

Bookshelf

Summer Bookshelf

Summer for physicists is the season of conferences, with holidays squeezed in where possible. This year many particle physicists are no doubt already working hard on preparing the latest results from the LHC, based on the bumper crop of data already achieved.

For those who can find time for reading something other than drafts of their latest papers and preprints with new results, this Bookshelf reviews a few less technical books for more relaxed reading – or for recommending to family and friends while the hard work continues.

The Quantum Story

By Jim Baggott

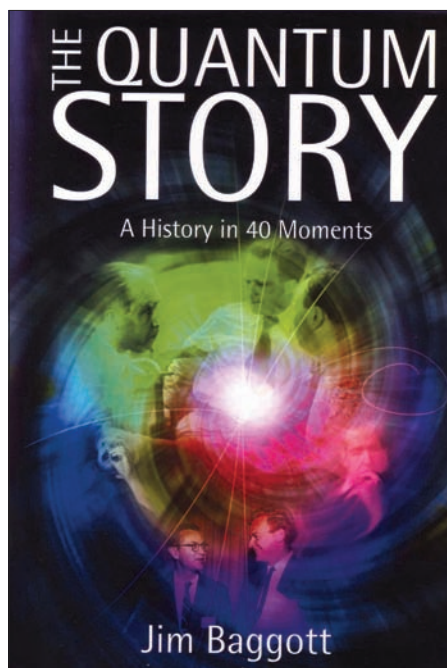
Oxford University Press

Hardback: £16.99 \$29.99

The Quantum Story provides a detailed “biography” of the 111-year-old quantum physics, from its birth with Planck’s quantum of action all of the way up to superstrings, loop quantum gravity and the start of the LHC – a machine that is expected to put physics back on the right track, with experimental measurements forcing some “figments of the theoretical mind” to confront reality.

The first chapters are simply delicious and ideally suited for summer reading on a sunny, late afternoon with a fresh drink close by. I was pleased to revisit most of the stories and characters I met as a teenager when reading books by or about Einstein, Bohr, Pauli, Heisenberg, de Broglie, Schrödinger, Dirac and many other universal heroes. Baggott explains the basics and wonders of quantum physics in a surprisingly clear way, despite its intrinsically “unsettling” and “wholly disconcerting” nature. A multitude of advances and a fair share of dead ends are exposed with excitement and suspense, almost as in a detective story, and the pace of the action is such that I was often reminded of Dan Brown’s novels. You begin to wonder if some of the main characters ever slept, such as during the Solvay conference in 1927, when each breakfast time Einstein would attack with a new *gedankenexperiment*, which Bohr would counter throughout dinnertime in Brussels’ “Hotel Britannique”.

We all know about Einstein’s “year of miracles” when, perhaps inspired by not having a respectable position to lose in the academic world, he revolutionized



physics with an incredible succession of amazing papers. It is less known that he also wrote several “unpublished papers”, some of which influenced new and important ideas, such as Born’s probabilistic view of Schrödinger’s wavefunctions, submitted for publication in June 1926. This “hastily written” paper was followed one month later by a second one giving a “more considered” perspective, complemented by a note added to the proofs of the first, mentioning that the probabilities are proportional to the *square* of the wavefunctions.

Somehow, it had not crossed my mind that even in those days many physicists were in a hurry to get their ideas in print. The “publish or perish” motto has long applied. Pauli submitted a paper deriving Balmer’s formula from matrix quantum mechanics just five days before Dirac did the same; maybe Dirac’s delay was caused by his proverbial perfectionism with clear language. Baggott mentions other notes added by the authors in the proofs of their papers, as when Heisenberg writes that: “Bohr has brought to my attention that I have overlooked essential points in the course of several discussions in this paper [on uncertainties].” Ouch... this must have hurt. It continues: “I owe great thanks to Professor Bohr for sharing with me at an early stage the results of these more recent investigations of his.” The Copenhagen interpretation did not have an easy birth.

The topic of quantum reality strikes

back later in the book, in chapters 30 to 35, where the reader needs a higher level of concentration to follow detailed developments regarding the topics of hidden variables, Bell’s and Leggett’s inequalities, entanglement and the surprisingly accurate experimental work recently made in this area. In chapters 18 to 29, the reader learns the crucial steps in the development of quantum field theories, quantum electrodynamics, quantum chromodynamics, quark asymptotic freedom and infrared confinement, the J/Ψ revolution, the discovery of the intermediate vector bosons, etc. This must be the nicest introduction to the Standard Model that I have read so far.

Given the style (and target audience) of the book, the almost complete absence of mathematics is quite understandable and I should say that the author succeeds remarkably well in explaining many leading-edge physics topics without the help of equations. It is true that “modern theoretical physics is filled with dense, impenetrable, complex mathematical structures”, which often obscure the deep meaning of what is being done. Nevertheless, and with the confidence gained after reading the 410 pages of main text plus several end-of-book notes, I dare to express the wish of seeing this book reprinted in a “special illustrated edition” (following the nice examples of Bill Bryson’s *A Short History of Nearly Everything* and Stephen Hawking’s *A Brief History of Time*), with more diagrams, pictures and equations.

In summary, this is a truly exceptional book, which I highly recommend. It will be enjoyable reading for many professional physicists as well as for bright high-school students waiting for something to trigger a decision to follow a career in physics.

● Carlos Lourenço, CERN.

Present at the Creation: The Story of CERN and the Large Hadron Collider

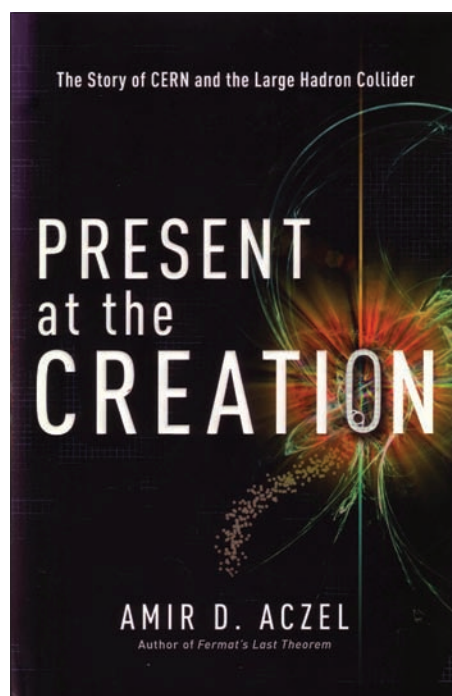
By Amir D Aczel

Crown

Hardback: £15.73 \$25.99

Mathematician and science writer Amir D Aczel is well known for his factually convincing and captivating story of *Fermat’s Last Theorem*. His recent book on CERN follows a similar recipe for writing a gripping story: impressions from several visits to the laboratory – notably witnessing the LHC restart from the CERN Control

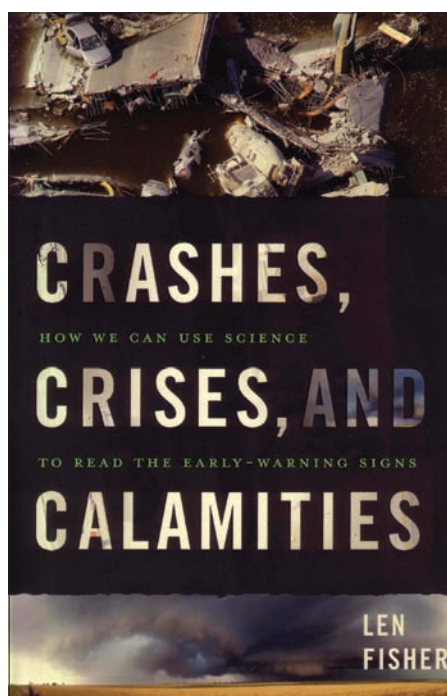
Bookshelf



Centre on 5 March 2010 and from the CMS Control Centre earlier in the day – as well as interviewing respective experts and leading physicists, including 13 Nobel laureates.

The story develops in 14 chapters that are illustrated with colour photographs, black-and-white line drawings, photographs and tables. An afterword, notes and a bibliography complete the picture, together with three more “technical” appendices: how an LHC detector works; particles, forces and the Standard Model; and the key physics principles used in the book. Aczel covers the LHC and its potentialities and risks, the four big detectors, symmetries of nature and Yang–Mills theory, the Standard Model, the Higgs particle, string theory, dark matter, dark energy and the fate of the universe. The result is a splendid effort to inform a wider public of CERN’s achievements set in an appropriate context.

As would be expected, Aczel is at his best when explaining mathematical theories such as that of Yang and Mills. Given the breadth of the material covered, it is not surprising that there are some lacunae and even errors. What struck me as an accelerator physicist was the erroneous explanation for the PS Booster synchrotron in the accelerator chain that feeds the LHC, which he attributes to the limited increase of particle velocity in a given synchrotron. In fact, the need for the Booster arose from the luminosity requirements of the Intersecting Storage Rings (and successive storage rings) – that is higher beam intensity and (phase space) densities or, in other words,



limited transverse and longitudinal beam emittances. It would have been helpful if Aczel had been able to interview the late Nobel laureate Simon van der Meer.

Altogether, however, it is a book that can be highly recommended to anybody who wants to know “everything” about CERN and who likes a narrative style. I would personally be interested to know how much a complete newcomer understood after a first reading.

● *Helmut Reich, formerly CERN.*

Crashes, Crises, and Calamities: How We Can Use Science to Read the Early-Warning Signs

By Len Fisher

Basic Books

Hardback: £13.99 \$23.99

When I received the book, I was eager to start reading it, particularly because of its subtitle: *How We Can Use Science to Read the Early-Warning Signs*. How can we? In fact, after reading the book, the conclusion is that we cannot.

Although realizing it caused some disappointment, I can confirm that, even without the million-dollar answer, the book is an interesting read. Len Fisher is an experienced writer, capable of explaining difficult concepts with simplified – but never simplistic – language. The book talks about equilibrium states, physical and mathematical models, negative feedback etc. When you study such topics in textbooks, you can quickly become bored that

everything seems so obvious. However, the mathematics that formalizes all of this is far from being obvious; and the million-dollar question has no answer precisely because of this.

Fisher’s writing is engaging because it moves the hard concepts into everyday life, giving them a framework that makes the reader forget about the complex physics and mathematics behind them. Thus, the equilibrium states that remain theoretical in textbooks, are here explained in real and contextual situations, so that the reader learns about the evolution of biological species, the main facts that determine the solidity of a newly constructed bridge (but it could be your house) and even the factors that lead the dynamics between two people who become a couple.

I found this enjoyable reading and the disappointment of the missing conclusion was partly compensated for by the genuine attention that the author pays to the reader’s entertainment. I recommend the book to a non-scientific readership, which, I believe, will greatly profit from Fisher’s explanation of how and why things work, or, conversely, why they don’t work and can break down.

● *Antonella Del Rosso, CERN.*

Le vrai roman des particules élémentaires

De François Vannucci

Éditions Dunod

Broché: €18

Version numérique: €14.99

De l’identification des atomes, à la fin du XIX^{ème} siècle, à la (incessamment sous peu ?) mise en évidence du boson de Higgs, la physique des particules est une aventure palpitante. Dans ce livre, le physicien François Vannucci dévoile les dessous des grandes avancées dans ce domaine trop peu populaire, et guide les amateurs de science, physiciens ou non, dans le monde des particules élémentaires. Le lecteur découvrira ainsi comment « les progrès de l’exploration de l’infiniment petit ont franchi les étapes successives de la molécule, de l’atome, du noyau, pour aboutir finalement aux constituants élémentaires ».

Si certains passages ardues nécessitent quelques prérequis, et s’il faut parfois s’accrocher pour ne pas s’égarer dans les méandres de la terminologie, la lecture de cet ouvrage reste dans l’ensemble très agréable et relativement accessible à un large public. En effet, plus qu’un véritable livre de physique, il s’agit d’un roman d’aventures – humaines et scientifiques – à travers lequel les amateurs de science au sens large peuvent revivre les moments clés de cette discipline : le lecteur en ressort

avec une bonne vue d'ensemble des grandes étapes qui ont marqué le monde de la physique des particules, qu'il s'agisse de la mise en évidence de nouvelles particules ou de la construction d'accélérateurs toujours plus puissants. Le texte est accompagné de quelques photographies historiques ainsi que de nombreux schémas. Malheureusement, ces illustrations restent trop souvent obscures au profane, faute de légendes suffisamment étayées.

En annexe, une frise chronologique retraçant les découvertes majeures et les Prix Nobel – de la découverte des rayons X par Wilhelm Röntgen en 1895 aux études sur la symétrie brisée de Yoichiro Nambu, Makoto Kobayashi et Toshihide Maskawa, nobélisés en 2008 – permet de (re)découvrir, en quelques pages, les grands noms de la physique des particules.

• *Anais Schaeffer, CERN.*

Decoding Reality: The Universe as Quantum Information

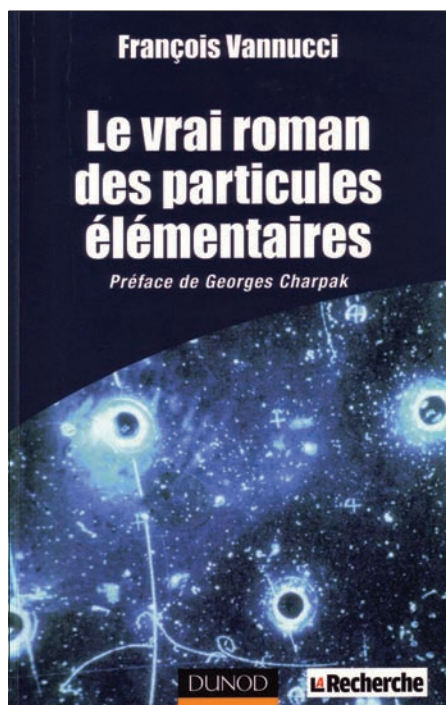
By Vlatko Vedral

Oxford University Press
Hardback: £16.99

When I picked up this “engaging, non-technical exploration of what the new theory of quantum information and computation tells us about life, the universe and everything” (David Deutsch, quantum computation pioneer, author of *The Fabric of Reality* and, like Vedral, an Oxford University professor) I was hoping to get to grips with arcane topics such as entanglement and teleportation. When I reached the end of the book I was suffering from information overload, the point at which life ends according to Vedral.

The author begins by describing many aspects of “observed reality” in terms of classical information theory, from natural selection and global warming to poker playing and racial segregation. He then dives into the “real world” of quantum mechanics, where bits morph into qubits and nothing is as it seems. Part three is almost entirely speculative – how to get rid of God – and there I finally wilted.

The book is untidy, repetitive and in need of some error correction; 10^{100} divided by 10^{17} is not “about 10^{90} ”, or did I miss something? It is replete with the work of great thinkers, many of them Nobel laureates, so there are tough ideas to be absorbed, yet Vedral explains how to calculate 70% of 60%, and tells us that an unknown unknown is something we don't know we don't know. Well, er, yes... Discursive anecdotes and irritating bursts of whimsy often obscure the message, making



it easy for the reader to lose the plot.

Decoding Reality certainly contains an abundance of interesting facts but I didn't manage to get to grips with quantum information. The opinion of well-known scientist and communicator, Paul Davies, that it “is the finest treatment (he has) read of the weird interplay of quantum reality, information and probability”, leaves me wondering which book to pick up next.

• *Peggie Rimmer, Satigny and Oxford.*

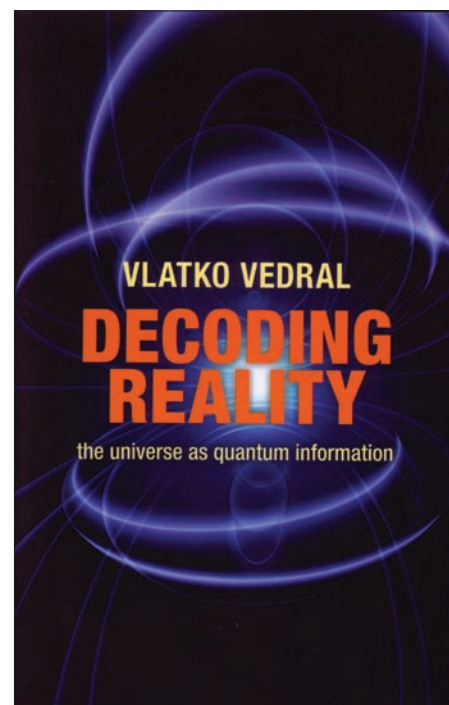
Books received

Energy, the Subtle Concept: The discovery of Feynman's blocks from Leibniz to Einstein

By Jennifer Coopersmith

Oxford University Press
Hardback: £29.95 \$55

In tracking the history of energy, this book is filled with the thrill of the chase, the mystery of smoke and mirrors, and presents a fascinating human-interest story. Moreover, following the history provides a crucial aid to understanding: this book describes the intellectual revolutions that were required to comprehend energy—revolutions as profound as those stemming from relativity and quantum theory. Using only a minimum of mathematics, the book recounts the emergence of the modern concept of energy, in all its forms, including Hamilton's mechanics and how it shaped 20th-century physics, and the meaning of kinetic energy, potential energy, temperature, action, and entropy. It is as much an explanation of



fundamental physics as a history of the fascinating discoveries.

Consciousness and Quantum Mechanics: Life in Parallel Worlds, Miracles of Consciousness from Quantum Reality

By Michael B Mensky

World Scientific
Hardback: £74 \$107
E-book: \$139

The phenomenon of consciousness includes mysterious aspects that provide a basis for many spiritual doctrines (including religions) and psychological practices. These directions of human knowledge are usually considered to contradict the laws of science. However, quantum mechanics — in a sense, the mysterious direction of science — allows us to include the phenomena of consciousness and life in the sphere of science. Wolfgang Pauli, one of the pioneers of quantum mechanics, together with psychologist Carl Gustav Jung, guessed about the relation between quantum mechanics and consciousness at the beginning of the 20th century, but only the “many-worlds” interpretation of quantum mechanics, proposed in 1957 by Hugh Everett III, gave the real basis for the systematic investigation of this relation. In this book, Michael Mensky of the PN Lebedev Institute elaborates what he calls the Extended Everett's Concept, which allows the derivation of the main features of consciousness and super-consciousness (intuition, or direct vision of truth) from quantum mechanics.