

science so utterly disconnected from the practice of science? Does anybody actually read *Physical Review Letters*? And, of course, the mother of all questions: How do we properly pronounce “quark”?

The most recent essays in the book mostly focus on the quantum world and just what is and isn’t wrong with it. They include the most insightful—and yet brief—exposition of quantum computing that I have come across. Several of the previously unpublished pieces are birthday speeches, summaries of lectures, or obituaries. The reader also hears again from Professor Mozart, a semifictional character that Mermin introduced in his Reference Frame columns.

Even though some of Mermin’s essays are accessible for the uninitiated, most of them would likely be incomprehensible to those without some background in physics, either because he presumes technical knowledge or because the relevance of his subject will not be clear to the reader. The first essay is a good example. It channels Mermin’s outrage over “Lagrangeans,” and even though written with both humor and purpose, it criticizes a spelling that I doubt nonphysicists would perceive as properly offensive. Likewise, a 12-verse poem on the standard model and elaborations on how to embed equations into text will find their audience mostly among physicists.

My only prior contact with Mermin’s writing was with a Reference Frame column from May 2009, in which Mermin lays out his favorite interpretation of quantum mechanics, QBism. Proposed by Carlton Caves, Christopher Fuchs, and Rüdiger Schack, QBism views quantum mechanics as the observer’s rule book for updating information about the world. In his column, Mermin argues that it is a “bad habit” to believe in the reality of the quantum state. “I hope you will agree,” he writes, “that *you* are not a continuous field of operators on an infinite-dimensional Hilbert space.”

I wrote a response to that column lamenting that Mermin’s argument was “polemic” and “not very insightful,” off-hand complaints that *PHYSICS TODAY* published in September 2009. Mermin replied that his column was “an amateurish attempt” to contribute to the philosophy of science and quantum foundations. But while reading *Why Quark Rhymes with Pork*, I found his ama-

teurism to be a benefit: In contrast to professional attempts to contribute to the philosophy of science (or linguistics, or sociology, or scholarly publishing), Mermin’s writing is mostly comprehensible. I’m thus happy to leave further complaints to philosophers.

Why Quark Rhymes with Pork is a book I’d never have bought. But having read it, I think you should read it too, because I’d rather not discuss the same questions 20 years from now.

And the only correct way to pronounce quark is, of course, the German way, as “qvark.”

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Key Nuclear Reaction Experiments

Discoveries and Consequences

Hans Paetz gen. Schieck

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Nuclear physics is one of the most difficult topics in science. On the one hand, nucleons are composite objects, constituted of quarks and gluons, and on the other, they combine into highly complex many-body systems. Nuclear-physics experiments are expensive; they require complicated particle detectors in addition to nuclear accelerators that generate particles fast enough to penetrate an atom’s electron cloud and react with a target nucleus. Additionally, it is challenging to understand enough nuclear-physics theory to carry out present-day research in nuclear medicine, nuclear reactions, stellar evolution, and other hot topics of nuclear science.

Hans Paetz gen. Schieck’s new book, *Key Nuclear Reaction Experiments: Discoveries and Consequences*, aims to provide a basic overview of the theory and practice of nuclear physics. A few decades ago, Theo Mayer-Kuckuk wrote *Kernphysik: Eine Einführung* (B. G. Teubner, 1984), a concise and relatively simple book introducing the reader to the basic concepts of nuclear physics. A similar book by Walter Meyerhof, *Elements of Nuclear*

Physics (McGraw-Hill, 1967), exists in the US but is out of print. Schieck’s book is comparable to those in style, but it is focused on nuclear reaction experiments. It might therefore be useful for a one-semester course that gives a general introduction to nuclear physics. It can also be used by experienced researchers who have little knowledge of complementary aspects of their field.

Key Nuclear Reaction Experiments occasionally assumes more knowledge of nuclear physics than a beginning reader would possess. As early as chapter 2, for example, the reader has to know such basic concepts of quantum mechanics as Fermi’s golden rule. However, the author tries to keep such prerequisites to a minimum and derives most results from scratch or intuitively. The text and derivations are concise and the figures are well drawn; they effectively guide the reader through the main concepts under discussion.

In his relatively short volume, Schieck manages to cover a remarkable range of nuclear reactions that test the geometry of nuclei. In chapter 4, which introduces those reactions, he explains differences in neutron and proton matter distributions, the experimental setups used to ascertain those differences, and the connection with other nuclear systems such as neutron stars. In a follow-up in chapter 5, he presents the newly blazed path to the discovery and understanding of nuclear halo systems and vividly describes loosely bound three-body systems, also known as Borromean systems. Perhaps a few more words could have been said about Efimov states, which manifest some of the most beautiful aspects of feebly bound three-body systems.

In its middle chapters, the book takes a sudden turn into the particle zoo. Schieck focuses on the parts of the zoo that are of main interest to nuclear physics, including the neutron, quarks, and gluons. He also discusses some of the history of nuclear physics, such as the discovery of the neutron and the development of nuclear accelerators. From there he covers a range of nuclear experiments and phenomena, including direct nuclear reactions, such as stripping reactions; the nucleon–nucleon interaction and its symmetries; Mott scattering;



molecular resonances; and excited, compound nuclei.

Two chapters near the end of the book reflect Schieck's research passion: They introduce the reader to the first experiments to use polarized beams with particular reaction systems. The final chapter discusses the discovery and our present understanding of giant resonances in nuclei. I would have liked to see some sentences about pigmy resonances, collective vibrations found in neutron-rich nuclei at energies too low for giant resonances.

In the end, Schieck delivers a delightful book appropriate for the reader seeking a first acquaintance with the subject. He is a highly reputable nuclear physicist and well experienced with public lectures and review articles. No wonder that he was able to describe a broad field of physics with so few words and so few equations.

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How Do You Find an Exoplanet?

John Asher Johnson

Princeton U. Press, 2016. \$35.00 (178 pp.). ISBN 978-0-691-15681-1

In *How Do You Find an Exoplanet?* John Asher Johnson explains the four key methods that have been used to discover exoplanets—planets that orbit around stars other than the Sun. Those are the radial velocity method, observations of transits, analysis of gravitational microlensing, and direct imaging. As Johnson states in his preface, many books explore the subject matter in much greater depth and complexity. His aim, however, is to make it accessible to anyone with an understanding of freshman physics. In that aim he succeeds. Readers with an understanding of Kepler's laws or even just Newtonian gravity will find the topics covered to be comprehensible and the progression of topics easy to follow.

The book starts with a short description of how Johnson first became interested in astronomy and, in particular, how he "discovered" his first planet—Jupiter—shining like a bright star in the night sky. The story

helps readers identify with the author and points out that even those who grew up in a city with hardly any awareness of the nighttime stars above could be bitten by the astronomy bug. The introduction then gives a brief history of astronomy that includes a concise overview of the Copernican revolution. Even if the historical material is familiar to many readers, Johnson's perspective serves to illustrate how scientific ideas and discoveries progress and, in particular, how they can challenge our perceptions of our place in the universe. The introduction is also a good review for readers who need a brief refresher on the basics of Kepler's laws.

Johnson writes in a familiar tone and includes anecdotes from his own career as a professional astronomer on the hunt for exoplanets. At times, I could imagine myself in one of Johnson's classes, listening as he explains in his conversational style the theory behind the exoplanet discovery techniques and points to his whiteboard sketches to illustrate the basic concepts. That said, I should clarify that the diagrams in the book are by no means straight off a whiteboard. Rather, they are mostly clear, simple, well-labelled line diagrams.

I particularly like how Johnson starts from basic principles and explains jargon terms; he even includes a glossary at the back of the book in case readers forget. Reading a book that actually starts with simple approximations is a refreshing change. Once the general concept is clear and examples are given to provide approximate numerical values of observables, Johnson adds to the foundation by introducing terms such as eccentricity and angles of inclination to better describe real-life systems.

The ordering of the chapters and the number of pages dedicated to each discovery method approximate the order of how successful the technique has been in finding exoplanets. Currently, microlensing and direct imaging are competing for third place, although I expect direct imaging to become the dominant discovery method as scientists overcome the technological hurdles. And that brings me to my only quibble with the book: I would have liked a few more pages spent on direct imaging. That method had the fewest pages



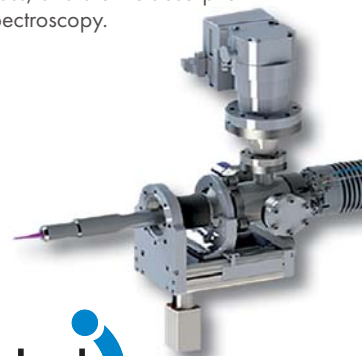
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