

# Bookshelf

## Neutrino

By Frank Close

Oxford University Press

Hardback: £9.99

“Of all the things that make the universe, the commonest and weirdest are neutrinos.” Thus starts Frank Close’s latest book, *Neutrino*, a fascinating look into one of the most compelling and surprising scientific advances of the past century.

With its very basic title, a reader might imagine that this book, written by a leading particle theorist, would be an accurate but dry discourse on the eponymous particle. They would be surprised to find a moving book centred on the lives and work of three individuals: Ray Davis, John Bahcall and Bruno Pontecorvo. *Neutrino* manages to capture not only their impressive scientific contributions but something of their personalities and the times, through an excellent choice of quotes and stories from friends and colleagues. Consequently it is a book that is brief, scientifically accurate and full of drama.

The neutrino’s origins in the early 20th century studies of radiation, stellar astrophysics and neutrino oscillations are all carefully and clearly explained. This book fills in many of the gaps left by more cursory treatments, in particular the road from Wolfgang Pauli’s proposal of the neutrino to the development of the theory of beta decay by Enrico Fermi. But the pedagogic scope is wisely limited and the author does not shy away from leaving the scientific explanations to a footnote if they are incidental to the main storyline.

*Neutrino* also manages to capture the full spectrum of ideas, events and relationships that play a part in particle physics. The path between brilliant theoretical insight and triumphant experimental verification can be long and precarious. The prosaic (and often deciding) factors – the casual encounter with a colleague that sparks a new idea, incorrect theoretical assumptions identified and corrected, incremental advances in technology, site selection, the vagaries of funding decisions, politics, the role of industrial partners, and just plain luck – are accurately and entertainingly discussed.

That this book succeeds on a number of levels is a credit to the author’s deep knowledge of the physics and his meticulous research, as well as a concise and imaginative writing style. The omission of the LSND and MiniBooNE experiments is the only notable absence, though hardly surprising since the experimental



situation here is far from resolved. If the signatures of antineutrino appearance from these experiments stand up to further investigation, neutrinos will have proved to be even weirder than we thought and will provide the author with rich material for a second edition.

● Hugh Gallagher, Tufts University.

## How to Teach Quantum Physics to Your Dog

By Chad Orzel

Oneworld

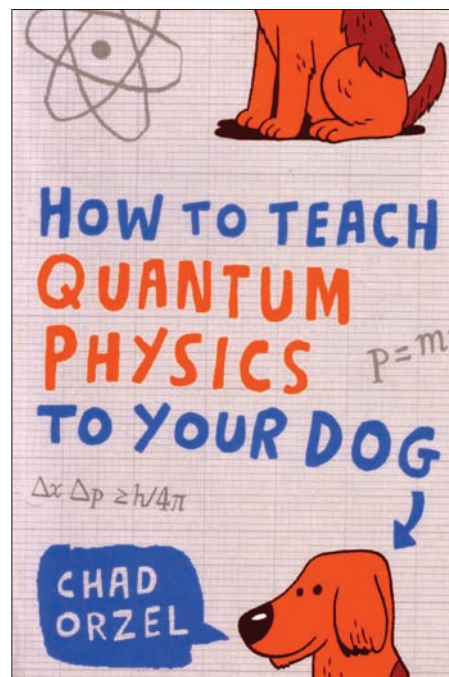
Hardback: £7.99

When I first sat down with *How to Teach Quantum Physics to Your Dog* I was expecting a little light reading, something to pick up on Sunday after lunch. After all, if a dog could understand it, surely someone who has a PhD in physics wouldn’t find it too challenging? I was wrong.

Initially Chad Orzel’s analogies with squirrels and dog wavefunctions are both amusing and enlightening, but as the book moves on they don’t make his subject any clearer. By the time he has reached incoherence it is hard to see how anyone without a good grounding in physics would cope. But it is worth persevering.

Orzel’s style – especially his references to dog treats, bunnies and squirrels – get irritating at times, but despite this I found myself enjoying the book.

To quote Orzel, “quantum mechanics is often subtle and difficult to understand”. His



book reminds us why that is, and overall he succeeds in making it a little clearer.

● Catriona Charlesworth, St Jean de Gonville.

## Field Computation for Accelerator Magnets: Analytical and Numerical Methods for Electromagnetic Design and Optimization

By Stephan Russenschuck

Wiley

Hardback: £165 €204 \$275

The LHC is an amazing engineering achievement supported by a long programme of developments. CERN has been encouraging the development of technologies required to complete the project since the late 1960s (for example, the GESSS collaboration between the Saclay, Karlsruhe and Rutherford Laboratories). The quality of this work has been recognized internationally and it has contributed to spin-off activities, especially in the development of superconductors and in magnetic-field computation. With the completion of the LHC, and recognizing CERN’s desire to maintain the competences required to design accelerators, it is the right time to publish a book on the computer methods developed to design the LHC magnets.

In this book, Stephan Russenschuck provides an extremely useful and comprehensive description of magnetic-field computation for particle-accelerator

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magnets. It gives practical information and describes simple methods of analysis; in addition, it includes the abstract mathematics necessary to understand the finite element methods that were developed specifically for the design of the magnets for the LHC's main ring. The final chapter examines optimization methods, particularly those implemented in the ROXIE software.

The successful design of the LHC magnets required highly accurate field-computation methods that were capable of modelling effects such as conductor and cable magnetization, which are uniquely important to accelerators. Even the LHC's superconducting magnets quench, when a small resistive volume diffuses rapidly through the coil structure, driven forward by the heat it generates. This book's chapters describe methods for modelling these effects, and demonstrate the accuracy of the results by comparison with measurements. The appendices include practical information about cryogenic material properties required for quench analysis.

This is a well presented book that makes excellent use of computer graphics to show results and explain phenomena. The graphics showing interstrand coupling currents in conductors and cables are particularly clear and help to make this chapter easy to understand.

Russenschuck has written a valuable addition to the library of those involved in the design of accelerator magnets.

● John Simkin, *Vector Fields Software*.

### Sonne, Mond und Sterne... 52 kosmische Antworten

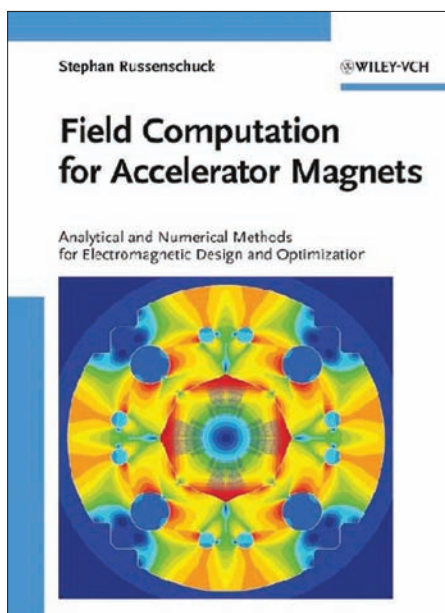
By Franz Kerschbaum and Franz Simbürger

Seifert Verlag

Paperback: €10.90 SFr19.70

The general public shows an ever-growing interest in following the latest advances in scientific research, in particular when it comes to some of the most fundamental questions of mankind, such as how big and old is our universe, how is it structured, what is dark matter and energy, why is it that our Sun shines and will it shine forever?

To answer many of these questions for a broad audience, Franz Kerschbaum, head of the Institute for Astronomy at the University of Vienna, took part in a weekly radio programme by the ORF (Austria's public TV and radio broadcaster). Called *Wissen aktuell* and mediated by Franz Simbürger, the series was so successful that the questions and their concise answers have been made into a book, interspersed with some spectacular illustrations.



The 52 questions introduce the reader to many astrophysical objects and the associated scientific research: dwarf stars, pulsars, black holes, dark matter, the cosmic-ray background, etc. They also address more practical aspects concerning the universe, the Sun and our planetary system: how to look for new planets, why we need space telescopes, the dimensions of the Solar system, etc. An advantage of the book over the radio programme is that readers can easily combine information from the individual contributions.

Despite being concise, this book contains plenty of information and places events in historical context. For instance, we are reminded of the revolutionary discoveries made by Galileo Galilei, despite the simplicity of his "spyglass" compared with today's amateur and scientific telescopes, and of the fact that the Phoenicians and Greeks already knew that the Earth is round, long before the Portuguese and Spanish sailed around the "globe".

This book is particularly suited to curious high-school students who – when lying on the grass, looking at the sky – might ask themselves questions such as, why is the sky so blue (or red at sunset), why do stars scintillate, what is a shooting star, why is Earth the only (currently known) planet where life exists? It is also a good entry point for learning more about the fascinating fields of astrophysics and cosmology.

It is just a pity that the word *Millionen* (million) was written as *Milliarden* (thousand million), misleading the naive reader into thinking that the Herschel and SOHO satellites orbit the Earth at 1.5 *Milliarden* km, a distance 10 times larger



than the distance from the Earth to the Sun.

● Hermine K Wöhri, CERN.

## Books received

### Practical Guide to Computer Simulations

By Alexander K Hartmann

World Scientific

Hardback: £67 \$108

Paperback: £40 \$64

After working through this book, the reader will possess the necessary background knowledge, from program design, programming in C, fundamental algorithms and data structures, all of the way to data analysis, presentation and publishing. In each of these fields, no preliminary knowledge is assumed. All techniques are explained using many examples in C; the C codes, as well as solutions to the exercises, are available in the accompanying CD-ROM. The techniques described are independent of the fields of research and hence are suitable for projects in physics, chemistry, computer science, biology and engineering. The general-purpose nature also means that problem-dependent algorithms are not included.

### Scientific Computation

By Gaston H Gonnet and Ralf Scholl

Cambridge University Press

Hardback: £35 \$68

E-book: \$52

Using real-life applications, this graduate-level textbook introduces different mathematical methods of scientific computation to solve minimization problems using examples

ranging from locating an aircraft, finding the best time to replace a computer, analysing developments on the stock market and constructing phylogenetic trees. The book focuses on several methods, including various optimization procedures. Each chapter solves several realistic problems while introducing the modelling optimization techniques and simulation as required. This allows readers to see how the methods are used, making it easier to grasp the basics.

### Networks: An Introduction

By MEJ Newman

**Oxford University Press**

Hardback: £45 \$85

The scientific study of networks, including computer, social and biological networks, has received an enormous amount of interest over the past few years. The rise of the internet and the wide availability of inexpensive computers have made it possible to gather and analyse network data on a large scale, and the development of new theoretical tools has allowed the extraction of new knowledge from many different kinds of networks. Important developments have occurred

in many fields, including mathematics, physics, computer and information sciences, biology and the social sciences. This book brings together, for the first time, the most important breakthroughs in each of these fields and presents them in a coherent fashion, highlighting the strong connections between work in different subject areas.

### Classical and Quantum Dynamics of Constrained Hamiltonian Systems

By Heinz J Rothe and Klaus D Rothe

**World Scientific**

Hardback: £62 \$62

E-book: \$117

This is an introduction to the field of constrained Hamiltonian systems and their quantization – a topic that is of prime interest to theoretical physicists who wish to obtain a deeper understanding of the quantization of gauge theories, such as describe the fundamental interactions in nature. Beginning with the early work of Dirac, this book covers the main developments in the field up to more recent topics, such as the field–antifield formalism of Batalin and Vilkovisky (including a short discussion of how gauge anomalies may

be incorporated into this formalism). All topics are well illustrated with examples that emphasize points of central interest. The book is aimed at graduate students and researchers in theoretical and mathematical physics, quantum mechanics and quantum field theory.

### Modern Atomic and Nuclear Physics: Problems and Solutions Manual (Revised Edition)

By Fujia Yang and Joseph H Hamilton

**World Scientific**

Hardback: £13 \$19

This “problems and solutions” manual is intended as a companion to an earlier textbook, *Modern Atomic and Nuclear Physics (Revised Edition)*, also by World Scientific. This manual presents solutions to many end-of-chapter problems in the textbook. These solutions are valuable to instructors and students working in the modern atomic field. Students can master important information and concepts in the process of looking at solutions to some problems, and become better equipped at solving other difficulties that the instructors propose.



# Physics at LHC 2011

## Perugia, Italy, 6–11 June 2011

**Congress Center Gio**

**Chairs: G Mantovani, G Mitselmakher, L Rossi**

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