

BOOKSHELF

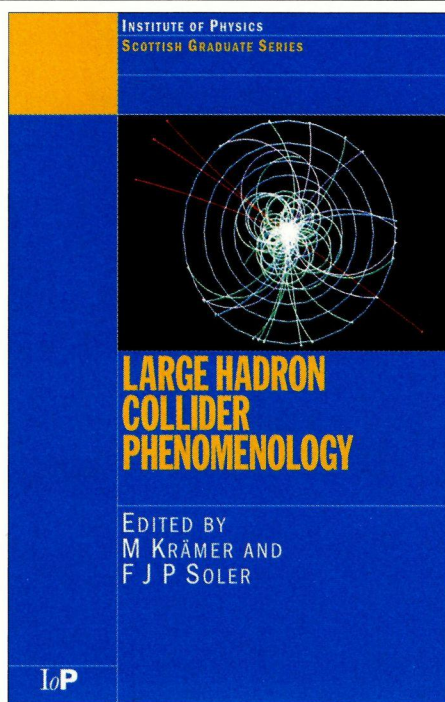
Large Hadron Collider Phenomenology by M Krämer and F J P Soler (eds), Institute of Physics Publishing. Hardback ISBN 0750309865, £75 (\$125).

The Large Hadron Collider (LHC) is often described as the machine needed by the worldwide community of high-energy particle physics experimentalists and theorists to search for and, it is hoped, discover physics signals beyond those expected from the Standard Model of particle interactions. The general-purpose experiments now completing construction (ATLAS and CMS) are often described as huge facilities optimized for the search for the elusive Higgs boson, the one key element missing in the Standard Model. About three years from now, the whole community in our field will focus on new and, we hope, unexpected physics results. These will cover a wide range of topics, extending over all possible theoretical conjectures published to date, that are relevant to experiments at the scale of tera-electron-volts.

Given the dearth of guidance from experiments (aside from the beautiful but maddening agreement of even the most precise measurements with the predictions of the Standard Model), the driving goal of all theoretical developments beyond this very same Standard Model is that of solving the many fundamental issues in particle physics, which today are also relevant to cosmology, a science that has become much more mature experimentally over the past 10 years or so.

This book presents a series of lectures attempting to cover LHC phenomenology in the broadest possible sense. They range on one side from the intricacies of scalar fields, string theory and extra dimensions, to the basics of detector physics, which for more than 10 years has guided R&D in our field. This has led to the optimized design of the huge and complex detectors needed to extract minute signals from the huge backgrounds, involving today's exciting physics (electroweak gauge-boson production, quantum chromodynamic multi-jet events, and heavy flavour production). But the lectures also range from accelerator science to modern e-science (the birth of the computing Grid) and from the less well known intricacies of heavy-ion physics to those of forward physics, where diffractive and quasi-elastic phenomena dominate.

These lectures were meant for today's young physicists, many of whom will surely be



the driving force behind the physics analyses and publications of the LHC experiments over the coming years. They were delivered on the occasion of the 57th Scottish Universities Summer School in Physics in summer 2003, by a well balanced mix of experienced theorists (D Ross, K Ellis and J Ellis) and seasoned experimentalists (V Gibson, H Hoffmann, B Müller, M A Parker, A de Roeck, R Schmidt and T S Virdee).

The emphasis in most of the lectures was on giving a snapshot of the current status of understanding in theory, phenomenology and accelerator and detector performance. The inevitable fate of such snapshots is to become fairly quickly obsolete, given the huge ongoing development of both the hardware and the software (should one add the middleware?) needed to operate the experiments, to simulate their performance accurately, to analyse their data quickly but unerringly, and to give a fair chance to all participants on all continents to join in the fun in the summer of 2007. Another drawback of such attempts is that, unavoidably, certain topics are treated superficially. However, I believe upon reading large sections of the book that this is largely outweighed by the benefit, for the young and less young reader, of finding in one volume a really complete coverage of all aspects relevant to LHC physics with a sufficiently rich bibliography to pursue in-depth reading.

For example, the reader interested in the phenomenology of quantum chromodynamic (QCD) beyond its direct application to LHC physics is referred to the book *QCD and Collider Physics* (by K Ellis, J Stirling and B Webber, 1996), the reader interested in more in-depth studies of accelerator physics and technology is referred to the *Handbook of Accelerator Physics and Engineering* (by A Chao and M Tigner, 2002), and the reader interested in the design and optimization of the general-purpose ATLAS and CMS detectors is referred to "Experimental challenges in high luminosity collider physics" (by N Ellis and T S Virdee, *Ann. Rev. Nucl. Part. Sci.* **44** 609, 1994) and to all the Technical Design Reports published from these experiments between 1996 and 2005.

In summary, this book is an excellent introduction to LHC physics for any person entering the field now, at a moment when a huge effort from the whole community is still ongoing to meet the difficult challenge of assembling the various jigsaws needed to observe the first proton-proton collisions at the tera-electron-volt scale in summer 2007.

The reader has to be aware though that, apart from the foundations of the Standard Model, of supersymmetric and string theories, and of particle interactions in matter, many of the details provided in the lectures to illustrate the wonderful and exciting potential of the LHC and its associated detectors are to be considered as examples only. These will most likely bear little resemblance to the results published in the final publications a few (or many) years from now. I believe that most experimentalists, who have devoted a large fraction of their professional lives to make the LHC dream come true, hope that reality at the tera-electron-volt scale is something quite different from what has been envisaged to date by our theory colleagues. It is indeed the fulfilment of such a hope that can give a new and much needed impetus to our field, thereby surely opening up rich and thrilling prospects for the generations of theorists and experimentalists to come.
Daniel Froidevaux, CERN.

In Conclusion: A Collection of Summary Talks in High Energy Physics by James D Bjorken, World Scientific. Hardback ISBN 981023869X, £86 (\$116). Paperback ISBN 9812384650, £40 (\$54).

Few people have been asked to give as

many conference summary talks as James D Bjorken; no-one has given them better. It is therefore an interesting idea to collect "Bj's" summaries into a single volume; to some extent, the idea works.

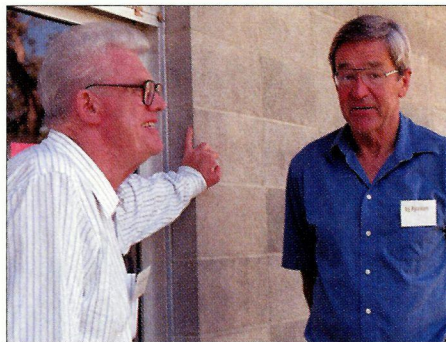
This book is divided into four sections, covering major areas of interest and activity in the author's career. Each section contains around five to seven talks stretching over the 40 or so years of Bj's activity at the forefront of theoretical physics. Each section is preceded by perhaps the most valuable element in the book: a preface in which the author puts each talk in its historical context, explains his thought processes and often delights the reader with a typical piece of self-deprecatory wit.

It must be admitted that many of the talks emit a musty air of controversies long stilled and ideas long forgotten; in particular, the first section, "From Current Algebra to Partons", is at times arcane and difficult unless one is familiar with the subject.

Nevertheless, there are moments of real pleasure in the elegance of Bj's thinking about deep inelastic scattering before the experiments at SLAC made the subject topical. An example is the idea that the known locality of the lepton electromagnetic and weak currents, and their great phenomenological similarity to the hadron currents, strongly implies that the weak and electromagnetic charges in the proton are also point-like. Other gems include the fortunate demise of the US proposal to name the quark colours red, white and blue!

Another fascinating section lays out the background to the discovery of the J/ψ ; some of the plots clearly show the J/ψ enhancement, albeit with poor resolution, while theorists were trying to fit the data with various exotic parton densities and wondering why they got poor fits. Another theme throughout the book, illuminated with Bj's mordant wit, is the wonderful nature of hindsight.

The second half of the book is significantly more interesting to the experimentalist than the first, particularly the talks relating to the interpretation of electron-positron annihilation. A particular joy is the inclusion on page 233 of Bob Gould's immortal cartoon of the J/ψ discovery. The final section deals with futurology. Many of the ideas contained therein are remarkably prescient and of value even today. Typically, Bj draws attention to areas in which he went spectacularly wrong:



Bjorken (right) at the symposium Bj's Day in the Sun, held at SLAC in 2000. On the left is his SLAC colleague and 1990 Nobel laureate Dick Taylor. (Courtesy Harvey Lynch.)

first opposing the Superconducting Super Collider (SSC) as too ambitious, he became a convert and just before its demise gave a talk saying how wrong he had been and that the SSC was clearly politically secure. Well, this reviewer made the same mistake and is proud to be in such illustrious company.

There is much pure gold in this book. As a primer on many of the major ideas of modern particle physics explained by one of its foremost architects, it is a work of lasting value. Sadly, it is littered with misprints and typographical errors, but presumably these are propagated unchanged from the original articles. Reading it from cover to cover is not to be recommended; dipping into it and benefiting from Bj's unique combination of wisdom and wit most certainly is.

Brian Foster, Oxford.

Fermi Remembered by James W Cronin (ed.), University of Chicago Press. Hardback ISBN 0226121119, \$45.00.

Enrico Fermi is one of the great physicists of the 20th century. He died relatively young at the age of 53, so many of us (where "us" means even retired physicists) never had the opportunity to have direct contact with him, and the younger generation had no chance to meet him anyway. This is one reason why it is so important to collect testimonies about Fermi to try to get a picture of his work and of his personality. So the enterprise undertaken by Jim Cronin is certainly extremely useful. It also comes at the right time, before all those who were in contact with Fermi disappear (some, such as Herb Anderson, are no longer with us).

I never had the occasion to meet Fermi despite the fact that I am old enough to have known many of the participants in the

Manhattan Project. I did not have the luck to attend, as Georges Charpak and Michel Gourdin did, the lectures given at Les Houches during his last summer in 1954. (Curiously, nobody, not even Segrè, in the biography that is included in the book, mentions these lectures.) At that time, my only contact with Fermi was through his magnificent lecture course, the notes of which were written by Orear, Rosenfeld and Schluter.

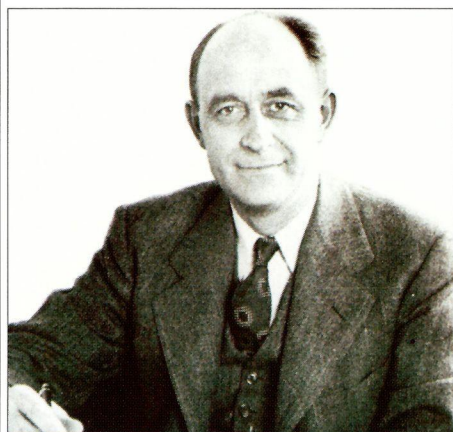
Before reading this book, I had heard many testimonies from Fermi's Italian and US colleagues or students. All admired his genius and all liked him very much as a man. All except one – my late friend Boris Jacobsohn, who had a better relationship with Teller (which was strange because Boris was a liberal). One gets a somewhat better idea of who Fermi was after reading the 26 testimonies in this book.

It is no accident that among these accounts we find seven Nobel laureates and one winner of the Wolf prize, plus a few exceptional individuals such as Dick Garwin. It proves the quality of Fermi's teaching, and the fact that he attracted very gifted people. He was of course extremely intelligent. He was able to simplify any problem, solve it and make it appear simple, to a point that sometimes people could not reconstruct his arguments afterwards. And he never made mistakes. On these two points Murray Gell-Mann commented that sometimes he preferred the not well prepared lectures of Vicky Weisskopf as well as his mistakes, which were more educative.

Fermi disliked generalities and preferred concrete things, in theory preferring to work examples until the end (a point of view with which I have a great sympathy), in experiments going as far as inventing and constructing his own instruments, such as the cart for moving a target inside the Chicago cyclotron. He was very careful, very precise, and this may be the key to his success in producing the first fission chain reaction in natural uranium, where criticality was, after all, rather marginal.

Fermi's contacts with politics and politicians were rather minimal. Yet he wrote to Benito Mussolini asking him to search for the missing Ettore Majorana and to Dean Acheson asking him to let Linus Pauling travel outside the US. However, he never tried to influence the decision to drop the bomb.

Fermi was very nice with young people, inviting them to parties and organising game



FERMI

REMEMBERED

EDITED BY
JAMES W. CRONIN

which he liked to win. He liked to win at sports too, whether swimming in Lake Michigan, rock climbing or playing tennis (although he lost against Leprince Ringuet, who, it must be said, was trained by the French champion Jean Borotra). He also liked to compete in physics. He once said to Jack Steinberger with some regret but great honesty: "I missed fission." Yet he was also extremely fair, referring to "Fermi statistics" as "Pauli statistics".

Curiously he was not interested in art, while most scientists are at least attracted by music.

Among the testimonies, I would say that the most objective, the most balanced, is that of "Murph" Goldberger. In others one feels sometimes a kind of "cult of the personality". A very amusing chapter is that of Nina Byers, in which she compares two very different individuals, Fermi and Leo Szilard, who both did pioneering work on nuclear reactors, but whose paths separated completely. In this way, Byers, a well known opponent of the use of nuclear weapons, manages not to criticize Fermi explicitly for not opposing the use of the bomb. Also of great interest are the review of

Fermi's theoretical achievements by Frank Wilczek, who received the Nobel prize probably after writing his article; Fermi's talk on the genesis of the nuclear-energy project, which is more complete than in his 1947 review in *Science*; and the reconstruction by Jim Cronin of Fermi's far sighted talk on the future of accelerator research.

I can only very strongly recommend reading this book. Just a detail: if you have my eyesight use a "Fresnel lens" to read the reproductions of the letters, which have been unnecessarily reduced. Regarding Fermi's Italian time, there is other material besides the biography by Segrè, mentioned above, in particular the article by Edoardo Amaldi in *History of Twentieth Century Physics*, Academic Press, New York, 1977, pp295–351. There are also the videotapes of the lectures of Gian-Carlo Wick in the Academic Training programme at CERN. *André Martin, CERN.*

Enrico Fermi: His Work and Legacy by Carlo Bernardini and Luisa Bonolis (eds), Springer. Hardback ISBN 3540221417, €35.95 (\$49.95).

In 2001, the centenary of Enrico Fermi's birth, the Italian Physical Society, commissioned a series of articles to pay tribute to the man who was probably the most famous Italian scientist of the 20th century. Written by close colleagues as well as scientists whose fields Fermi influenced profoundly, the papers were published originally in Italian in *Conoscere Fermi nel centenario della nascita 29 settembre 1901–2001* (SIF 2001). Now they have been translated into English and are available in this volume, which bears witness to the originality and breadth of Fermi's scientific work. They confirm that Fermi was a rare combination of theorist, experimentalist, teacher and inspiring colleague.

The book begins with three biographical overviews written by close colleagues after Fermi's death and ends with a year-by-year chronology of his scientific endeavours. In

between are 14 chapters by a variety of distinguished scientists, which span the breadth of Fermi's achievements in physics. With an extensive bibliography and many illustrations, the book is written for a general scientific audience.

Books received

Superconductivity by V L Ginzburg and E A Andryushin, World Scientific. Hardback ISBN 981238913X, £10 (\$16).

First written in 1989, this non-technical introduction to superconductivity has now been published as a revised edition. Written in a lively style, the book provides an excellent background for students at school or college, without recourse to mathematics. One of the authors, Ginzburg, received the Nobel Prize for Physics in 2003.

Gravitation: from the Hubble Length to the Planck Length by I Ciufolini *et al.* (eds), Institute of Physics Publishing. Hardback ISBN 0750309482, £80 (\$125).

This volume in the series *High Energy Physics, Cosmology and Gravitation* provides a summary of modern research in experimental gravity, cosmology and the quantum theory of gravitation. Based on lectures at the Villa Mondragone International School on Gravitation and Cosmology, it brings together leading experts who present an up-to-date review of their field.

A Modern Introduction to Quantum Field Theory by Michele Maggiore, Oxford University Press. Hardback ISBN

0198520735, £47.95 (\$99.50). Paperback 0198520743, £23.95 (\$44.50).

This book is a welcome addition to the *Oxford Master Series in Statistical, Computational, and Theoretical Physics*, aimed at final-year-undergraduate and beginning-graduate level. Assuming no previous knowledge of quantum-field theory, it introduces modern developments in the field. The inclusion of more advanced topics will also make this a useful book for graduate students and researchers.

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