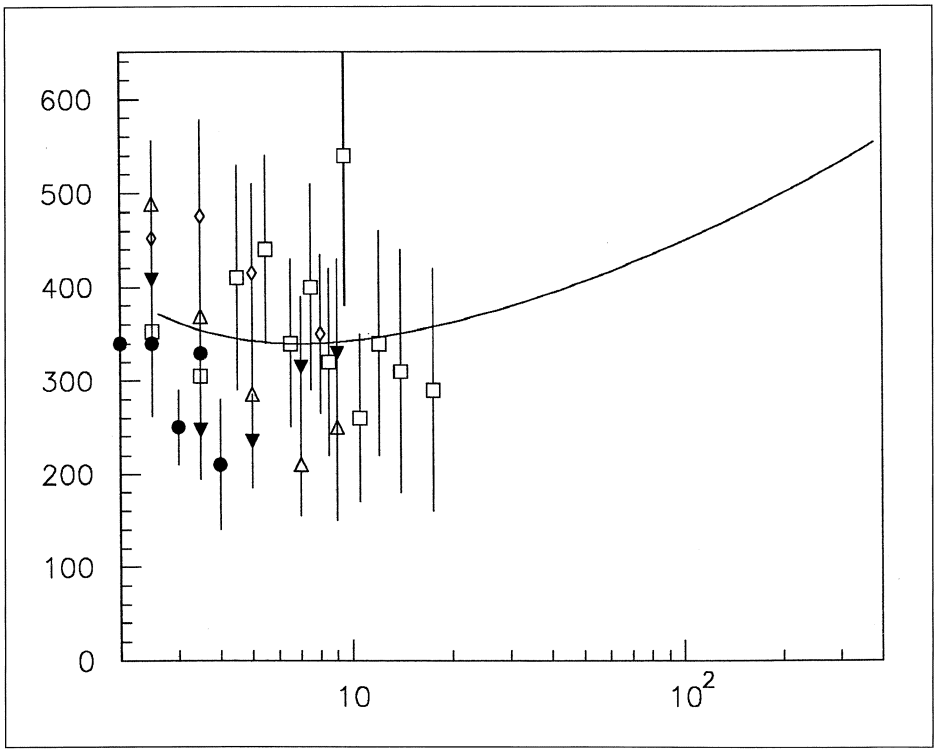
The photon-photon reaction rate (cross-section) showing the data collected so far by a range of experiments and its expected extrapolation into the region to be covered by LEP working at higher energies.



imager, whose main components are a proximity focused image intensifier coupled to a CCD, has also been developed, the device being self triggered by the intensifier's anode pulse. With samples carrying a suitable radioactive tracer, such as sulphur 35, a resolution of 15 microns is achieved, with the image built up a hundred times faster than conventional emulsion-based recorders.

Another instrument, the scintillating optical fibre imager, is designed to handle a much larger sample area. The radioactive sample is immediately above two orthogonal layers of fibres and the resulting light read out from the ends of the fibres at the edges of the layers. This technique is more powerful than X-ray methods and can be used in geology and other applications as well as biology.

Tale of two photons

A very profitable spinoff from electron-positron collisions is two-photon physics. Rather than the electron and positron interacting directly via an exchanged photon, two virtual (transient) photons, one from each particle, get tangled up.

With new electron-positron colliders appearing on the scene, a topical meeting on two-photon physics - 'From DAPHNE to LEP 200 and beyond' - held from 2 - 4 February in Paris, in the premises of the Ministry of Higher Education and Research, was particularly timely. Some 60 physicists, both experimentalists and theorists, participated, with some thirty speakers.

The meeting (sponsored by IN2P3-CNRS, DAPNIA-CEA and Collège de France and organized by J. Parisi of Collège de France and F. Kapusta of LPNHE Paris) was motivated by the ongoing or planned building of new electron-positron colliders covering a wide spectrum of energies and expected to have, as a common feature, a luminosity (a measure of their collision rate) of some 10^{33} cm^{-2} s^{-1}, much higher than machines of the previous generation. Their integrated luminosities of the order of 10^{40} cm^{-2} should considerably boost two-photon physics.

The first part of the meeting was devoted to DAPHNE, a machine of total energy 1 GeV presently being built at Frascati, with its detector (KLOE) and a tagging system planned for two-photon experiments. Prospects for two-photon physics include the production of charged and neutral pion pairs near threshold, as well as of low-mass resonances. Calculations of the pion pair production by two photons at low energy were presented by several theorists using different approaches.

The second part of the meeting was devoted to machines of somewhat higher energy - a Tau/Charm Factory of total energy 3 - 6 GeV that might be built somewhere in Europe, and the B Factory for Stanford (SLAC). Two-photon physics at the Stanford B Factory and its detector (BABAR) could open up meson spectroscopy (up to and including charmonium) and examine the kinematic behaviour of resonance production, where quantum chromodynamics (QCD) has made interesting predictions. There are particular implications for the production of quark-antiquark mesons having non-zero orbital angular momentum, as well as the production of gluonic mesons ("glueballs").

LEP 200 - the energy upgrade of CERN's LEP collider - was the subject of the third part of the meet-

Bookshelf

ing. There, two-photon physics potential includes the production of heavy flavours, violent electron-photon scattering, and jet production. This work has many theoretical implications.

The final part of the meeting was given over to the prospects offered by a future linear electron collider of very high energy (some 500 - 1000 GeV total energy). This type of machine would be used either as such, or after conversion into a photon-photon or a photon-electron collider. Such a conversion would use Compton back-scattering of either or both electron beams on a laser, yielding a photon beam of approximately the same energy and intensity as its "parent" electron beam. Each of these three options has its own physics implications.

With the non-electromagnetic behaviour of the photon still little understood (September 1993, page 22), the meeting showed how increased luminosity from new machines would open up a more systematic study of the interactions of highly virtual photons.

Conceptual Foundations of Modern Particle Physics, by Robert E. Marshak (World Scientific, ISBN 98 102109 81)

Particle physics really began as an independent scientific discipline after the Second World War. Robert Marshak was one of its pioneers on the theoretical front, starting out his career with important contributions on meson theory (together with Hans Bethe). The life of Marshak, who died in December 1992, was intimately interwoven with the post-war development of particle physics. His work on weak interaction theory was an important step towards the formulation of the V-A theory, the main pillar on which the modern electroweak theory rests erected. He is also remembered as the founder of the biennial 'Rochester' conference series (March 1993, page 24).

Particle physics pioneers Robert E. Marshak (left, 1916-1992) and Maurice Goldhaber. Marshak completed his book 'Conceptual Foundations of Modern Particle Physics', now available from World Scientific, just before he died.

Just before his death Robert Marshak finished writing his book on the concepts of particle physics. The book starts out with an historical account of the development of the field. He divides it into the startup period (1945-60) - the period of meson physics, the physics of strange particles, parity violation etc; the heroic period (1960-1975) when the Standard Model of the electroweak and strong interactions was developed; and finally the period of consolidation and speculation (since 1975).

Marshak's recollection of the development of particle physics represents a personal view, worth reading by young researchers, although it does not attempt to provide a complete picture.

After the historical chapter Marshak introduces the reader to the basics of quantum field theory (space-time symmetries, global internal symmetries and their breaking, gauge symmetries). Later he turns to a description of QCD and the gauge theory of the electroweak interactions. A whole chapter is devoted to the problems related to anomalies.

In the last part of the book Marshak discusses various hypotheses of unifying the strong and electroweak interactions, especially the various facets of the SO(10) theory, followed by a long discussion of the fermion generation problem and of preon models. The book concludes with an extensive description of topological effects in gauge theories (instantons, solitons, index theorems etc.).

Marshak's book cannot be regarded as a textbook, but rather a personal account of the theory of elementary particles, given by one of its founders. The first part of the book, fairly easy to read, could also be used as an introduction to the theory of elementary particles. On the other