RECENT EXPERIMENTAL RESULTS AT ADONE

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This report will be mainly concerned with very recent and mostly unpublished analysis of ADONE first generation experiments (1970-1973). Also new data on e^+e^- → many hadrons will be reported.

I. Many Hadrons Production in e^+e^- Interactions

(a) New results on the reaction $e^+e^- \to \pi^+\pi^-\pi^o\pi^o$ have been obtained by the μπ group[1]. By combining new data from Adone at total C.M. energies 2E = 1.2, 1.3 GeV with previous data obtained at lower energies with ACO[2] and at higher energies with ADONE the excitation curve shown in fig. 1 has been obtained. This curve has been derived assuming a pure phase space momentum distribution for the final state $\pi^+\pi^-\pi^o\pi^o$. Explicit tests as to what extent the result depends on this assumption have been made. Assuming, for instance, that this final state is reached via quasi-two body intermediate processes like $e^+e^- \to \omega^o\pi^o$, $A^\pm\pi^\mp$,... the cross section is essentially unchanged, within the errors, for 2E $\lesssim$ 1.3 GeV, while it is critically dependent on the assumed production mechanism for 2E > 1.3 GeV. The behaviour of the data in the energy range 2E = 1 - 1.3 GeV has been interpreted by the authors as an indication in favour of the existence of a new vector meson ρ' (1250). Also new data[1] on the reaction $e^+e^- \rho'' \to \rho^o\varepsilon^o \to \pi^+\pi^-\pi^+\pi^-$ have been obtained and are shown together with previous results in Fig. 2. The peak cross section turns out to be σ_{peak} = 17 ± nbarn, the mass of the ρ'' meson, m_ρ'' = 1550 ± 60 MeV and the total width Γρ'' = 360 ± 100 MeV.

(b) New results have been obtained by the "γγ" group at ADONE on the relevant problem of the fraction of

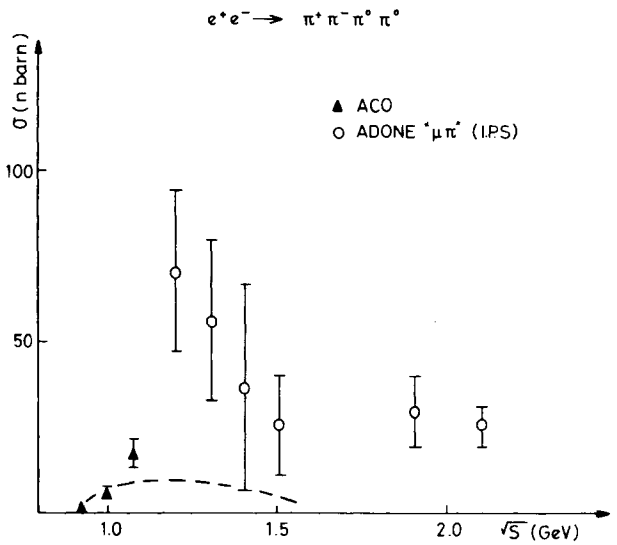

Fig. 1 Cross-section for the reaction $e^+e^- \to \pi^+\pi^-\pi^o\pi^o$ (ref. 1).

energy which goes into neutral particles in the reaction e^+e^- → many hadrons. Under the hypothesis of a phase space distribution of the produced particles assumed to be only pions, the authors estimate:

(i) The average number of charged pions as a function of the total C.M. energy √S = 2E (see fig.3);

(ii) The average number of neutral pions. In Fig.3 also previous results from μπ group are reported. The error bars take into account the uncertainties due to the assumptions made in the analysis. In the same figure the average total multiplicity is also reported.

Under the hypothesis previously mentioned the ratio

$$\frac{\text{Average Number of } \pi^\pm}{\text{Average Total Number of } \pi} = \frac{\text{Average Charged Energy}}{\text{Average Total Energy}}$$

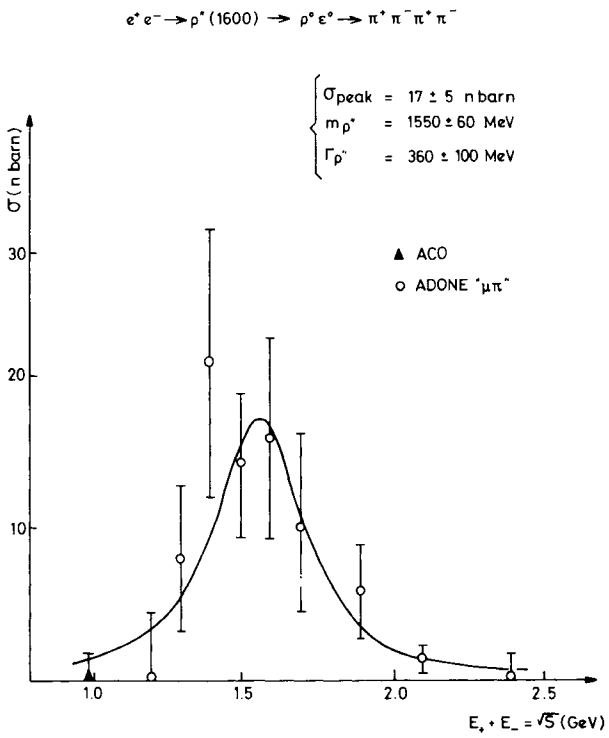

Fig. 2 Cross-section for the reaction $e^+e^- \to \rho^0(1600) \to \rho^0\varepsilon^0 \to \pi^+\pi^-\pi^+\pi^-$.

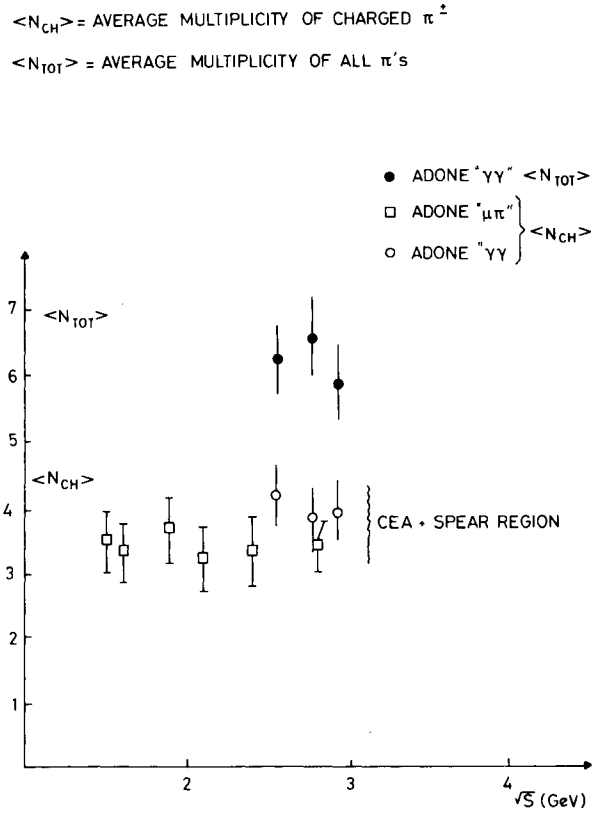

Fig. 3 Charged and total multiplicity in e^+e^- annihilation.

is also obtained and shown in Fig.4, together with the SPEAR[4] results. It is interesting to see the agreement between the two different approaches up to 3 GeV: in the case of the Frascati "γγ" group the energy going into neutrals is directly estimated from γ ray detection, while in the SPEAR case it is reconstructed by the missing energy.

(c) At the end of 1973 a cylindrical multiwire proportional chamber set-up (MADKA)[5] has started to operate at ADONE. During the tests of this set-up (which is able to analyse the events practically "on-line") data have been collected on the reaction $e^+e^- \to$ many-hadrons at C.M. energies of 1.6 and 1.96 GeV.

The main differences between this set-up and the first generation experiments at ADONE are a bigger solid angle ($\Delta\Omega$ = .90 x 4π) and a "softer trigger".

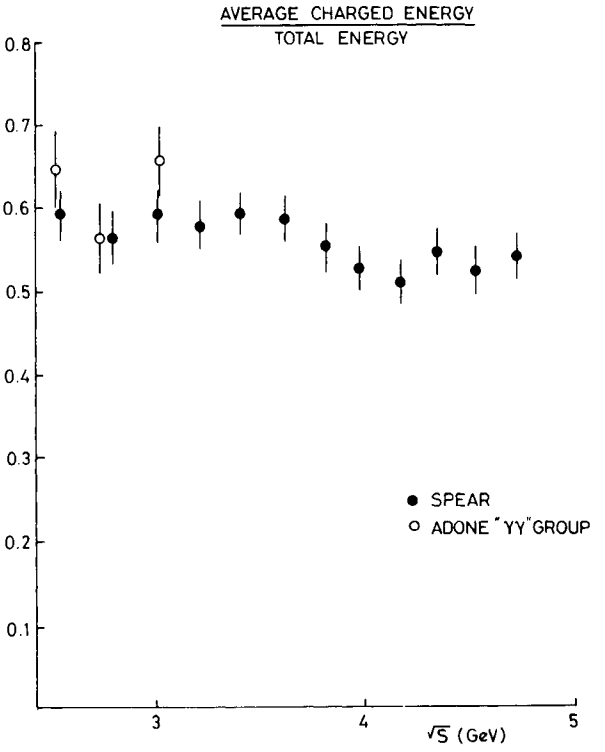

Fig. 4 Fraction of total energy carried by charged particles in e^+e^- annihilation into hadrons. Data from Adone and Spear.

298 beam-beam interaction events have been collected with at least four detected particles (2 charged + 2γ or 3 charged + 1γ or 4 charged). The results are summarised in Table I. Most of them are in agreement with previous Frascati measurements. Furthermore, upper limits not previously obtained have been established for higher multiplicity states.

II. Hadron Production in Two-Photon Processes

The process $e^+e^- \to e^+\gamma\, e^-\gamma \to e^+e^-X$, X = hadronic state, has been investigated at ADONE, where the equivalent mass of the hadronic system has been measured with counters tagging the two final state electrons.

(d) Two events compatible with $\varepsilon^o(660)$ production have been observed[6]

$$e^+e^- \to e^+e^-\varepsilon^o \longrightarrow \pi^+\pi^-$$

from which the γγ width of $\varepsilon^o(660)$ has been obtained to be

$$= 9.6 \begin{matrix} +\,12.3 \\ -\,8.0 \end{matrix} \text{ KeV}$$

(e) One event was observed in the η' mass region

$$e^+e^- \to e^+e^-\eta' \to e^+e^-\pi^+\pi^- \ldots$$

Depending on the evaluation of the non resonant contribution of γγ→ many hadrons, the value

$$\Gamma_{\eta'\gamma\gamma} = 11 \begin{matrix} +8 \\ -6 \end{matrix} \text{ KeV}$$

is obtained if the event comes from γγ→η'; alternatively the upper limit

$$\Gamma_{\eta'\gamma\gamma} \leq 33 \text{ KeV (95\% confidence level)}$$

is obtained if the event originates from a non resonent reaction γγ→ many hadrons.

Table I Partial Cross-Sections for e^+e^- annihilation. Data from reference 5.

A) 2E = 1.6 GeV

1) $\sigma_{4ch} = (18.7 \pm 4.0)$nb
2) $\sigma_{2ch2\pi^o} = (27 \pm 12)$nb
3) $\sigma_{4ch1\pi^o} = (5 \pm 4)$ nb
4) $\sigma_{4ch2\pi^o} < 2$ nb
   $\sigma_{6ch} < 1$ nb
   $\sigma_{8ch} < 0.6$ nb

B) 2E = 1.96 GeV

1) $\sigma_{4ch} = (5.0 \pm 1.0)$nb
2) $\sigma_{6ch} = (2.1 \pm 0.4)$nb
3) $\sigma_{4\pi1\pi^o} = (1.4 \pm 1.0)$nb
4) $\sigma_{4\pi2\pi^o} = (2.4 \pm 1.0)$nb
5) $\sigma_{6ch1\pi} = (0.8 \pm 0.4)$nb
6) ($\sigma_{2ch2\pi^o} = (14 \pm 4)$ ub or:
   ($\sigma_{2ch3\pi^o} = (7 \pm 2)$ nb
7) $\sigma_{8ch} < 0.6$ nb
   $\sigma_{4ch3\pi^o} < 1$ nb
   $\sigma_{4ch4\pi^o} < 1$ nb sum < 1 nb
   $\sigma_{6ch2\pi^o} < 1$ nb

III. Experimental Programme at ADONE

My last remark concerns the status of the experiments now operating at ADONE. Three experiments are running at present: the magnetic detector "MEA", the "γγ2" experiment and the "$B\bar{B}$" experiment. The MEA experiment