

BOOKSHELF

Engines of Discovery: A Century of Particle Accelerators by Andrew Sessler and Edmund Wilson, World Scientific. Paperback ISBN 978-9812700711. £17.

It is said that Galileo always kept 10% of his purse in reserve for his lens grinder so that he could look forward to peering further into the heavens through the next telescope in line. He also actively collaborated with the telescope builder and shared his joy of discovering each new star. Instrument builders and their users have often been the same community and sharing the enterprise together was the norm. Such was also the case with early sub-atomic physicists and chemists in the late 19th and early 20th century, with Ernest Rutherford, John Cockcroft, Ernest Walton, James Chadwick, and so on. The “chasm” began to open in the mid- to late 20th century with the emergence of the culture of large-scale experimental science via teams of specialists in accelerators, detectors, data processors, theoreticians, etc. Today, however, the demands of the next frontier in particle physics are sufficiently daunting that the gap is forced to close again. Witness the emergence of self-organized communities around the world that are working together in moving the field forward.

Engines of Discovery is written by two well-respected practitioners of accelerator science, recognized for their contributions to the field. Andrew Sessler and Edmund Wilson both began their careers at a time when the “chasm” had started to take root and continue in their trade today when it is beginning to heal again – a golden era in the history of development dominated by the use of large particle accelerators.

Sessler received a classical and advanced education from Harvard College and Columbia University in the middle of the last century at a time when the US was a scientific hot-bed, with great pre- and post-war scientists from around the world. Exposed to the greatest minds of the times, Sessler contributed to the very beginnings of the field via his contributions at MURA, the Wisconsin-based Midwestern Universities Research Association. This group pioneered the concept of the fixed field alternating gradient (FFAG) synchrotron – a concept that has been resurrected with a prototype for electrons now being built at the Cockcroft Institute and Daresbury Laboratory in the

ENGINES OF DISCOVERY



A Century of Particle Accelerators

Andrew Sessler · Edmund Wilson

UK. Sessler then continued to lead the great laboratory in California created by one of the early pioneers, Ernest Lawrence. Sessler brings a substantive and unique perspective that is hard to match through his eminent stature in the community of scientists and humanitarians. He is known for his many contributions to theoretical accelerator physics, including collective beam instabilities, non-linear dynamics, muon colliders and free-electron lasers. Joining him is Edmund Wilson, a veteran from the world-renowned accelerator-based CERN laboratory. Educated at Oxford and having the rare experience of tutelage from and working with John Adams, the architect of many of CERN's accelerators, Wilson brings his decades of research experience in operating accelerators and his formidable skills of inherited pedagogy, composition, literacy and the overall art of story-telling to complete this fascinating saga.

It is indeed a masterly tale of the emergence and growth of a field, told from a unique personal perspective, by two working scientists in the field. Understandably, the book is rich, dense and selective as it starts with the heritage of atomic, nuclear and particle physics and continues through to the end of the 20th century. The field eventually diversified into other basic sciences such as those driven by synchrotron radiation sources, free-electron lasers, laser-plasma

interaction, high-field physics, etc – which have spawned much of the innovation and creativity of the latter years. The field has also become immensely global during the past few decades.

The book may appear relatively lean in promoting such diversity of sciences and characters in these recently emerging fields. Such incommensurate expression can be understood in the context of the historical footprint of the authors themselves and is only to be expected for a book of this scope. I would be remiss if I did not point out the brilliance, genius and creativity of the generation of bright emerging international scientists and technologists from Europe, the Americas, Asia and Africa who are transforming the field today. The authors only hint at it in the book via colleagues such as Katsunobu Oide and Chan Joshi, but today one will find many others at institutions around the world.

This is not a book to look at through the lens of a precise historian – or with the obsession of a perfectionist – demanding a complete lexicon, chronology, historical credit, etc. It is above all a book of inspiration. Nevertheless, the book does achieve a natural sense of historical progress and is made even more exciting by the anecdotal and factual bits and pieces put together about some of the players – more so in their order of appearance on the scene, than in any other sense. For every player that is mentioned and adds flair to the book, there are many who are not, including the authors themselves, whose contributions have been substantive.

Above all, this book uplifts one's spirit; one reads it with zest, admiration and awe. The power of sheer dedication, brilliance, creativity, humility and humanity of the whole enterprise expressed in the pages of the book is sure to inspire and motivate generations to come.

Speaking as an individual in the wake of a personal transition from the US to the UK, and taking stock of shifting priorities in the field, I must thank the authors for providing a contextual basis for carrying our work forward with the noble mission of the ultimate quest for the ways of nature and life.

Swapan Chattopadhyay, Sir John Cockcroft Chair of Physics, Universities of Liverpool, Manchester and Lancaster, and director, Cockcroft Institute.

Books received

Exploring the Quantum: Atoms, Cavities, and Photons by Serge Haroche and Jean-Michel Raimond, Oxford University Press. Hardback ISBN 0198509146 £45 (\$89.50).

The counter-intuitive aspects of quantum physics have long been illustrated by thought experiments; from Einstein's photon box to Schrödinger's cat. These experiments are now real, with single particles – electrons, atoms or photons – directly unveiling the weird features of the quantum. *Exploring the Quantum* describes a class of thought experiments made real, highlighting measurement processes and decoherence at the quantum-classical boundary. Combining theory and experiments, the book will interest students of quantum physics, teachers seeking illustrations for their lectures, and researchers in quantum optics and quantum information.

Quantum Liquids: Bose Condensation and Cooper Pairing in Condensed-Matter Systems by AJ Leggett, Oxford University Press. Hardback ISBN 0198526431 £35 (\$64.50).

Starting from first principles, this book introduces the closely related phenomena of Bose condensation and Cooper pairing, in which a very large number of single particles or pairs of particles are forced to behave in exactly the same way, and explores their consequences in condensed-matter systems. The author uses simple concepts and arguments to account for the new phenomena that arise in Bose-condensed and Cooper-paired systems, including superconductivity and superfluidity. The physical systems discussed include liquid He^4 , superfluid He^3 , the BEC alkali gases, classical and exotic superconductors, and the recently stabilized Fermi alkali gases. The book should suit beginning graduate students in physics or advanced undergraduates.

Introduction to Quantum Information Science by Vlatko Vedral, Oxford University Press. Hardback ISBN 0199215707 £35 (\$70).

Based on a series of invited lecture courses at various universities, this book offers a concise and up-to-date introduction to quantum information. In addition to treating quantum communication, entanglement and algorithms in great depth,

it also addresses a number of other topics, such as Maxwell's demon, the Bekenstein bound and Caratheodory's treatment of the second law of thermodynamics. All mathematical derivations are based on clear physical pictures, making it ideal as a first introduction to the subject and also to appeal to the specialist.

Lattice Methods for Quantum Chromodynamics by Thomas DeGrand and Carleton DeTar, World Scientific. Hardback ISBN 9812567275 £35 (\$64).

This book provides a thorough introduction to the specialized techniques needed to carry out numerical simulations of QCD, namely: a description of lattice discretizations of fermions and gauge fields; methods for doing a simulation; descriptions of common strategies to connect simulation results to predictions of physical quantities; and a discussion of uncertainties in lattice simulations. Moreover, the many connections of lattice QCD to continuum field theory and elementary-particle physics phenomenology are carefully explained. This book is a useful resource for graduate students and researchers interested in the properties of strong interactions.

Path Integrals in Quantum Mechanics, Statistics, Polymer Physics, and Financial Markets, 4th edition by Hagen Kleinert, World Scientific. Hardback ISBN 9812700080 £79 (\$138). Paperback ISBN 9812700099 £22 (\$38).

This is the fourth, expanded edition of the comprehensive textbook on the theory and applications of path integrals – the first to solve path integrals explicitly for a range of non-trivial quantum-mechanical systems, in particular the hydrogen atom. The book explains the Feynman–Kleinert variational approach and develops it systematically into a variational perturbation theory. It features a variety of systems from the fractional quantum Hall effect to the application of path integrals to financial markets.

Cosmological Relativity: The Special and General Theories for the Structure of the Universe by Moshe Carmeli, World Scientific. Hardback ISBN 9812700757 £26 (\$34).

Moshe Carmeli describes the large-scale structure of space, time and velocity

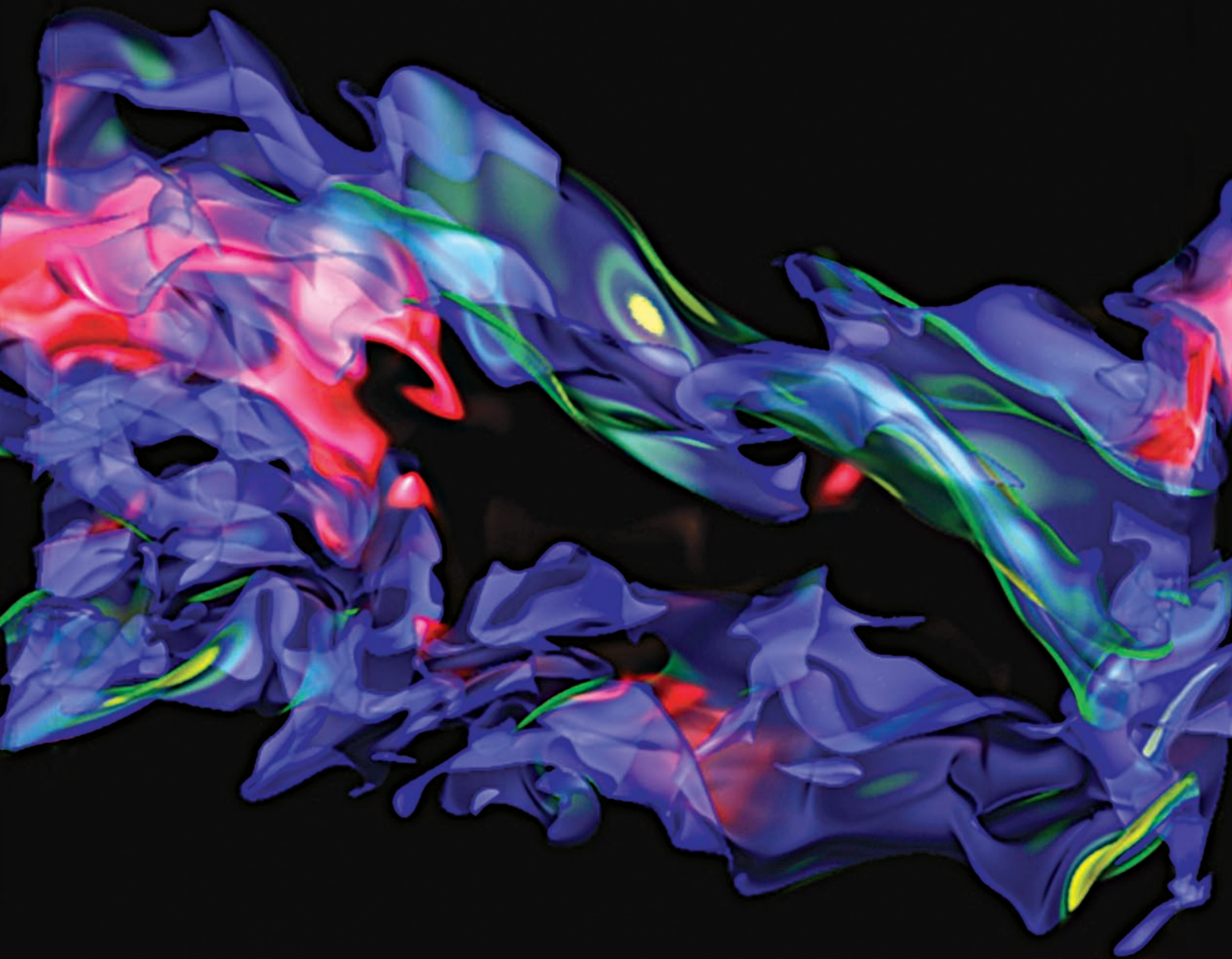
as a new cosmological special relativity. He derives a cosmological, Lorentz-like transformation that relates events at different cosmic times and applies it to obtain a new law of addition of cosmic times and derive inflation in the early universe. In the appendices, gravitation is added in the form of a cosmological general relativity theory and a five-dimensional, unified theory of space, time and velocity. Astrophysicists, cosmologists, theoretical physicists and mathematical physicists should all find this book of great interest.

Statistical Mechanics: Algorithms and Computations by Werner Krauth, Oxford University Press. Hardback ISBN 0198515359 £49.95 (\$99.67). Paperback ISBN 0198515367 £24.95 (\$47.50).

Part of the *Oxford Master Series in Physics*, this book discusses the computational approach in modern statistical physics, adopting simple language and an attractive format with many illustrations, tables and algorithms. Individual chapters focus on subjects as diverse as the hard sphere liquid, classical spin models, single quantum particles and Bose–Einstein condensation, with in-depth discussions of algorithms ranging from basic enumeration methods to modern Monte Carlo techniques. A CD with schematic code, numerical tables and image sequences is included. Like other books in the series, it is aimed at final-year undergraduate and beginning graduate students.

Physics of Strongly Coupled Plasma by Vladimir Fortov, Igor Iakubov and Alexey Khrapak, Oxford University Press. Hardback ISBN 0199299803 £65 (\$130).

Strongly coupled plasma has generated much interest recently, as states of matter with high concentration of energy became accessible experimentally. This book is devoted to the physics of such high-density plasma, which has been compressed so strongly that the effects of interparticle interactions and non-ideality govern its behaviour. It presents methods of generation and diagnostics of strongly-coupled plasmas, along with the main theoretical methods and experimental results on thermodynamical, kinetic and optical properties. The book is aimed at physicists, astrophysicists, engineers and material scientists.



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Visualization of stoichiometric mixture fraction, scalar dissipation rate, and OH radical mass fraction variables in a turbulent CO/H₂ jet flame
(image courtesy of **H Akiba** and **K-L Ma**, University of California, Davis, USA) **E R Hawkes**, **R Sankaran**, **J C Sutherland** and **J H Chen** 2005 *Journal of Physics: Conference Series* **16** 65–79.

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