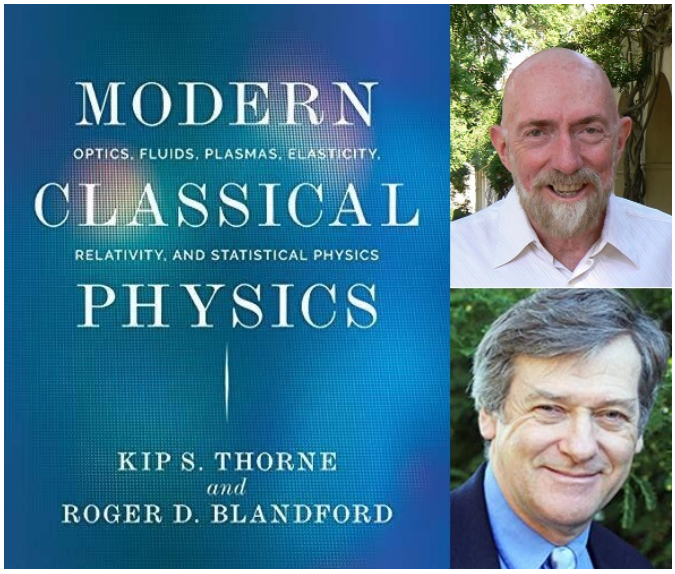
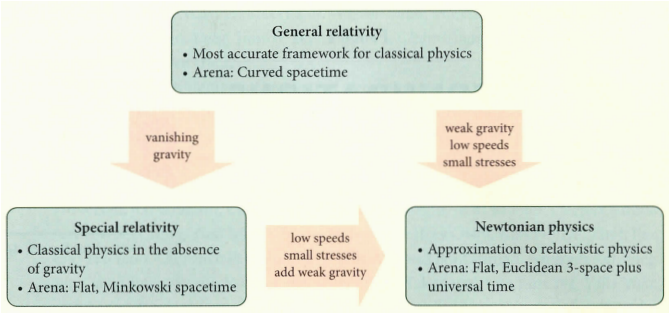
Modern Classical Physics (xl+1511 pages)
by Kip S. Thorne and Roger D. Blandford.
Reviewed by Sebastià Xambó.



The Classical Physics in the title refers, roughly speaking, to macroscopic physics (so there is no chapter devoted specifically to Quantum Physics), while the Modern qualification refers primarily to the extensive presentation of materials devoted to contemporary developments and applications, but also to the systematic use of intrinsic geometric methods. Actually, as stated at the beginning of Part I (Foundations): "In this book, a central theme will be a *Geometric Principle: The laws of physics must all be expressible as geometric (coordinate-independent and reference-frame-independent) relationships between geometric objects (scalars, vectors, tensors,...) that represent physical entities*".

The authors classify the classical laws of physics and their relationships as follows (Fig. 1 in the text):



The book spans 28 chapters collected in seven parts: Foundations (2 chapters: the first on Newtonian Physics and the second on Special Relativity); Statistical Physics (chapters 3-6; chapter 5 covers Statistical Thermodynamics and chapter 6 is devoted to Random Processes); Optics (chapters 7-10); Elasticity (chapters 11-12); Fluid Dynamics (chapters 13-19); Plasma Physics (chapters 20-23); and General relativity (chapters 24-28, the last on Cosmology).

Although Quantum Physics is not treated specifically (it is non-classical), its language is briefly explained in different places (for example: pages 165-166 for Quantum Statistical Mechanics; 174-175, for quantum states of a single particle and of many particles; pages 194-195 for the Bose-Einstein condensate; section 23.3 for 'plasmons') to set up bridges with relevant classical materials: "In our journey, we seek to comprehend the fundamental laws of classical physics in their own terms, and also in relation to quantum physics" (page xxxii); "classical physics should *not* be studied in isolation from quantum mechanics and its modern applications" (page xxxiv); and "Classical physics is sometimes used, pejoratively, to suggest that 'classical' ideas were discarded and replaced by new principles and laws. Nothing could be further from the truth. The majority of applications of physics today are still essentially classical. This does not imply that physicists or others working in these areas are ignorant or dismissive of quantum physics. It is simply that the issues with which they are confronted are mostly addressed classically. Furthermore, classical physics has not stood still while the quantum world was being explored. In scope and in practice, it has exploded on many fronts and would now be quite unrecognizable to a Helmholtz, a Rayleigh, or a Gibbs. In this book, we have tried to emphasize these contemporary developments and applications at the expense of historical choices, and this is the reason for our seemingly oxymoronic title, *Modern Classical Physics*" (pages xxxi, xxxii).

The book evolved from graduate courses taught by the authors over decades in Caltech and, to a lesser extend, in Stanford. As prerequisites, the authors mention an undergraduate-level command of classical mechanics, electromagnetism, thermodynamics, and applied mathematics. As observed by Edward Witten in [1], "The present work is more straightforward in tone and approach than [2], though in spots you'll see an attenuated version of the flair and exuberance for which *Gravitation* is known. [...] Given world enough and time, most of us would do well to put everything else aside for a couple of months, study *Modern Classical Physics* systematically, and come back with our knowledge well refreshed. Short of that, we could satisfy our curiosity—or possibly pique it further—on many topics. And certainly, many of us would appreciate this book as a reference. On the whole, Modern Classical Physics is a magnificent achievement".

References

[1] E. Witten, A hefty textbook for an ever-changing discipline, Physics Today **71** (2018), no. 10, 52-53. https://doi.org/10.1063/PT.3.4046.

[2] Charles W. Misner, Kip S. Thorne, and John A. Wheeler, *Gravitation*, Freeman San Francisco, CA, 1973.