

E162: Observation of the decay mode $K_L \rightarrow \pi^+\pi^-e^+e^-$

Physics Motivation The $K_L \rightarrow \pi^+\pi^-e^+e^-$ decay provides a good testing ground to study CP/T-Violation phenomena, and thus it has attracted much attention both theoretically and experimentally. When we started the E162/CP experiment at KEK, only an upper limit for the branching ratio had been given.

Results of the E162/CP Experiment We have established this mode successfully. Fig.1 shows a scatter plot of $\pi^+\pi^-e^+e^-$ candidate events: the horizontal axis represents the $\pi^+\pi^-e^+e^-$ invariant mass while the vertical axis θ^2 , where θ being the angle between the reconstructed K_L momentum and the line connecting the decay vertex and the production target. We see a cluster of events inside the signal box (hatched in red). Fig.2 shows a projection onto the θ^2 axis for the events which satisfied $|M_{\pi\pi ee} - M_{K_L}| < 3\sigma_{M_K}$. As expected, the signal events are observed as a peak at $\theta^2 \simeq 0$. The histogram (hatched in blue) represents the background events by Monte Carlo simulation. The MC events, normalized to the actual K_L flux, reproduce the real data well. From these, we have established 13 ± 4.5 signal events, and have determined its branching ratio as $Br(K_L \rightarrow \pi^+\pi^-e^+e^-) = (4.4 \pm 1.3(\text{stat.}) \pm 0.5(\text{syst.})) \times 10^{-7}$. The result is found to agree well with a theoretical model as well as a recent measurement at FNAL.

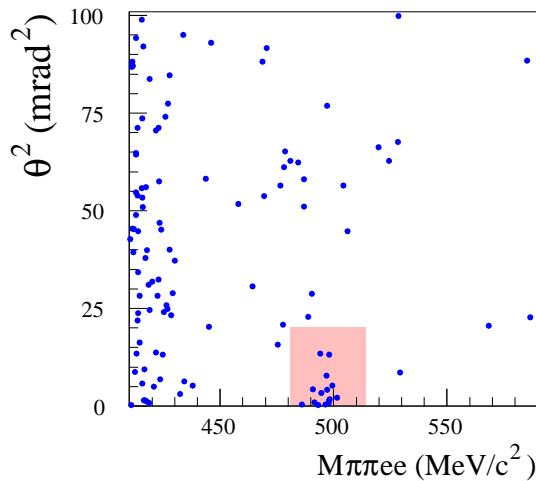


Fig.1

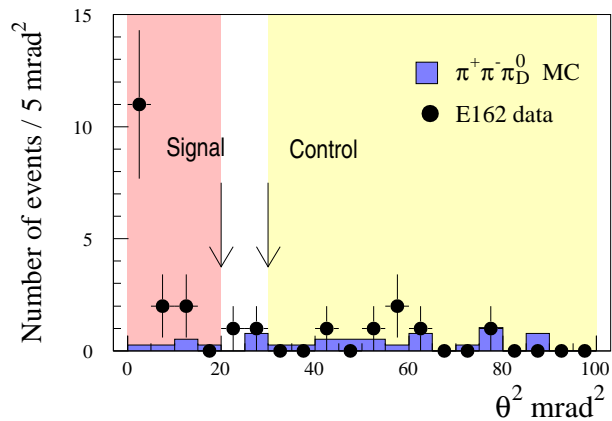


Fig.2

Analysis for Other Modes Other rare decay modes, such as $K_L \rightarrow e^+e^-\gamma$ and $K_L \rightarrow \pi^0e^+e^-\gamma$, are being analyzed currently. We hope to publish their results soon.

Publication from this Experiment

- [1] T.Nomura *et al.*, Phys. Lett. **B408**, 445 (1997)
- [2] Y.Takeuchi *et al.*, Phys. Lett. **B443**, 409 (1998)