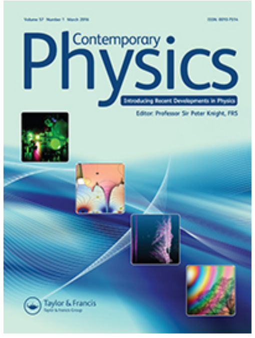

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Modern classical physics: optics, fluids, plasmas, elasticity, relativity, and statistical physics

Miguel A. F. Sanjuán

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BOOK REVIEW

Modern classical physics: optics, fluids, plasmas, elasticity, relativity, and statistical physics, by Kip S. Thorne and Roger D. Blandford, Cambridge, Cambridge University Press, 2017, 1552 pp., £104.95 (hardback), ISBN: 9780691159027. Scope: textbook, reference. Level: postgraduate, early career researcher, researcher, scientist.

Discovering this book was really a pleasant surprise. On the one hand, the broad contents of classical physics (only classical mechanics, electromagnetism and elementary thermodynamics are missing), on the other hand the size (more than 1500 pages). Needless to say, the fact that the authors are the reputed theoretical physicists Kip S. Thorne, the co-winner of the 2017 Physics Nobel Prize, and Roger D. Blandford, co-winner of the 2016 Crafoord Prize in Astronomy, both members of the National Academy of Sciences of the USA, was an important issue. My first impression was outstanding since I consider that the project of this book was a worthwhile attempt to incorporate into the teaching of physics detailed descriptions of classical disciplines such as optics, fluid mechanics, physics of plasmas, elasticity, special and general relativity, and statistical physics. Even the title of the book seems rather appropriate since the focus is on classical physics including many modern and original contributions and insights that usually differ from the traditional viewpoint. The material covered in the book has been taught by the authors for a long time to first-year graduates. The rich tradition of physics courses such as the well-known ten-volume Landau-Lifshitz Course of Theoretical Physics or The Feynman Lectures on Physics seems to have inspired the authors. However, I find it different both with respect to the size and to the contents, incorporating positive values of both approaches. Furthermore, it is worthy of praise the special attention focused on numerous modern real-world applications of physics, engineering and technology.

The book is organised in seven parts including foundations, statistical physics, optics, elasticity, fluid mechanics, plasma physics, and general relativity making it a total of twenty-eight chapters. In the foundations part, a geometric principle is adopted by which all physical quantities and laws are expressed in geometric forms that are independent of any coordinate system. This affects Newtonian physics and the special relativity. The second part is devoted to statistical physics comprising kinetic theory, statistical thermodynamics, statistical mechanics (with interesting applications to gravity and astrophysics) and random processes. The part devoted to optics is perhaps one of the most original, and rather different from the traditional approach taken in other textbooks. Numerous examples of applications in gravity and experimental techniques used in the research on gravitational waves have been incorporated. The parts on elasticity, fluid dynamics and plasma physics are more standard, though it contains key chapters on turbulence, magnetohydrodynamics, and kinetic theory of plasmas. In the final part, devoted to general relativity and cosmology, there is a remarkable chapter on gravitational waves and experimental tests of general relativity, difficult to find elsewhere. Each chapter contains a rich collection of exercises all along the text. A few are brief, but most of them are described in great detail attempting to help the student to deepen into the subject, and oftentimes increasing the contents with new ideas and insights. Furthermore, at the end of each chapter, there is a brief section devoted to bibliographic notes, with an outstanding and careful selection of references with useful comments. The textbook edition has been made with much care, both from the contents and from the presentation point of view, with numerous illustrations, and guides for the reader that are quite fruitful.

In general, the level of the material is high, so that a few prerequisites are necessary to take a major advantage from its reading. A strong understanding of classical mechanics, electromagnetic theory, elementary thermodynamics, and a high level of mathematical methods is also assumed. These subjects are typically taught in the undergraduate physics curricula. However, many physics graduates are not exposed to most of the material included in the book. And this is one of the reasons that makes this book so special.

Undoubtedly, this book can be an excellent tool for students and researchers as an introduction to classical subjects usually missing from most modern physics curricula. Moreover it admits different uses. Teachers might find it useful as a reference to teach different courses on the various classical disciplines described. Actually, each part could be used as if it were a different book so that different courses can benefit from it. Likewise, students might find it helpful as an excellent reference on the fundamentals of classical physics. As a matter of fact, the goal of the authors has been to offer the reader a clear understanding of the fundamentals of classical physics, and furthermore to provide tools of how to apply ideas from classical physics to broaden the knowledge of physicists, both students and researchers. In short, it can be a valuable reference for physicists about modern approaches of the development and applications of classical physics that should exist in any library of science.

Miguel A. F. Sanjuán
Universidad Rey Juan Carlos
miguel.sanjuan@urjc.es
http://orcid.org/0000-0003-3515-0837

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