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The second edition of *Introduction to Cosmology* is an exciting update of this award-winning textbook. It is aimed primarily at advanced undergraduate students in physics and astronomy, but is also useful as a supplementary text at higher levels. It explains modern cosmological concepts, such as dark energy, in the context of the Big Bang theory. Its clear, lucid writing style, with a wealth of useful everyday analogies, makes it exceptionally engaging. Emphasis is placed on the links between theoretical concepts of cosmology and the observable properties of the universe, building deeper physical insights in the reader. The second edition includes recent observational results, fuller descriptions of special and general relativity, expanded discussions of dark energy, and a new chapter on baryonic matter that makes up stars and galaxies. It is an ideal textbook for the era of precision cosmology in the accelerating universe.

BARBARA RYDEN received her PhD in astrophysical sciences from Princeton University, New Jersey in 1987. After postdocs at the Harvard-Smithsonian Center for Astrophysics and the Canadian Institute for Theoretical Astrophysics, she joined the astronomy faculty at The Ohio State University, where she is now a full professor. She has over twenty years of experience in teaching, at levels ranging from introductory undergraduate courses to advanced graduate seminars. She won the Chambliss Astronomical Writing Award for the first edition of *Introduction to Cosmology* (2002), and is the co-author, with Bradley Peterson, of *Foundations of Astrophysics* (2010).

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Second Edition

Barbara Ryden

The Ohio State University

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University Printing House, Cambridge CB2 8BS, United Kingdom

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www.cambridge.org
Information on this title: www.cambridge.org/9781107154834

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First edition published in 2002 by Pearson Education, Inc.
Second edition published 2017

Printed in the United Kingdom by TJ International Ltd, Padstow, Cornwall

A catalog record for this publication is available from the British Library.

Library of Congress Cataloging-in-Publication Data
Names: Ryden, Barbara Sue, author.
Title: Introduction to cosmology / Barbara Ryden,
The Ohio State University.
Description: Second edition. | New York, NY : Cambridge University Press, 2017. |
Includes bibliographical references and index.
Identifiers: LCCN 2016040124 | ISBN 9781107154834 (Hardback ; alk. paper) |
ISBN 1107154839 (Hardback ; alk. paper)
Subjects: LCSH: Cosmology.
Classification: LCC QB981 .R93 2016 | DDC 523.1–dc23 LC record
available at https://lccn.loc.gov/2016040124

ISBN 978-1-107-15483-4 Hardback

Additional resources for this publication at www.cambridge.org/cosmology

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Preface

The first edition of this book was based on my lecture notes for an upper-level undergraduate cosmology course at The Ohio State University. The students taking the course were primarily juniors and seniors majoring in physics and astronomy. In my lectures, I assumed that my students, having triumphantly survived freshman and sophomore physics, had a basic understanding of electrodynamics, statistical mechanics, classical dynamics, and quantum physics. As far as mathematics was concerned, I assumed that, like modern major-generals, they were very good at integral and differential calculus. Readers of this book are assumed to have a similar background in physics and mathematics. In particular, no prior knowledge of general relativity is assumed; the (relatively) small amounts of general relativity needed to understand basic cosmology are introduced as needed.

The second edition that you are reading now is updated with observational and theoretical developments during the 14 years that have elapsed since the first edition. It has been improved by many comments by readers. (My thanks go to the eagle-eyed readers who caught the typographical errors that snuck into the first edition.) The second edition also contains an extended discussion of structure formation in the final two chapters. For a brief course on cosmology, the first ten chapters can stand on their own.

Unfortunately, the National Bureau of Standards has not gotten around to establishing a standard notation for cosmological equations. It seems that every cosmology book has its own notation; this book is no exception. My main motivation was to make the notation as clear as possible for the cosmological novice.

Many of the illustrations in this book were adapted from figures in published scientific papers; my thanks go to the authors of those papers for granting permission to use their figures or to replot their hard-won data. Particular thanks go to Avishai Dekel (Figure 2.2), Wendy Freedman (Figure 2.5), David Leisawitz (Figure 8.1), Alain Coc (Figure 9.4), Richard Cyburt (Figure 9.5), Rien van de Weygaert (Figure 11.1), Ashley Ross (Figure 11.6), Xiaohui Fan (Figure 12.3),

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and John Beacom (Figure 12.4). Extra thanks are due to Anže Slosar and José Alberto Vázquez for their assistance with Figures 6.6, 8.7, and 11.7.

Many people (too many to name individually) helped in the making of this book. I owe particular thanks to the students who took my undergraduate cosmology course at Ohio State University. Their feedback, including nonverbal feedback such as frowns and snores during lectures, greatly improved the lecture notes on which the first edition was based. The students of the graduate cosmology course at Ohio State have assisted in the development of the second edition, by field-testing the end-of-chapter problems, proposing new problems, and acting as all-around critics of the manuscript. Adam Black and Nancy Gee, at Pearson Addison Wesley, made possible the great leap from rough lecture notes to polished book. Vince Higgs and Rachel Cox, at Cambridge University Press, helped with the second great leap to a new, improved second edition. The reviewers of the text, in both its first and second editions, pointed out many omissions and suggested many improvements.

The first edition of this book was dedicated to Rick Pogge, who acted as my computer maven, graphics guru, personal chef, and general sanity check. Obviously, there was only one thing to do with such a paragon. Reader, I married him.

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