EXPERIMENTAL LIMITS ON MONOJET PRODUCTION IN e^+e^- ANNIHILATION AT 29 GeV

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Abstract

A search was made for $e^+e^- \to X_1X_2$ where X_1 consists of one or more light unobservable particles and X_2 decays promptly to a visible jet of particles. One event was found for an integrated luminosity of 176 pb^{-1}, a rate consistent with known backgrounds. This result places a significant constraint on a number of theoretical models.

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We report results[1] from a search for monojets with the High Resolution Spectrometer (HRS) at the PEP e^+e^- storage ring.

Several ideas have been suggested to explain the CERN UA1 monojet events.[2] They include the production of supersymmetric particles, bound states of gauge bosons, and anomalous decays of the Z^o bosons.[3] Such phenomena all lie outside the domain of the Standard Model. It is therefore important to search for such events in other experimental situations.

The search was conducted at a c.m. energy of 29 GeV with an integrated luminosity of 176 pb^{-1}. Monojets are defined here as events with energetic clusters of particles, all of which are contained within one hemisphere and for which the net momentum vector is at large angles with respect to the beams. Such events exhibit large unbalanced momentum and missing energy. We found one such event.

The dominant source of potential background for this search consists of events with initial-state radiation of a high-energy photon at large angles and the annihilation of the remaining electron-positron system into hadrons. If the photon enters the detector gap, such event will be misidentified as monojet. The overall background to monojets is expected to be 3.3 ± 1.5 events.

Therefore we present upper limits for prompt monojet production using the result that we have observed no events with monojet masses below 3.6 GeV/c^2 and, at most, one possible candidate at higher masses.

Figure 1 shows detection efficiencies as well as 90% C.L. upper limits for the production cross section of hadronically decaying scalar particles as a function of their mass. These limits vary from 0.05 to 0.12 pb over the mass range 2-10 GeV/c^2.

We note that similar searches for events with unbalanced momentum were conducted by the JADE group at PETRA and the MKII group and the MAC group at PEP.[4]

In conclusion, we have searched for monojets in e^+e^- annihilation at 29 GeV. We find one event with one monojet originating from the interaction region. This event is consistent with the background expected from events with large-angle, initial-state radiation where the radiated photon is not detected. We set limits on the production of monojets which exclude with high probability that Z^o-mediated production of scalar

particles in the mass range 2-9 GeV can account for most of the observed CERN monojet events. We can not exclude the possibility that the CERN events arise from the Z^0-mediated production of heavy, neutral leptons. Finally, our data place some constraints on supersymmetric models (Fig. 2).

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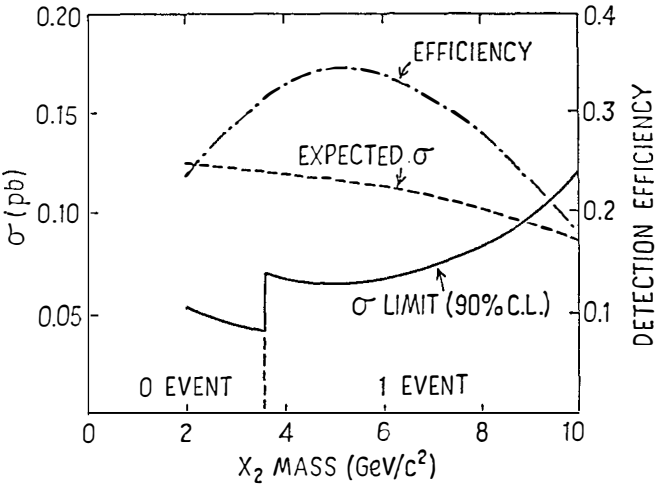

Fig. 1. Detection efficiencies, expected cross sections, and 90% C.L. cross section limits for prompt, hadronic monojets from the production and decay of scalar particles.

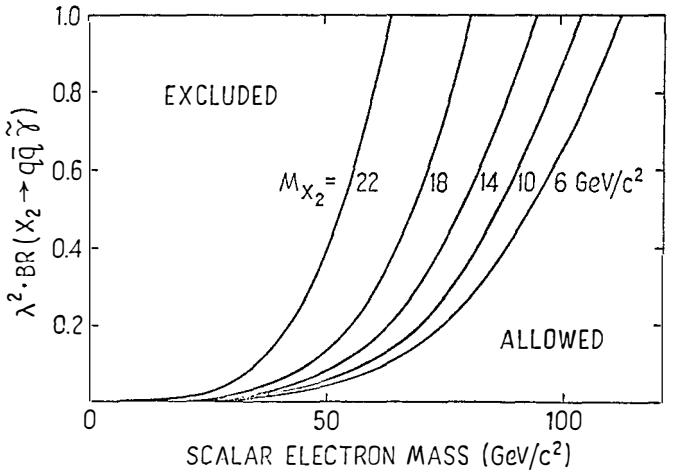

Fig. 2. Limits on the mass of the scalar electron from the process $e^+e^- \to X_1X_2$ as a function of the mass of the neutral fermion X_2.