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# FIRST RESULTS FROM ASP ON RESONANCE PRODUCTION IN $\gamma\gamma$ INTERACTIONS*

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## ABSTRACT

The reaction $e^+e^- \to e^+e^-\gamma^*\gamma^* \to (e^+e^-)\eta$, with subsequent decay of the $\eta$ into two photons, has been observed with the ASP detector at the PEP $e^+e^-$ storage ring at $\sqrt{s} = 29$ GeV. A measurement of the radiative width of the $\eta$ yields the preliminary result $\Gamma(\eta \to \gamma\gamma) = .489 \pm .009 \pm .055$ keV. Evidence for the production of the $\eta'$ with decay into two photons has also been observed.

## 1. THE DETECTOR

The ASP detector is well-suited to the detection of all-neutral final states produced in $\gamma\gamma$ interactions. It is a non-magnetic device consisting of 632 extruded lead glass bars, arranged in four quadrants of five layers each. The lead glass calorimeter covers 94% of $4\pi$ and has an energy resolution of $\frac{\sigma_E}{E} = \frac{10.0\%}{\sqrt{E}}$. A central tracker inside the lead-glass stack distinguishes charged from neutral tracks. In the forward regions, lead-scintillator calorimeters extend the coverage to within 21 mr of the beamline.

The trigger is based on sums from the lead-glass calorimeter. The lowest threshold on total energy is set at .7 GeV, with the additional requirement that one and only one quadrant, or two opposite quadrants, have at least .2 GeV deposited in the back four layers only. The efficiency of this trigger for $\eta \to \gamma\gamma$ events is approximately 50%.

The ASP detector has accumulated an integrated luminosity of 115 pb$^{-1}$ on the PEP $e^+e^-$ storage ring at $\sqrt{s} = 29$ GeV.

## 2. THE ANALYSIS

Understanding the trigger efficiency is the crucial aspect of this analysis. To achieve this goal, a parallel analysis of the process $e^+e^- \to (e^+e^-)e^+e^-$ has been performed. This final state has a topology similar to the $\eta \to \gamma\gamma$ signal and is logged out by the same trigger. It is a well-understood $\alpha^4$ QED process and a copious source of events. Thus it is possible to make a quantitative check of

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the trigger simulation by comparing data and Monte Carlo distributions versus total energy for this process. The result is shown in fig. 1; good agreement is observed.

The invariant mass distribution for the $\gamma\gamma$ final state is shown in fig. 2. A maximum likelihood fit to a combination of the $\eta$, $\eta'$, $f_2(1270)$ and a smooth background was performed. The $f_2(1270)$ contributes by its decay to two $\pi^0$'s; the $\pi^0$'s decay to two photons which can overlap and simulate a single photon in the detector. The fit yields $3005 \pm 55$ $\eta$ events, over a background of approximately 300 events. Pending further background studies a systematic error of 50% was assigned to the background. The other major source of systematic error is the trigger efficiency; this error has been estimated using the $(e^+e^-)e^+e^-$ sample.

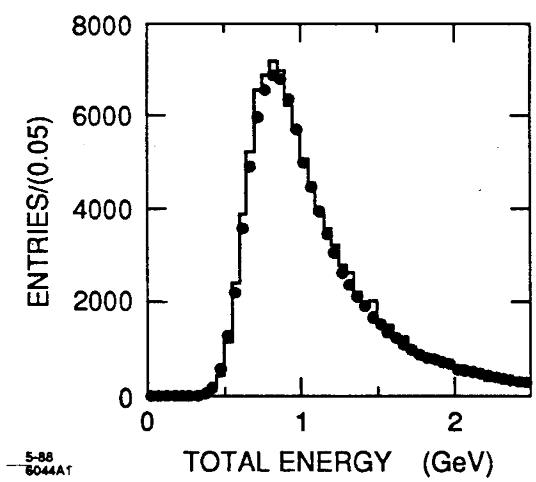


Fig. 1. Total energy distribution for $(e^+e^-)e^+e^-$ events. The histogram is from Monte Carlo simulation, the points are data.

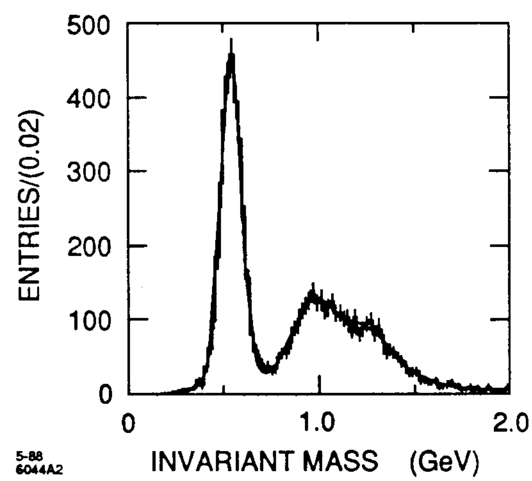


Fig. 2. Invariant mass distribution for $\gamma\gamma$ events. The solid line is the fit.

The result for the radiative width of the $\eta$ is $\Gamma(\eta \to \gamma\gamma) = .489 \pm .009 \pm .055$ keV, where the first error is statistical and the second is systematic. This is a preliminary result; a reduction of the systematic error will be achieved with further study. This result is in good agreement with the average value from other two-photon measurements, $\Gamma(\eta \to \gamma\gamma) = .52 \pm .04$ keV.