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A SEARCH FOR SINGLE ELECTRON PRODUCTION IN e^+e^- ANNIHILATION AT 29 GEV *

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ABSTRACT

A recent search for single electron events performed with the ASP detector at PEP is presented. No anomalous signal is observed and limits on masses of the supersymmetric partners of the electron and photon are obtained.

The ASP detector[1] was designed to search for single photon events at the PEP e^+e^- storage ring at SLAC ($\sqrt{s} = 29$ GeV). The results of that search have set limits on the masses of supersymmetric particles and on the number of light neutrino generations[2]. We have also performed a search for single electron events. Such events would result from the production of single supersymmetric electrons ("selectrons") through the process[3] $e^+e^- \rightarrow e^{\mp}\tilde{e}^{\pm}\tilde{\gamma}$ followed by the decay $\tilde{e}^{\pm} \rightarrow e^{\pm}\tilde{\gamma}$. Unlike searches for pair-production of selectrons, this method enables a search to be made for the production of selectrons with a mass greater than the beam energy of the collider.

Other experiments at PEP and PETRA have searched for this signature and set limits on the selectron and photino masses[4–7]. However, all but the MAC experiment have used the equivalent photon approximation (EPA) to calculate the expected cross section in order to determine their mass limits. The MAC group[7] has used a complete Monte Carlo to calculate this process (including all 8 Feynman diagrams) and finds that this results in a cross section that is 40 % lower than when the EPA is used. We have used this full Monte Carlo to calculate our results.

The ASP detector is fully hermetic with coverage extending to within 21 mrad of the beam line. Its major component is a central lead-glass/proportional wire chamber calorimeter that provides energy measurement, as well as tracking, trigger, timing and pattern recognition information. Inside the calorimeter, a central tracker surrounded by a layer of veto scintillators serves to distinguish charged and neutral tracks. The forward regions are covered by lead-scintillator sandwich calorimeters with tracking provided by proportional wire chambers and drift chambers.

The detector was designed to eliminate the expected backgrounds from QED events, beam gas interactions and cosmic rays. The dominant background from radiative Bhabha events is kinematically vetoed: the forward coverage ensures the transverse momentum of any track with $p_t > 0.6$ GeV/c will be balanced by another

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track that is detected. However, if the photon in one of these events fails to convert, while one of the electrons escapes undetected down the beam line, the other electron may have $p_t > 0.6$ GeV/c and will be the only detected track. A Monte Carlo calculation of this background indicates that it can be reduced to an acceptable level by rejecting events where the photon would have traversed fewer than 13 radiation lengths in the detector, and requiring the observed electron have an energy greater than 4 GeV. The central acceptance is further defined by requiring the electron to be at $\theta > 20°$ from the beam line, to ensure the trigger is fully efficient and to obtain good tracking and pattern recognition.

The original data sample of 30 million events, corresponding to an integrated luminosity of 109.6 pb^{-1}, was searched for single electron events. The events were first passed through a fast filter which selected annihilation events with very high efficiency. The events were then tracked and only those with single tracks within the central acceptance that were from the origin and in time with the beam crossing were saved. Occupancy cuts were applied to the detector regions away from the observed track, which was also subjected to track quality cuts.

The overall efficiency for selecting events with single electron tracks was determined using diagnostic events to be 82.1 %. No events were observed within the acceptance, which allows limits to be set on possible selectron and photino masses as shown in fig. 1. Selectron masses substantially greater than beam energy are excluded.

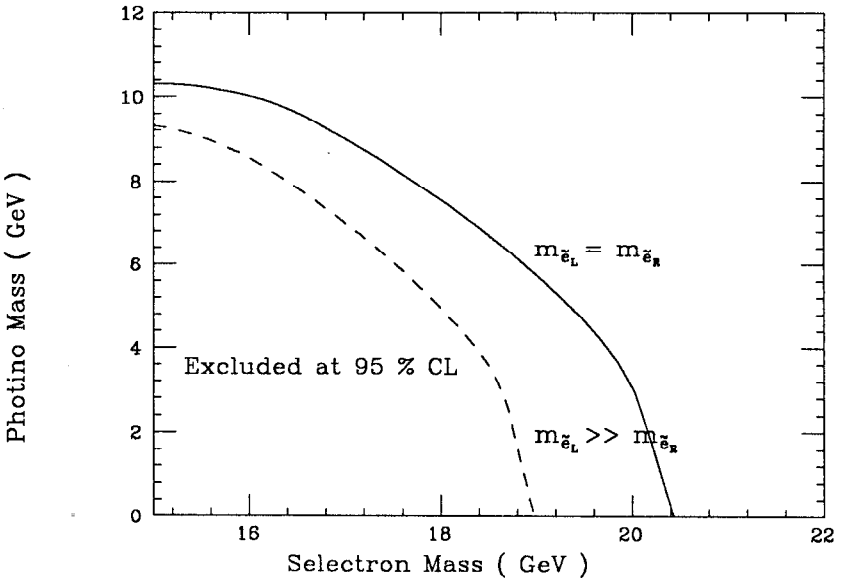

Figure 1. The region of selectron and photino masses within the contours are excluded at the 95 % CL.

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