

BOOKSHELF

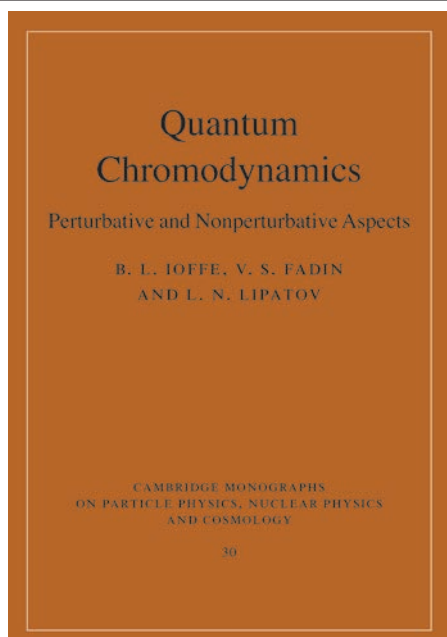
Quantum Chromodynamics: Perturbative and Nonperturbative Aspects by Boris L. Ioffe, Victor S. Fadin and Lev N. Lipatov, Cambridge University Press. Hardback ISBN 9780521631488, £110.00 (\$180). E-book ISBN 9780511717444 \$144.

The latest addition to the large library of books devoted to the strong interaction, *Quantum Chromodynamics: Perturbative and Nonperturbative Aspects*, is a long awaited gem. For a long time I witnessed the efforts of one of the editors, Peter Landshoff, waiting for the manuscript finally to come to life. The authors, Boris Ioffe, Victor Fadin and Lev Lipatov, are outstanding theoretical physicists and true masters in the field. They have made crucial contributions to a theory that, despite Titanic efforts, has kept its most intimate mysteries as secret as in its childhood days.

Before highlighting its content, it is fair to say that this is not an easy book to read; it is more of a wise companion to work with. There is a clear intention to present the results from first principles, departing from other more “user friendly” textbooks. There are numerous references to research papers to help the reader reach a deep understanding of the discussions presented in the text. The underlying spirit is that learning must follow from full control of the technical details, leaving analogies and “pretty pictures” for “amateurs”.

In almost 600 pages, the authors have been able to cover only selected topics in line with their research interests. The final result, a collage of perturbative and nonperturbative aspects of the theory, is nevertheless attractive. In many newspapers there are weekly columns dedicated to reviews of the best moves of famous chess games: the final results are known but we are still delighted with the details of certain moves. Let us follow this philosophy and comment on the most remarkable “games” in this book.

It begins by introducing quantization, with a lucid discussion of the Gribov ambiguity and renormalization schemes. It continues with the spontaneous violation of chiral symmetry and introduces chiral-effective theories at low energies. The axial and scale anomalies are then presented with care. The nontrivial structure of the QCD vacuum is also explored, first introducing tunnelling in quantum mechanics, followed by a superb description of instantons



and topological currents. To illustrate the divergent nature of quantum field theory, the authors provide many examples on how to estimate higher-order corrections ranging from renormalons to functional approaches – this is highly recommendable. QCD sum rules are then explained in detail, together with a nice discussion on the determination of the running of the strong coupling and condensates from low-energy data. Different meson and baryon properties are derived in depth.

When the perturbative window is opened, the evolution equations in the parton model take central stage. The presentation here is very original, full of useful intermediate steps and dealing with less well known subjects such as parton-number correlators. Parton distributions for unpolarized and polarized nucleon targets, quasipartonic operators and infrared evolution equations at small Bjorken x are included in the menu. Jet production, starting with e^+e^- annihilation into hadrons, also appears. I recommend that the reader pay special attention to the sections devoted to colour coherence.

The last two chapters are closest to my heart: the Balitsky-Fadin-Kuraev-Lipatov (BFKL) approach and high-energy QCD. This subject attracted a great deal of attention in physics at the HERA collider at DESY, and is returning in a rather unexpected way: the anti de Sitter/conformal-field theory (AdS/CFT) correspondence. The original derivation

of the BFKL equation, including the next-to-leading-order kernel, is presented. Special emphasis is put on using the dominant degrees of freedom at high energies, the reggeized gluons and the solid bootstrap conditions that they fulfil. The book closes with a presentation of an effective action to describe reggeized gluon interaction, the appearance of integrability, the current view of the hard pomeron in supersymmetric theories and its connection to graviton exchange in dual theories. This line of research has a bright future, but this will be the subject for other books. For the time being, remember to keep this one, not at your bedside, but on your work table.

Agustín Sabio Vera, Department of Theoretical Physics and Institute for Theoretical Physics IFT-UAM/CSIC, Autónoma University of Madrid.

Relatività Generale e Teoria della Gravitazione by Maurizio Gasperini, Springer. Paperback ISBN 9788847014206, €25.72 (£19.99).

Maurizio Gasperini's book is a textbook on the theory of general relativity (GR), but it does not present Einstein's theory as the final goal of a course. Rather, GR is seen here as an intermediate step towards more complex theories, as already becomes clear from the table of contents. In addition to the standard material on Riemannian geometry, which always accompanies the development of the physical content of GR, and on the solutions of the Einstein equations for the case of a weak field (including a treatment of gravitational waves) and for the case of a homogeneous and isotropic system (including black holes), there are also chapters on gauge symmetries (local and global), supersymmetry and supergravity.

Given the purpose of the book, it is not surprising to find the treatment of the formalism of tetrads (vierbein), forms and duality relations, which constitute the bridge between the Riemannian manifold describing space-time and gravity and the flat tangent space with Minkowski metric. For the same reason, the author considers the general case in which the torsion of the curved space-time is not null (as in Einstein's GR) in order to address the general case of a curved manifold, which is needed for the theory of the gravitino (i.e. of a local supersymmetry between fermions and bosons).

Other nice aspects of the book are the analogy between the Maxwell equations in a curved Riemannian manifold and in an optical medium, the computation of the precession of Mercury in the context of both the special and general theories of relativity, as well as several exercises whose solutions are a valuable ingredient of the book. Given the relatively small number of pages (fewer than 300), I can understand why a few stimulating aspects have been omitted ("gravitomagnetism" or Lense–Thirring precession, Hawking radiation and a discussion of the topological aspects left free by GR), but I sincerely hope that they could be included in a future edition.

Special mention should be made of the last four chapters, which deal with the Kasner solution of the Einstein equations in a homogenous but anisotropic medium, with the bridge between the curved Riemannian manifold and the flat tangent space, with quantum theory in a curved space–time and with supersymmetry and supergravity. These make the book different from most texts of its kind. In conclusion, I warmly recommend reading this book and hope that an English translation can help it reach a wider audience. *Diego Casadei, New York University and CERN.*

Books received

Let There Be Light: The Story of Light from Atoms to Galaxies by Alex Montwill and Ann Breslin, Imperial College Press. Hardback ISBN 9781860948503, £47 (\$85). Paperback ISBN 9781848163287, £26 (\$48). E-book ISBN 9781860948510, \$111.

This book is devoted to the key role played by light and other electromagnetic radiation in the universe. Readers are introduced to philosophical hypotheses, such as the universality of natural laws, and then guided to practical consequences, such as the rules of geometrical optics and Einstein's relationship, $E = mc^2$. Most chapters feature a pen-picture of a relevant scientific figure. Going a step beyond the popular level, the book provides an overall view for undergraduate and postgraduate physics students that is often missing in their courses. It will suit general readers with basic mathematics, as well as teachers.

Approaches to Quantum Gravity: Toward a New Understanding of Space, Time and Matter edited by Daniele Oriti, CUP. Hardback



ISBN 9780521860451, £60 (\$110). E-book ISBN 9780511512407, \$88.

With contributions from leading researchers in this field, this book presents the fundamental issues involved in the construction of a quantum theory of gravity and a quantum picture of space and time. It introduces the most current approaches and reviews their main achievements, thus providing a complete overview of the field for graduate students and researchers. Part I introduces the problem of quantum gravity, parts II to IV present current approaches, including string/M theory and loop quantum gravity, and part V covers effective models of quantum gravity. Each part ends in questions and answers, in which the contributors explore the merits and problems of the various approaches.

General Relativistic Dynamics: Extending Einstein's Legacy Throughout the Universe by Fred I Cooperstock, World Scientific. Hardback ISBN 9789814271165, £41 (\$51). E-book ISBN 9789814271172, \$62.

Bringing Einstein's general relativity into action in new ways, Fred Cooperstock presents the case that Einstein's theory of gravity can describe the observed dynamics of galaxies without invoking the "dark matter" required in models based on Newtonian gravity. Drawing on his experience as a lecturer as well as on his research, the author

covers the essentials of Einstein's special and general relativity at a level accessible to undergraduate students. The early chapters provide an introduction to relativity for readers who have little or no knowledge in the subject. Later, general relativity is used to extend the concept of the Planck scale, to address the role of the cosmological term and to analyse the concept of "time machines".

Feynman Motives by Matilde Marcolli, World Scientific. Hardback ISBN 9789814271202, £36 (\$48). Paperback ISBN 9789814304481, £18 (\$24). E-book ISBN 9789814271219, \$62.

Matilde Marcolli presents recent and ongoing research aimed at understanding the relation between the computations of Feynman integrals in perturbative quantum field theory and the theory of motives of algebraic varieties and their periods. One of the main problems in the field is understanding when the residues of Feynman integrals in perturbative quantum field theory evaluate to periods of mixed Tate motives. Two different approaches to the subject are described: a "bottom up" approach; and a "top down" approach developed by Marcolli and Alain Connes. The text is based partly on lecture notes for a graduate course given at Caltech in 2008.

Quantum Mechanics with Basic Field Theory by Bipin R Desai, CUP. Hardback ISBN 9780521877602, £55 (\$95).

This textbook covers, step by step, important topics in quantum mechanics, from traditional subjects such as bound states, perturbation theory and scattering, to more current topics that include coherent states, quantum Hall effect, spontaneous symmetry breaking, superconductivity and basic quantum electrodynamics with radiative corrections. A large number of topics are covered in concise chapters and are explained in simple but mathematically rigorous ways. Derivations of results and formulae are carried out from beginning to end, without leaving students to complete them. With more than 200 exercises to aid understanding of the subject, this textbook provides a thorough grounding for students planning to enter research in physics. Several exercises are solved in the text and password-protected solutions for others are available to instructors from the publisher's website.

Single Photon Counting
No Noise
High Dynamic Range
Fast Frame Rate
Adjustable Energy Threshold

DECTRIS X-ray detector systems

DECTRIS offers a wide variety of detector systems for a broad range of applications

PILATUS 2-D detector systems

PILATUS detector systems are based on CMOS hybrid-pixel technology and deliver outstanding results in various applications. A wide range of models ensures that a suitable PILATUS detector can be chosen for every measurement.



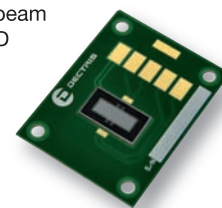
MYTHEN 1-D detector systems

MYTHEN is a one dimensional silicon strip detector system, which can be combined to form multi-detector arrays covering large angles (MYTHEN 6K).



XBPM Beam Position Monitors

XBPM4 is a 4-quadrant x-ray beam position monitor based on CVD diamond technology, suitable for hard x-ray synchrotron beam lines.



CAEN Silicon PhotoMultiplier Development Kit

The all-in-one solution for Single Photon Counting and Spectroscopy Applications

CAEN realized a modular development kit dedicated to Silicon Photomultipliers, representing the state-of-the-art in low light field detection with photon number resolving capabilities.



Desktop Digitizer (DT5720A)

- 2 Channel 12bit 250 MS/s Digitizer
- Digital Pulse Processing for Charge Integration DPP - CI
- Best suited for PMT and SiPM/MPPC readout at low and high rates
- Mid-High speed signals (Typ: output of PMT/SiPM)
- Good timing resolution with fast signals (rise time < 100 ns)
- Optical Link and USB 2.0 interfaces



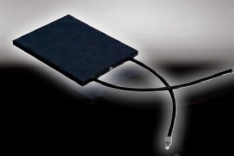
2 Channels General Purpose Amplifier and Power Supply Unit (SP5600)

- Variable amplification gain (up to 50 dB)
- Low noise, not to spoil the sensor performances for small signals
- Wideband, to comply with the fast sensor response
- Fast leading edge discriminator and time coincidence
- Provides the bias for the sensors with gain stabilization
- USB 2.0 interface
- Mechanical structures with two embedded SiPM 1 x 1 mm²



LED Driver (SP5601)

- Width of pulse 3 ÷ 60 ns
- LED color: violet (400nm) 1500 mcd
- Pulse generator: internal/external
- Optical output connectors: FC
- Optical fiber included



Scintillating Tile (SP5602)

- Sensitive volume: 100 x 100 x 10 mm³
- Scintillator: polystyrene
- Light guide: embedded WLS fiber
- Output connectors: FC



Mini Spectrometer (SP5603)

- Mechanical structure for optimal SiPM to crystal coupling
- Crystal dimensions: 3 x 3 x 15 mm³
- Included crystals: LYSO, BGO, CsI
- One SiPM 3 x 3 mm² embedded

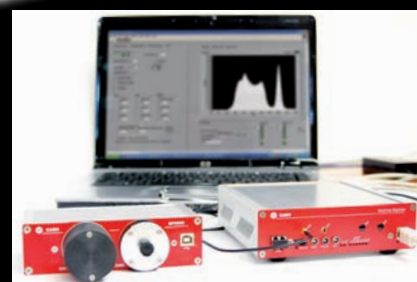
Control Software included



Set-up for SiPM testing & characterization



Set-up for detecting cosmic rays and β particles



Set-up for detecting gamma rays

The different building blocks can be assembled in a customized configuration, according to the specific application and the user's requirements. Upon request, sensors from the main producers can be provided, fully integrated in the mechanical structures.

The kit was developed within the EC-FP6 project RAPSODI, licensed to CAEN by the Research & Technology Development parties.

www.caen.it

Small details Great differences

Meet us at the following events:

pshp2010 – International Workshop on Probing Strangeness in Hard Processes

October 18 - 21, 2010

NuFact10 – 12th International Workshop on Neutrino Factories, Superbeams and Beta Beams

October 20 - 25, 2010

ASPERA Technology Forum – Photosensors and auxiliary electronics

October 21 - 22, 2010

2010 Nuclear Science Symposium and Medical Imaging Conference

October 30 - November 6, 2010