
Bookshelf

during a panel discussion. While a unanimous opinion has not yet been reached in all matters, the consensus is that an NLC should be built somewhere and vigorous research and development should pursue promising new areas such as the muon collider and new modes of particle acceleration.

Given the long lead times necessary for the design of new particle accelerators, it is important for the high energy physics community to decide soon what types and energy ranges of colliders are necessary to address the additional questions which current machines and the LHC may not be able to answer.

From Zohreh Parsa (Brookhaven)

HISTORY Carnegie reunion

A recent Pittsburgh reunion of 80 people who had worked at the Carnegie 450MeV synchrocyclotron relived the heady physics of the 1950s.

The Carnegie accelerator was similar to contemporary university machines at Berkeley, Chicago, Columbia, Harvard, Liverpool, McGill, Rochester and Uppsala as well as those at Harwell, CERN and Dubna Laboratories.

The Carnegie machine was designed and built by the faculty and students of the Carnegie Institute of Technology, now Carnegie-Mellon University, from 1949-53 with initial support from the Buhl Foundation and the US Office of Naval Research, and later from the US Atomic Energy Commission.

The 1947 discovery of the pion in cosmic rays pointed to the need to increase the energy from the 300MeV initially planned. A combination of an efficient magnet design by Martin Foss and a bold decision by Ed Creutz, then Chairman of Physics, to plan for increased energy even though funds were not in hand, resulted in a machine of 450MeV, built on land donated by the Westinghouse Corporation in the village of Saxonburg, 50km north of Pittsburgh.

The site and buildings had been used earlier for the transmitter of the first US commercial radio station - KDKA. The village was also the site of John Roebling's first factory to manufacture steel wire rope, used in the construction of a number of suspension bridges - including the Brooklyn bridge.

One notable early synchrocyclotron result came from the measurements of pion-proton reaction rates by Julius Ashkin and his collaborators - the observation of the first pion resonance, the delta, also discovered by Fermi's group at Chicago.

After the meeting, a visit to the Saxonburg site revealed that the cyclotron buildings are now occupied by a high-tech company making high purity crystals and other optical components for laser systems. Those who attended the reunion looked back with nostalgia to when milestone high energy physics experiments could be completed within months by a few people.

Introduction to Quantum Field Theory, by Michael Peskin and Daniel Schroeder, Addison Wesley, ISBN 0 201 50397 2

I remember having been told as a student that in order to understand Quantum Field Theory (QFT), one should know it already. However paradoxical, few can deny that there is some truth in this statement: it is hard to reach a deep comprehension of the subtleties and surprises of QFT by just starting from a list of axioms, rules and theorems. Better to learn just enough to start doing some interesting calculation, and then go back to the fundamentals for a deeper perspective. The authors of this book, authorities in the field, must have felt the same way. Their technique is to anticipate and start using, in concrete examples, results that require the development more formalism before being rigorously proved.

Formal discussions alternate with well selected practical examples, elegantly worked out. All physical aspects of a given problem are explored with insight and presented with a style that makes reading a real pleasure (I did most of my reading in bed, before going to sleep, and, as with the best thrillers, could not put the book down).

A few examples: the elementary derivation of differential distributions in the production of muon pairs from electron-positron pairs, without the use of Feynman rules; the parallel treatment of soft radiation in classical electrodynamics and the low-energy limit of QED; and the discussion on asymptotic freedom.

This over-800-page book is divided into three main parts. The first contains an introduction to Feynman

diagrams, QED, and radiative corrections. Here even the canonical sections on the quantization of the free field or the optical theorem have a special zest! Several examples of higher-order calculations are worked out in detail, including all standard examples such as the anomalous magnetic moment, as well as less standard subjects such as the resumption of soft divergences and Sudakov form factors.

The second part deals with renormalization, presented within the Wilson approach. The functional integral is introduced, as well as the connection between the physics of phase transitions and QFT and the interplay between symmetries and renormalization. The third part, which with 300 pages is almost a book in itself, discusses non-Abelian gauge theories, and the Standard Model in particular. A lot of the material cannot be found in standard QFT textbooks: operator product expansions, parton evolution, Drell-Yan and dijet production in hadronic collisions, the equivalence theorem, electroweak radiative corrections, are just some examples; all of them are worked out with a care that is uncommon even in books on the specific subjects.

Ample sets of problems, with helpful hints for their solution, complete each chapter, while more demanding research projects are proposed at the end of each part. Most problems are taken from current advanced research topics and provide good self-contained introductions. This excellent book will enable all students, whether theorist or experimentalist, to attain a deep understanding of QFT and to learn how to make profitable use of it.

Michelangelo Mangano

The Origin of the Concept of Nuclear Forces, by L.M. Brown and H. Rechenberg, Institute of Physics Publishing, ISBN 0 7503 0373 5, hbk £49/\$79.50

In our present understanding, the forces at work deep inside the nucleus involve fractionally charged quarks and are mediated by ‘coloured’ gluons. In this picture, the interactions between atomic nuclei, although strong, are secondary, analogous to the chemical interactions between atoms. This perspective took a long time to develop, and from 1932 until the arrival of quark physics in the 1960s, physicists tried to understand nuclear interactions as a basic force using whatever limited means they had at their disposal.

This book candidly traces the frustration of trying to understand nuclear forces from 1932 (the discovery of the neutron) to 1950 (the discovery of the neutral pion).

At a time when once again a unified field theory is a major goal of mainstream physics, the authors point out ‘Our story can be read as a cautionary tale: all of the earlier proposed fundamental theories of nuclear forces aspired to be ‘unified field theories’ which unified at least the strong and weak nuclear forces - but during the two decades in question, Nature’s response was always “no”, or at least, “not yet”.’

A valuable insight into the history and confusion of an earlier epoch, full of historical anecdotes, providing a useful reminder that physics is human.

In Search of the Ultimate Building Blocks, by Gerard ‘t Hooft, published by Cambridge University Press, ISBN 0 521 57883 3 (pbk £9.95, \$14.95), 0 521 55083 1 (hbk £27.95, \$39.95)

A neat little book on particle physics by a distinguished author which emphasizes progress in theoretical understanding and looks forward to further such advances, with chapters on recent developments in technicolour, grand unification, supergravity, superstrings, and black hole physics. Required reading for those wishing to understand better the role of spontaneous symmetry breaking. In general experimental details take a background seat (the glossary runs to ‘sigma model’, but not to synchrotron), but a good read for all those who want to know about elementary particles and prefer a theoretical approach.

Books received

Constitutions of Matter: Mathematically Modelling the Most Everyday of Physical Phenomena, by Martin H. Krieger, University of Chicago Press, ISBN 0 226 45304 9 (hbk \$65, £51.95), also pbk.

The mathematics behind physics, particular in the domain of thermodynamics and phase changes.

Mathematica 3.0: Standard Add-On Packages, Wolfram Research/Cambridge University Press, ISBN 0 521 58585 6 (pbk, £19.95, \$29.95) 0 521 58586 4 (hbk £40, \$59.95)

Useful goodies for algebra, calculus, graphics, discrete and numerical mathematics, number theory, statistics, etc.