

Study of $K_L \rightarrow \pi e \nu e e$

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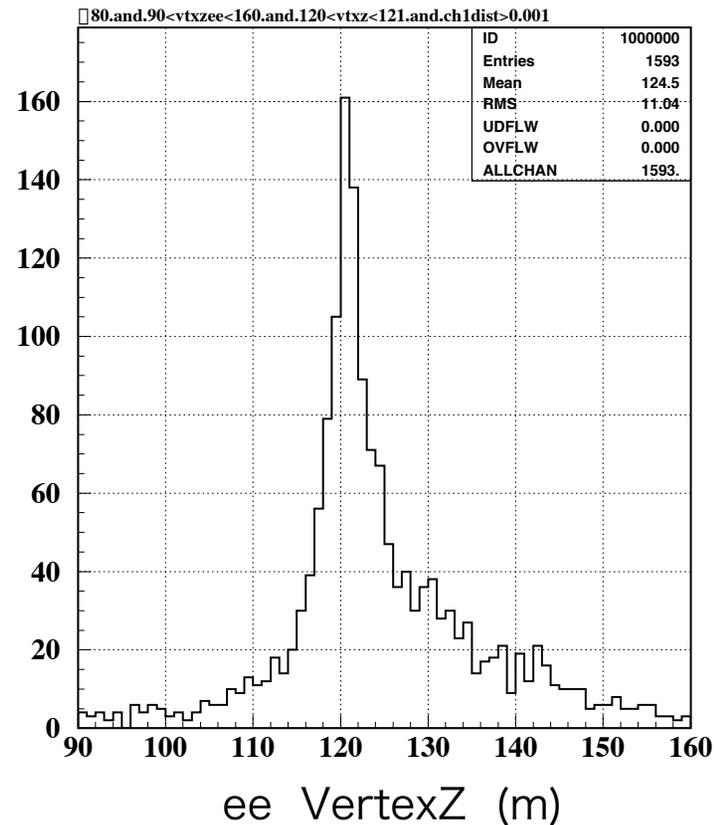
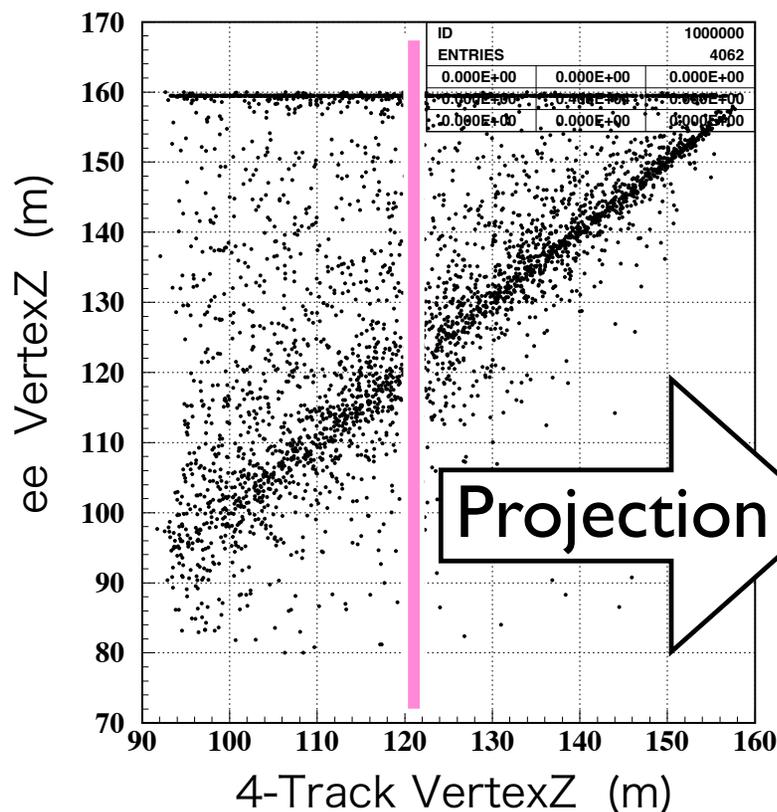
Oct. 25, 2003

Fermilab

Talk about

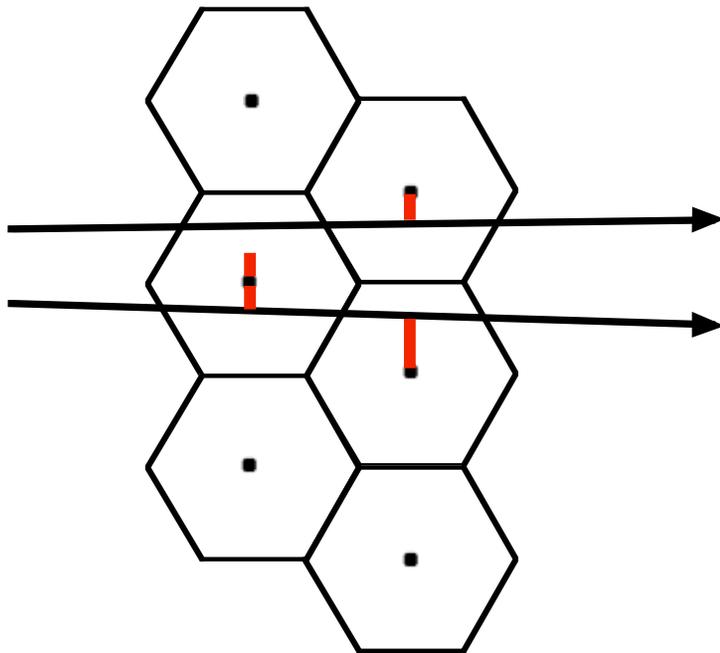
- Phenomenon that vtxz of e^+e^- pair is distributed into downstream.
- e^+e^- pair due to radiative $Ke3$ with external conversion at the Vacuum window.

e^+e^- pairs are distributed into downstream



- Distribution of e^+e^- vtxz is asymmetric

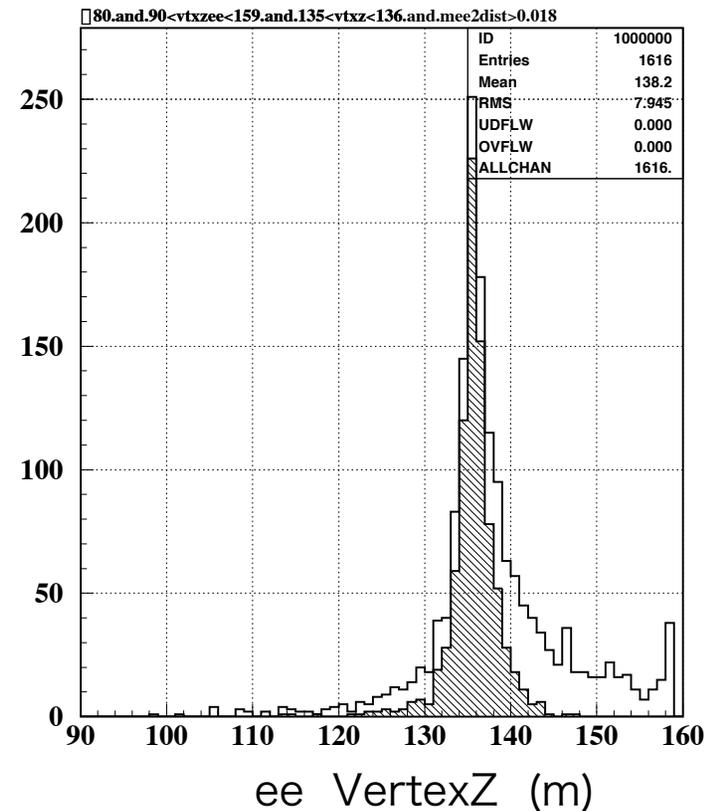
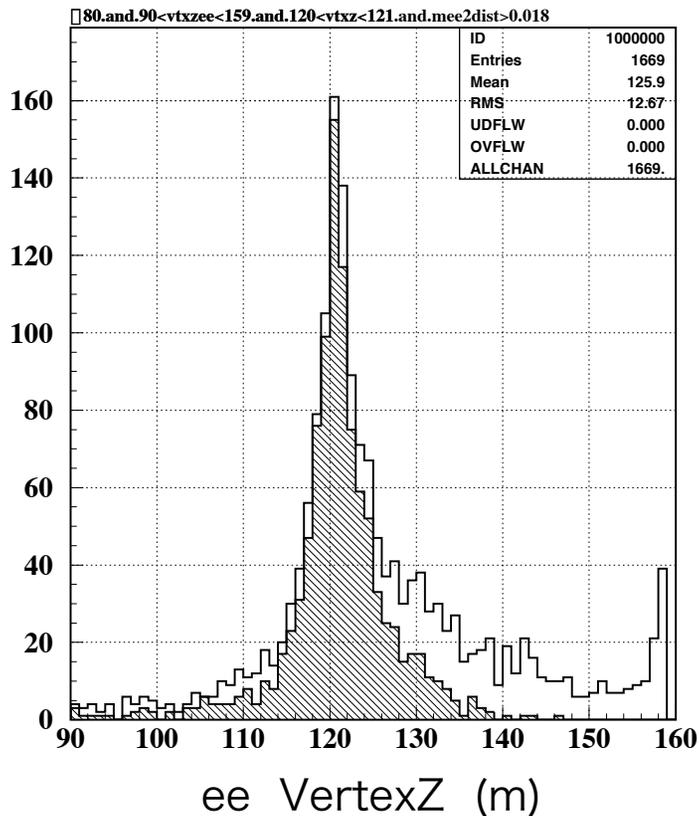
An explanation why vtxz of e^+e^- are distributed into down stream



DC1

- When we have three reconstructed adjacent hit wires, track separation is always smaller than the true value, and this happens more often in DC1 than in DC2

Cut the events whose separation at DC1 is less than the cell width



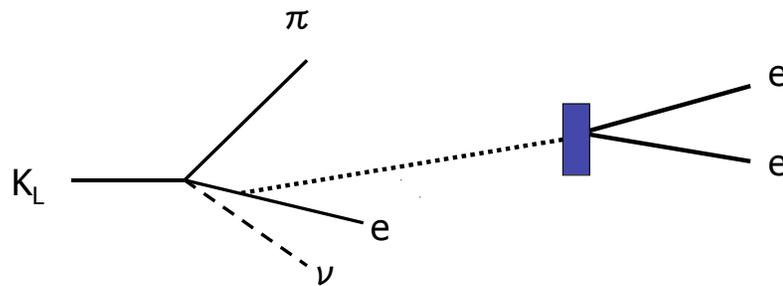
- Distribution of remainder is symmetric

External conversion events at Vacuum window

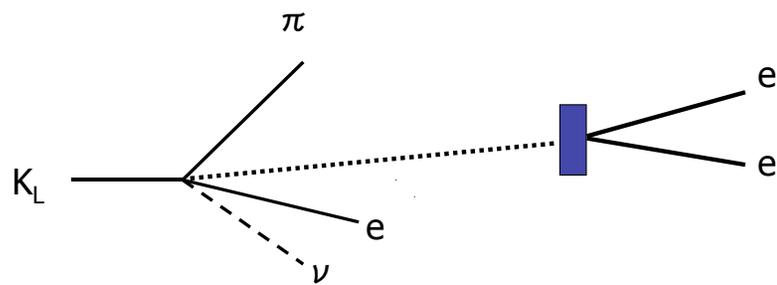
- Events which real gamma converted at the vacuum window are background events for $K_L \rightarrow \pi e \nu ee$, but we can cut them easily.
- It is important to investigate $K_L \rightarrow \pi e \nu ee$ to compare with phenomena of external conversion event.
- Simultaneously external conversion events are good probe to investigate radiative $Ke3(\text{real gamma})$ through e^+e^- pair.

Study of radiative Ke3 using external conversion event

- External conversion of real photon from radiative Ke3 can be used to reject accidental photons



Inner Brem.



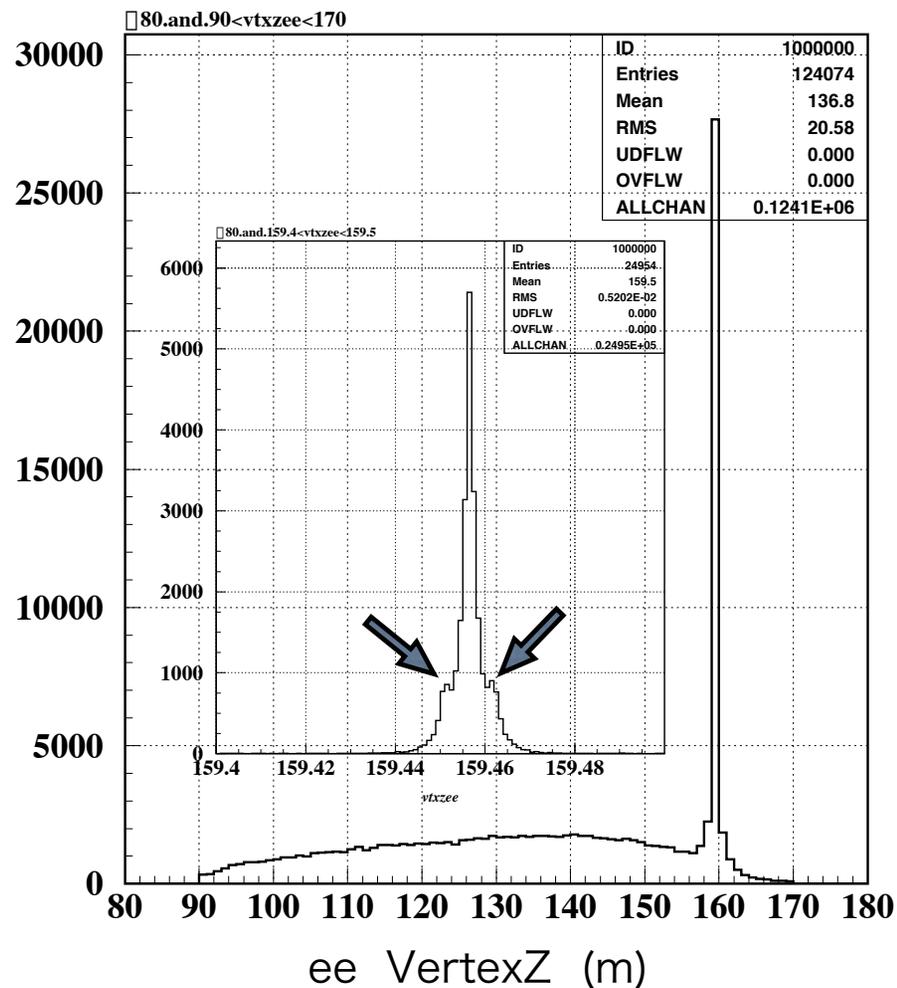
Direct Emission

$K_L \rightarrow \pi e \nu ee$ and

external conversion of radiative $Ke3$

	Probe	Inner Brem.	Structure dependent
Virtual photon	$K_L \rightarrow \pi e \nu ee$?	?
Real photon	Ext. conv. of $Ke3$	>99%	Direct emission <1%

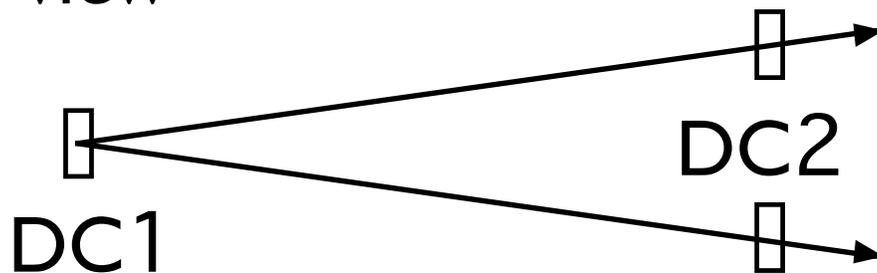
Peak of vtxz of e+e- pair is too narrow !



- Peak is at DC1 (x-plane 159.465m) not at Vacuum window (158.89 m).
- Two small peaks exist on the side. Both peaks are at the 1st plane and 2nd plane, respectively.

The reason why v_{txz} of e^+e^- has too narrow a peak

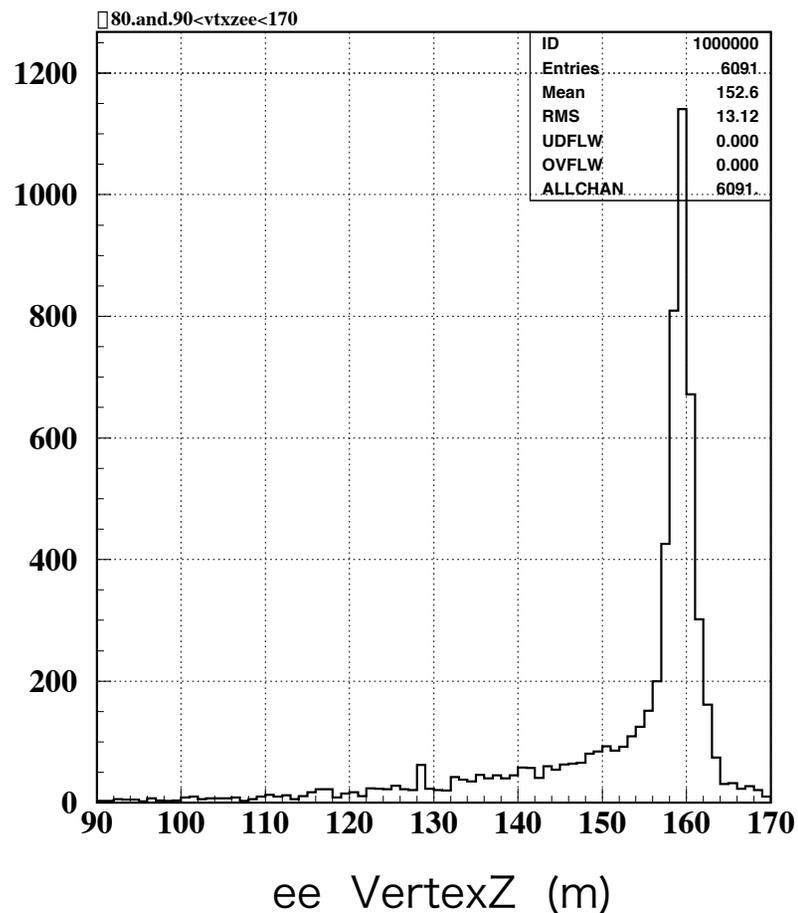
X-view



(c.f. Most e^+e^- tracks is shared in Y-view)

- One track of constituents of 4-track vertex is allowed to share hit with another track at DC1, DC2 in x-view. If hit is shared by the tracks of e^+e^- pair at DC1, the point of v_{txz} of e^+e^- is fixed at the hit point, even if resolution is large.

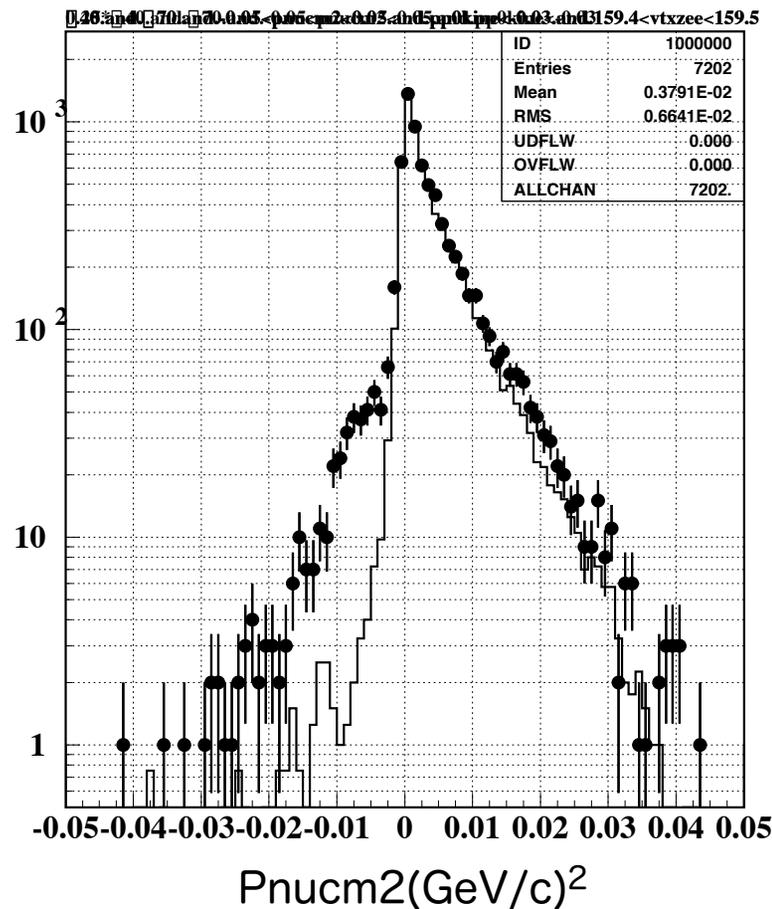
In MC we can see reasonable peak width for the resolution of vtxz



- RMS of events which are in 155m~165m is 1.71m and error of vtxz is 1.8m
- Real gamma conversions were made using MCPHOT2

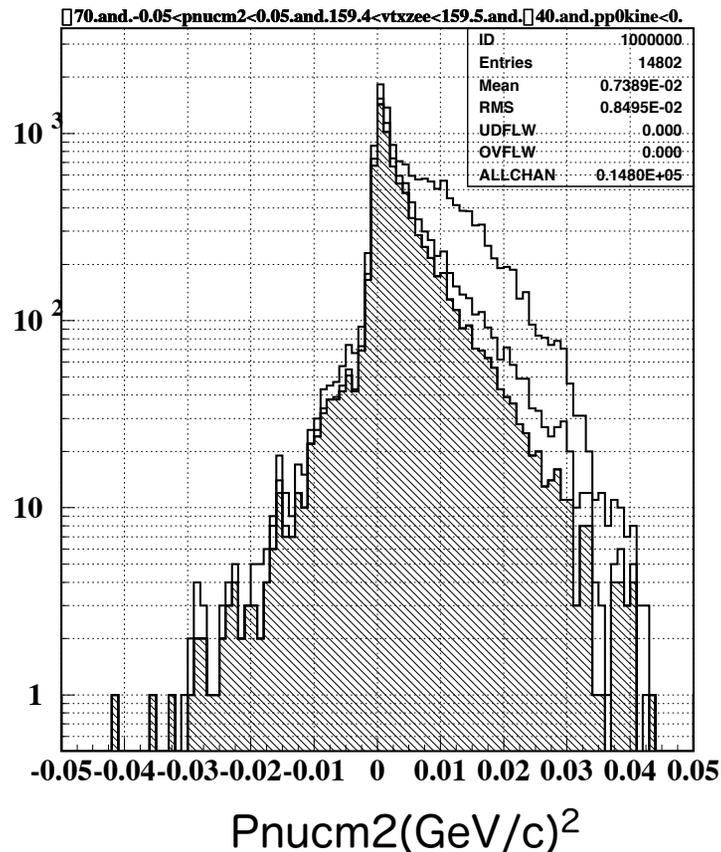
- I have not resolved this problem yet, but will I show you comparisons of conversion events and radiative Ke3 Monte Carlo events.

Squared longitudinal component of neutrino momentum



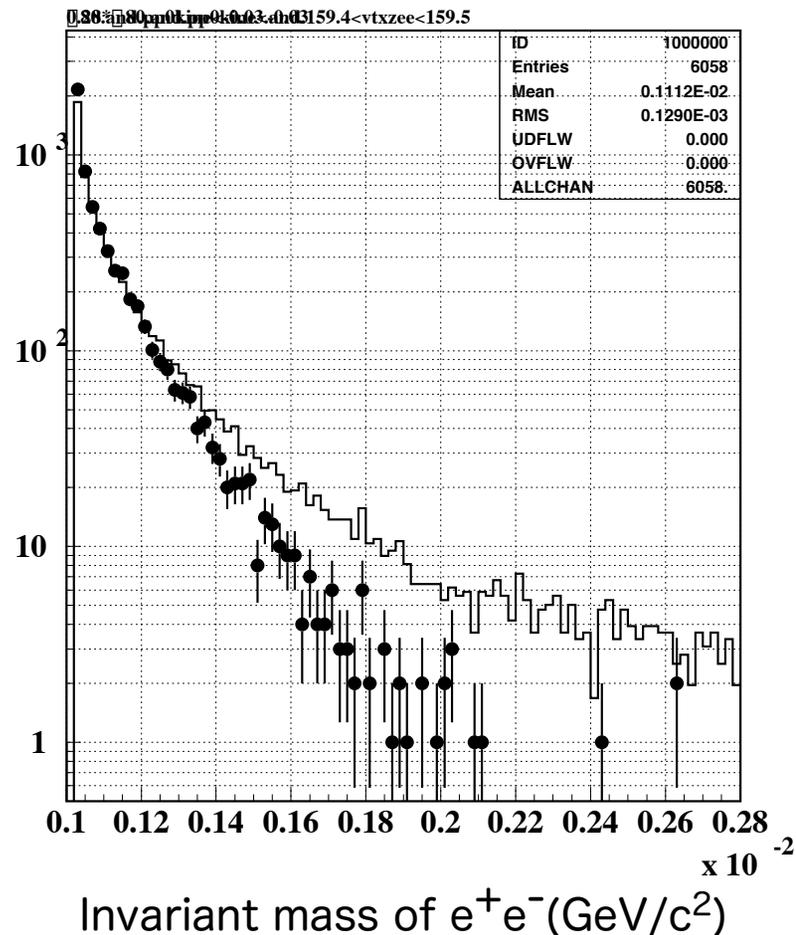
- for electron track
 $0.95 < E/p < 1.05$
- for π^\pm track
 $E/p < 0.8$
- TRD Pion probability
for electron
 < 0.02
- $P_{p0kine} < 0$.

Effect to cut $K_L \rightarrow \pi^+ \pi^- \pi^0$ by TRD and PPOKINE



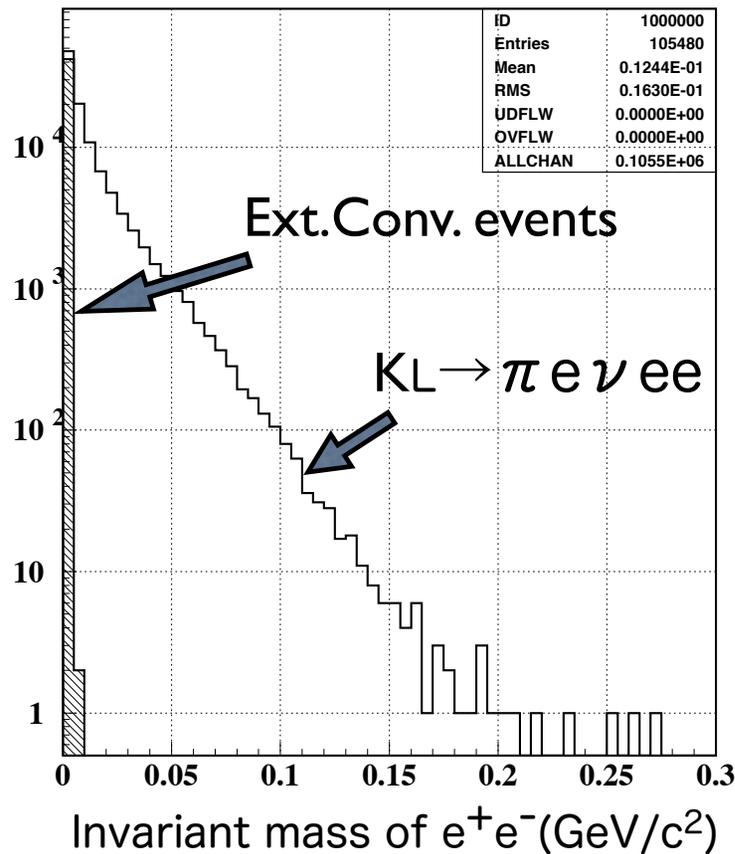
- $K_L \rightarrow \pi^+ \pi^- \pi^0$ decay in which one of charged pion fakes electron is a background event
- 1st cut; effect of TRD
- 2nd cut; effect of pp0kine

Invariant mass of e^+e^- pair



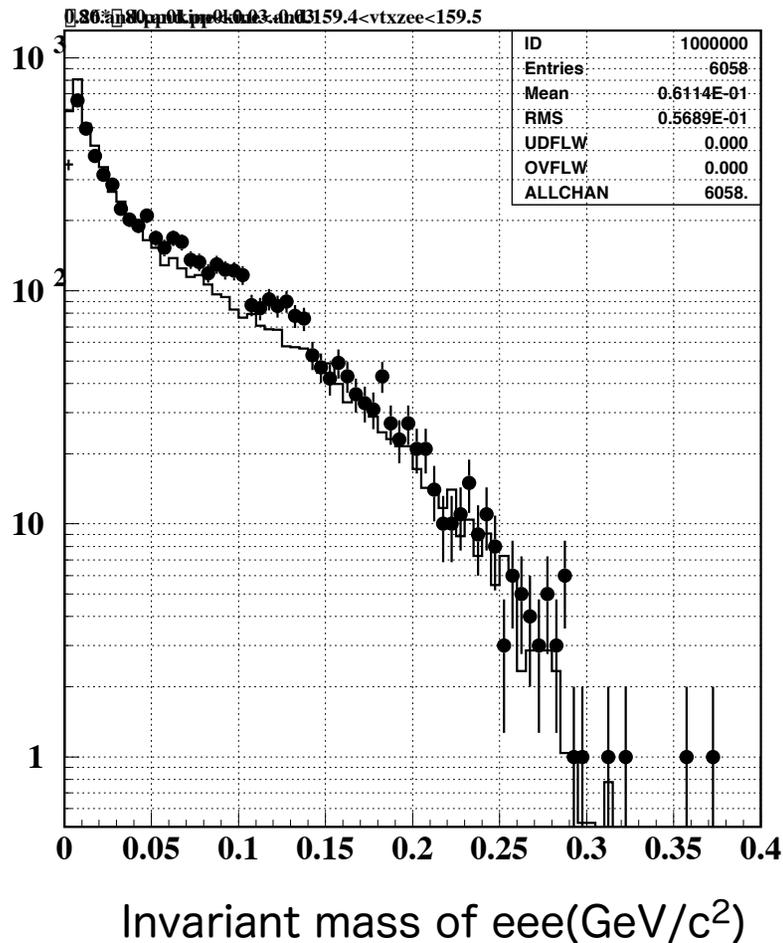
- InMC real gamma from radiative Ke3 was converted to e^+e^- pair using MCPHOT2
- There is difference between MC between MC and Data in the mass distribution of e^+e^- pair.

Invariant mass of e^+e^-



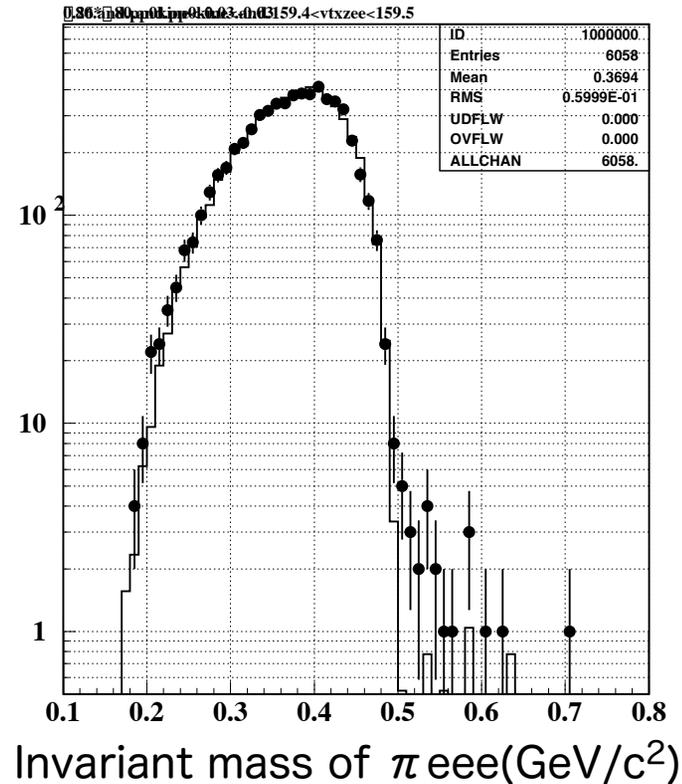
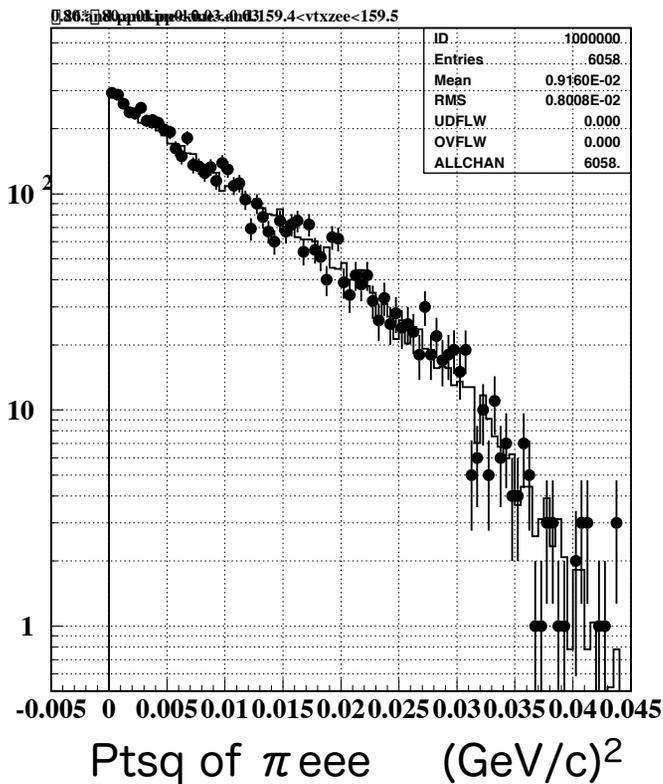
- Mass of e^+e^- pair of $\text{K}_L \rightarrow \pi e \nu ee$ is larger than that of external conversion event.

Invariant mass of three electrons



- MC almost agrees with data
- There is a little bit difference near pion mass

Ptsq and invariant mass of pi eee from Radiative Ke3 with external conversion



- MC have good agreement with data on Ptsq and invariant mass of Pi eee system

Conclusion

1. Some of the e^+e^- v_{txz} is shifted downstream of 4-track vertex because of hit-sharing in DC1
2. The peak of v_{txz} of e^+e^- due to conversion at vacuum window is at DC1 and it does not show true resolution. This does not happen in MC.
3. MC by Ke3gdk with Mcphot2 is comparable with data about external conversion event, but some differences are left in e^+e^- mass and three electron mass.

Plan

1. To understand what makes the difference of shape of vtxz peak between MC and Data.
2. To understand differences between MC and Data on invariant mass of e^+e^- pair and three electrons.
3. To compare RadKe3 with external conversion and $K_L \rightarrow \pi e \nu ee$.