

BOOKSHELF

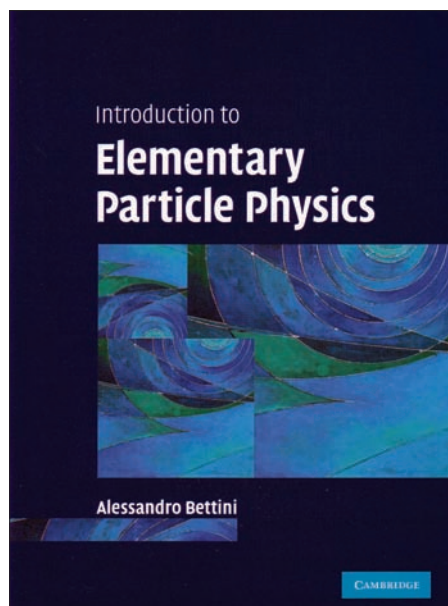
Introduction to Elementary Particle Physics

by Alessandro Bettini, Cambridge University Press. Hardback ISBN 9780521880213, £35 (\$70). Also available in e-book format.

I was a graduate student when the first version of *Introduction to High Energy Physics* by Donald H Perkins appeared; the slim one with the plain grey cover, written before the discovery of charm. This book was a welcome sight to many of us “youngsters” because it contained a wealth of concentrated information so valuable to the budding experimentalist. The book began with a nice discussion of the passage of radiation through matter in a form that was not as dated or cumbersome as the two must-read classics by Bruno Rossi and Emilio Segrè. It was also sufficiently detailed to call upon as a ready reference for an upcoming oral exam. Since then, perhaps in part because I have lived through all subsequent discoveries in particle physics, I have not been impressed with any of the rather few particle-physics texts that have appeared; not, at least, until the publication of Alessandro Bettini's *Introduction to Elementary Particle Physics*. Like Perkins before him, Bettini's expertise as a careful, methodical and experienced experimentalist shines brightly throughout the text. The reader is never left in any doubt that physics is an experimental science.

The choice of topics and the level of detail are excellent and the explanations are clear. The book is rich in physics content, especially its emphasis of important concepts, including relativistic kinematics, the wave nature of particles and quantization of fields. Some of my favourite examples are determination of the spin and parity of the pion and why this is important, the Lamb shift in quantum electrodynamics and the discussion of α_s and the proton mass. The author is an expert in neutrino physics and this comes through in the material clearly. He does a good job of emphasizing the physics at an appropriate level without getting absorbed in the mathematics of Feynman diagrams, which belongs in a course on field theory. The text is sprinkled with a few historic gems, such as the story of Marty Block asking Dick Feynman who asked C-N Yang at the 1956 Rochester conference: “Is it possible to think that parity is not conserved?” The book is extremely well written, topically informative and easy to read – but best of all it is full of physics.

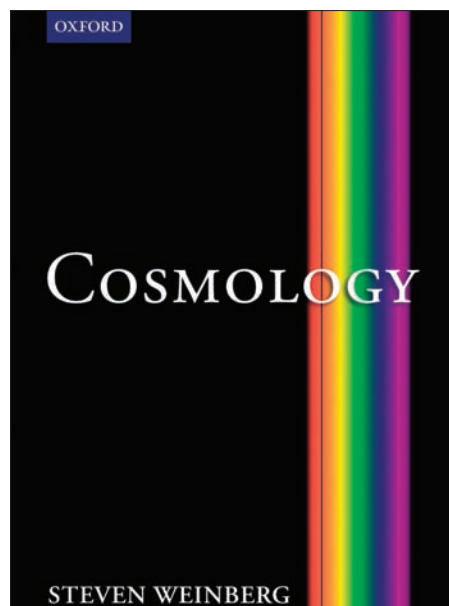
Bettini's text is suited for a one-semester



introductory course in particle physics; the one I have taught at Boston University is attended by a mixture of beginning graduate students and advanced undergraduates. The text (431 pages) is organized into 10 chapters, which can be easily covered in 16 weeks. Each chapter contains a number of accessible and readable references, as well as a generous number of end-of-chapter problems. A complete instructors' solution manual is also available in electronic form.

After this well deserved praise, do I have any complaints? Sure, but they are relatively minor: the use of dashed lines instead of wavy lines for W and Z propagators; time not going “up” in Feynman diagrams; and Λ_{QCD} written unconventionally as λ_{QCD} . I would personally have introduced several aspects of the weak interaction much earlier, such as parity violation in beta decay, helicity in pion decay, and the discovery of the τ . I would also have covered deep-inelastic scattering before QCD and included more details on hadron jets, but these are largely personal choices. I was somewhat disappointed that a large number of complete solutions to end-of-chapter problems are available in the text, limiting what I could assign from the book as homework. The bottom line, however, is that as a particle physicist I enjoyed Bettini's book three times – not unlike a fine wine: the first time when admiring its contents; the second when reading it; and a third time when teaching from it. Bravo, Sandro!

James W Rohlf, Boston University.

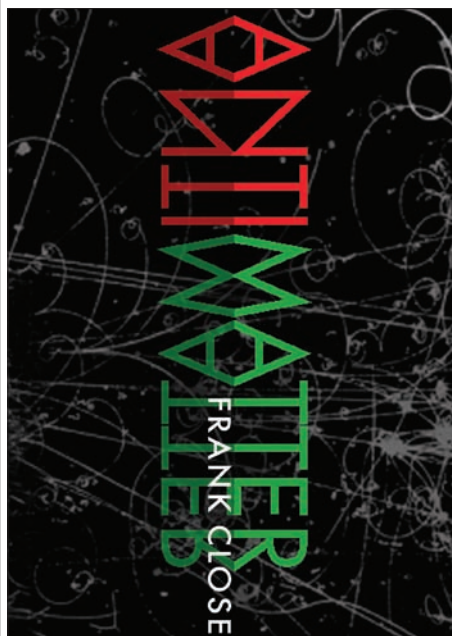


Cosmology by Steven Weinberg, Oxford University Press. Hardback ISBN 9780198526827, £45 (\$90).

Those who think that a book on cosmology and gravitation overlaps with science fiction should probably not even try to flick through the latest treatise by Nobel laureate Steven Weinberg. Conversely, those who believe that gravitation, astrophysics and cosmology could offer fertile playgrounds for the analytical methods of theoretical physics will find in *Cosmology* a stimulating source of intellectual excitement. Finally, those who think that the physics of the early universe is a mere mathematical game with no observational relevance will also be disappointed, because observations play a central role in the book's nearly 600 pages.

On the 30th anniversary of the discovery of neutral currents by Gargamelle, a round-table discussion took place in the main auditorium of CERN (*CERN Courier* December 2003 p25). Various Nobel laureates, including Weinberg, were present. Some of the questions from the audience addressed the worries of the particle-physics community, always anxious about novelty and excitement; some of Weinberg's replies in that discussion reverberate in the preface of this book: “Today cosmology offers the excitement that particle physicists had experienced in the 1960s and 1970s”.

The treatise consists of 10 chapters organized around the three observational pillars of the standard cosmological



paradigm, i.e. the physics of the cosmic microwave background (CMB), the analysis of supernova light-curves and the observations of large-scale structures. The first four chapters, following a didactical trail, cover the basic aspects of the standard paradigm, often dubbed the Λ_{CDM} scenario, where Λ stands for the dark-energy component and CDM refers to the cold dark-matter component. The remaining six chapters cover, with more theoretical emphasis, the description (chapter 5), the evolution (chapter 6), the effects (chapters 7, 8 and 9) and the normalization (chapter 10) of inhomogeneities in Friedmann–Robertson–Walker universes.

Readers will not find the usual pretty pictures and maps that often decorate cosmology books. Instead the author adapts the style of theoretical particle physics to cosmology and gravitation: solid, analytical calculations and semi-analytical estimates are preferred over fully numerical results. Analytical methods are implicitly viewed as a mandatory step for an effective comprehension of natural phenomena. The latter aspect is evident in the discussion of the anisotropies in the CMB, where the author exploits some of his own results that have appeared over the past five years in *Physical Review*. The book contains eight assorted appendices, which are useful for both newcomers and experienced readers. The notations used by the author are unusual at times but may quickly become a standard.

While the relevant technical aspects of the presentation can only be fully appreciated after a careful reading, a clear message emerges with vigour after the first reading: atomic physics, nuclear physics, field theory, high-energy physics and general relativity all come together in the description of our universe. In other words, *Cosmology* provides a vivid example of the basic unity of physics, which is something to bear in mind during the decades to come.

Massimo Giovannini, CERN.

Antimatter by Frank Close, Oxford University Press. Hardback ISBN 9780199550166, £9.99 (\$19.95).

Is antimatter the stuff of angels and demons? Yes, and we learn in this marvellous little book that the angels are called Paul Dirac and Ernst Stueckelberg, but I will not name the demons. Though the author on occasion waxes a little over-lyrical, I thoroughly enjoyed the story. It reads like a murder-mystery plot – but it's not the butler who did it.

While at CERN I myself had to answer questions about antimatter from the lay public, so I fully appreciate how difficult it is to debunk myths and expose reality instead. Explaining why there is “something” rather than “nothing” – i.e. why matter exceeded antimatter when the naive assumption is that after the Big Bang there were exactly equal amounts of each – is a difficult task, but I think that I have understood it now.

Frank Close does an excellent job of pulling all of the known pieces together into a coherent story; a story that shows how much antimatter has been present in the study of physics throughout the history of quantum mechanics. Fortunately, he does not shy away from including a little maths and a few diagrams, both of which are necessary because these physics concepts cannot be expressed by language alone.

The book is concise, clear and its small format is easy to handle. The artwork is exemplary, which is quite unusual for works in this category. In all, this is a good read for anyone who would like to know more than the *Star Trek* platitudes.

Robert Cailliau, Préveessin.

Books received

The Self-Evolving Cosmos: A Phenomenological Approach to Nature's Unity-in-Diversity, Series of Knots and

Everything, Vol. 18 by Steven M Rosen, World Scientific. Hardback ISBN 9789812771735, £48 (\$88). Paperback ISBN 979812835819, £26 (\$48).

This book offers an original way of thinking about two of the most significant problems confronting modern theoretical physicists: the unification of the forces of nature and the evolution of the universe. In bringing out the inadequacies of the prevailing approach to these questions, the author demonstrates the need for more than just a new theory. The meanings of space and time must themselves be radically rethought, which requires a whole new philosophical foundation. To this end, the book turns to the phenomenological writings of Maurice Merleau-Ponty and Martin Heidegger. Their insights into space and time bring the natural world to life in a manner well suited to the dynamic phenomena of contemporary physics. The author's pioneering work in topological phenomenology is applied to such topics as quantum gravity, cosmogony, symmetry, spin, vorticity, dimension theory, Kaluza–Klein and string theories, fermion–boson interrelatedness, hypernumbers and the mind–matter interface.

Topological Foundations of

Electromagnetism by Terence W Barrett, World Scientific Series in Contemporary Chemical Physics – Vol. 26. Hardback ISBN 9789812779960, £36 (\$69).

This book seeks a fundamental understanding of the dynamics of electromagnetism. It marshals the evidence that in certain precisely defined topological conditions, electromagnetic theory (Maxwell's theory), must be extended or generalized in order to provide an explanation and understanding of, until now, unusual electromagnetic phenomena. The key to this generalization is an understanding of the circumstances under which the so-called “A potential” fields have physical effects. Basic to the approach taken is that the topological composition of electromagnetic fields is the fundamental conditioner of the dynamics of these fields. A major thread is the treatment of electromagnetism from, first, a topological perspective, continuing through group theory and gauge theory, to a differential calculus description. Suggestions for potential new technologies based on this understanding and approach to conditional electromagnetism are also given.

RF Amplifiers *Klystron Drivers*

Solid-State Linear Power Amplifiers for High Energy Physics

Customers include:

500w 1Kw & 2Kw output power

Class A & AB linear designs

Pulsed power or CW designs

Low distortion pulsed class A

Ultra fast switching speeds

Unconditional stability

Open & short circuit protection

TTL Remote Interface

Optimisation to user frequency

Forced air or watercooling

Modular, rack mountable/bench top



**GaN debut at
PAC09**

CPI

SLAC

BESSY

ORNL

CCLRC

PSI

NSLS

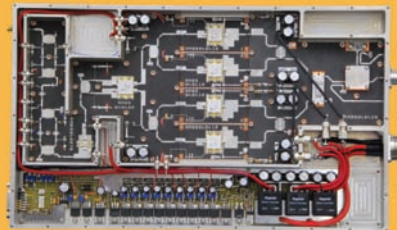
NSRRC

DESY

E2V

THALES

**GaAs FET
&
GaN HEMT**



1kW GaN HEMT



1kW GaAs FET

For a wide range of RF amplifiers for Industrial and Communications System development and research

Come to us first for all your amplifier needs

www.maltd.com Microwave Amplifiers Ltd sales@maltd.com

4 High St Nailsea, Bristol, BS48 1BT. UK Tel: +44 (0)1275 853196 Fax: +44 (0)1275 858502 ISO9001 LRQ0963054

Local Representative: Intertronic Solutions Inc Tel: +001 450 424 5666 Fax: +001 450 424 6611 www.intertronicsolutions.com