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AN IMPROVED UPPER LIMIT ON ν_τ MASS*

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ABSTRACT

We update out previous analysis of the $\tau \rightarrow 3\pi^{\pm}\pi^{0}\nu$ decay mode by the addition of new data to obtain an improved upper limit on the ν_{τ} mass of 143 MeV/c^2 at the 95% confidence level.

The Mark II collaboration has previously reported an upper limit on the ν_τ mass from an analysis of e^+e^- annihilation data corresponding to an integrated luminosity of 158 pb^{-1}.[1] This Brief Report gives an update of that result based on all the statistics collected by the Mark II detector up to its removal from PEP beam line in May 1984. The total integrated luminosity used here is 220 pb^{-1}, with all data taken at a center of mass energy of 29 GeV.

The method to determine the ν_τ mass is the same as described in Ref 1. We measure the 4π invariant mass spectrum from the $\tau \to 3\pi^\pm\pi^0\nu$ decay mode near its end point where it is sensitive to the ν_τ mass. A sample of $e^+e^- \to \tau^+\tau^-$ was selected in which one of the τ's decayed to $3\pi^\pm\pi^0\nu$ and the opposite one to one charged particle. Two photons, detected in the liquid argon calorimeter, were required to accompany the three charged pions, and to be consistent with the hypothesis that they were the decay products of a π^0. The two photons were then kinematically constrained to the π^0 mass. Eighty-three $\tau \to 3\pi^\pm\pi^0\nu$ decays were reconstructed and satisfied all of the event selection requirements.[1] From a Monte Carlo simulation, we estimate that 2.5 of these events are background from hadronic events, $e^+e^- \to q\bar{q}$.

Figure 1 shows the 4π invariant mass spectrum. The region above 1.5 GeV/c^2, was compared to the expected behavior for different values of the ν_τ mass[2] and different assumptions about the four-pion state. This region contains 22 events including an estimated background of 2.2 events. A maximum likelihood method was applied to determine an upper limit from the events in this region under the assumption that the four-pion state is dominated by the ρ' resonance of mass 1570 MeV/c^2 and width 510 MeV/c^2.[3] After including uncertainties in background, invariant mass resolution, and the mass and width of the ρ', we

obtain an upper limit of $m_{\nu_\tau} < 143$ MeV/c^2 at the 95% confidence level. The limit is not sensitive to the assumption of ρ' dominance; it becomes slightly more restrictive if one assumes that the 4π final state is distributed purely according to phase space.

REFERENCES

1. C. Matteuzzi *et al.*, *Phys. Rev. Lett.* **52**, 1869 (1984). The upper limit reported in this reference was $m_{\nu_\tau} < 164$ MeV/c^2 at the 95% confidence level.
2. Y. S. Tsai, private communication.
3. A. Cordier *et al.*, *Phys. Lett.* **109B**, 129(1982).

FIGURE CAPTIONS

1. Four-pion invariant mass distribution of the selected events. The curve shows the expected spectrum for $m_{\nu_\tau} = 0$ under the assumption that the four-pion τ decay mode is dominated by the ρ' resonance.

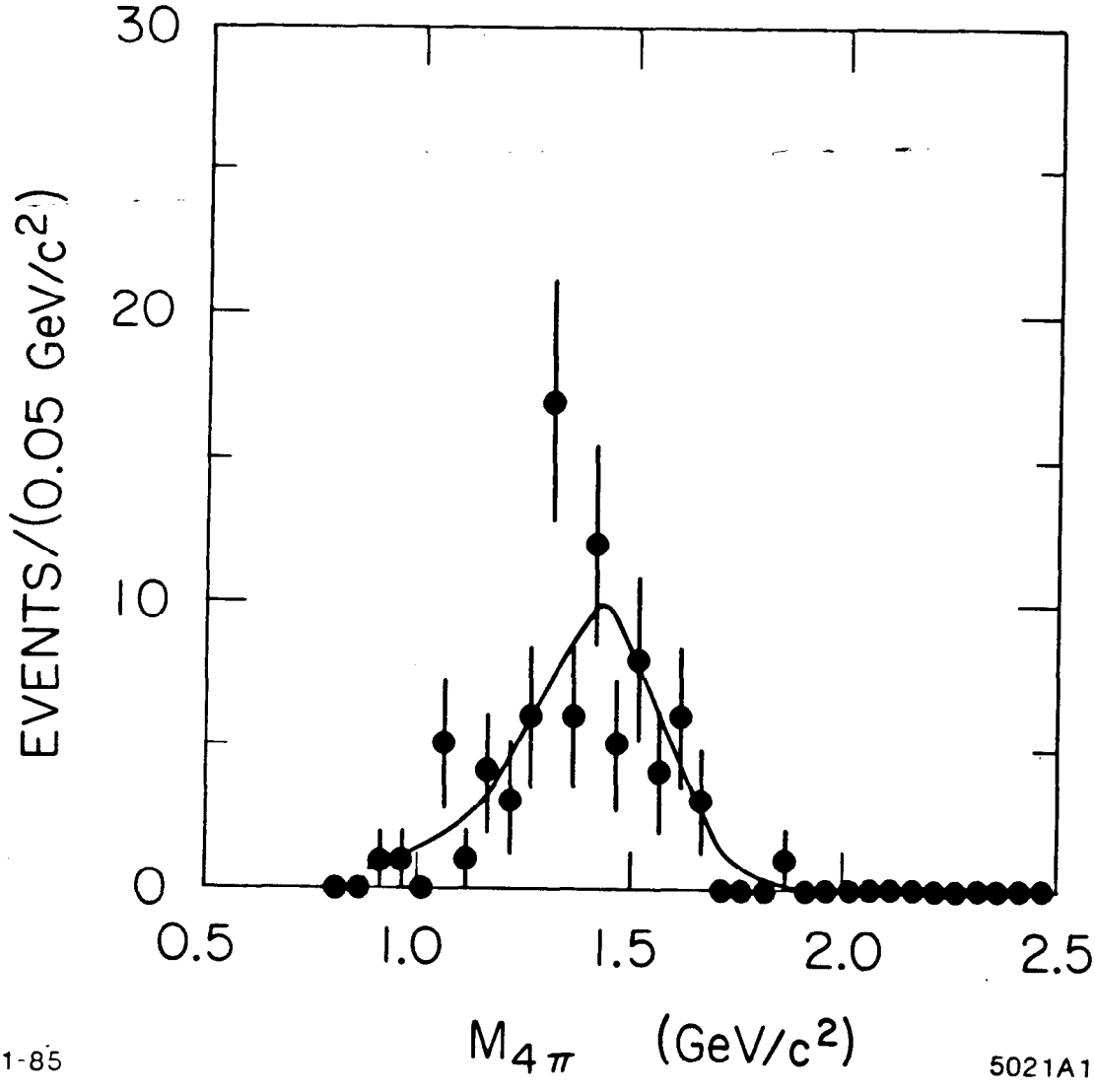

Fig. 1