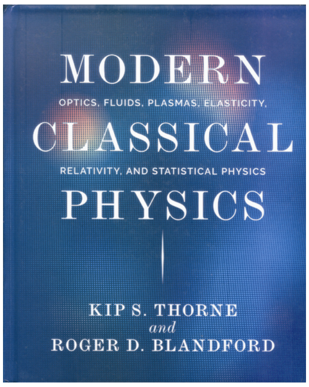

Modern Classical Physics: Optics, Fluids, Plasmas, Elasticity, Relativity, and Statistical Physics. Kips S. Thorne and Roger D. Blandford. Princeton University Press, 41, William Street, Princeton, New Jersey 08540, USA. 2017. xl + 1511 pages. Price: US$ 125.

This book has been compiled based on the courses offered by the authors in Caltech and Stanford University, over a period of about four decades. Majority of the topics covered in the book are designed for a full-year course at the first-year Ph D (graduate) level (at least that is how the authors mostly used it when they taught). However, many final-year undergraduate (UG) students seem to be successful in grasping it as well. Many physics/astronomy/engineering students doing their research for Ph D use classical physics extensively. Sometimes they establish their careers with classical physics as an essential component; this book is designed for them. In addition, this book is designed to fill gaps and explain the relationships between advanced topics, which we often encounter during our professional and research careers, and basic topics we have already explored. Indeed, a large fraction of physicists develop their careers outside the core of fundamental physics; for them a broad exposure of non-core stuff can be of great importance, which this book offers as well. Consequently, while the book is primarily meant for physicists, it may be useful for larger community including engineers, mathematicians, chemists, biologists, etc. In fact, the examples illustrated in the book demonstrate how the problem-solving techniques are freely swapped across the disciplines.

Unlike many other books covering similar topics, this book is quite unique in its approach, as geometry is a deep theme throughout the evolution of this book. Being outstanding general relativists and astrophysicists working on the topics related to gravitational physics, mastery of these authors seems to find it a more natural and elegant approach towards these topics. Note that indeed the concepts of general relativity established by A. Einstein in 1915 are better understood in a geometric approach, which the authors attempt to implement throughout the classical physics. Nevertheless, geometry illuminates the characters emerged in any classical principles (need not be those involved with general relativity) and helps to bridge them with the related quantum principles. This makes the book elegant as well. In this approach, one can avoid tedious algebraic calculations which are mostly co-ordinate based, long-known to be useful in the advanced physics topic like general relativity.

The scope of book is ambitious, but it assumes that the readers have already learned the basic classical mechanics, electromagnetic theory and thermodynamics. In this way the book is able to focus on the topics that are less frequently taught in UG and graduate/Ph D courses. The authors undertake the fundamental laws of classical physics in relation to quantum physics in exploring the spacetime and phase space with the use of statistical and continuum mechanics, and also optics and relativity. This way they uncover some deep relationships among the various fundamental laws and connections between the techniques used in different branches of physics. Nevertheless, as the main theme is to uncover truth (when physics is a progressive discipline to understand happening based on careful observation and experiment organized by fundamental principles and laws), and majority of observable application today are still essentially classical, the book aims to present the readers a clear understanding of classical concepts. However, due to intimate connection between classical and quantum physics, often the quantum concepts appear in this book. For example, nonlinearly interacting plasma waves are best treated as quanta, i.e. plasmons, even though they are solutions of classical field equations.

As the modern topics covered by the book are quite vast and some readers may like to be selective, the authors have judiciously organized the book into parts: ‘track one’ and ‘track two’, so that by avoiding the materials marked as ‘track two’ the readers can completely grasp their required concepts. Also, the choice of topics is quite judicious in the premise of advanced classical physics. The ‘Foundations’ introduced in chapter one is a must read. There itself the authors introduce the geometric approach in their methodology and all the common concepts they have reintroduced in the geometric point of view.

The book also includes many applications and exercises which may require user friendly numerical packages, e.g. Maple, Mathematica, Matlab, etc. to produce interesting numerical results. This is expected to bring the readers enthusiasm for computational physics along with physical insight. This is a very useful move in a textbook, when modern physics as well as science in general are deeply involved with computational techniques in order to obtain novel, unknown yet, solutions.

Astrophysical topics, at least the modern ones, involve the elements of classical physics, e.g. fluid/plasma, statistical, optical, acoustical physics, apart from special and general relativity, depending on the specific field under consideration. Therefore, being two of the outstanding astrophysicists and relativists, the authors have evolved the book step-by-step by introducing topics of basic classical physics.

After the introductory topic, namely Foundations, the authors have developed Statistical Physics. In it, statistical thermodynamics and theory of random processes are included, which are useful to develop fluid and plasma physics which is introduced later in the book.

In the part Optics, the authors then have introduced all sorts of classical waves, including radio, sound and gravitational waves, which are deeply involved with modern astrophysics. Many examples/discussions therein are involved with astrophysics. Note that the radio astronomy is now science and the gravitational wave astronomy and astrophysics is becoming science, after direct observational evidence of gravitational wave, when K. Thorne (the first author) is directly involved with it and is awarded the Nobel Prize for the same in 2017. Hence, they are timely placed in the book. Many astrophysical flows are supersonic, e.g. those around black holes; hence sound waves often play an indispensable role in astrophysics, apart from their implications in daily-life, which the authors have introduced. This part is also involved with the issues of geometric optics, including their astrophysical and/or gravitational physics applications, e.g. gravitational lensing.

Many modern fields of research are involved with the knowledge of fluid/plasma physics, including magnetohydrodynamics. Origin of (experimentally) observed sub-critical transition to turbulence in laboratory shear flows, e.g. plane Couette flow, plane Poiseuille flow, is a long-standing puzzle. Similar problems lie in several astrophysical flows, which often are nothing but rotating shear flows. The related astrophysical issue is the origin of viscosity and transport in an accretion disk, which is known to have an insignificant molecular viscosity. Hence, any transport therein is argued as of turbulence origin, which is difficult to explain as the underlying flows are stable under (linear) perturbation. In order to resolve these outstanding issues, a solid foundational level knowledge of fluid/plasma physics is very important which this book offers.

After developing all the above topics, finally the authors have embarked on general relativity, including recapitulation of required special relativity and some cosmology. Perhaps, this is the only textbook, as of now, discussing general relativity, however brief it may be, which also contains chapters with in-depth discussion of statistical, optical (geometrical, physical and nonlinear), acoustical and fluid/plasma physics along with electrodynamics. Some modern ideas/topics are included in this part, e.g. Penrose and Blandford–Znajek (via exercise) processes, detection of gravitational waves. The former is employed for extracting energy from a rotating black hole by means of electromagnetic effects, which often helps explaining the jet-power of magnetized accretion flows around a spinning black hole. This process was proposed by one of the authors of the book in late 1970s. However, a similar idea was also proposed by an Indian relativist N. Dadhich and his collaborators, who considered the magnetized version of Penrose process and showed that it is extremely efficient for as little as milli gauss order of magnetic field. The prediction of this process has now been verified by general relativistic magnetohydrodynamic simulations. Gravitational wave is perhaps going to be the topic of this century, which the authors have judiciously discussed concisely, when the first author himself is one of the pioneers in this field of research.

Photograph of the two vortices emerging from the wingtips of an Airbus, made visible by light scattering off water droplets in the vortex cores. Photo © Danel Umaña.

There are many excellent textbooks on general relativity including that by the first author of this book. Also, the theme of this book is not to elaborate upon general relativity, rather classical physics. Therefore, the authors have kept the part on general relativity reasonably concise and end the book by leaving three mysteries of the universe.

All the above discussions establish the book to be a very useful and unique one. However, in a lighter note, I feel the book to be quite heavy, weight-wise, and easily could be split into a few volumes, which perhaps could be more handy for the readers. Nevertheless, it is perhaps the style of the authors, in particular, the first author whose book titled *Gravitation* is equally heavy. More so, having all the materials in a single volume has its advantage too, so that one does not need to search around various volumes for a topic of interest. The book presents a timely set of chapters, as discussed above. It has separated track two from track one in such a way, that without going through more demanding track two, the readers can grasp the subject matter of their interest.

On the whole, this is definitely a special addition to the Princeton University Press and is expected to be a valuable asset for the library collecting advanced textbooks.

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Annual Review of Phytopathology, 2016. Jan E. Leach and Steven Lindow (eds). Annual Reviews, 4139 El Camino Way, P.O. Box 10139, Palo Alto, California 94303-0139, USA. Vol. 54. x + 603 pages. ISSN: 0066-4286, ISBN: 978-0-8243-1354-8. Price: US$ 102.00.

Development of novel plant disease management strategies requires knowledge of the co-evolution or arms race, affecting phenotypic variations of disease in nature. Advances in understanding genetics of disease resistance and its functional aspects, especially pathogen-secreted (elicitors/effectors) and host surveillance (effector targets) molecules, underpin the recognition and specificity in plant–pathogen interactions at the molecular level operating through cell-autonomous, multilayered immune system in plants. Seven of the 25 reviews in this volume connect to this theme, demonstrating the significance and expectations from it for better crop improvement. Two of these chapters (Hawes *et al.* and Deleris *et al.* – annotated below) even take a step closer in connecting plant and animal immunity systems.

Pertinently, this volume opens up with an autobiographical reflection of a remarkable academic de Wit, who was engaged in understanding host–pathogen interactions in tomato – *Cladosporium fulvum* pathological system, with an urge to protect crop plants with their own immune system[1]. Passing through the critical stage of understanding recognition and specificity, more particularly in eukaryotic pathogen and plant relationship, his pioneering achievements include identification of the first fungal avirulence gene in addition to four more; isolation and purification of the *Avr* gene products from *in planta* interactions, now known as effectors, lead to cloning of these genes, and elucidating their functions. These credited de Wit to be the first to provide molecular proof for the pathogen race-cultivar specificity envisaged by gene-for-gene hypothesis. Cloning of the effector genes enabled the research group of Jonathan Jones to isolate all the cognate immune receptor genes that include the first fungal disease resistance gene to be isolated[2]. The products of these genes which are receptor-like proteins mediate recognition of matching effectors, directly or indirectly.