Simple model for e^+e^- annihilation predicts rapid rise of hadron multiplicity observed at PETRA

T. R. Mongan
84 Marin Avenue, Sausalito, California 94965
(Received 5 November 1979)

The simple model for e^+e^- annihilation developed in an article previously published in this journal [Phys. Rev. D **20**, 1093 (1979)] is extended to the PETRA energy range (10 to 40 GeV in the c.m.). The calculated values of the average charged-hadron multiplicity are in reasonable agreement with experiment.

Preliminary results from PETRA[1] at the Deutsches Elektronen Synchroton in Hamburg, Germany indicate the following:

(a) The dominant mechanism in the c.m. energy range 10 to 31.6 GeV for e^+e^- annihilation into hadrons is the production of a quark and an antiquark, each of which subsequently generates a narrow jet, although there are indications, at the higher energies, of a small admixture of three-jet events resulting from hard-gluon bremsstrahlung.

(b) The average charged-hadron multiplicity grows more rapidly than a simple logarithmic extrapolation of the low-energy experimental data would suggest.

In a recent paper,[2] I developed a simple model for the dominant mechanism of hadron production in two jets initiated by a quark-antiquark pair generated from the one-photon intermediate state resulting from e^+e^- annihilation and applied it for c.m. energies below 10 GeV. Table I shows the average charged-hadron multiplicity $\bar{n}_{ch}$ calculated from my model for several values of the c.m. energy between 10 and 40 GeV, the (preliminary) experimental results from PETRA,[3] and the average charged-hadron multiplicity as estimated by Wolf's[1] parametrization of the experimental data:

$$\bar{n}_{ch} = 2.0 + 0.2 \ln s + 0.18 (\ln s)^2 .$$

The values of the three input parameters to the model used in Ref. 2 were also used in this calculation. Although no attempt was made to search for optimum values of the input parameters, the calculated values obtained from my model are in reasonable agreement with experiment.

TABLE I. Average charged-hadron multiplicity in e^+e^- annihilation at different values of the c.m. energy in GeV. Experimental values were provided by G. Wolf of the TASSO collaboration at PETRA. The calculated values were obtained from the model developed in Ref. 2. The column headed "Wolf parametrization" exhibits the values obtained from the parametrization of the experimental data presented by Wolf in Ref. 1. The calculated value of $\bar{n}_{ch}$ at 38 GeV is given because this is the highest c.m. energy expected to be reached at PETRA.

$E_{c.m.}$ (GeV)	$\bar{n}_{ch}$ (experiment)	$\bar{n}_{ch}$ (calculated)	Wolf parametrization
13.0	7.8 ± 1.0	7.206	7.763
17.0	8.6 ± 1.0	8.319	8.913
22.0	9.5 ± 1.0	9.535	10.116
27.6	10.8 ± 1.0	10.740	11.253
30.0	11.7 ± 1.0	11.217	11.690
31.6	11.4 ± 1.0	11.525	11.967
38.0		12.684	12.982

[1]Gunter Wolf, DESY Report No. 79/41, 1979 [rapporteur talk given at the 1979 EPS International Conference on High Energy Physics, Geneva, 1979 (unpublished)].

[2]T. R. Mongan, Phys. Rev. D 20, 1093 (1979).

[3]Data provided by Dr. Gunter Wolf of PETRA (private communication from A. Ali).

 © 1980 The American Physical Society