

I'd had David Mermin's new book then!

It's About Time: Understanding Einstein's Relativity is based on Mermin's lectures to non-science majors at Cornell University, which the author has been giving intermittently for the past 30 years. This is his second book on relativity theory, the first being *Space and Time in Special Relativity* (McGraw-Hill, 1968). Both books share the goal of introducing special relativity to nonexperts; in broad terms, both cover similar topics. But since his first book, Mermin's ideas about how relativity should be taught have developed considerably. Given the lectures on which the new book is based, it's no surprise that *It's About Time* contains only simple algebra; yet there's nothing superficial about the level of understanding that it aims to impart.

The book begins with an unusually clear discussion of the principle of relativity in Newtonian mechanics. The reader needs very little prior knowledge. For example, in chapter 1, Newton's first law is stated, and Mermin spells out the distinction between speed and velocity. Reference frames are introduced and used to predict what will happen in simple collisions. The way in which velocities transform between frames is considered carefully, so that when the constancy of the speed of light appears for the first time in chapter 3, its strangeness is immediately apparent. Later chapters cover the relativistic velocity-addition law, simultaneity, and measurements of time and distance by different observers. The book ends with an introduction to spacetime diagrams, a derivation of $E=mc^2$ in which the algebra gets a little harder, and a brief look at time in general relativity.

Topics covered are standard for a book of this sort. What makes Mermin's book special, however, is the high quality of exposition at every level. He offers such delightful minor touches as using "Alice" and "Bob" to replace the reference frames S and S' . His use of the foot as the unit of length—redefined so that the speed of light is exactly 1 ft/ns—is amusing, especially when combined with centimeters. The book has plenty of clever and—to me, at least—original arguments that get the important ideas

across in a very clear way. For those who wish to teach the subject themselves, one example in particular, which involves two trains with opposite velocities, is well worth copying. What makes the book as a whole so enjoyable to read is the steady pace at which the subject unfolds. The author spends as much time on each idea as he considers necessary instead of treating each in proportion to the number of questions anticipated on an end-of-the-year examination. As a result, the book has excellent sections on reference frames and collisions in non-relativistic mechanics, and its long introduction to spacetime diagrams is the best I've ever seen. Nowhere is the book too intense, and the learning curve for readers has a fairly constant slope.

The book contains no four vectors and no Lorentz transformation; it mentions the Michelson–Morley experiment only in passing. Despite its elementary level, I'd recommend *It's About Time* to physicists. They won't learn any new physics, but they can watch Mermin, a master teacher, at work—and instructors will almost certainly include some of the ideas in their own teaching. Although Mermin's book doesn't have enough material to make it suitable as a standalone text for an undergraduate course, any undergraduate can read it with profit, either before or after learning about special relativity.

What about younger people? I teach physics to pupils aged 13 to 18, and I shall certainly be ordering some copies for a few of them to read. The book's high English-to-math ratio means that even some of the 13-year-olds could get something out of it. Those 16 and older should be able to learn a lot from the book, and I'm sure they'd enjoy it. The physics I teach at school rarely involves chains of reasoning with more than two steps. I hope *It's About Time* will show some of my students what real physics is like.

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Fundamentals in Nuclear Physics: From Nuclear Structure to Cosmology

Jean-Louis Basdevant, James Rich, and Michel Spiro
Springer, New York, 2005. \$79.95 (515 pp.). ISBN 0-387-01672-4

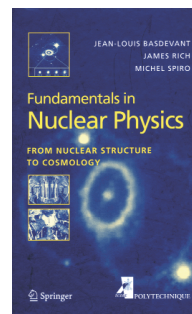
The past 30 years have brought significant advances in astrophysics, cosmology,

and neutrino physics. Observers using very powerful telescopes can explore element abundances in distant metal-poor stars. Researchers are making increasingly more precise observations of the many elements formed in the early universe, various aspects of the cosmic microwave background radiation, and the accelerated expansion of the universe. Physicists now understand the reasons for the deficiency of solar neutrinos in earlier measurements and have glimpsed the physics beyond the standard model by measuring differences between squares of neutrino masses and two of the neutrino mixing angles. Experimenters are now working to measure the third angle and reduce the uncertainties in what has already been measured.

Nuclear physics plays a crucial role in all of the above developments, a fact perhaps not widely recognized. *Fundamentals in Nuclear Physics: From Nuclear Structure to Cosmology*, by Jean-Louis Basdevant, James Rich, and Michel Spiro, is aimed at those readers who need a working knowledge of nuclear physics to design neutrino- or dark-matter detection experiments and need to analyze their results. Similarly, interpretation of observations of the stellar and primordial element abundances requires an extensive knowledge of nuclear physics.

The authors are well-regarded scientists who work at the interface of nuclear and particle physics and astrophysics, and the book is based on the late-1980s lectures they gave at the École Polytechnique in Paris. The text succeeds quite well in its aims. Not too many books on the subject share the same goals. The venerable *Experimental Nuclear Physics* (Wiley, 1953–59) by Emilio Segrè is out of date: It covers neither modern neutrino physics nor astrophysics. Two widely cited books, *Cauldrons in the Cosmos: Nuclear Astrophysics* (U. of Chicago Press, 1988) by Claus Rolfs and William Rodney and the revised version of *Principles of Stellar Evolution and Nucleosynthesis* (U. of Chicago Press, 1983) by Donald Clayton, originally published in 1968, are mostly focused on nuclear astrophysics and also need to be updated.

In *Fundamentals in Nuclear Physics* the authors have found the right balance between presenting nuclear physics as a domain of fundamental



research and exploring its applications in neutrino physics, plasma physics, astrophysics, and cosmology. They provide a very readable introduction to nuclear physics and nuclear models. Some readers will appreciate such historical anecdotes as the origin of "borromean," used to describe a class of nuclei. The chapter on nuclear reactions includes a compact but complete summary of quantum-mechanical tools needed to understand a wide class of nuclear reactions. The authors give an extensive discussion of recent neutrino-physics experiments and the role nuclear physics plays in those experiments. Discussions of nuclear astrophysics and cosmology are brief but provide a good basis for students wishing to consult more specialized texts.

The book offers a thorough treatment of cosmogenic radioactivity, which is so important in planning various low-background counting experiments, and explores at length the overlap between nuclear physics and the fields of plasma physics and nuclear engineering. The authors cover not only the basic physics underlying nuclear fission and fusion but also neutron transport in matter, different kinds of nuclear reactors, and magnetic and laser-driven inertial confinement. The brief accounts of various applications of nuclear radioactivity and of the prehistoric natural reactor in Oklo, Gabon, are nice examples of the kind of supplementary information that most other texts omit.

Most readers should be able to correct the book's few typographical errors from the context in which they appear. As in many other texts covering a rapidly evolving field, some data the authors mention—including, for example, evidence for pentaquarks—are very preliminary. The authors could have given more information on the physics

of exotic nuclei and tools used to explore them, such as radioactive-beam facilities. They also could have included a discussion of relativistic heavy-ion beams and properties of quark-gluon plasmas. But inclusion of those topics would have significantly lengthened the book, making it less appropriate for a one-semester graduate course.

Overall, *Fundamentals in Nuclear Physics* is a suitable textbook for a graduate-level introductory course aimed at providing background material in nuclear physics to students who intend to specialize in particle physics, plasma physics, and astrophysics. It can also be used as a supplementary textbook in a graduate course designed for students who plan to specialize in nuclear physics.

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Theaters of Time and Space: American Planetaria, 1930-1970

Jordan D. Marché II
Rutgers U. Press, New Brunswick,
NJ, 2005. \$49.95 (266 pp.).
ISBN 0-8135-3576-X

We do not usually associate James Dean with science education, but as Jordan D. Marché II reminds us in his scholarly account, *Theaters of Time and Space: American Planetaria, 1930-1970*, the opening scenes of *Rebel Without a Cause* were filmed at the Griffith Observatory in Los Angeles. In the film, the planetarium lecturer follows up a portrayal of the Big Bang with a speech about the smallness of human beings in the chilling immensity of the universe. By 1955, when the movie was released, the plan-

etarium had become a common feature of American life, and *Theaters of Time and Space* is primarily concerned with why that was so. The book also examines the boom in planetarium building that followed on the heels of *Sputnik I* in 1957 as American lawmakers scrambled to plug what they saw as alarming gaps in the US educational system.

Marché, a lecturer in astronomy at the University of Wisconsin-Madison and a planetarium specialist, opens his book with an account of mechanical models of the universe. He moves on quickly to the story of the projection planetarium, in which Oskar von Miller played a key role. Miller was the director of the

Deutsches Museum in Munich, Germany, at the turn of the 20th century and initially wanted to secure mechanical models for the museum. But during a meeting in 1914 between Miller and representatives of the Carl Zeiss Optical Co, Walther Bauersfeld and Werner Straubel hit upon the chief ideas of the projection planetarium. In 1923, the first public demonstrations were given at the Deutsches Museum.

Such was the popularity of these new devices that by 1930 engineers had constructed 15 planetaria in Europe. In that year, with the aid of a hefty donation from the vice president of Sears, Roebuck and Co, the Adler Planetarium opened in Chicago. In the following decade, Zeiss projectors were housed in Philadelphia and Pittsburgh in Pennsylvania, in Los Angeles, and in New York City. Two smaller, non-Zeiss planetaria were located in San Jose, California, and Springfield, Massachusetts.





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