

# Physics & Astrophysics 2020



# Congratulations to James Peebles, Joint Winner of the Nobel Prize in Physics

Dear Readers,

Princeton University Press is delighted to extend its warmest congratulations to P. James E. Peebles, joint winner of the 2019 Nobel Prize in Physics. We have had the honor of being his publisher since 1972, working with him on such landmark titles as *Principles of Physical Cosmology* and *Large-Scale Structure of the Universe*. Here, we are thrilled to announce the publication of his newest book, forthcoming in 2020: *Cosmology's Century*, his insider's history of the field from Einstein to our modern era. It leads off a wonderful list of titles in physics and astronomy that we are proud to present, and which we hope you will enjoy discovering in the pages that follow.

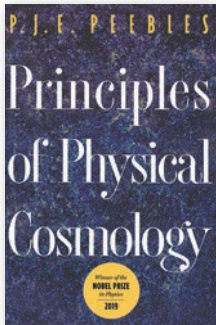
Sincerely,

**Jessica Yao**

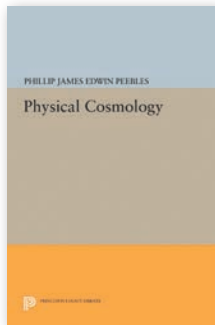
*Associate Editor, Physical Sciences*

**Ingrid Gnerlich**

*Publisher for the Sciences*



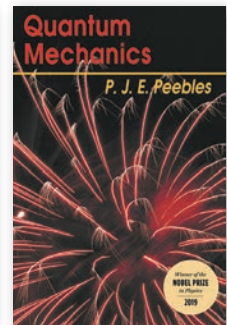
**Principles of  
Physical Cosmology**  
P. J. E. Peebles  
Paperback 9780691019338  
\$95.00 | £78.00



**Physical Cosmology**  
P. J. E. Peebles  
Paperback 9780691620138  
\$53.00 | £44.00  
E-book 9781400868773



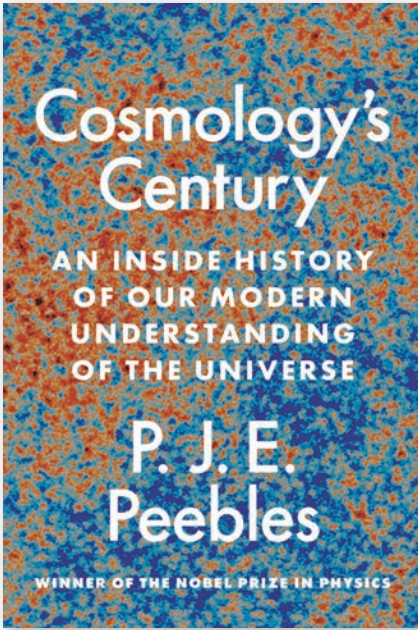
**Large-Scale Structure  
of the Universe**  
P. J. E. Peebles  
Paperback 9780691082400  
\$95.00 | £78.00



**Quantum Mechanics**  
P. J. E. Peebles  
Hardback 9780691087559  
\$125.00 | £104.00

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Princeton Series in Astrophysics 20 – Princeton Series in Modern Observational Astronomy 21  
Albert Einstein 22 – Of Related Interest 24



## Cosmology's Century

From Nobel Prize–winning physicist  
P. J. E. Peebles, the story of cosmology  
from Einstein to today

Modern cosmology began a century ago with Albert Einstein's general theory of relativity and his notion of a homogenous, philosophically satisfying cosmos. *Cosmology's Century* is the story of how generations of scientists built on these thoughts and many new measurements to arrive at a well-tested physical theory of the structure and evolution of our expanding universe.

In this landmark book, one of the world's most esteemed theoretical cosmologists offers an unparalleled personal perspective on how the field developed. P. J. E. Peebles was at the forefront of many of the greatest discoveries of the past century, making fundamental contributions to our understanding of the presence of helium and microwave radiation from the hot big bang, the measures of the distribution and motion of ordinary matter, and the new kind of dark matter that allows us to make sense of these results. Taking readers from the field's beginnings, Peebles describes how scientists working in independent directions found themselves converging on a theory of cosmic evolution interesting enough to warrant the rigorous testing it passes so well. He explores the major advances—some inspired by remarkable insights or perhaps just lucky guesses—as well as the wrong turns taken and the roads not explored. He shares recollections from major players in this story and provides a rare, inside look at how natural science is really done.

A monumental work, *Cosmology's Century* also emphasizes where the present theory is incomplete, suggesting exciting directions for continuing research.

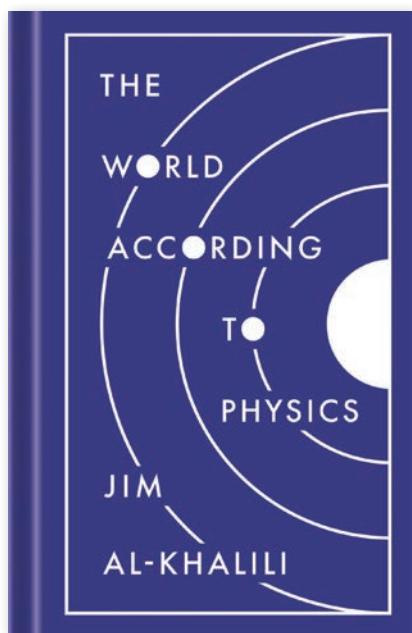
**P. J. E. PEEBLES** is a Nobel Prize–winning physicist and the author of *Principles of Physical Cosmology*, *Quantum Mechanics*, and *Physical Cosmology* (all Princeton). He is the Albert Einstein Professor of Science Emeritus in the Department of Physics at Princeton University.

June 2020. 400 pages. 16 color + 33 b/w illus. 3 tables.  
Hardback 9780691196022 \$35.00 | £30.00  
E-book 9780691201665

“An inspiring history of cosmic ideas.”  
—Joseph Silk, author of *The Infinite Cosmos: Questions from the Frontiers of Cosmology*

“Peebles offers a broad and deep description of cosmology, presenting the history of the field as well as many of the side turns, dead ends, and wrong paths that researchers explored along the way. I really enjoyed reading this book.”  
—David W. Hogg, New York University

“Peebles offers a remarkable account of how, over the course of a century, researchers in several disparate areas of physics, astronomy, and cosmology pursued questions about the nature and evolution of the universe. *Cosmology's Century* is a welcome and valuable tour of a fascinating intellectual adventure.”  
—David Kaiser, author of *How the Hippies Saved Physics: Science, Counterculture, and the Quantum Revival*



## The World According to Physics

Quantum physicist, *New York Times* bestselling author, and BBC host Jim Al-Khalili offers a fascinating and illuminating look at what physics reveals about the world

Shining a light on the most profound insights revealed by modern physics, Jim Al-Khalili invites us all to understand what this crucially important science tells us about the universe and the nature of reality itself.

Al-Khalili begins by introducing the fundamental concepts of space, time, energy, and matter, and then describes the three pillars of modern physics—quantum theory, relativity, and thermodynamics—showing how all three must come together if we are ever to have a full understanding of reality. Using wonderful examples and thought-provoking analogies, Al-Khalili illuminates the physics of the extreme cosmic and quantum scales, the speculative frontiers of the field, and the physics that underpins our everyday experiences and technologies, bringing the reader up to speed with the biggest ideas in physics in just a few sittings. Physics is revealed as an intrepid human quest for ever more foundational principles that accurately explain the natural world we see around us, an undertaking guided by core values such as honesty and doubt in the search for truth. The knowledge discovered by physics both empowers and humbles us, and still, physics continues to delve valiantly into the unknown.

Making even the most enigmatic scientific ideas accessible and captivating, this deeply insightful book illuminates why physics matters to everyone and calls one and all to share in the profound adventure of seeking truth in the world around us.

**JIM AL-KHALILI** is professor of physics at the University of Surrey. He is one of Britain's best-known science communicators and has written numerous books, including *Quantum: A Guide for the Perplexed*; *The House of Wisdom: How Arabic Science Saved Ancient Knowledge and Gave Us the Renaissance*; and *Life on the Edge: The Coming of Age of Quantum Biology*. He is a fellow of the Royal Society.

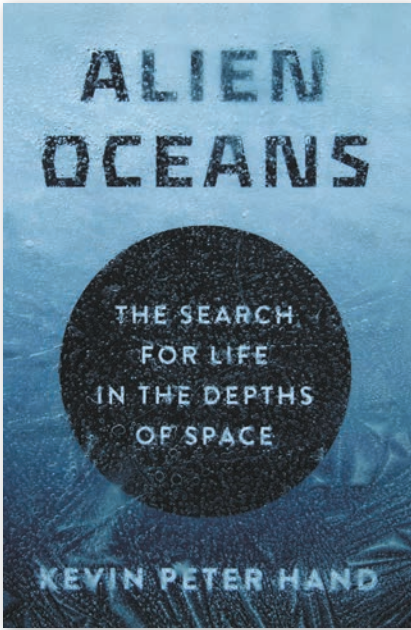
March 2020. 320 pages. 6 b/w illus.  
Hardback 9780691182308 \$16.95 | £12.99  
E-book 9780691201672 Audiobook 9780691205052

“So much science packed into such a tiny package! Jim Al-Khalili manages to give an accessible overview of an enormous amount of modern physics, without it ever feeling rushed. This book will be enjoyed by anyone who wants a glimpse of how modern physicists are thinking about some of the hardest problems in the universe.”

—Sean Carroll, author of *Something Deeply Hidden: Quantum Worlds and the Emergence of Spacetime*

“A clear, simple, and fascinating account of what physics tells us about our universe, and—crucially—what evidence supports that view, from one of the most talented, inspiring, and informative popularizers of science. A triumph!”

—Ian Stewart, author of *Do Dice Play God?*



April 2020. 304 pages. 15 color + 22 b/w illus.  
Hardback 9780691179513 \$27.95 | £22.00  
E-book 9780691189642 Audiobook 9780691205595

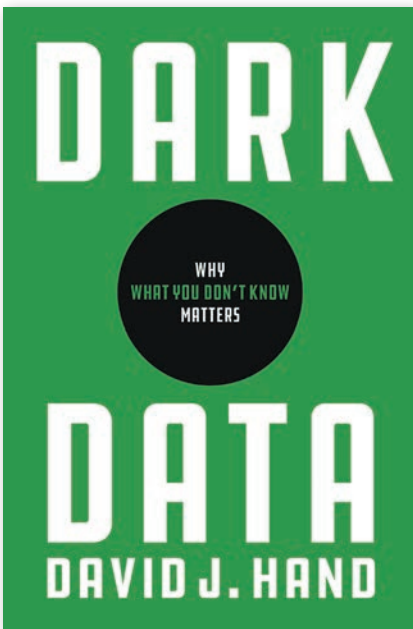
“Hand humanizes the science behind the search for life on icy worlds in our solar system and beyond.”

—Gordon Southam, University of Queensland

## Alien Oceans

Where is the best place to find life beyond Earth? We often look to Mars as the most promising site in our solar system, but recent scientific missions have revealed that some of the most habitable real estate may actually lie farther away. Beneath the frozen crusts of several of the small, ice-covered moons of Jupiter and Saturn lurk vast oceans that may have been in existence for as long as Earth, and together may contain more than fifty times its total volume of liquid water. Could there be organisms living in their depths? *Alien Oceans* reveals the science behind the thrilling quest to find out.

**KEVIN PETER HAND** is a scientist at NASA’s Jet Propulsion Laboratory, where he has served as deputy chief scientist for solar system exploration and is leading an effort to land a spacecraft on the surface of Europa. He has helped lead expeditions to the glaciers of Kilimanjaro, the Dry Valleys of Antarctica, and the sea ice of the North Pole.



January 2020. 344 pages. 6 b/w illus. 6 tables.  
Hardback 9780691182377 \$29.95 | £25.00  
E-book 9780691198859 Audiobook 9780691199177

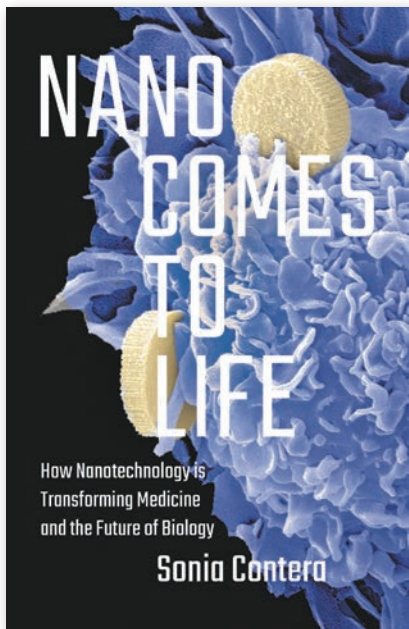
“David Hand shines a bright light onto the dark corners of statistics. This is a learned book but a witty, readable, and important one.”

—Tim Harford, author of *Fifty Inventions That Shaped the Modern Economy*

## Dark Data

In the era of big data, it is easy to imagine that we have all the information we need to make good decisions. But in fact the data we have are never complete, and may be only the tip of the iceberg. Just as much of the universe is composed of dark matter, invisible to us but nonetheless present, the universe of information is full of dark data that we overlook at our peril. In *Dark Data*, data expert David Hand takes us on a fascinating and enlightening journey into the world of the data we don’t see.

**DAVID J. HAND** is emeritus professor of mathematics and senior research investigator at Imperial College London, a former president of the Royal Statistical Society, and a fellow of the British Academy.



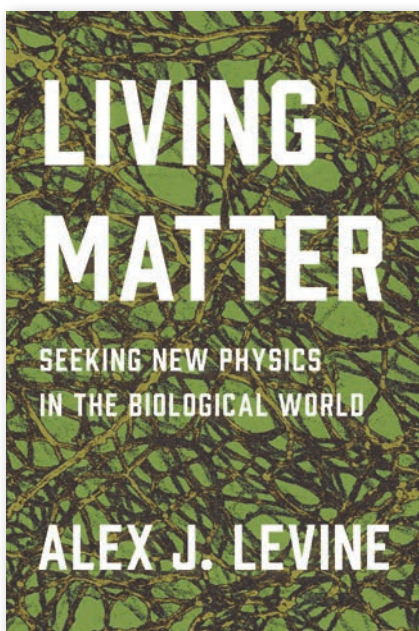
2019. 240 pages. 12 color + 11 b/w illus.  
Hardback 9780691168807 \$24.95 | £22.00  
E-book 9780691189284

“Your body is built and maintained by molecular nanomachines, and the future of medicine will depend on our ability to work in the nanoscale realm. *Nano Comes to Life* tells the story of progress and the path forward. The prospects are amazing.”  
—K. Eric Drexler, author of *Radical Abundance: How a Revolution in Nanotechnology Will Change Civilization*

## Nano Comes to Life

*Nano Comes to Life* opens a window onto the nanoscale—the infinitesimal realm of proteins and DNA where physics and cellular and molecular biology meet—and introduces readers to the rapidly evolving nanotechnologies that are allowing us to manipulate the very building blocks of life. Sonia Contera gives an insider’s perspective on this new frontier, revealing how nanotechnology enables a new kind of multidisciplinary science that is poised to give us control over our own biology, our health, and our lives.

**SONIA CONTERA** is professor of biological physics in the Department of Physics at the University of Oxford and one of today’s leading nanotech pioneers.

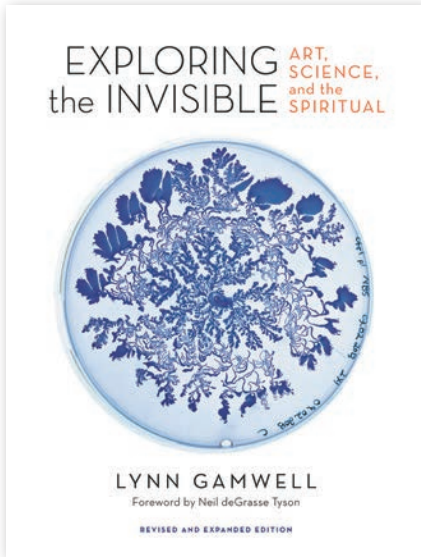


August 2020. 288 pages. 16 color + 40 b/w illus.  
Hardback 9780691177229 \$29.95 | £25.00  
E-book 9780691189833

“*Living Matter* is a call to arms for readers to see biophysics as the next frontier of physics, one that has potentially wide-ranging consequences for science and technology.”  
—Peter M. Hoffmann, author of *Life’s Ratchet: How Molecular Machines Extract Order from Chaos*

The frontiers of physics can seem impossibly remote—located in the invisible quantum realm or the farthest reaches of the cosmos. But one of physics’ most exciting frontiers lies much closer than we realize: within our own bodies and other living organisms, which display astonishingly intricate structural patterns and dynamic processes that we don’t yet understand. In *Living Matter*, leading biophysicist Alex Levine explains why unraveling the mysteries of life may ultimately demand a new physics—one that takes full account of the fundamental differences between living and nonliving matter.

**ALEX J. LEVINE** is director of the Center for Biological Physics at the University of California, Los Angeles, where he is also a professor in the departments of chemistry and biochemistry, physics and astronomy, and biomathematics.



March 2020. 528 pages. 332 color illus. + 183 b/w illus.  
 Hardback 9780691191058 \$49.95 | £42.00

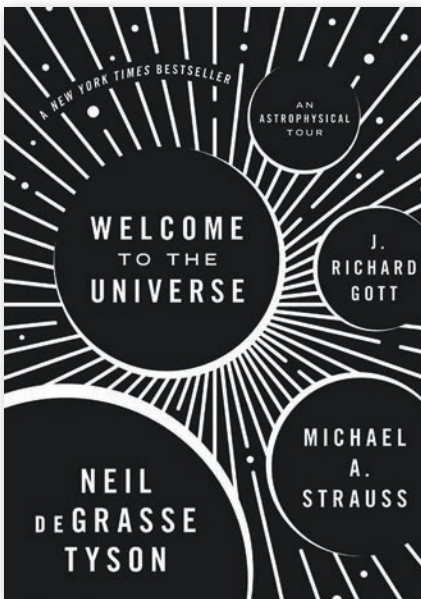
“This pathbreaking study is daring, innovative, and above all, clearly written. . . . Art historians don’t know enough about science; scientists don’t know enough about art. Miraculously, probably uniquely, Lynn Gamwell seems equally at home in both areas.”

—Robert Rosenblum, author of *Transformations in Late Eighteenth Century Art*

## Exploring the Invisible

*Exploring the Invisible* shows how modern art expresses the first secular, scientific worldview in human history. Now fully revised and expanded, this richly illustrated book describes two hundred years of scientific discoveries that inspired French Impressionist painters and Art Nouveau architects, as well as Surrealists in Europe, Latin America, and Japan.

**LYNN GAMWELL** is a lecturer in the history of art, science, and mathematics at the School of Visual Arts in New York. She is the author of *Mathematics and Art: A Cultural History* (Princeton). **NEIL DEGRASSE TYSON** is director of the Hayden Planetarium at the American Museum of Natural History.



2016. 480 pages. 95 color illus.  
 Hardback 9780691157245 \$39.95 | £34.00  
 E-book 9781400883226  
 A New York Times Bestseller

“A breathtaking guide to the cosmos.”

—*Cosmos Magazine*

“The best book about the universe in the universe.”

—*New Scientist*

## Welcome to the Universe

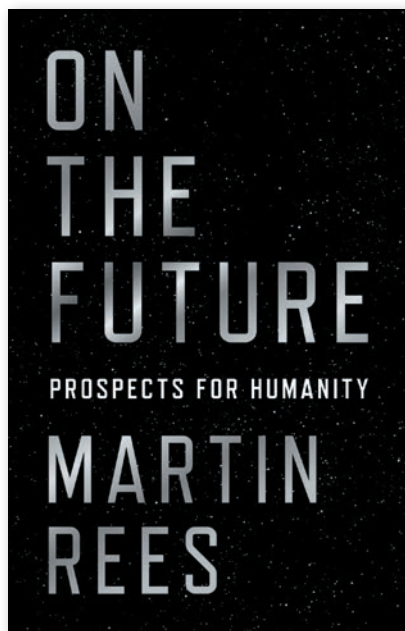
*Welcome to the Universe* is a personal guided tour of the cosmos by three of today’s leading astrophysicists. Inspired by the enormously popular introductory astronomy course, this book covers it all—from planets, stars, and galaxies to black holes, wormholes, and time travel. Breathtaking in scope and stunningly illustrated throughout, this book is for those who hunger for insights into our evolving universe.

**NEIL DEGRASSE TYSON** is director of the Hayden Planetarium at the American Museum of Natural History. **MICHAEL A. STRAUSS** is professor of astrophysics at Princeton University. **J. RICHARD GOTT** is professor of astrophysics at Princeton University.

### Welcome to the Universe: The Problem Book

2017. 264 pages. 14 b/w illus.  
 Paperback 9780691177816 \$35.00 | £30.00  
 Hardback 9780691177809 \$65.00 | £54.00  
 E-book 9781400888993





2018. 272 pages.

Hardback 9780691180441 \$18.95 | £15.99

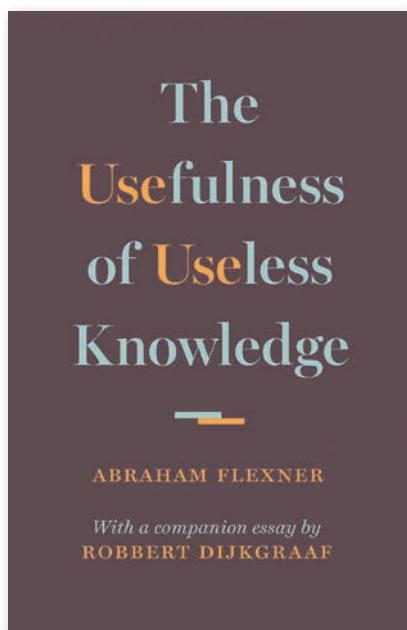
E-book 9780691184401 Audiobook 9780691192994

“This slim volume, written in Rees’s characteristically elegant style, will frighten and inspire—and above all, entertain.”—Clive Cookson, *Financial Times*

## On the Future

Humanity has reached a critical moment. Our world is unsettled and rapidly changing, and we face existential risks over the next century. Various outcomes—good and bad—are possible. Yet our approach to the future is characterized by short-term thinking, polarizing debates, alarmist rhetoric, and pessimism. In this short, exhilarating book, renowned scientist and bestselling author Martin Rees argues that humanity’s prospects depend on our taking a very different approach to planning for tomorrow. Rich with fascinating insights into cutting-edge science and technology, this accessible book will captivate anyone who wants to understand the critical issues that will define the future of humanity on Earth and beyond.

**MARTIN REES** is Astronomer Royal, and has been Master of Trinity College and Director of the Institute of Astronomy at Cambridge University.



2017. 104 pages.

Hardback 9780691174761 \$9.95 | £8.99

E-book 9781400884629

“A small and hugely powerful book.”

—Karen Shook, *Times Higher Education*

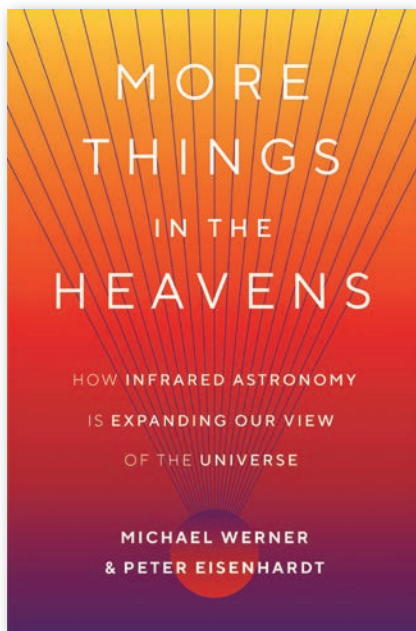
## The Usefulness of Useless Knowledge

A forty-year tightening of funding for scientific research has meant that resources are increasingly directed toward applied or practical outcomes, with the intent of creating products of immediate value. In such a scenario, it makes sense to focus on the most identifiable and urgent problems, right? Actually, it doesn’t. In his classic essay “The Usefulness of Useless Knowledge,” Abraham Flexner describes a great paradox of scientific research. The search for answers to deep questions, motivated solely by curiosity and without concern for applications, often leads not only to the greatest scientific discoveries but also to the most revolutionary technological breakthroughs. In short, no quantum mechanics, no computer chips.

**ABRAHAM FLEXNER** (1866–1959) was the founding director of the Institute for Advanced Study.

**ROBERT DIJKGRAAF** is director and Leon Levy Professor at the Institute for Advanced Study.





2019. 304 pages. 104 color + 13 b/w illus.  
 Hardback 9780691175546 \$35.00 | £30.00  
 E-book 9780691191966

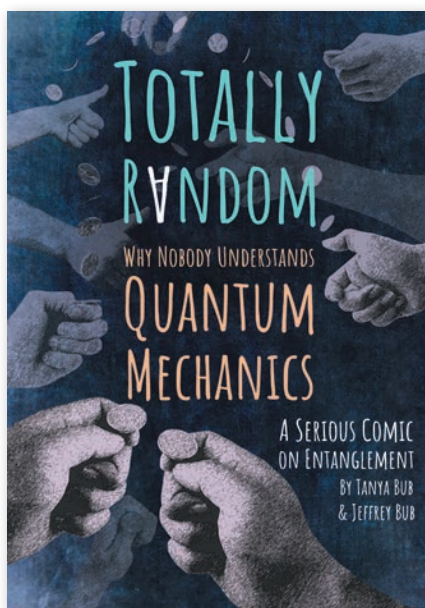
“A fascinating insight into how the scientific process of discovery works.”

—Dr. Chris North, *BBC Sky at Night*

## More Things in the Heavens

Astronomers have been studying the heavens for thousands of years, but until recently much of the cosmos has been invisible to the human eye. Launched in 2003, the Spitzer Space Telescope has brought the infrared universe into focus as never before. Michael Werner and Peter Eisenhardt are among the scientists who worked for decades to bring this historic mission to life. Here is their inside story of how *Spitzer* continues to carry out cutting-edge infrared astronomy to help answer fundamental questions that have intrigued humankind since time immemorial: Where did we come from? How did the universe evolve? Are we alone?

**MICHAEL WERNER** is a senior research scientist at the NASA Jet Propulsion Laboratory, California Institute of Technology. **PETER EISENHARDT** is a senior research scientist at the Jet Propulsion Laboratory.



2018. 272 pages. 254 b/w illus.  
 Paperback 9780691176956 \$22.95 | £18.99  
 E-book 9781400890392

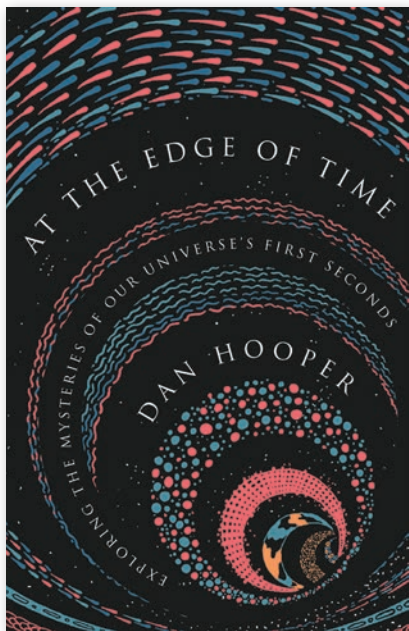
“An excellent introduction to quantum mechanics.”

—John F. Barber, *Leonardo Reviews*

## Totally Random

Measure two entangled particles separately, and the outcomes are totally random. But compare the outcomes, and the particles seem as if they are instantaneously influencing each other at a distance—even if they are light-years apart. This, in a nutshell, is entanglement, and if it seems weird, then this book is for you. *Totally Random* is a graphic experiential narrative that unpacks the deep and insidious significance of the curious correlation between entangled particles to deliver a gut-feel glimpse of a world that is not what it seems.

**TANYA BUB** is founder of 48th Ave Productions, a web development company. **JEFFREY BUB** is Distinguished University Professor in the Department of Philosophy and the Institute for Physical Science and Technology at the University of Maryland, where he is also a fellow of the Joint Center for Quantum Information and Computer Science.



2019. 248 pages. 11 b/w illus.  
 Hardback 9780691183565 \$24.95 | £22.00  
 E-book 9780691197005  
 Science Essentials

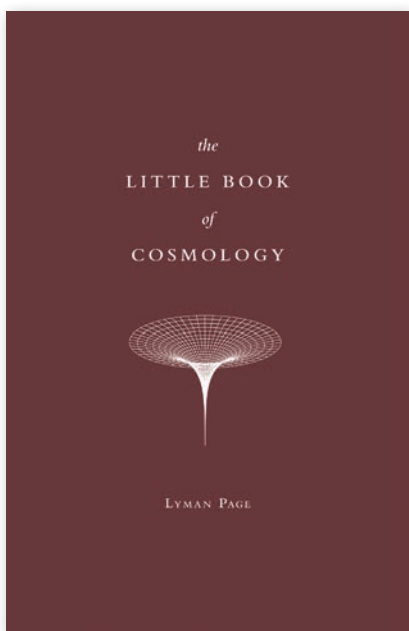
“A clear and engaging tour of the mysterious birth of our universe.”

—Daniel Whiteson, coauthor of *We Have No Idea: A Guide to the Unknown Universe*

## At the Edge of Time

Scientists in the past few decades have made crucial discoveries about how our cosmos evolved over the past 13.8 billion years. But there remains a critical gap in our knowledge: we still know very little about what happened in the first seconds after the Big Bang. *At the Edge of Time* focuses on what we have recently learned and are still striving to understand about this most essential and mysterious period of time at the beginning of cosmic history.

**DAN HOOPER** is a senior scientist and the head of the Theoretical Astrophysics Group at the Fermi National Accelerator Laboratory and a professor of astronomy and astrophysics at the University of Chicago. He is the author of *Dark Cosmos* and *Nature's Blueprint* (both Smithsonian/Harper Collins).



April 2020. 152 pages. 9 color + 13 b/w illus. 1 table.  
 Hardback 9780691195780 \$19.95 | £16.99  
 E-book 9780691201696

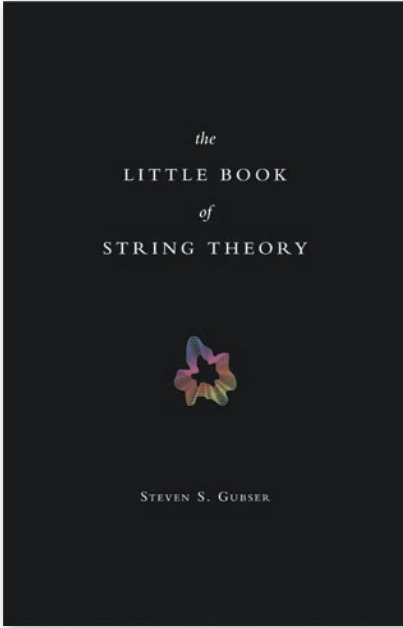
“A very nice primer on the current state of cosmology. Page offers short and simple examples to put amazingly complex topics into perspective.”

—Mark Devlin, University of Pennsylvania

## The Little Book of Cosmology

*The Little Book of Cosmology* provides a breathtaking look at our universe on the grandest scales imaginable. Written by one of the world's leading experimental cosmologists, this short but deeply insightful book describes what scientists are revealing through precise measurements of the faint thermal afterglow of the big bang—known as the cosmic microwave background, or CMB—and how their findings are transforming our view of the cosmos.

**LYMAN PAGE** is the James S. McDonnell Distinguished University Professor of Physics at Princeton University. He is the coeditor of *Finding the Big Bang*.



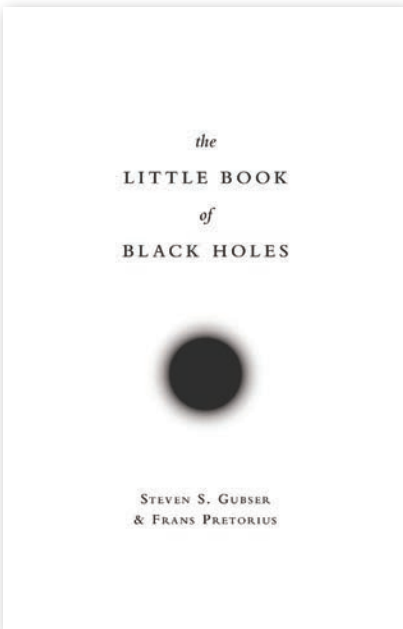
2010. 184 pages. 21 b/w illus.  
Hardback 9780691142890 \$19.95 | £16.99  
E-book 9781400834433

“Gubser does a masterly job of introducing string theory in simple terms and without using math. His goal is not to convert people to the cause but to help them better understand the ideas.” —*Library Journal*

## The Little Book of String Theory

*The Little Book of String Theory* offers a short, accessible, and entertaining introduction to one of the most talked-about areas of physics today. String theory has been called the “theory of everything.” It seeks to describe all the fundamental forces of nature. It encompasses gravity and quantum mechanics in one unifying theory. But it is unproven and fraught with controversy. After reading this book, you’ll be able to draw your own conclusions about string theory. *The Little Book of String Theory* is the essential, most up-to-date beginner’s guide to this elegant, multidimensional field of physics.

**STEVEN S. GUBSER** (1972–2019) was professor of physics at Princeton University.



2017. 200 pages. 29 b/w illus.  
Hardback 9780691163727 \$19.95 | £16.99  
E-book 9781400888290

“Gubser and Pretorius offer clarity on a difficult topic, with a healthy dose of wonder to boot.”  
—*Publishers Weekly*

“Entertaining as well as informative. *The Little Book of Black Holes* is well written, well organized, and enjoyable to read.” —Gary Horowitz, University of California, Santa Barbara

## The Little Book of Black Holes

Black holes, predicted by Albert Einstein’s general theory of relativity more than a century ago, have long intrigued scientists and the public with their bizarre and fantastical properties. *The Little Book of Black Holes* takes readers deep into the mysterious heart of the subject, offering rare clarity of insight into the physics that makes black holes simple yet destructive manifestations of geometric destiny.

**STEVEN S. GUBSER** (1972–2019) was professor of physics at Princeton University. **FRANS PRETORIUS** is professor of physics at Princeton.



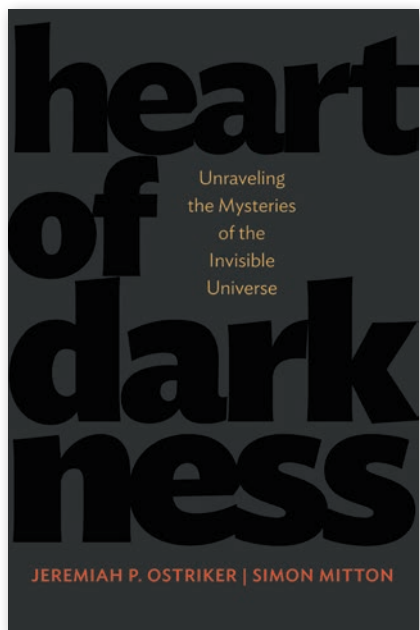
2016. 264 pages. 15 color + 73 b/w illus.  
 Paperback 9780691169187 \$19.95 | £16.99  
 E-book 9781400850075

“Freese ... tells a lively personal tale of her trajectory through the world of science. ... You end up thinking that being a physicist is certainly important and definitely difficult—but it could also be a lot of fun.”  
 —Nancy Szokan, *Washington Post*

## The Cosmic Cocktail

*The Cosmic Cocktail* is the inside story of the epic quest to solve one of the most compelling enigmas of modern science—what is the universe made of?—told by one of today’s foremost pioneers in the study of dark matter. Many cosmologists believe we are on the verge of solving the mystery. Katherine Freese provides the foundation needed to fully fathom this epochal moment in humankind’s quest to understand the universe.

**KATHERINE FREESE** is director of Nordita, the Nordic Institute for Theoretical Physics, in Stockholm, and professor of physics at the University of Michigan.



2015. 328 pages. 16 color + 40 b/w illus.  
 Paperback 9780691165776 \$19.95 | £16.99  
 E-book 9781400844647

“Jeremiah Ostriker and science historian Simon Mitton seamlessly blend historical narrative with lucid scientific explication, from the depths of classical time to the data-fuelled hyperdrive of the past 50 years.”—*Nature*

## Heart of Darkness

*Heart of Darkness* describes the incredible saga of humankind’s quest to unravel the deepest secrets of the universe. Over the past thirty years, scientists have learned that two little-understood components—dark matter and dark energy—comprise most of the known cosmos, explain the growth of all cosmic structure, and hold the key to the universe’s fate. The story of how evidence for the so-called “Lambda-Cold Dark Matter” model of cosmology has been gathered by generations of scientists throughout the world is told here by one of the pioneers of the field, Jeremiah Ostriker, and his coauthor Simon Mitton.

**JEREMIAH P. OSTRIKER** is professor of astrophysical sciences at Princeton University. **SIMON MITTON** is affiliated research scholar in the history and philosophy of science and a fellow of St. Edmund’s College, University of Cambridge.

**PRINCETON SCIENCE LIBRARY**



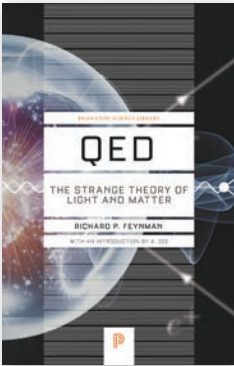
**Reinventing Discovery**  
 Michael Nielsen  
 Paperback 9780691202846 \$17.95 | £14.99  
 E-book 9780691202853



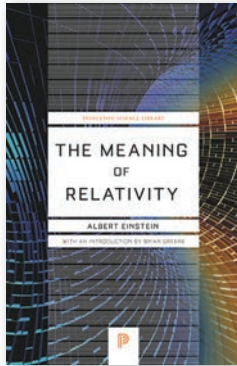
**Our Cosmic Habitat**  
 Martin Rees  
 Paperback 9780691178097 \$17.95 | £14.99  
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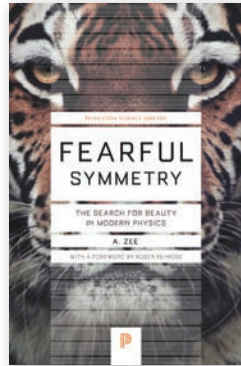
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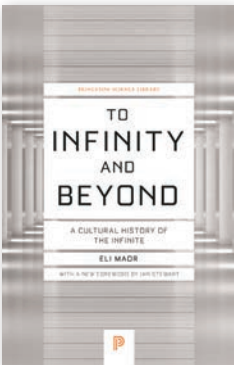
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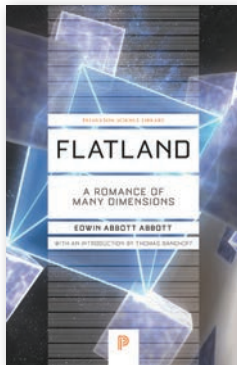
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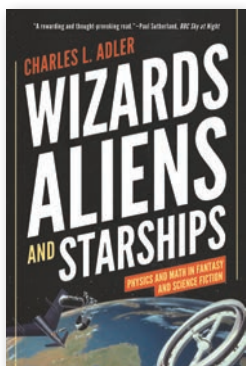
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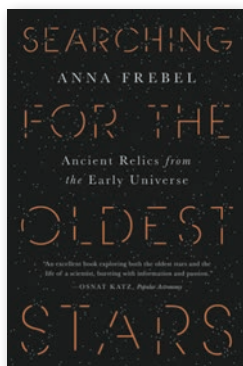


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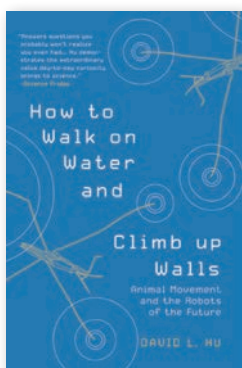


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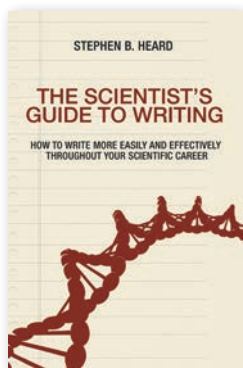


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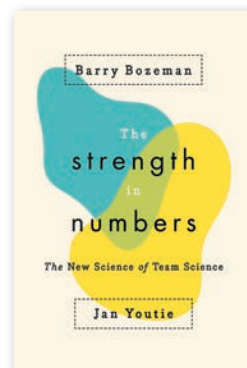


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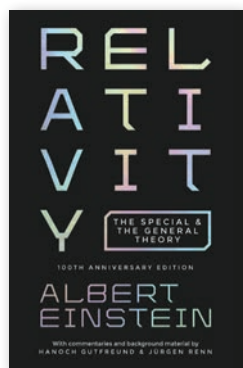


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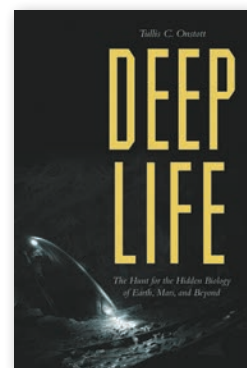


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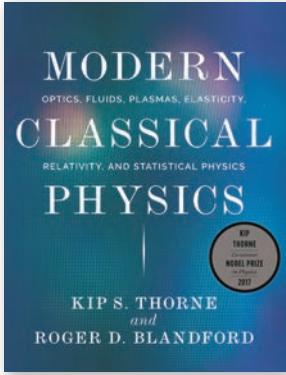


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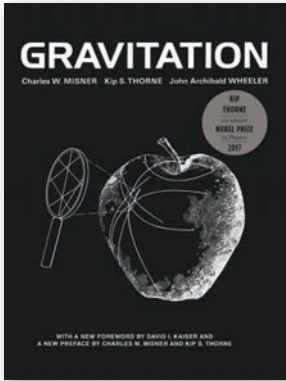
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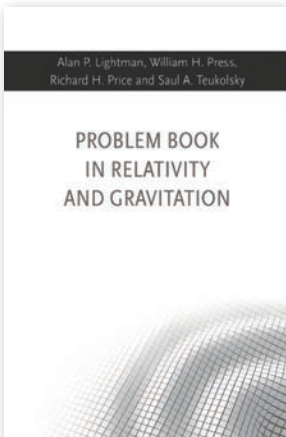
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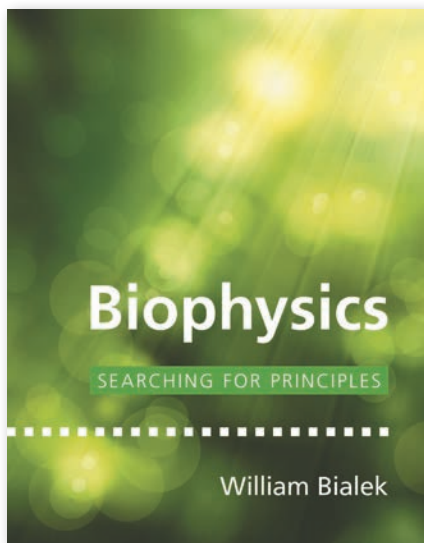
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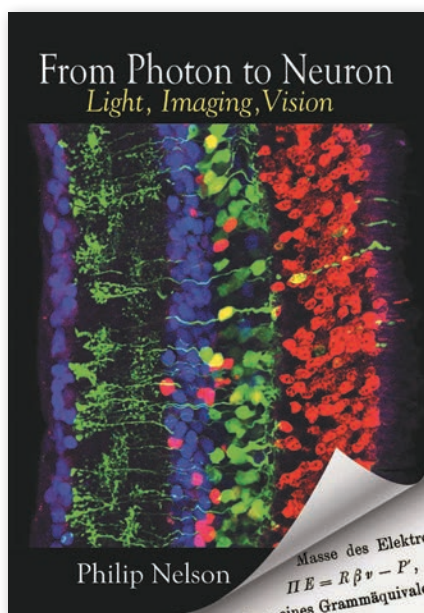
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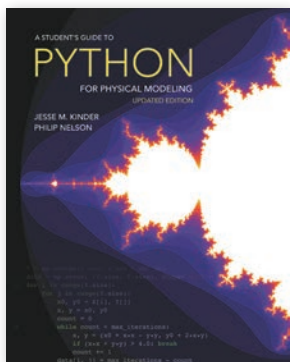
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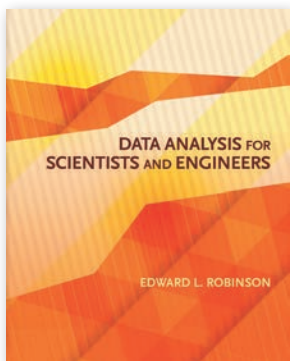
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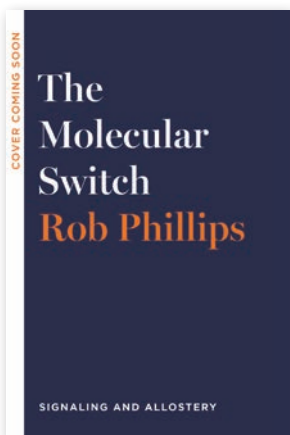
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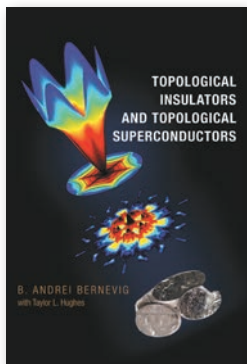
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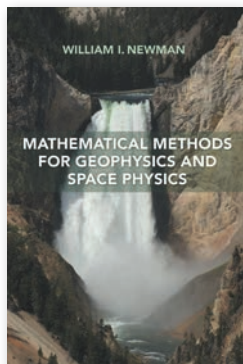
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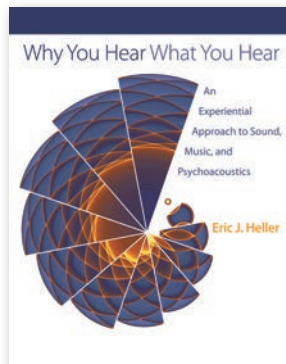
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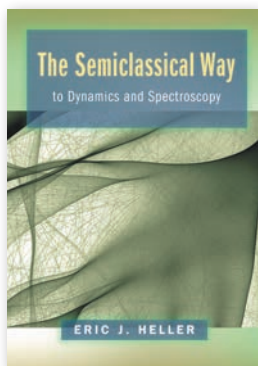
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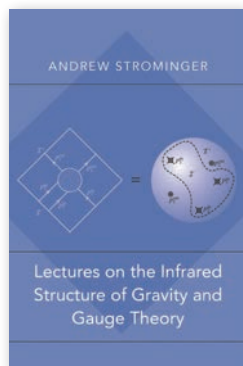
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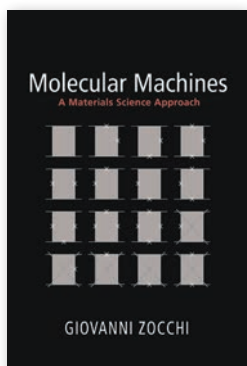
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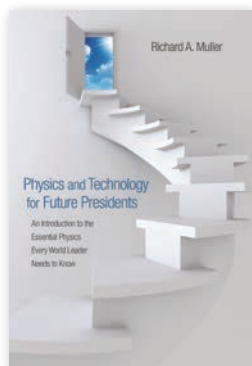
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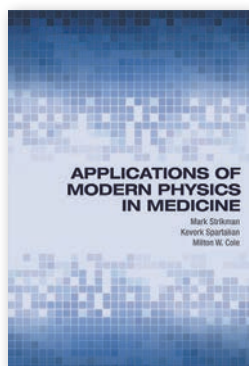
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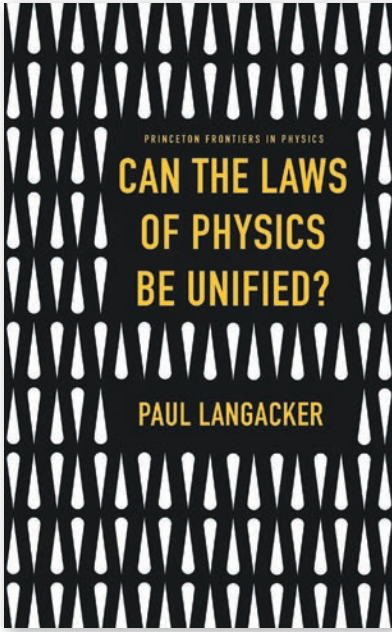
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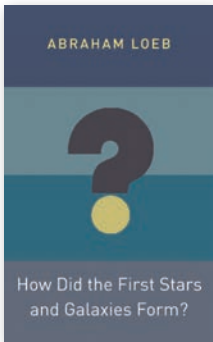
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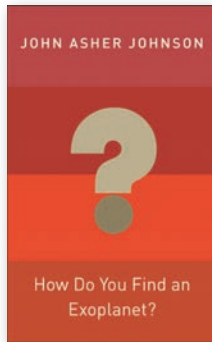
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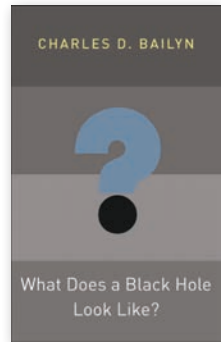
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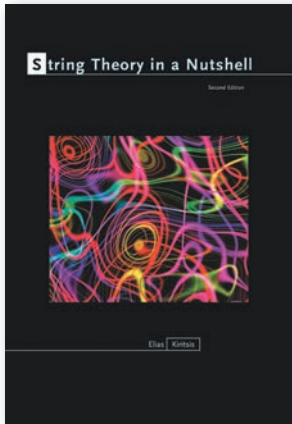
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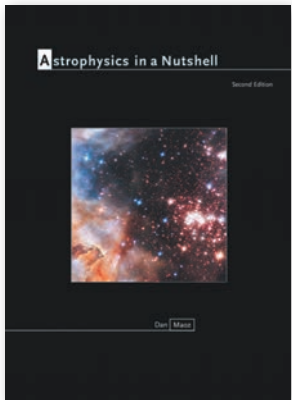
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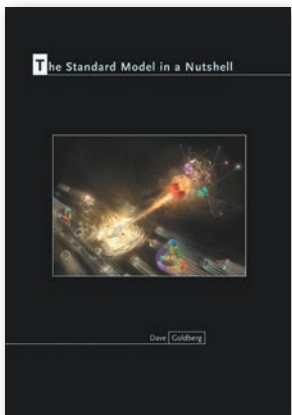
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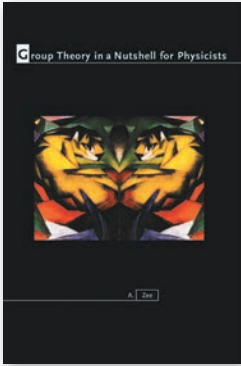
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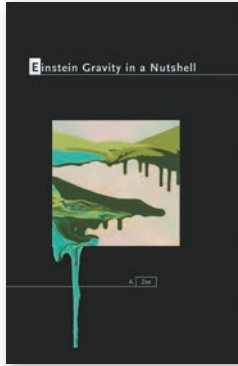
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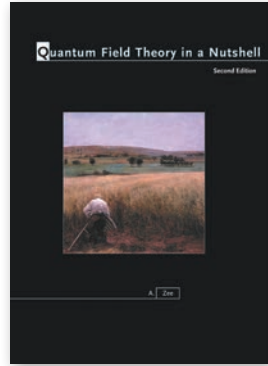


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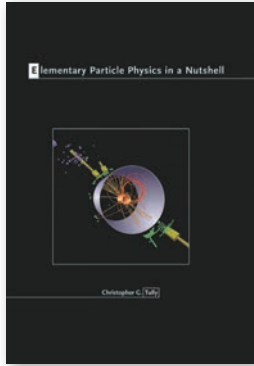
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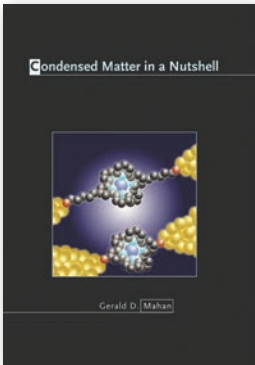
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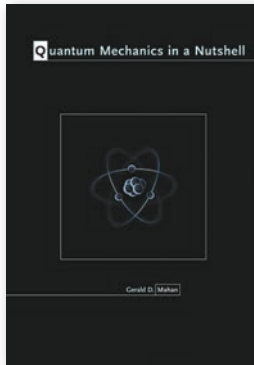
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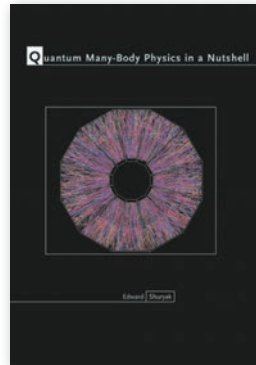
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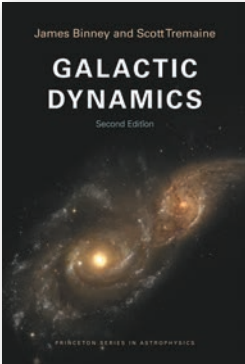
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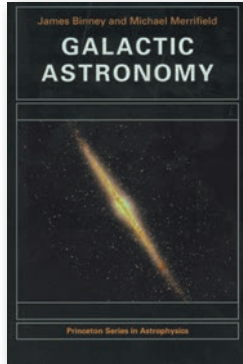
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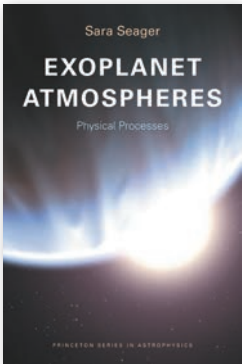
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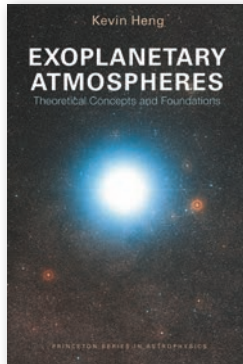
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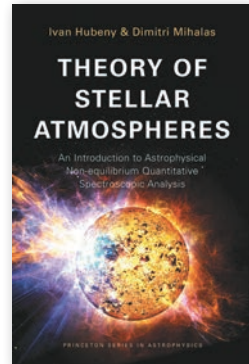
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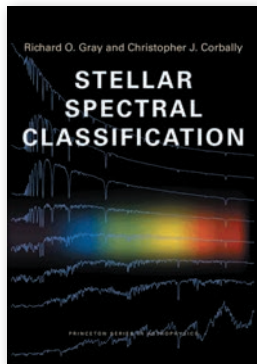
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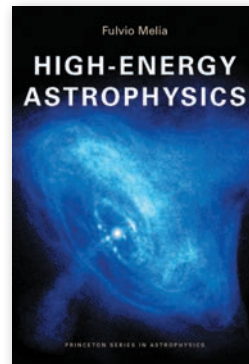
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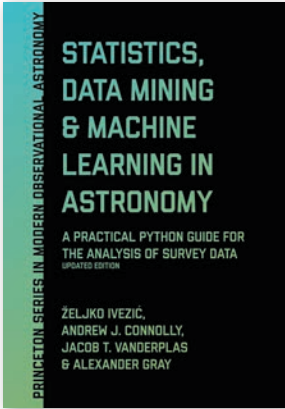
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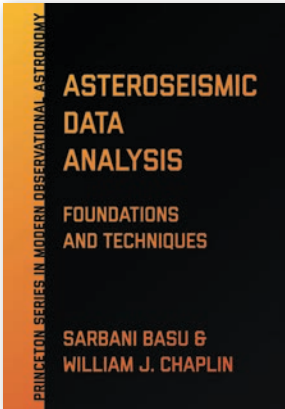
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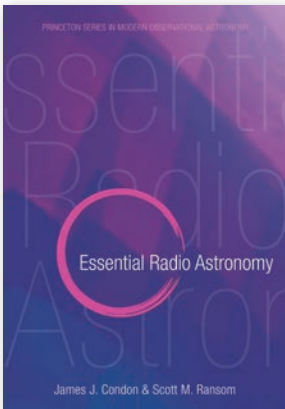
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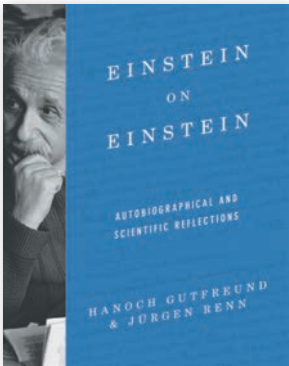
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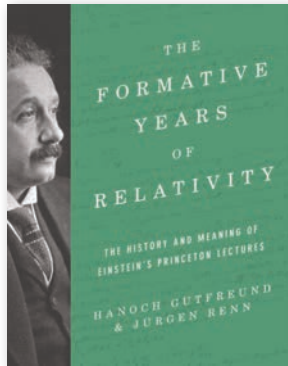
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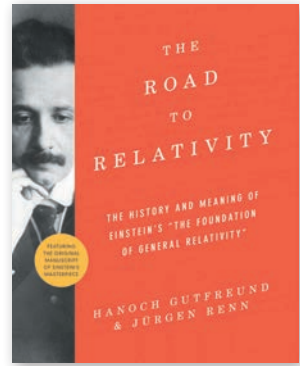
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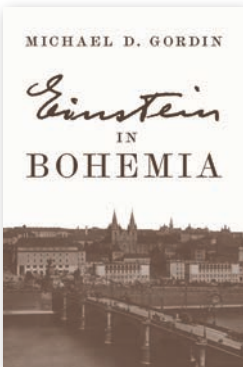
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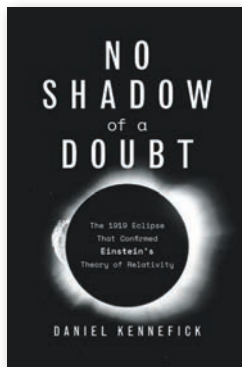
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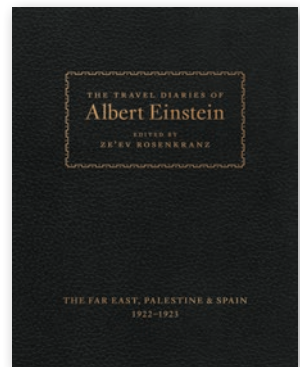
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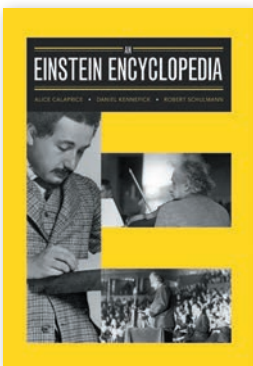
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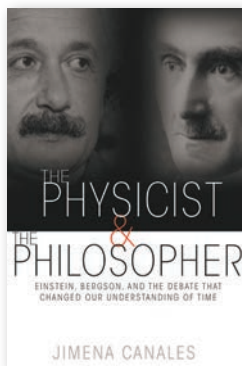
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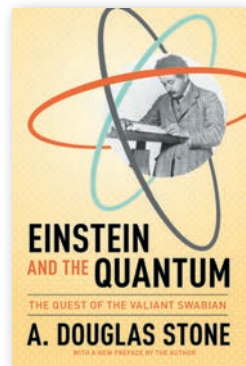
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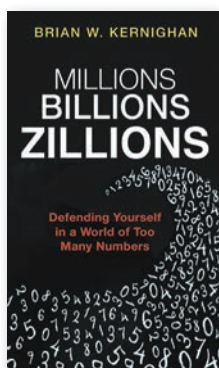
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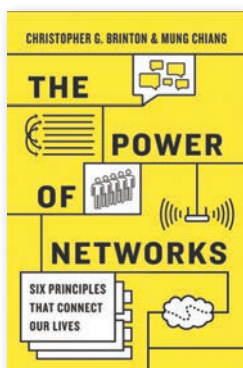
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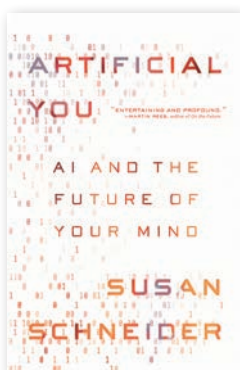
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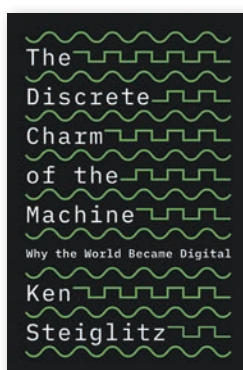
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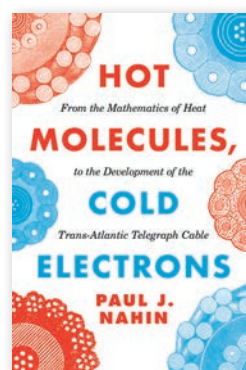
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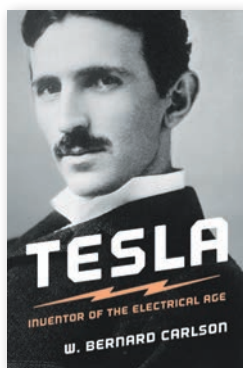
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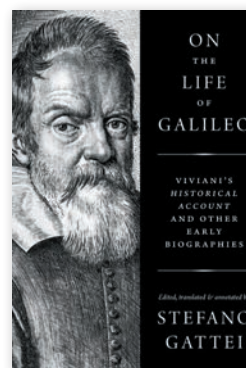
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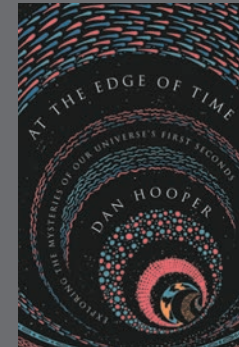
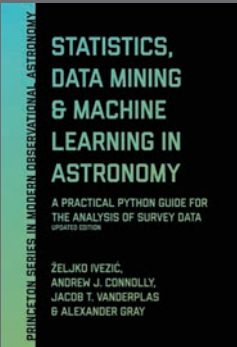
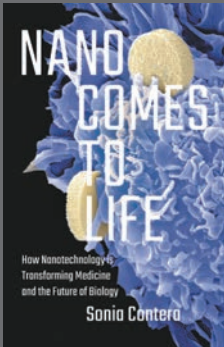
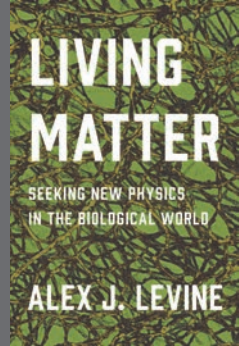
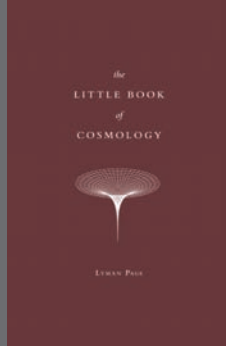
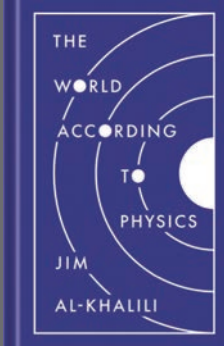
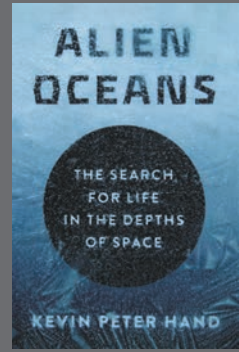
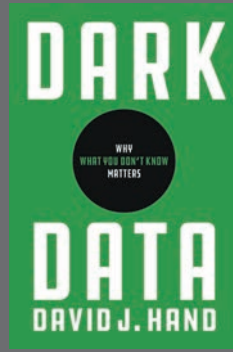
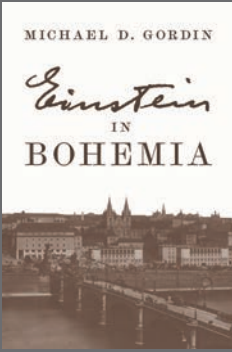
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