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Effective Theories in Physics: From Planetary Orbits to Elementary Particle Masses

By James D Wells

Springer Verlag

Paperback: £44.99 €52.70 \$49.95

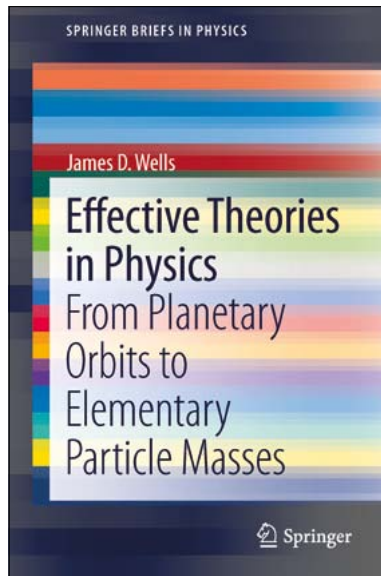
E-book: £35.99 €41.64 \$39.95

This remarkable and charming book introduces the idea of effective field theories from a novel point of view, making the concepts natural and – in retrospect – inevitable. As the author makes clear, all theories are effective theories. At just 73 pages, it is easily accessible to a graduate student or a bright undergraduate. It will also be welcomed by professional physicists for its readability and clear, compelling style.

In introducing the idea of effective theories, the author begins by considering Galileo's law for falling bodies, neglecting air resistance. Keeping the symmetries assumed for the problem – here translational invariance – and the idea that the constant downward acceleration might be an approximation to a more complete theory that involves a dependence of g on height above the ground, Wells derives the form of the leading correction by taking into account Newton's law of gravitation without explicitly invoking the inverse square law. Such an effective theory could have been used to search for an extension to Galileo's law or to accommodate data, even in the absence of Newton's more complete theory of gravity. The second chapter continues the discussion of gravity, this time assuming circular orbits (and the simple harmonic oscillator) and the sorts of deviations that might be allowed for, using the ideas of effective theories to analyse deviations from perfect circularity.

Chapter 3 considers effective theories of classical gravity, arguing for the general expectation of perihelion precession and that something like black holes could have been predicted and the Schwarzschild radius estimated before the discovery of general relativity. Using both Lagrangian and Hamiltonian formulations of the problem, this discussion is not only enlightening but a delight to read. The presentation of effective theories in these simple contexts – requiring neither field theory nor even quantum mechanics – makes their meaning, importance and universality clearer than the usual, more advanced introductions.

Assuming some knowledge of the Standard Model, chapter 4 shows how the Fermi theory can be thought of as an effective field theory that approximates it.



Here the author considers in some detail the origin of mass and in particular neutrino masses beyond the Standard Model. He then concludes with a discussion of naturalness and the hierarchy problem – all from the viewpoint of effective theories.

The fifth and final chapter is more philosophical in nature, emphasizing how and why effective theories are more than truncations of more comprehensive theory. It also looks at how one can go about choosing between theories, before closing with implications for the LHC.

I was pleasantly surprised by this book. The approach is original and makes the whole concept of effective theories clear and natural. I will be urging all of my students to take an afternoon to read this wonderful introduction – and to think carefully and deeply about the many points that the author makes so well.

• John Swain, Northeastern University.

À la recherche du boson de Higgs

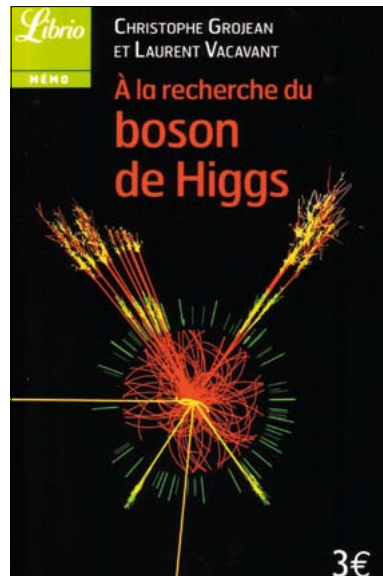
De Christophe Grosjean et Laurent Vacavant

Librio

Broché : €3

Vous n'avez rien compris au boson de Higgs ? Alors ce petit livre est peut-être fait pour vous. Il faut saluer en effet le très grand effort des auteurs pour tenter de rendre accessible à tous les concepts qui se cachent derrière l'une des plus grandes découvertes de ces dernières années.

De la relativité au mécanisme qui donne



leur masse aux particules, en passant par la physique quantique, cet ouvrage aborde le plus simplement possible les notions qui permettront à chacun d'appréhender le monde complexe des particules ainsi que les lois du Modèle standard. Les nombreuses analogies – souvent drôles – aident à rendre concrets des phénomènes le plus souvent abstraits que seul le formalisme mathématique est en mesure de réellement retranscrire. Vous découvrirez notamment dans cet ouvrage pourquoi le père Noël ne peut être qu'un objet quantique vu son comportement (c'est de saison), ou encore pourquoi la recherche du boson de Higgs revient à chercher un tibia de mammoth dans un immense cimetière d'éléphants !

Bien sûr, les spécialistes et les puristes trouveront certainement des défauts à certaines analogies : nul doute que nous n'avons pas terminé de discuter sur la meilleure manière de présenter simplement le mécanisme de Higgs... L'avantage de ce petit livre, c'est aussi qu'en moins d'une centaine de pages, il aborde les grandes étapes de l'aventure du LHC en les replaçant dans le contexte historique et international. Il rend également compte des stratégies et technologies mises en œuvre dans les expériences ATLAS et CMS pour enregistrer et traiter une quantité de données vraiment phénoménale.

Je recommande donc sans hésitation la lecture de cet ouvrage pour sa concision, sa simplicité et son approche légère qui devrait

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ravir tous ceux dont la vue d'une simple équation est en mesure de provoquer une indigestion.

● Arnaud Marsollier, CERN.

Books received

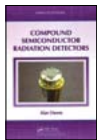
Compound Semiconductor Radiation Detectors

By Alan Owens

CRC Press

Hardback: £82

Also available as an e-book



Bringing together information scattered across many disciplines, this book summarizes the status of research in compound semiconductor radiation

detectors. It examines the properties, growth and characterization of compound semiconductors as well as the fabrication of radiation sensors, with emphasis on the X- and γ -ray regimes. It explores the limitations of compound semiconductors and discusses current efforts to improve spectral performances, pointing to where future discoveries might lie. A resource for the established researcher, this book serves as a comprehensive and illustrated reference on material science, crystal growth, metrology, detector physics and spectroscopy. It can also be used as a textbook for those who are new to the field.

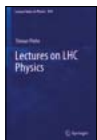
Lectures on LHC Physics

By Tilman Plehn

Springer

Paperback: £40.99 €47.43 \$59.95

E-book: £31.99 €35.69 \$39.95



Anyone trying to apply the solid knowledge of quantum field theory to actual LHC physics – in particular to the Higgs sector and certain regimes of QCD – inevitably meets an intricate maze of phenomenological know-how, common lore and intuition, often historically grown, about what works and what does not. These lectures are intended to be a brief but sufficiently detailed primer on LHC physics that will enable graduate students and any newcomer to the field to find their way through the more advanced literature, as well as helping them to start work in this timely and exciting field of research.

The Conceptual Framework of Quantum Field Theory

By Anthony Duncan

Oxford University Press

Hardback: £77.50

Also available as an e-book



This book attempts to provide an introduction to quantum field theory by emphasizing conceptual issues. The aim is to build up the theory systematically from clearly stated foundations. The first section, “Origins”, consists of two historical chapters that situate quantum field theory in the larger context of modern physical theories. The three remaining sections follow a step-by-step reconstruction of this framework, beginning with a few basic assumptions: relativistic invariance, the basic principles of quantum mechanics, and the prohibition of physical action at a distance embodied in the clustering principle. Problems are included at the ends of the chapters and solutions can be requested via the publisher’s website.

Silicon Solid State Devices and Radiation Detection

By Claude Leroy and Pier-Giorgio Rancoita

World Scientific

Hardback: £89

E-book: £67



Using their many years of experience both in research with silicon detectors and in giving lectures at various levels, Leroy and Rancoita address the fundamental principles of interactions between radiation and matter, together with working principles and the operation of particle detectors based on silicon solid-state devices. They cover a range of fields of application of radiation detectors based on these devices, from low- to high-energy physics experiments, including those in outer space and medicine. Their book also covers state-of-the-art detection techniques in the use of such radiation detectors and their read-out electronics, including the latest developments in pixelated silicon radiation detectors and their applications.

Quantum Field Theories in Two Dimensions: Collected Works of Alexei Zamolodchikov (2 volumes)

By Alexander Belavin, Yaroslav Pugai and Alexander Zamolodchikov (ed.)

World Scientific

Hardback: £124



These two volumes contain original contributions of Alexei Zamolodchikov (1952–2007), who was a prominent theoretical physicist of his time. Volume 1 contains his work on conformal field theories, 2D quantum gravity and Liouville theory.

Volume 2 includes his pioneering work on non-perturbative methods in 2D quantum field theory and on integrable models. Both volumes can be used as an advanced textbook by graduate students specializing in string theory, conformal field theory and integrable models of quantum field theory. They are also highly relevant to experts in these fields.

Exploring Quantum Mechanics: A Collection of 700+ Solved Problems for Students, Lecturers, and Researchers

By Victor Galitski, Boris Karnakov, Vladimir Kogan and Victor Galitski Jr

Oxford University Press

Hardback: £95 \$165

Paperback: £45 \$84.99

Also available as an e-book



Mastering quantum physics is a non-trivial task and a deep understanding can only be achieved through working out real-life problems and examples. It is notoriously difficult to come up with new quantum-mechanical problems that would be solvable with a pencil and paper, within a finite amount of time. This book presents more than 700 original problems in quantum mechanics, together with detailed solutions covering all aspects of quantum science. Collected during 60 years, first by the late Victor Galitski Sr, the material is largely new to an English-speaking audience. New problems were added and the material polished by Boris Karnakov. Finally, Victor Galitski Jr, has extended the material with problems relevant to modern science.

Reminiscences: A Journey through Particle Physics

By Adrian Melissinos

World Scientific

Hardback: £28

E-book: £21



A personal account as a research physicist for more than 50 years in areas of particle physics and related fields, Adrian Melissinos’s insights into the ways that general research was carried out and the evolution of particle physics from 1958 to 2008 will prove interesting to science-history enthusiasts and particle physicists alike. Through this mix of personal reminiscences and professional journey, readers can relive the joy and excitement of research and teaching in small groups during those early years, while gaining a partial historical perspective of particle physics since the late 1950s.

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