hadron cross section is much larger than the two-muon cross section. The Gell-Mann–Zweig quark model predicts for the ratio of multihadron production to muon-pair production a value of 2/3. The newer quark model, involving current quarks with para-Fermi statistics, which Richard Feynman has called "red, white and blue quarks," predicts a value for the ratio three times as big, namely two. In the Han–Nambu scheme, which involves three triplets of quarks with integer charges, the ratio is four. All these predictions apply, however, only in the asymptotic region, when you would see a $1/s$ fall-off, and in the absence of asymptotic behavior, all bets are off. So it is too soon to make any general statements about one or another model being vindicated or thrown out the window.

Two years ago Stanley Brodsky (SLAC), Toichiro Kinoshita and Hidezumi Terazawa (Cornell), V. M. Budnev and I. F. Ginzburg (Novosibirsk), and Paul Kessler and his colleagues at College de France argued that there would be a competing process to multihadron production through e^+-e^- annihilation. They proposed that for beam energies higher than 1 GeV the cross section for producing two photons in the intermediate state in reactions of the type $e^+ + e^- \rightarrow e^+ + e^- + 2\gamma \rightarrow e^+ + e^- +$ hadrons becomes increasingly more important than for one photon, increasing as a power of log E. This "two-photon" process will produce hadrons predominantly along the electron and positron beam direction but Brodsky told us that neither Adone nor CEA data tells definitely whether any of the events seen were due to this two-photon process. Another process that may obscure any attempt at present energies to find an asymptotic fall-off is resonance production. There may be a ρ'' and a ρ''' hidden in the Adone and CEA data. Elucidation requires the higher luminosity expected from newer storage rings coming into action. High-energy workers will be eagerly awaiting the results that will eventually come out of SPEAR in Stanford (3.0 GeV in each beam) and DESY in Germany (3.5 GeV in each beam).

The members of the $\gamma\gamma$ group are C. Bacci, R. Baldini-Celio, G. Capon, Mencuccini, G. P. Murtas, G. Penso, G. Salvini, M. Spinetti, B. Stella and A. Zallo.

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The boson group members are B. Bartoli, F. Felicetti, G. Martini, A. Nigro, H. Ogren, Silvestrini and F. Vanoli.

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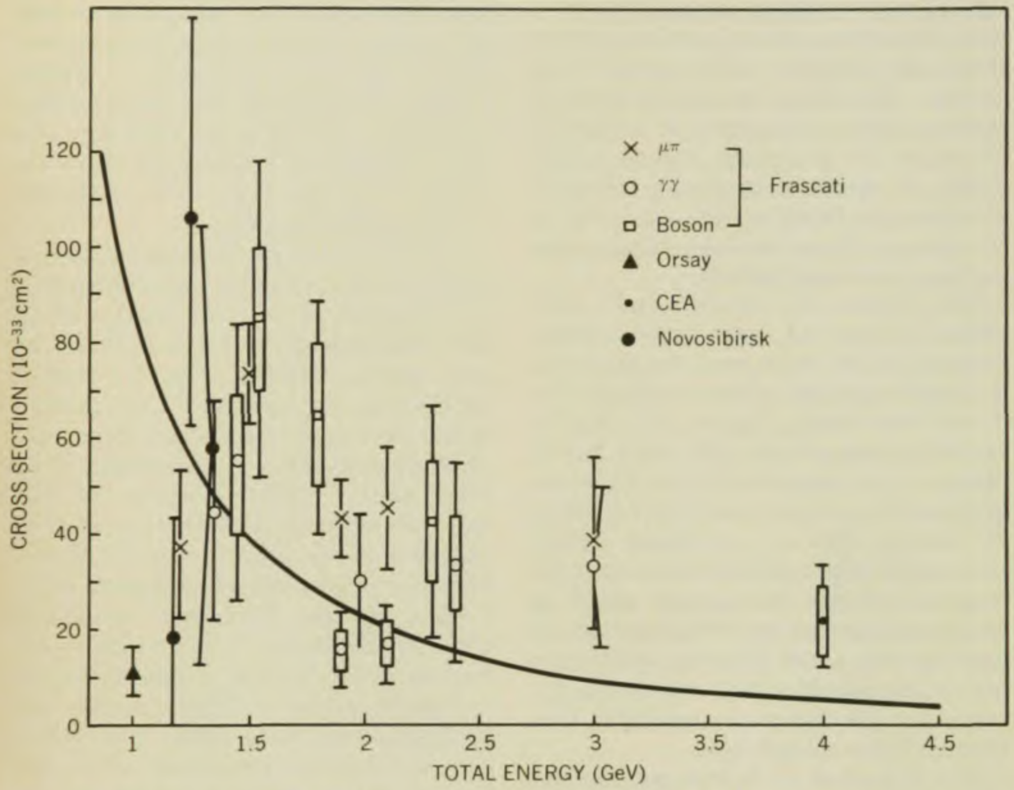

Cross section for electron–positron annihilation into hadrons as measured at various colliding-beam devices. Colored curve is cross section for muon-pair production as computed from quantum electrodynamics. Hadron production is higher than expected.

Westinghouse tests 5-MW superconducting generator

Researchers at Westinghouse have developed a superconducting electric generator, which is expected to produce five megawatts at 60 Hz. Except for its small size it is believed suitable for use as a utility generator. The Westinghouse generator has been tested under open-circuit and short-circuit conditions.

The generator has a superconducting rotor made of a niobium–titanium alloy and copper and is kept between four and five degrees Kelvin by liquid helium. The rotor is contained in what is essentially a rotating Dewar vessel that turns at 3600 rpm. The stator is similar to those in conventional generators except that the high magnetic field in the generator—40 to 50 kilogauss—requires that it be built of more finely divided copper.

The work on the generator was initiated in late 1969 by George Wiener, research director at Power Systems, and John Hulm, research director at Westinghouse Research Laboratories. John Mole, the chief engineer, has had about 40 people working on the project.

Hulm told us about some of the problems that were encountered in designing the generator. The only way to get liquid helium into the rotor is through the rotating generator shaft, and so special rotating seals had to be developed. Furthermore, the generator shaft turned out to be a major source of heat loss to the rotor, yet it had to be strong enough to withstand the torque applied to the generator by the prime mover. The researchers designed a tube with thin walls to minimize heat loss, yet maintain adequate strength.

The first power application of the superconducting generator is expected to be as a peaking power generator. This type of generator usually has an output between 50 and 100 MW and is used by utilities to supply power during periods of high demand. Eventually, says Hulm, they expect to have superconducting generators that will produce up to 1000 MW and higher. These could be used as main generators in a power station.

Superconducting generators have higher efficiencies than conventional generators; in the higher power models it is expected that energy losses will be reduced by a factor of two. In the long run superconducting generators will also be cheaper to build, Hulm says. —SMH □