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Einstein's Physics: Atoms, Quanta, and Relativity – Derived, Explained, and Appraised

By Ta-Pei Cheng

Oxford University Press

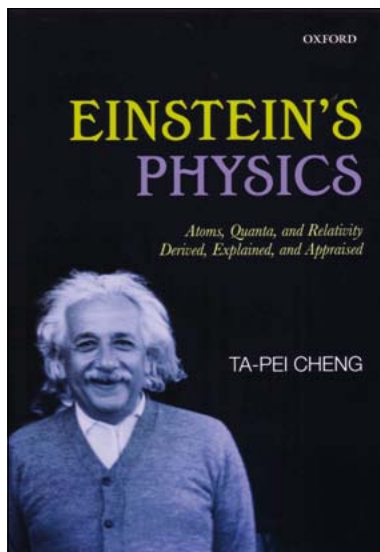
Hardback: £29.99

Also available as an e-book

Being familiar with the work of Ta-Pei Cheng, I started this book with considerable expectations – and I enjoyed the first two sections. I found many delightful discussions of topics in the physics that came after Albert Einstein, as well as an instructive discussion on his contributions to quantum theory, where the author shares Einstein's reservations about quantum mechanics. However, the remainder of the text dedicated to relativity and related disciplines has problems. The two pivotal issues of special relativity, the aether and the proper time, provide examples of what I mean.

On p140, the author writes "...keep firmly in mind that Einstein was writing for a community of physicists who were deeply inculcated in the aether theoretical framework", and continues "(Einstein, 1905) was precisely advocating that the whole concept of aether should be abolished". Of course, Einstein was himself a member of the community "inculcated in the aether" and, indeed, aether was central in his contemplation of the form and meaning of physical laws. His position was cemented by the publication in 1920 of a public address on "Aether and the Theory of Relativity" and its final paragraph "...there exists an aether. According to the general theory of relativity space without aether is unthinkable; for in such space there not only would be no propagation of light, but also no possibility of existence for standards of space and time...". This view superseded the one expressed in 1905, yet that is where the discussion in the book ends.

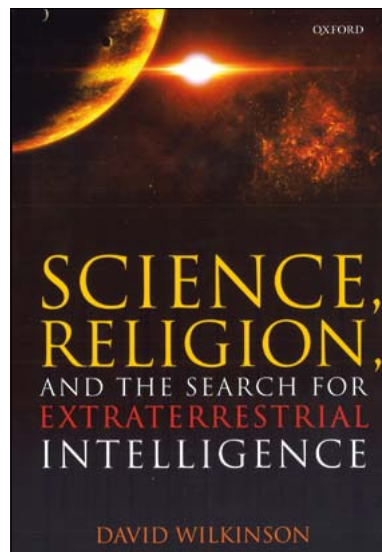
The last paragraph on p141 states that "...the key idea of special relativity is the new conception of time." Einstein is generally credited with the pivotal discovery of "body time", or in Hermann Minkowski's terminology, a body's "proper time". The central element of special relativity is the understanding of the invariant proper time. Bits and pieces of "time" appear in sections 9–12 of the book, but the term "proper time" is mentioned only incidentally. Then on p152 I read "A moving clock appears to run slow." This is repeated on p191, with the addition "appears to this observer". However, the word "appears" cannot be part of an unambiguous explanation. A student



of Einstein's physics would say "A clock attached to a material body will measure a proper-time lifespan independent of the state of inertial motion of the body. This proper time is the same as laboratory time only for bodies that remain always at rest in the laboratory." That said, I must add that I have never heard of doubts about the reality of time dilation, which is verified when unstable particles are observed.

Once the book progresses into a discussion of Riemannian geometry and, ultimately, of general relativity, gauge theories and higher-dimensional Kaluza–Klein unification, it works through modern topics of only marginal connection to Einstein's physics. However, I am stunned by several comments about Einstein. On p223, the author explains how "inept" Einstein's long proof of general relativity was, and instead of praise for Einstein's persistence, which ultimately led him to the right formulation of general relativity, we read about "erroneous detours". On p293, the section on "Einstein and mathematics" concludes with a paragraph that explains the author's view as to why "...Einstein had not made more advances...". Finally, near the end, the author writes on p327 that Einstein "could possibly have made more progress had he been as great a mathematician as he was a great physicist". This is a stinging criticism of someone who did so much, for things he did not do.

The book presents historical context and dates, but the dates of Einstein's birth and death are found only in the index entry



"Einstein", and there is little more about him to be found in the text. A listing of 30 cited papers appears in appendix B1 and includes only three papers published after 1918. The book addresses mainly the academic work of Einstein's first 15 years, 1902–1917, but I have read masterful papers that he wrote during the following 35 years, such as "Solution of the field of a star in an expanding universe" (Einstein and Straus 1945 *Rev. Mod. Phys.* **17** 120 and 1946 *Rev. Mod. Phys.* **18** 148).

I would strongly discourage the target group – undergraduate students and their lecturers – from using this book, because in the part on special relativity the harm far exceeds the good. To experts, I recommend Einstein's original papers.

● Johann Rafelski, University of Arizona.

Science, Religion, and the Search for Extraterrestrial Intelligence

By David Wilkinson

Oxford University Press

Hardback: £25

Also available as an e-book

With doctorates in both astrophysics and theology, David Wilkinson is well qualified to discuss the subject matter of this book. He provides a captivating narrative on the scientific basis for the search for extraterrestrial intelligence and the religious implications of finding it. However, the academic nature of the writing might hinder the casual reader, with nearly every paragraph citing at least one reference.

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Scientific and religious speculation on the possibility of life elsewhere in the universe is age-old. Wilkinson charts its history from the era of Plato and Democritus, where the existence of worlds besides our own was up for debate, to the latest data from telescopes and observatories, which paint vivid pictures of the many new worlds discovered around alien suns.

Readers familiar with astrophysics and evolutionary biology might find themselves skipping sections of the book that go into the specific conditions that need to be met for Earth-like life to evolve and attain intelligence. Wilkinson, however, is able to tie these varied threads together, presenting both the pessimism and optimism towards the presence of extraterrestrial life exhibited by scientists from different fields.

Despite referring to religion in the title, Wilkinson states early on that his work mainly discusses the relationship of Christianity and SETI. In this regard, the book provided me with much insight into Christian doctrine and its many – often contradictory – views on the universe. For example, despite the shaking of the geocentric perspective with the so-called Copernican Revolution, some Christian scholars from the era maintained that the special relationship of humans with God dictated that only Earth could harbour God-fearing life forms. Earth, therefore, retained its central position in the universe in a symbolic if not a literal sense. Other views held that nothing could be beyond the ability of an omnipotent, omnipresent God, who to showcase his glory might well have created other worlds with their own unique creatures.

After covering everything from science fiction to Christian creation beliefs, Wilkinson concludes with his personal views on the value of involving theology in searches for alien life. I leave you to draw your own conclusions about this! Overall, the book is a fascinating read and is recommended for those pondering the place of humanity in our vast universe.

● Achintya Rao, CERN.

The Theory of the Quantum World: Proceedings of the 25th Solvay Conference on Physics

By David Gross, Marc Henneaux and Alexander Sevrin (eds.)

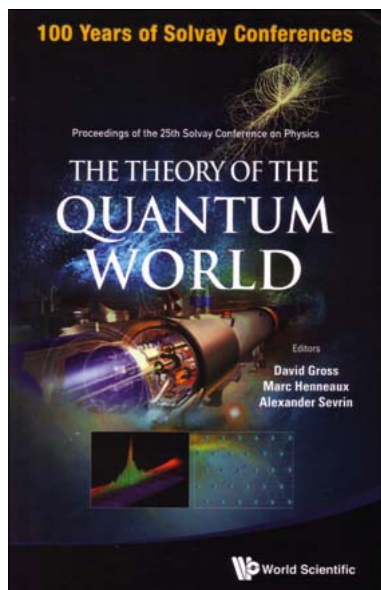
World Scientific

Hardback: £58

Paperback: £32

E-book: £24

Since 1911, the Solvay Conferences have helped shape modern physics. The 25th edition in October 2011, chaired by David Gross, continued this tradition,



while also celebrating the conferences' first centennial. The development and applications of quantum mechanics have been the main threads throughout the series, and the 25th Solvay Conference gathered leading figures working on a variety of problems in which quantum-mechanical effects play a central role.

In his opening address, Gross emphasized the success of quantum mechanics: "It works, it makes sense, and it is hard to modify." In the century since the first Solvay Conference, the worry expressed by H A Lorentz in his opening address in 1911 – "we have reached an impasse; the old theories have been shown to be powerless to pierce the darkness surrounding us on all sides" – has been resolved. Physics is not in crisis today, but as Gross says there is "confusion at the frontiers of knowledge". The 25th conference therefore addressed some of the most pressing open questions in the field of physics. As Gross admits, the participants were "unlikely to come to a resolution during this meeting...[but] in any case it should be lots of fun".

The proceedings contain the rapporteur talks and, in the Solvay tradition, they also include the prepared comments to these talks. The discussions among the participants – some involving dramatically divergent points of view – have been carefully edited and are reproduced in full.

The reports cover the seven sessions: "History and reflections" (John L Heilbron and Murray Gell-Mann); "Foundations of quantum mechanics and quantum

computation" (Anthony Leggett and John Preskill); "Control of quantum systems" (Ignacio Cirac and Steven Girvin); "Quantum condensed matter" (Subir Sachdev); "Particles and fields" (Frank Wilczek); and "Quantum gravity and string theory" (Juan Maldacena and Alan Guth). The proceedings end – as did the conference – with a general discussion attempting to arrive at a synthesis, where the reader can judge if it fulfilled the prediction by Gross and was indeed "lots of fun".

Books received

Mathematics of Quantization and Quantum Fields

By Jan Dereziński and Christian Gérard

Cambridge University Press

Hardback: £90 \$140

Also available as an e-book



Unifying a range of topics currently scattered throughout the literature, this book offers a unique review of mathematical aspects of quantization and quantum field theory. The

authors present both basic and more advanced topics in a mathematically consistent way, focusing on canonical commutation and anti-commutation relations. They begin with a discussion of the mathematical structures underlying free bosonic or fermionic fields, such as tensors, algebras, Fock spaces, and CCR and CAR representations. Applications of these topics to physical problems are discussed in later chapters.

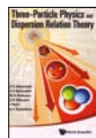
Three-Particle Physics and Dispersion Relation Theory

By A V Anisovich, V V Anisovich, M A Matveev, V A Nikonov, J Nyiri and A V Sarantsev

World Scientific

Hardback: £65

E-book: £49



The necessity of describing three-nucleon and three-quark systems has led to continuing interest in the problem of three particles. The question of including relativistic effects appeared together with the consideration of the decay amplitude in the dispersion technique. The relativistic dispersion description of amplitudes always takes into account processes that are connected to the reaction in question by the unitarity condition or by virtual transitions. In the case of three-particle processes they are, as a rule, those where other many-particle states and resonances are produced. The description of these interconnected reactions and ways of handling them is the main subject of the book.

WHAT POWERS *YOUR* ACCELERATOR?



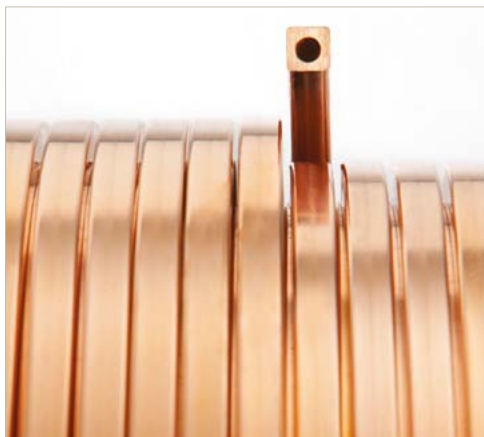
HV and RF Technology Innovations from L-3

L-3 Electron Devices is leading the technology revolution with powerful solutions like the 13 kW klystron for the 12 GeV Upgrade at the Thomas Jefferson National Accelerator Facility and the 90 kW IOT amplifier for Brookhaven National Lab's NSLS-II Booster RF Transmitter System. For high-voltage switching or stable and reliable RF power, L-3's thyratrons, klystrons, IOTs and TWTs are meeting the demanding requirements of many of the world's major accelerator systems, and we are working to produce the next generation of devices for tomorrow's new accelerators.

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