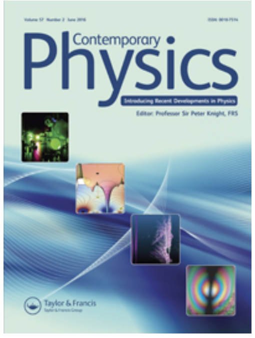

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Simulations of oscillatory systems: with award-winning software, physics of oscillations, edited by Eugene I. Butikov

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to whether the concept could also be applied in the optical domain. This era of the maser is treated in chapters 4 and 5. The third period is the time between the first demonstration of a laser in 1960 until around 1970 when work began to vastly diversify and numerous kinds of lasers for all kinds of applications were beginning to be developed (Chapter 6, 'The first lasers'). All these developments fall into a fourth period which is still ongoing and is treated in the following chapters 'Laser properties and progress in novel lasers', the completely new chapter on 'Non-linear optics' and 'More exotic lasers'. Finally, there is a chapter on 'The statistical properties of light' in which topics like coherence, quantum optics and Bose–Einstein condensates are discussed.

By type, this book is a monograph which consists of a highly readable scientific essay on the subject, a historic outline with high information density. The physics under discussion is presented with mathematical rigour and is fully referenced to scientific publications. The end-of-chapter references are comprehensive and carefully chosen, which adds value to the text in particular as far as the early times are concerned. The text is supported by numerous black-and-white figures and pictures, including portraits of important scientists. A number of individual pages throughout the book feature colour prints on glossy paper. The quality of the figures and the print is good, as is the paper. The binding of the book could be better, as it is rather stiff and not evenly done. As a nice feature, the index is divided into a subject index and an author index which helps finding individual scientists directly. Overall, this book can be highly recommended as an additional read to a course in laser physics, as part of a course on the history of physics or as a historical reference to anyone in the field.

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Simulations of oscillatory systems: with award-winning software, physics of oscillations, edited by Eugene I. Butikov, London, CRC Press, 2015, 363 pp., £57.99 (hardcover), ISBN 978-1-4987-0768-8. Scope: textbook. Level: undergraduate, advanced undergraduate, postgraduate, early career researcher, researcher.

Oscillations are ubiquitous in nature. They appear in mechanical systems, in celestial mechanics, in photonics, condensed matter physics, electromagnetism, physiology and biomedical sciences and a large etcetera. From the point of view of the history of sciences, the introduction of the mathematical equations of the harmonic oscillator in the middle of the eighteenth century contributed strongly to the construction of the linear theory of oscillations with so many applications to the sciences and technology. One century later, mathematical models of nonlinear oscillators were introduced by physicists and engineers like Helmholtz, Lord Rayleigh, van der Pol, Duffing, etc., contributing to the foundations of the nonlinear theory of oscillations. There is no doubt that the study of oscillations constitutes a field of science by itself with numerous applications in Physics and many other scientific disciplines. Consequently, there exist many textbooks on oscillations of many different levels and approaches. Here we have a new one written by a physicist who has devoted much of his research efforts to the study of oscillations. This certainly gives a particular and personal touch to the book, since it is a topic to which he has devoted a lot of time.

There are many ways to classify the world of oscillations, and perhaps the simplest one is the one that has been adopted by the author of the book: linear oscillations and nonlinear oscillations. This is actually the natural way of presenting them. The book is composed of two different parts. Part I is dedicated to linear oscillations and it contains six chapters and Part II to nonlinear oscillations and it contains just five chapters.

Each chapter of Part I is organised following a very similar scheme. First of all, there is a summary of the theory with the basic ideas and theoretical background, then it is offered a review of the principal formulas, which is very helpful and finally there is a section devoted to questions, problems and suggestions. This last section contains many exercises, where some of them appear as small research projects that could be very useful for the students to better understand some particular parts of the science of oscillations. These chapters describe the free, damped and forced linear oscillations, the torsion spring oscillator with dry friction and linear oscillators subjected to a square wave or parametric excitation. The illustrations of the textbook are of very good quality helping to visualise many phenomena associated to the somehow abstract mathematical theory of oscillations, which some textbooks used to omit.

Nonlinear oscillations are described in Part II. The scheme of the chapters is somehow different than the one followed in Part I, in particular, as with respect to the interesting section on questions, problems and suggestions. Only the chapters dedicated to the pendulum, which is the paradigmatic nonlinear oscillator, have this interesting section. The rest of the book deals with more advanced and sophisticated aspects of the nonlinear physics of the oscillations, including parametric oscillations, auto-oscillations and a very interesting and complete chapter on the inverted pendulum, among other topics. I find of paramount importance this second part of the book, because nonlinear oscillations play a very important role in science nowadays. However, and too often, textbooks on oscillations forget to include them, causing harm to students when this important area is simply ignored.

But perhaps the most important contribution of this book to students is its associate software, *The Physics of Oscillations*. In words of the author: 'The textbook and software are designed for use at a wide range of levels and can be adapted to meet the needs of many physics courses', and I do agree with that. Both materials can be appropriately adapted depending on the course, the students and the interests of the instructor. The software can be of much help to visualise and understand the abstract concepts and applications of the physics of oscillations. Definitely, the book can be very useful for undergraduate and graduate students, and I would include as well researchers who would need to have a broader overview of the world of oscillatory phenomena.

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The Story of Collapsing Stars: Black Holes, Naked Singularities, and the Cosmic Play of Quantum Gravity, by Pankaj S. Joshi, Oxford, Oxford University Press, 2015, 240 pp., £25 (hardback), ISBN 978-0-19-968676-6. Scope: general interest. Level: specialist.

The Sun, at the end of its life, would become a white dwarf. The same applies to other stars just as massive. But what would happen to the more massive ones? Would they end up as white dwarfs, too? This is actually a poser that was first brought up by S. Chandrasekhar, the eminent Indian astrophysicist, about eighty years ago. Chandrasekhar, for whom the space telescope Chandra is named after, believed that stars greater than 1.4 $M_{\odot}$[1] would end their lives as something else entirely. And as the prevalent theory goes today, it is understood that those between 3 and 5 $M_{\odot}$ would eventually become neutron stars, while anything more massive would experience what is called a continual gravitational collapse and become black holes. However, this is not always the case as naked singularities could also materialise as an alternative.

Now, what is a naked singularity? Hypothetically speaking, the massive star collapse would create an invisible surface in space–time and while the collapse is going on, the star could enter the surface from which there is no return. This is actually the infamous one-way-ticket event horizon where everything is swallowed, even light, hence black hole. But if the event horizon fails to form altogether, the star becomes a naked singularity. As simple as that? Well, not quite.

There is something called cosmic censorship conjecture (CCC) in black hole physics. CCC states that black hole would always be the end product of massive star collapse with the singularity (always) being concealed inside it hence not naked therefore no naked singularities could ever be produced. So which is it – is there or is there not such a thing as *naked* singularity? The short answer is: no one knows; but the idea of naked singularity is highly appealing since the quantum gravity effects near it is supposed to be observable from across the Universe i.e. *we* would be able to see all the physical processes that would happen at the very end of the collapse; and the jackpot is, it would be as good as seeing the Big Bang[2] itself!

Most of what is written in this book is very high level as can be expected from the title. Nevertheless, initiated readers would find it a good and an enjoyable read. It discusses the development of the idea of black hole and event horizon that spawned from modelling the collapse of massive star by Oppenheimer and Snyder [1] and Datt [2]; how the Schwarzschild[3] metric – the solution to the Einstein's field equations – becomes the basis of black hole physics; the various collapse scenarios, e.g. dust collapse, that might lead to the formation of naked singularity, and many other related topics.

The engaging narrative makes the read more like a story, especially since there are no equations at all other than the very few embedded in the text that the readers should already know or at least be familiar with. It is definitely not for beginners as the assumed knowledge is just too much. Just a couple of snags, *B*. Datt mentioned above appears as both *S*. Datt and *A*. Datt here which is very confusing to those interested in looking up the paper; also it would have been better if 'ice cube' is written as IceCube[4] so the readers do not get it confused with the regular ice cube if not the rapper.

Notes

1. This is known as the Chandrasekhar limit.
2. The Big Bang is a space–time singularity. In principle, it is observable since it gives birth to the whole Universe.
3. Of Karl Schwarzschild, the German astrophysicist.
4. The neutrino observatory in Antarctica.

References

[1] J.R. Oppenheimer and H. Snyder, *On continued gravitational contraction*, Phys. Rev. 56 (1939), pp. 455–459.
[2] B. Datt, *Uber eine Klasse von Losungen der Gravitationsgleichungen der Relativitat* [On a class of solutions of the gravitation equations of relativity], Z. Phys. 108 (1938), pp. 314–321.

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