

freedom of choice; some people hate it, calling it metaphysics and theology and saying that it kills their dreams of a final theory. But in his 2005 paper, "Living in the Multiverse," Steven Weinberg compared the recent developments with the revolution in physics that happened with the invention of the special theory of relativity: "Now we may be at a new turning point, a radical change in what we accept as a legitimate foundation for a physical theory."

Perhaps the most emotional response is related to the anthropic implications of multiverse theory, which are actually quite trivial and, I believe, trivially correct: We can live and make our observations only in those parts of the inflationary multiverse where we can live.

Vilenkin's book contains only 200 pages, which is nearly optimal. The first part of the book includes a description of the Big Bang theory and inflationary cosmology. Years ago inflationary theory looked like an exciting piece of science fiction, but it is gradually becoming a widely accepted cosmological paradigm, and many of its predictions have been confirmed by observational data. The rest of the book is devoted to the theory of eternal inflation, creation of the universe "from nothing," the anthropic principle, the cosmological constant problem, and the string theory landscape. Many of the problems related to those theories are still unsettled, but the book conveys the sense of wonder and excitement that is known to those who take the risk to work on some of the most fundamental problems of modern physics.

It is impossible to write about inflationary theory and quantum cosmology without introducing some of the technical details. In less experienced hands, this could easily make such a book dry and intimidating. Fortunately, because of his deep understanding of the subject, Vilenkin successfully presents even the most complicated parts of the theory in a simple and intuitive way, and he does it without making any parts of his discussion vague or inaccurate—a real achievement.

Vilenkin also offers personal recollections and a well-balanced narrative of the history of the most interesting cosmological ideas of the 20th century. I found his discussion of the work of Russian cosmologists refreshing, particularly concerning Alexei Starobinsky and Viatcheslav Mukhanov, whose seminal contribution to the development of inflationary cosmology is underappreciated by the English-reading audience.

But what I like most about *Many Worlds in One* is its combination of Vilenkin's seriousness, intellectual honesty, and good sense of humor. When I opened the book, I did not expect that it would be so much fun to read. If you are not sure whether this book is for you, I recommend doing something that goes against the grain: First read the prologue, then the epilogue, and then, if you are intrigued, the rest of the book. If you are among those who want to learn about the emerging worldview and enjoy intellectual challenges, you are in for a real treat.

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Experimental Techniques for Low-Temperature Measurements

Cryostat Design, Material Properties, and Superconductor Critical-Current Testing

Jack W. Ekin
Oxford U. Press, New York, 2006.
\$125.00 (673 pp.).
ISBN 978-0-19-857054-7

At last a new book, not a collection of technical papers, has been published on the techniques of low-temperature measurements. Jack Ekin's *Experimental Techniques for Low-Temperature Measurements: Cryostat Design, Material Properties, and Superconductor Critical-Current Testing* is an encyclopedia of techniques, dos and don'ts for anyone starting measurements in the low-temperature field. The text is also a useful reference for old hands at the profession; its appendix provides a current list of suppliers and services and an up-to-date list of cryogenic materials and material properties. The information in the book's more than 650 pages is confined to temperatures between 1 K and room temperature because, according to Ekin, it is written "with special emphasis on superconductor critical-current measurements."

Ekin does not cover such topics as adiabatic demagnetization, dilution refrigeration, and helium-3 coexistence-curve pressure cooling. Those techniques are treated in Olli V. Lounasmaa's *Experimental Principles and Methods Below 1K* (Academic Press, 1974). And Ekin's book would require another 600 pages or more for those topics. Guy K. White's *Experimental*

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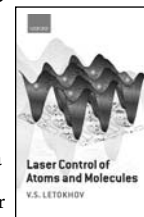


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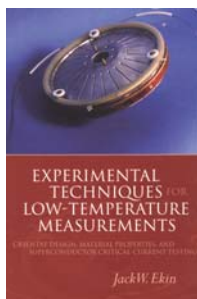
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Techniques in Low-Temperature Physics (Clarendon Press, 1959) was written at a time when the liquefaction of gases, especially helium, was still an art. White's book was followed by others: Lounasmaa's, Martin N. Wilson's *Superconducting Magnets* (Oxford U. Press, 1983), and *Experimental Techniques in Condensed Matter*



Physics at Low Temperatures (Addison-Wesley, 1988), edited by Robert C. Richardson and Eric N. Smith, which is a somewhat less coherent compendium of low-temperature techniques written by several authors. Oxford U. Press published a fourth edition of White's book, with Philip J. Meeson as the co-author, in 2002. The first chapter of Ekin's book contains a comprehensive list of books on cryogenic techniques, which is part of what makes *Experimental Techniques for Low-Temperature Measurements* so valuable.

Ekin acknowledges White "for his initial invitation to conceive and plan the text." But unlike White's book, Ekin's is available at a time when one can call up an industrial supplier to order liquid helium, when handling the cryogenic liquids and the cryostat design is more important than the liquefaction of helium. To get to temperatures below 1 K without laser cooling, one needs to first master the techniques for getting to 1 K—and for that Ekin's book is ideal. The text is written from a hands-on, experimental point of view. It contains many useful formulas and voluminous material on low-temperature properties, but the derivations of those formulas are not included. For readers curious about the origin of the equations, comprehensive lists of references are located at the end of each chapter and in the appendix.

Ekin is a respected member of the physics community and throughout his career as a research physicist at NIST in Boulder, Colorado, has written many papers on the characterization of superconductors. His book is divided into three parts with increasing specialization. Part 1, "Cryostat Design and Materials Selection," is for the general researcher working at low temperatures and an invaluable resource for the beginning researcher. For experts, it contains important information to help explain why equipment is not working as well as it should. The author also offers tips about how to improve the performance of equipment—or, better yet, how to design it correctly in the first place. Details and illustrations about how to construct effective solder or

weld joints and other features are strewn throughout the entire book.

Part 2, "Electrical Transport Measurements: Sample Holders and Contacts," and part 3, "Critical-Current Measurements and Data Analysis," are more specialized. In both parts, some of the subject material overlaps with that treated in Wilson's book; however, Ekin's text puts more emphasis on the characterization of superconductors and their properties than on the design of superconducting magnets and their components.

Reading *Experimental Techniques for Low-Temperature Measurements* is enhanced by mots at the beginning of each chapter. For example, chapter 1 starts with Albert Einstein's "Everything should be made as simple as possible, but not simpler." The final chapter has a quote by Diane Wakoski: "Poems reveal secrets when they are analyzed." Overall, I highly recommend Ekin's book. It is informative and well written, for beginners who are starting research at low temperatures and for veterans who will benefit from the author's experience.

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acoustics

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