Electron-Positron Annihilation Between 3 GeV and 9 GeV

R. F. Schwitters, Harvard University
Session Organizer

SUMMARY OF SESSION ON $E^+ E^-$ ANNIHILATION BETWEEN 3 GeV AND 9 GeV

R. F. Schwitters
Harvard University

The study of $e^+ e^-$ annihilation from the J/Ψ resonance to center-of-mass energies just below the Υ continued to be an active and interesting field in high energy lepton-photon interactions. At the session of the Conference devoted to this energy range, the first major results of two new experiments were reported. Dr. V Luth described the work done by the SLAC/LBL group using the Mark II magnetic detector at SPEAR and Dr. E. Bloom presented first results from the Crystal Ball experiment, a collaboration of physicists from CalTech, Harvard, Princeton, Stanford, and SLAC working at SPEAR. These can be considered as second generation detectors in the sense that they are major pieces of appartus that were built in response to the "new physics" discovered in the 3 GeV energy range. Dr. J. Kirkby reviewed the recent work done by earlier experimental setups at SPEAR and DORIS.

The most dramatic moment of the session came in the talk of Dr. Bloom where he presented new data on the inclusive photon energy spectum in ψ' decays that display a significant peak near 640 MeV. This result appears to clear up the longest standing problem in the charmonium system, namely the mass of the η_c state. The peak is interpreted as coming from an M1 transition of the ψ' (3684) to a state η_c near 2950 MeV/c^2, a mass in better agreement with current theoretical expectations than the previous candidate for the ground state of charmonium, the X(2830). Crystal Ball results on three-gamma decays of the ψ presented to the Conference ruled out a state of 2830 MeV to a higher sensitivity than previous measurements. Similarly, the evidence for a state near 3455 MeV/c^2, thought to be an excited state of the η_c, has evaporated in the new data presented by both the Crystal Ball group and the SLAC/LBL group at this Conference. In summary, experiment and theory for charmonium system have been brought back into reasonable accord, although there are still many important measurements to be made.

Charmed particles continue to play an important role in these experiments. Dr. Luth reported on the first observation of charmed baryons produced by $e^+ e^-$ annihilation through the decay mode $p \kappa \pi$ in an extended run by the Mark II detector at 5.2 GeV. A precise value of the mass was obtained that is in slight disagreement with other reported observations of the charmed baryon. Detailed studies of branching ratios of D mesons and preliminary branching ratio for the Λ_c were reported by Dr. Luth; Dr. Kirkby also discussed some of the detailed properties of D mesons that have been measured recently. Two of the most interesting results are the measurements of Cabibbo suppressed decays of D^0 mesons by the SLAC/LBL group and the apparent difference between the neutral and charged D meson-lifetimes implied by different semi-leptonic branching ratios seen with marginal statistics in both Mark II and DELCO experiments. There was no new data confirming the existence of the F meson, reported previously by the DASP experiment at DESY. The existence and properties of the F continue to be an outstanding issue in charmed meson spectroscopy.

The τ lepton is firmly established and all the data, which were reviewed by Dr. Kikby support the view that it is sequential with interactions just like the election and muon, but with its own lepton number. One interesting aspect of the standard view of the τ lepton is that τ decays may be the best method to study properties of the A1, an old problem in light-meson spectroscopy. One of the more important issues remaining is to set more stringent limits on the mass of the neutrino associated with the τ.

There is reasonably good agreement among various measurements of the total hadronic cross section over the energy range covered by this session. However, the number and shapes of structures in the 4 GeV region are still not completely known. The current experimental situation was reviewed by Dr. Kirkby and Dr. Bloom presented new data from 4 GeV region taken with the Crystal Ball apparatus.

Finally, new results concerning the two-photon process were presented by Dr. Luth. This field should become much more prominent in the future as experiments exploiting two-photon physics are performed at PETRA and PEP. Dr. Luth showed evidence for η' production by the two-photon process obtained by the SLAC/LBL group. The measured cross section allowed the determination of the lifetime of the η' which was found to agree with predictions of the fractionally charged quark model.