fully dissects those questions and offers his honest, thoughtful responses. Instead of forcing his conclusions on the reader, he presents a set of compelling arguments for the value of string theory while acknowledging its weaknesses and open challenges. Like courtroom juries, readers are encouraged to draw their own logical conclusions.

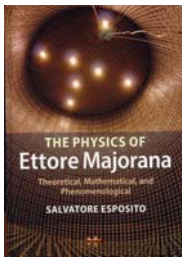
A physicist colleague once remarked to me, "There is rarely any doubt about the existence of dinosaurs, although almost certainly no humans were alive 65 million years ago to observe the extinction." Like paleontologists finding evidence for ancient life, string theorists work to tease out subtle signals from nature even though direct experimental verifications are currently out of reach. Conlon writes with flair and wit to give a lively account of the struggles and joys of theoretical physicists seeking to uncover the inner workings of a beautiful, wide-ranging theory.

Gary Shiu
University of Wisconsin Madison

The Physics of Ettore Majorana

Theoretical, Mathematical, and Phenomenological

Salvatore Esposito
Cambridge U. Press, 2015. $85.00
(382 pp.). ISBN 978-1-107-04402-9



When Paul Dirac proposed what we now call the Dirac equation, he apparently had gone through a dozen alternatives, which he discarded, even from his filing cabinet. To this day no one knows why he chose the simplest construction rather than the most obvious one or, indeed, any of the others that ended up filling his wastebasket. It is extraordinary that he even stumbled on his final formulation, simple and beautiful as it was, given that it was so far removed from the prevalent mathematics of his day, and also so full of physical oddities.

About a decade after the 1928 publication of the Dirac equation, the quirky Sicilian genius Ettore Majorana published a variation whose wavefunction solutions—Majorana fermions—are real. The truth is that Dirac's equation is bizarre, and plenty of alternatives existed even after Dirac's publication. The alternatives are in a way more curious. That some of them made it into the mainstream of physics—after originally being badly misinterpreted—just goes to show the inherent anarchy of the process of producing new science.

If you find this sort of thing interesting, you will love *The Physics of Ettore Majorana: Theoretical, Mathematical, and Phenomenological*, in which author Salvatore Esposito delves deep into Majorana's notebooks and published work. The book goes back to the time when relativistic quantum mechanics, quantum field theory, and particle physics were still embryonic. To read about the hits and misses, the clashes, the missed opportunities, the tensions between

physics and mathematics, can be nothing but humbling. The chapter on alternatives to the Dirac equation is perhaps the most poignant; the whole book is imbued with the feeling of sailing through uncharted seas.

Majorana was one of the first to think about fundamental theories of nature in terms of group theory and symmetry. At the time, no one around him understood what he was doing. The Majorana fermion and the possibility that the neutrino might be such a particle were some of the offshoots of his work. I have always been enthralled by Majorana's ability to think out of the box, to oppose trends, and to open up new avenues of reasoning. His mind was unique, and if reading his papers can be challenging, mainly for notational reasons, plodding through his notebooks can feel like a trek in the jungle. Esposito's book, however, provides the perfect guided tour through his brief but prolific career, in modern language and with proper contextualization.

A few years ago I wrote *A Brilliant Darkness* (Basic Books, 2009) on the science and person of Majorana because I did not like the pervasive Jekyll and Hyde descriptions of him. For the international physics community, his name conjures thoughts of neutrinoless double beta decay, representation theory, and atomic and nuclear physics. In Italy he has rock-star status because of a stunt he pulled towards the end of his known life. Majorana's final antic has become a popular detective story, revisited by the Italian press on a roughly biannual basis.

On the night of 26 March 1938, at the young age of 31, Majorana boarded a ship and was never seen again. He left behind notes and telegrams that may be construed as suicide letters, but he also took with him his passport and a large amount of cash. He may have jumped overboard, but his body was never recovered. He was later "sighted" on several occasions, leading to all manner of conspiracy theories. More fascinating, to my mind, is the drama and psychology behind his "vanishing," whatever might actually have happened on that night.

Majorana's story is one in which unconventional science mimics unconventional character, and the two aspects should be presented in tandem as much as possible. But if your interests lie in science rather than scientists, up until now you would mainly regret the gaping hole in the literature regarding Majorana's scientific output. His singular thinking was largely left to specialists happy to trudge through archives and old journals, as well as somewhat unreadable reprints of his papers, often not in English. This book fills the gap and celebrates his legacy in its full glory.

João Magueijo
Imperial College London
London, UK

Physics of Cancer

Claudia Tanja Mierke

IOP Publishing, 2015. $150.00 (449 pp.).
ISBN 978-0-7503-1135-9

Studies on the physical science of cancer are rapidly increasing, but few, if any, scholarly books exist that summarize the field and inspire current and future practitioners. To that end, Claudia Tanja Mierke's *Physics of Cancer* provides a wide-ranging introduction to the application of modern biophysical concepts to cancer research. It is appropriate for readers who study either physics or cancer biology; my graduate student Charlotte Pfeifer and my postdoc Jerome Irianto, both of whom helped me assess this book, fit the bill. Another recently released book that comes close to summarizing the field, and that covers a wider range of topics, is Bernard Gerstman's *Research on the Physics of Cancer: A Global Perspective* (World Scientific, 2016).

A physics professor at the University of Leipzig in Germany, Mierke has been working in the field since the early 2000s; her focus is on the migration of cancer cells in relation to their microenvironment, including neighboring cells. *Physics of Cancer* clearly draws on her experience: She has authored many research articles and review papers and some book chapters. In addition to providing up-to-date insights on cancer-cell migration, the book's first section provides a broad overview that readers unfamiliar with cancer science or biophysics could appreciate.

In many places, the author skillfully connects biophysical concepts, such as adhesion forces, to cancer. For example, in her discussion of the extracellular matrix under tissue-aging conditions, Mierke does a fine job of relating elevated and inappropriate collagen crosslinking to cancer and other aging-related diseases. As we know from basic polymer physics, crosslinking of any polymer gel will increase its stiffness. More cross-linked collagen equates to stiffer tissues; cells—including malignant ones—attach and crawl better on stiff, adherent things. The biophysics of such processes and its relation to cancer invasion are certainly timely topics.

However, the physical connection is obscure in a couple of key places. For example, Mierke could add a better explanation of how the nucleus inhibits migration and, therefore, how it acts in some ways as a tumor suppressor. Going beyond the biology literature, the author speculates on the physics of changes in lamin levels, a phenomenon observed in cancer patients. Lamin is a meshwork of intracellular structural proteins that surround DNA, including mutated DNA. But the physical underpinnings of that process could have been made more explicitly.

A second edition of this book might be optimized with the addition of a concluding chapter and more figures and diagrams to guide readers. Although the present edition features standalone chapters, which is a virtue for a text of its nature, they are not organized in the most natural sequence. For example, chapters 3 and 5 both address experimental techniques; a more logical sequence would put them next to each other following chapter 1, since they provide a foundation for much of the data reported throughout the text.

The handful of figures that appear in the book are simple, straightforward, and effective. But some places that seem to need figures do not have them. For instance, although the text has a discussion of the jamming phase diagram, it has no illustration. That said, the text's exhaustive citations allow readers to look up original figures.

A modicum of patience is needed because some terms or concepts are introduced and referenced well before a detailed explanation is provided. For example, a discussion of collagen in chapter 8 proceeds for dozens of pages before an adequate primer on the protein is presented. Also, the ratio γ/β is introduced well be-