to pay tribute to Rick and André (and to sadly acknowledge André's passing last year), along with their team of authors, for producing a piece of scholarship that has stood the test of time. We earnestly hope that the present volume will live up to their example.

This book has been a tremendous team effort, and we warmly thank the planetary rings research community for pulling together to bring it to pass. Of the 58 authors listed on the preceding pages, we particularly thank Imke de Pater, Matt Hedman, and Phil Nicholson for leading two chapters apiece. We also acknowledge (though we will keep their names anonymous) those who provided external peer reviews for the chapters in this book, helping to ensure that the views represented are scientifically responsible. This is an important service to the community, and we are grateful.

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