

## Field theory with French flair FREE

*From Classical to Quantum Fields.* , LaurentBaulieu, JohnIliopoulos, and RolandSénéor, Oxford U. Press, 2017, \$120.00

Francesca Vidotto



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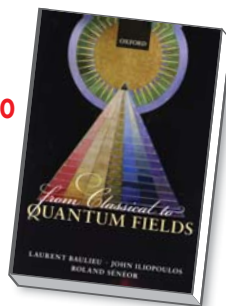
Since Denis Diderot's 1772 *Encyclopédie*, French textbooks have often been characterized by a wealth of topics. Examples that many physics students have encountered include classics such as Albert Messiah's *Quantum Mechanics* (1961) and the two-volume *Quantum Mechanics* (1977) by Claude Cohen-Tannoudji, Bernard Diu, and Franck Lalœ. Now a new French book stands out with its wide range: *From Classical to Quantum Fields* by Laurent Baulieu, John Iliopoulos, and the late Roland Sénéor.

This 992-page book takes the reader on a theorist-guided journey into the standard model of particle physics. The trip begins with a lengthy review of concepts in classical physics. From there, the authors proceed to the main attraction and explore our current understanding of fundamental interactions; they then lead the reader all the way to the uncertain terrain of physics beyond the standard model. *From Classical to Quantum Fields* has a distinctly French feeling, as it pays particular attention to the mathematical aspects of its topics. The authors successfully present the mathematical structures underlying quantum field

### From Classical to Quantum Fields

Laurent Baulieu,  
John Iliopoulos,  
and Roland Sénéor

Oxford U. Press,  
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theory without sacrificing the clarity and fluidity of the exposition. On the other hand, extensive physical applications are sparse.

The encyclopedic aspirations of the book are evident early: The first chapters include the electromagnetic and the gravitational classical fields along with a review of spacetime symmetries that allows the authors to offer a first look at the relativistic field equations and introduce spinors and the notion of physical state. The book's early chapters were originally designed as a master's-level course, in which students with a background in physics and those trained in mathematics would find a common language to proceed further into modern topics in theoretical physics.

The presentation of the concepts is

clear and never redundant. The authors aim to provide a compact path through basic topics rather than offer a complete course on them. Each chapter ends with a few problems suitable for a reader with some previous background on the subjects. The book is enriched with historical notes that provide pleasant interludes.

The highlights of the book come when the authors address more specialized topics, including ones to which they themselves made essential contributions. Those subjects are presented in greater detail than is found in most textbooks. The clear discussion of the path integral, for example, includes fermionic variables. The Euclidean path integral, instead of being relegated to an appendix, rightly finds a dedicated chapter. Also excellent are the explanations of the quantization of gauge theories, symmetry breaking, and Becchi-Rouet-Stora-Tyutin symmetry, in which the authors pay tribute to their friend and mentor Raymond Stora.

Even better is the material on renormalization, the authors' field of expertise. The chapters on the renormalization group and IR divergences are truly outstanding and original. *From Classical to Quantum Fields* also includes a useful presentation of Bargmann coherent states, which unfortunately is missing in many other texts.

At the end of the tour, have the authors passed over any points of interest? One topic that deserves more than a brief mention is extended field configurations such as instantons, monopoles, and skyrmions. What else? The authors say in the prologue that they "decided to leave out subjects, such as the attempts to obtain a quantum theory of gravity based on string theories, because, although they involve very beautiful modern mathematics, they have not yet been directly connected to concrete experimental results." Although sensible, that decision is not consistent with the inclusion of a chapter on supersymmetry, which also lacks concrete experimental results.

That kind of blind spot is one of the drawbacks of the book's theoretical-particle-physicist viewpoint. The limited perspective also undermines the material on gravity. The chapter on general relativity is quite dry and feels disconnected from the rest of the book. Al-

though *From Classical to Quantum Fields* presents many useful observations about the difficulties of achieving general covariance in a quantum field theory, it does not deal with the problem of quantizing gravity.

Unfortunately the authors also share two misconceptions common among particle physicists. The first concerns the phenomenological accessibility of quantum gravitational effects. The authors discuss how far particle accelerators are from reaching the energy scale of quantum gravity, but forget that we have already obtained important results from other kinds of experiments. We have more than just accelerators! For example,

astrophysical and cosmological observations place strong constraints on violations of Lorentz invariance.

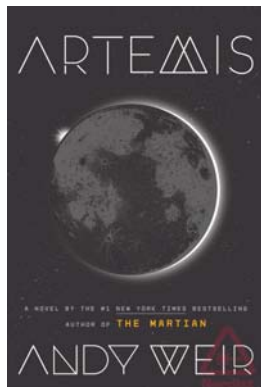
The second misconception in the book is that string theory is the only theory addressing the problem of quantum gravity. It is certainly not the only one, and today perhaps not even the most promising.

Despite a few flaws, *From Classical to Quantum Fields* makes for a fine companion for students and an excellent general reference for researchers in theoretical physics.

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## NEW BOOKS & MEDIA



### Artemis

Andy Weir

Penguin Random House, 2017. \$27.00

In 2014, first-time novelist Andy Weir had an unexpected smash hit with *The Martian*, a sci-fi adventure about a stranded astronaut who uses his wits and engineering skills to survive on the harsh surface of Mars. *Artemis*, Weir's sophomore novel, moves us from Mars to the Moon. Weir's worldbuilding is top-notch; he's thought through both the technical and economic challenges of life in the lunar city of Artemis, and the result is a rich and fascinating setting. The characters don't quite live up to the same standard, unfortunately, and protagonist Jazz Bashara is particularly under-

developed. Fans of *The Martian*'s scientific detail, however, will still find much to like here. For a full review and interview with Andy Weir by National Air and Space Museum curator Matthew Shindell, visit <http://physicstoday.scitation.org/doi/10.1063/PT.6.3.20171215a/full/>. —MB

### David Bohm

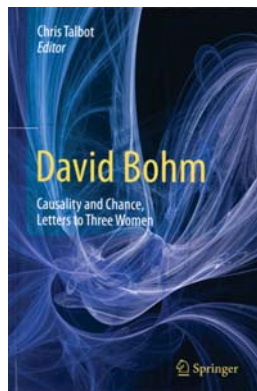
Causality and Chance, Letters to Three Women

Chris Talbot, ed.

Springer, 2017. \$199.00

The life and career of US theoretical physicist David Bohm spanned some of the most politically fraught periods in the country's history. Fired from his position at Princeton University after a federal investigation into his Communist ties, Bohm relocated to Brazil, where he became known for advocating an unusual causal interpretation of quantum mechanics. Editor Chris Talbot, a retired physicist, argues that understanding Bohm's Marxism is essential to fully appreciating his physics, and offers selections from Bohm's correspondence to support his thesis. Talbot features three Bohm correspondents in particular: Hanna Loewy, a former girlfriend; fellow physicist Melba Phillips, also a former student of Robert Oppenheimer; and mathematician Miriam Yevick. The fascinating letters deserve publication, but historians will be left wondering if these letters are representative or unusual for Bohm.

—MB



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