

by pads and strip chambers, allows pions to be distinguished from heavier particles (kaons and protons), which themselves are below Cherenkov threshold in the momentum range 3-8 GeV.

For each track, a fiducial circle is constructed in the photon detector around the projected point of impact, corresponding to the base of the emission cone of Cherenkov light. If photons are detected within this circle, the track is attributed to a pion. If the circle is empty the track is attributed to a kaon, a proton or a deuteron, differentiated in turn by time-of-flight.

The concept was tested in the lead ion run in 1994 with Cherenkov-photon detection using multi-wire counters with a pad cathode and TMAE gas. The results were very

satisfactory, but the large conversion gap for photons in TMAE limited the rate of beam on target since background radiation increased the current in the counter to unacceptable levels.

Meanwhile encouraging progress had been made by the RD26 research and development collaboration in the development of large cesium iodide photocathodes for use in a Ring-Imaging Cherenkov (RICH) detector. This would be used for particle identification at high momenta at CERN's future LHC collider when operated with heavy ions. With this work producing large area photocathodes for detecting Cherenkov rings with good quantum efficiency (15 detected photons per ring with a 10mm liquid radiator), NA44 decided to replace TMAE with

a solid cesium iodide photocathode in the 1995 SPS heavy ion run. This approach offers, among other things, a reduction in the active volume of the chamber (less background), faster response and easier operation.

Both TIC chambers were equipped with 25x80 cm² cesium iodide photocathodes and with the newly developed GASSIPLEX chip for frontend multiplexed analog readout. These photocathodes are among the largest produced so far and are the first to be used in a physics experiment. The detectors successfully operated during the 1995 lead ion run, and the success with cesium iodide photocathodes is an important milestone towards their future use in big detectors.

Bookshelf

Dirac in print

The Collected Works of P.A.M. Dirac, 1924-1948, edited by R.H. Dalitz, Cambridge University Press, ISBN 0 521 36231 8, £175/\$250

Paul Dirac (1902-1984) was one of the great physicists of the 20th century. Although he was not one of the pioneers who 'discovered' quantum mechanics, he developed a firm mathematical foundation for a subject notoriously difficult to understand for those handicapped by overexposure to ordinary 'everyday' logic.

Dirac's approach, as enshrined in his book 'The Principles of Quantum Mechanics', became universally acknowledged as 'the' way to handle and understand this otherwise sometimes impenetrable formalism.

Now published is a collection, carefully edited by Richard Dalitz, of Dirac's most influential work. (A second volume will cover the post-1948 period.)

Most of Dirac's papers are produced in their original form, beginning with his early work under R.H. Fowler at Cambridge. In 1925 Heisenberg gave a seminar at Cambridge, and Dirac's attention soon concentrated on a personal formulation of this incisive, but sometimes baffling new theory which

was to become quantum mechanics. Like Richard Feynman after him, Dirac preferred to think things out for himself, his thought patterns evolving into firm intellectual stepping stones on which others could subsequently tread.

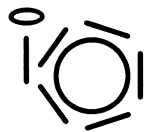
The book includes the contents and introduction of Dirac's PhD thesis on 'Quantum Mechanics'. This is widely supposed to have provided the template for his famous book, but Dalitz points out that while the chapter headings in the two works bear a superficial resemblance, the book material is substantially reworked.

In any case the first edition of the book (1930) proved especially hard to swallow, and Dirac embarked on a

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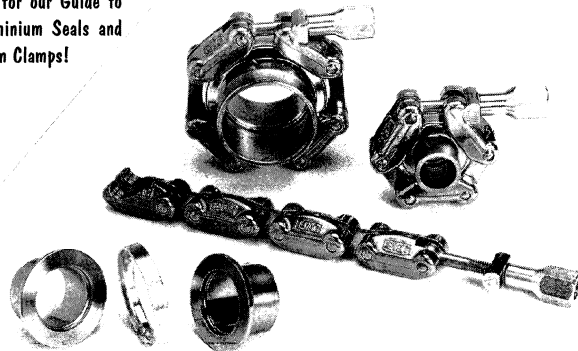


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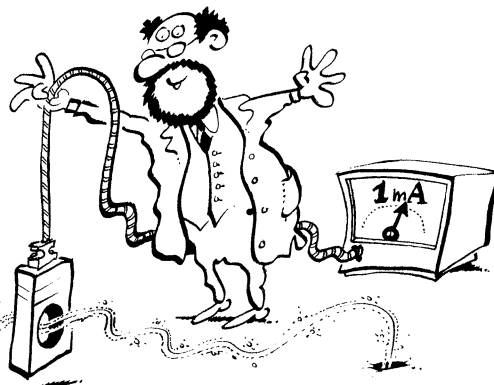
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substantial rewrite, published in 1934. The prefaces to these various editions are included in the book. Later editions of 'Principles' traditionally use only extracts from these early prefaces.

Naturally prominent is Dirac's work leading towards the formulation of a fully relativistic picture of the electron - what is now known as the 'Dirac equation'. This presaged the existence of antiparticles, and in a 1930 article in 'Nature' (included in the book) Dirac speculated that the proton could somehow be the antiparticle counterpart of the electron. He subsequently relinquished this point of view.

With attention focused on the World War II Manhattan Project, of which Dirac was not formally a part, his wartime work as a member of Peierl's group at Birmingham is little known. Included in the book are several revealing contributions on centrifugal isotope separation, however Dirac's now formally declassified papers on actual bomb problems which were despatched to the US have not been found.

The 1300-page book adds substantially to our knowledge of an already impressive figure.

Theoretical Nuclear and Subnuclear Physics, by J.D. Walecka, Oxford University Press 1995
(ISBN 0-19-507214-6) 610 pages, hard cover, price £50

This is a comprehensive textbook by an eminent expert on topics at the interface between nuclear and particle physics. It is particularly adapted to the needs of the community of physicists around CEBAF, but it is also of great interest

to any physicist working at this interface. It is based on lecture notes from three separate lecture courses that Dirk Walecka gave when he was Scientific Director at CEBAF: Graduate Quantum Mechanics, Advanced Quantum Mechanics, and Field Theory and Special Topics in Nuclear Physics.

The primary goal is the pedagogical one of providing a clear, logical and unifying treatment of many diverse topics of modern nuclear theory together with the necessary tools. The topics range from the non-relativistic many-body problem to the Standard Model of the strong, electromagnetic and weak interactions. There are four key subjects in the book: basic nuclear structure, the relativistic nuclear many-body problem, strong coupling QCD and electromagnetic interactions with nuclei. The book is written so as to give graduate students a basic understanding of modern nuclear physics and its numerous theoretical techniques as a preparation for research work. In addition it is an excellent refresher and reference for working physicists. The book has a large and superb set of instructive problems. A drawback is the absence of an alphabetical list of author references. The book will be a classical reference in the field for many years to come.

By Torleif Ericson

Books received

The Quantum Theory of Radiation, by E.R. Pike and Sarben Sarkar, Oxford University Press, ISBN 0 19 852032 8, Price £55

In the Oxford series of International Monographs on Physics, this book has the same title as Heitler's classic work which fuelled earlier generations of radiation theorists, before the advent of modern quantum electrodynamics. Designed as a sequel to Heitler, this book deals with quantum electrodynamics, spontaneously broken symmetries, and modern quantum optics.

Calorimetry in High Energy Physics (Proceedings of the 5th International Conference), edited by H.A. Gordon and D. Rueger, World Scientific, ISBN 981-02-23811, Price £78

Proceedings of the meeting at Brookhaven, 25 September - 1 October 1994, and as such a good survey of state-of-the-art techniques.

Frontiers of Fundamental Physics, Edited by Michele Barone and Franco Selleri, Plenum Press, ISBN 0-306-44825-4, Price \$178

Proceedings of the 1993 Olympia Conference, covering Astrophysics, Relativity, Geophysics, Particles and Fields, and Quantum Physics.
