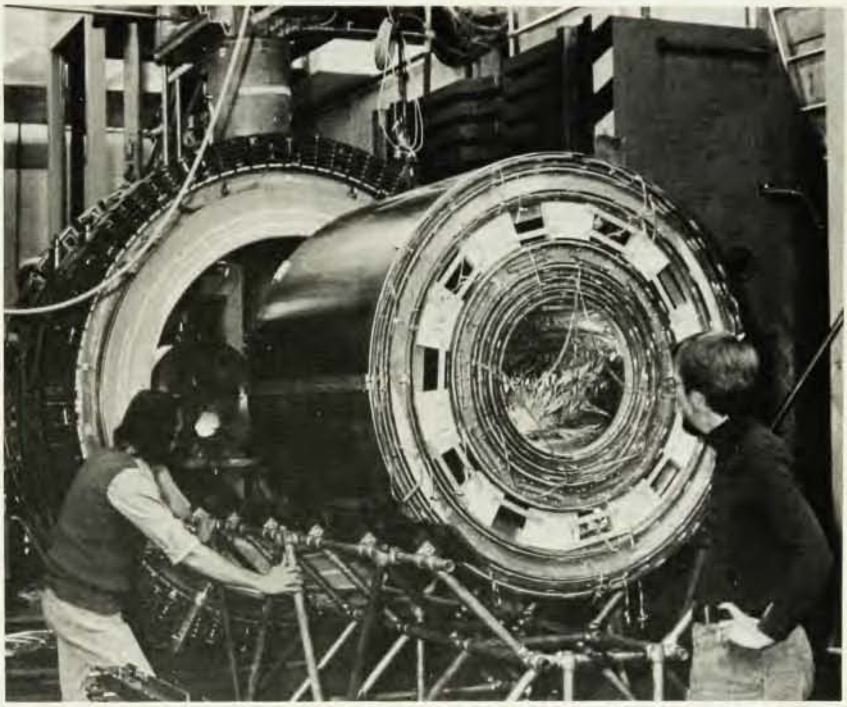
books

A summary of electron–positron interaction data

Electron–Positron Interactions

B. H. Wiik, G. Wolf
265 pp. Springer, New York, 1979. $34.80

Reviewed by Karl Berkelman



Cylindrical proportional chambers of the PLUTO magnet at DESY during assembly in 1974. Data provided by this device are summarized in *Electron-Positron Interactions.*

The period immediately following the November 1974 discovery at Brookhaven and SLAC of the ψ-particle (also called J) was an extraordinarily exciting time in the history of high-energy physics. The narrow width of the ψ, surprising for such a heavy meson, implied that it was a bound state of a new and heavier fourth quark and its antiquark. The then existing high-energy positron–electron storage rings, SPEAR at SLAC (Stanford) and DORIS at DESY (Hamburg) undertook to explore the states containing the new "charmed" quark. New discoveries followed in rapid succession: the ψ and ψ', the χ states, the ψ'', the D, D*, F, and F*, their properties and decay modes. Our present view of particle physics, the quarks and leptons, quantum chromodynamics and the electroweak theory, owes much to the e^+e^- colliding-beam experiments during this period.

Bjorn H. Wiik and Gunter Wolf served as leaders of the DASP group at the DORIS ring and are now leaders of the TASSO group at the newer PETRA ring. This book, volume 86 of the series of monographs *Springer Tracts in Modern Physics*, grew out of lectures they gave at the Les Houches School in 1976, at Cargèse, in 1977, and at Gomel, USSR in 1977. The first twelve chapters appeared in May 1978 as a DESY report (78/23). The last four were added in 1978.

Electron–Positron Interactions surveys the experimental information on high energy e^+e^- interactions available in 1978. The major portion of it concerns the exploration of the states of the charmed quark during this most exciting period. The experiment results, mainly from the Mark-1 and DELCO detectors at SPEAR and the DASP, PLUTO and DESY-Heidelburg detectors at DORIS, are all laid out in detail, in graphs, tables and text. The relevant theory and phenomenology are also briefly discussed. In addition, the book covers quantum electrodynamic processes, vector meson production at low energies, the τ heavy lepton, inclusive hadron production and the two-jet phenomenon. There is also a concise description of storage rings and detectors. The exposition is very well organized in a sparse and dry, but clear, style.

Although they are generally scrupulously fair, the authors occasionally betray their bias in the SLAC–DESY rivalry. For instance, they cover the production and nonleptonic decays of the F and F* (discovered at DESY by the authors' group) in seven pages, while devoting only four pages to the more extensive data (mainly from SLAC) on the D and D*.

The book is too detailed on the one hand and lacking in links to the rest of particle physics on the other hand, to serve as a text in a graduate course. In 1978 it would have been an excellent summary of the status of the field for anyone wishing to become active in it, say a graduate student beginning work with one of the experimental groups. Or it would have been a fine reference source on the experimental data for, say, a particle theorist. The field, however, has continued to develop rapidly since 1978. Many new advances are missing from the book: gluon bremsstrahlung, the η_c, higher Υ states, the B mesons, and so on. For the best survey of the field I would recommend not this book but a more recent summary by Wolf, available from DESY as preprint DESY 80/13 (February 1980).

Electron–Positron Interactions is useful now mainly as history, although it is certainly not written from a historical perspective. It is the best summary I know of the status of the field as of 1978 and the best bibliography of the earlier references. It is unfortunate that a book like this has to appear two years after it is written, in spite of its photoreproduced typewritten format.

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Karl Berkelman is a professor of physics at Cornell University. He is a member of the CLEO group working at the Cornell Electron Storage Ring.

An Introduction to High-Voltage Experimental Technique

D. Kind

240 pp. Vieweg, Wiesbaden, Fed. Rep. Germany (US dist.: Heyden, Philadelphia, Pa.) 1978. $19.50

In the past decades interest in high voltage has expanded from the area of electric power-line design to many areas of physics, chemistry and semiconductor engineering—fields in which high-intensity electric fields are now frequently found. Dieter Kind's book is most welcome because a good presentation on modern high-voltage techniques has long been needed.

The author is one of Europe's foremost authorities on the subject and was for years the director of the same institute at which the Marx surge generator was invented; he now is the president of Physikalisch-Technische Bundesanstalt, the "older brother" of our National Bureau of Standards. The book is written in the best tradition of European technical bookwriting where the student's and the practicing engineer/scientist's needs are merged with skillful balance. To quote: "Despite all progress in theoretical work, the physical phenomena in these materials is still not sufficiently understood. Hence, experiment is the bias of scientific work in this field. It follows, that experience in experimental work is essential for the successful treatment of numerous problems."

Kind considers the following topics in his treatment: the generation and measurement of high ac, dc, impulse voltages and currents; nondestructive testing; electric fields; liquid and solid dielectrics; partial discharges; breakdown of gases; internal overvoltages; traveling waves; arcs; impedance of plane conductors; statistical evaluation of test results; confidence limits; design and operation of high-voltage laboratories. Each chapter starts with five to seven page theoretical treatise, followed by a description of a related experiment concluding with an evaluation of techniques used. At the beginning of each chapter the most pertinent literature is given and, in the same way, all statements are referenced.

The translators have done a commendable job in making the book easy to read. Some of the British terminology used, like "earthing" instead of "grounding," and the use of International Electrotechnical Commission's alternative U for voltage, instead of E or V, should pose no problems to the reader. There are only two things to be aware of: following German standards the book has no graphical symbol for "impedance" and the complex coordinate system is shifted by $+90°$; thus the real axis points upward in the phasor/vector diagrams. The well designed and executed drawings and photographs add to the attractiveness of the book.

An Introduction to High-Voltage Experimental Technique is a must for the shelf of everyone involved in any aspects of high-intensity electric fields and of electric power engineers in general.

JOHN F. SZABLYA
Washington State University
Pullman, Washington

Elementary Particle Physics: An Introduction

D. C. Cheng, G. K. O'Neill

431 pp. Addison-Wesley, Reading, Mass. 1979. $29.50

The past decade has been one of continual ferment and extraordinary achievement in high-energy physics. The constituent (quark model) picture of the strongly interacting particles has steadily gained experimental support from the pointlike character of inelastic electron–proton scattering, the jet structures observed in electron–positron annihilation, the atom-like spectra of the ψ/J and Υ families of resonances, and more. Simultaneously, confidence has grown in the view that interactions among the fundamental constituents are described by gauge field theories. Prominent examples are the Weinberg–Salam model of weak and electromagnetic interactions and quantum chromodynamics, the gauge theory of strong interactions among quarks and gluons.

This new perspective has been shaped by both theoretical and experimental advances: the proof that the Weinberg–Salam theory is renormalizable, the discovery of weak neutral currents and the observation of charm; the recognition that gauge theories may be asymptotically free; the measurement of Bjorken-scaling violations in inelastic lepton–nucleon scattering, and the evidence for gluon jets. With this new perspective have come new experimental initiatives, including imminent searches for the intermediate bosons of the weak interactions, for proton instability and for neutrino oscillations.

In my view, high-energy physics is defined by what high-energy physicists are doing and a graduate course should introduce students to contemporary concerns. The selection of apposite topics is no easy task for the author of a textbook on such a rapidly moving field. In *Elementary Particle Physics*, David C. Cheng and Gerald K. O'Neill have chosen not to write a thoroughly modern introduction to particle physics, but rather to emphasize time-honored material. Unfortunately "time honored" all too often means antique. The book is divided into a brief introduction and major sections on the electromagnetic, weak and strong interactions. The strong-interaction portion, which makes up 40% of the text, contains only three post-1969 references: passing mention of the papers announcing asymptotic freedom and a citation of the 1978 *Review of Particle Properties*. The extensive studies of high-energy collisions carried out at the CERN Intersecting Storage Rings, at Fermilab and at the CERN Super Proton Synchrotron are thus ignored. This is regrettable, even within the authors' selection criteria, because many experiments and analyses of the recent era address traditional concerns more incisively than did earlier work. The rest of the book is scarcely more modern: it contains a half-dozen post-1975 references *en passant*.

Such complaints might be overlooked if *Elementary Particle Physics* were otherwise well-written. However, Cheng, a former high-energy experimenter now with Intel Magnetics and O'Neill, professor of physics at Princeton and a pioneer of colliding-beams research, have produced a disappointing book. It contains many statements that are misleading and many that are wrong.

For example, in a lengthy treatment of SU(3) and the quark model, there is continual confusion between the terminology "group" and "representation." The difference between SU(3) and the quark model is garbled, the photon is incorrectly described as isoscalar, and it is stated, also incorrectly, that charm as well as color is needed to reconcile the quark model with the Pauli exclusion principle.

A section on Regge theory (the utility of which has been confirmed by the high-energy experiments the book neglects) highlights something called the "interference model," which has been discredited since the discovery of duality in the late 1960s. The authors say that the total cross section should decrease as 1/log (center-of-mass energy). What should be meant is the *elastic* cross section. In any event, the big news of early 1973—not mentioned here—is that