

Search for $K_L \rightarrow \pi^0 \mu \mu$ in 1999 Data

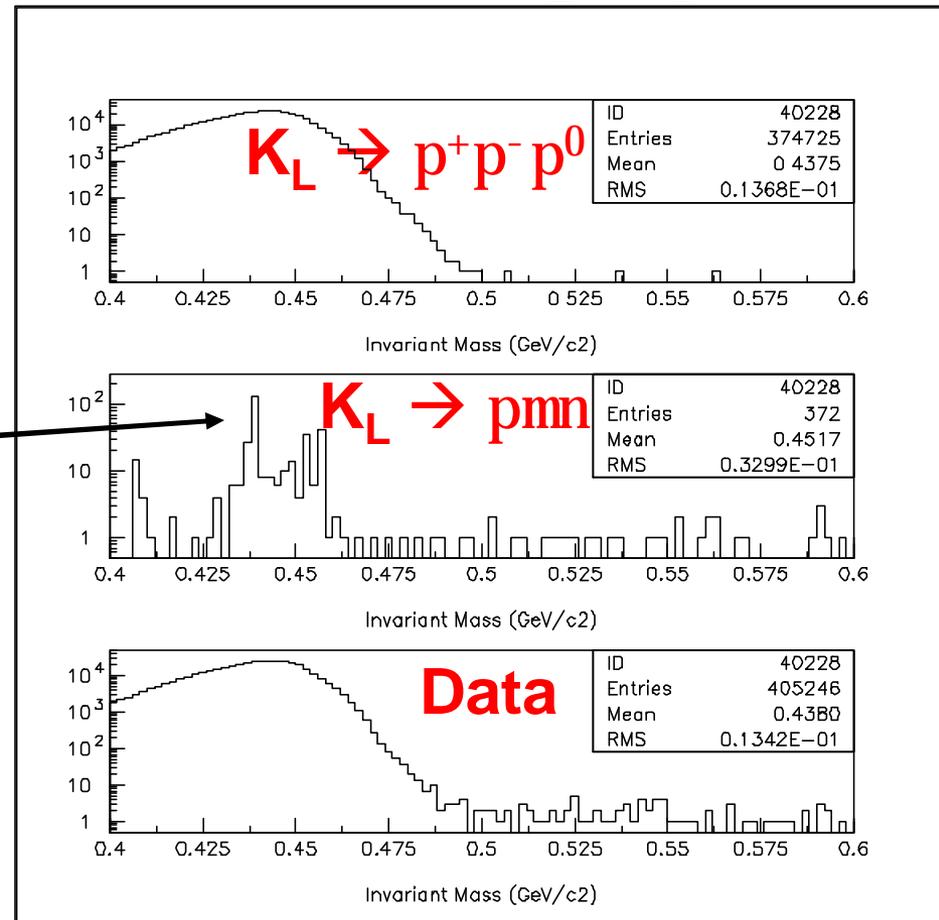
- Outline
 - Issues from last meeting
 - $K_L \rightarrow \pi^0 \mu \mu$ analysis
 - Backgrounds estimate issues: Spikes in $K_L \rightarrow \pi \mu \nu$ MC distributions
 - Reusing a few $K_L \rightarrow \pi^+ \pi^- \pi^0$ accidentals in MC
 - Estimate from data?
 - Current Issues & Plans

Data/ $K_L \rightarrow \pi^+\pi^-\pi^0$ + $K_L \rightarrow \pi\mu\nu$ MC

- Quick check of the number of events in the high mass region
 - Integrate from $0.5 \rightarrow 0.6$ GeV/c²
 - Kmu3 - 31 events x 1.79 = 56 evts
 - K3pi - 3 events x 0.95 = 3 evts
 - Total MC = 59 evts
 - Data - 68pts

Invariant Mass: Reconstruct as $K_L \rightarrow p^0mm$

Spikes



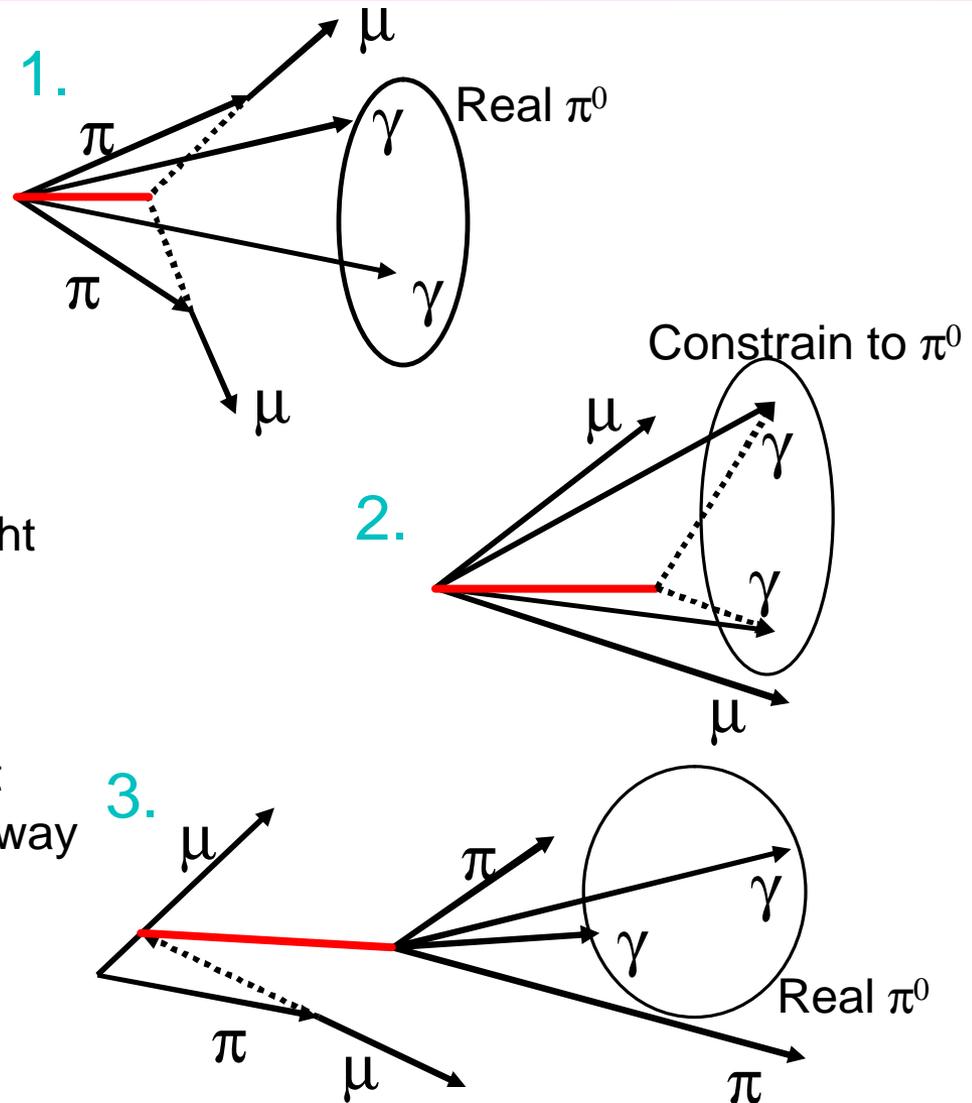
Spikes in $K_L \rightarrow \pi\mu\nu$ MC

- Events are real $K_L \rightarrow \pi^+\pi^-\pi^0$ accidental events
- At least some background coming from $K_L \rightarrow \pi^+\pi^-\pi^0 + K_L \rightarrow \pi\mu\nu$ double decays
- Need to estimate this effect when calculating event statistics from background MC

Background Estimate

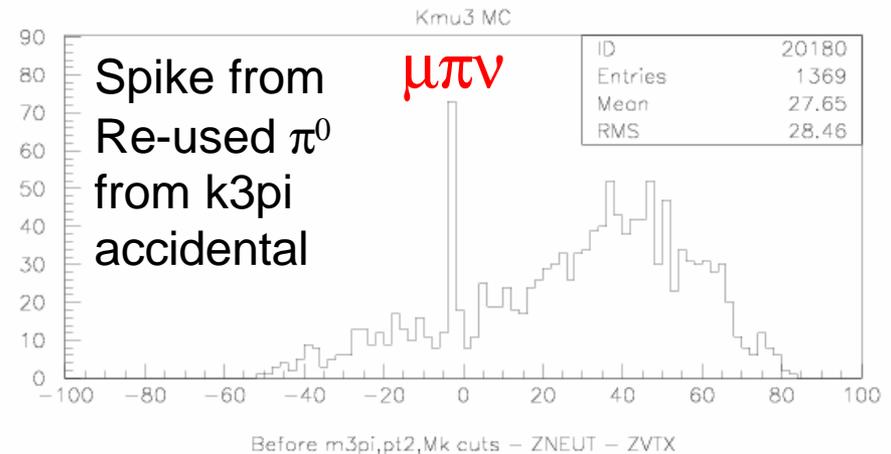
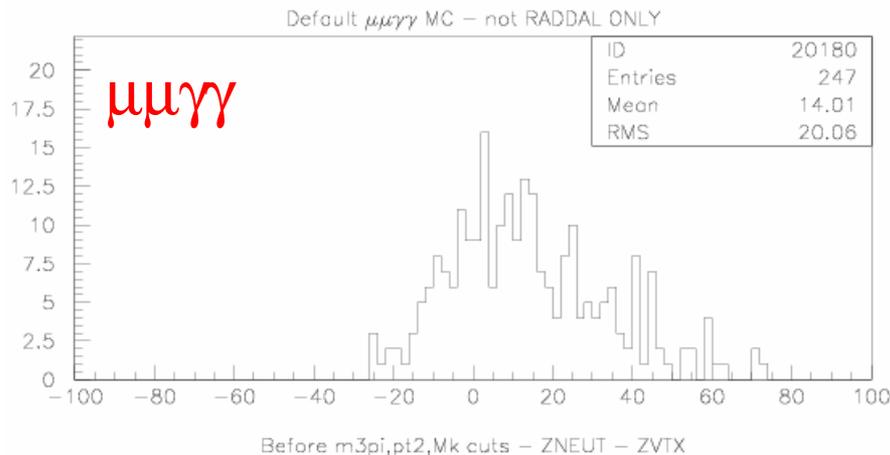
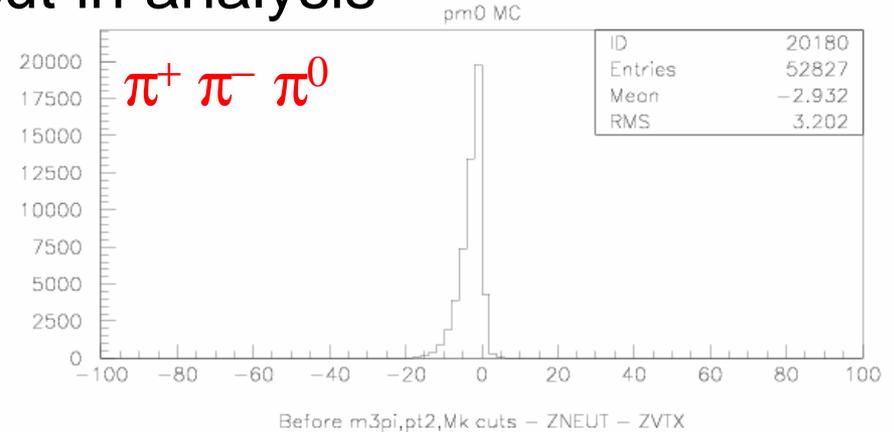
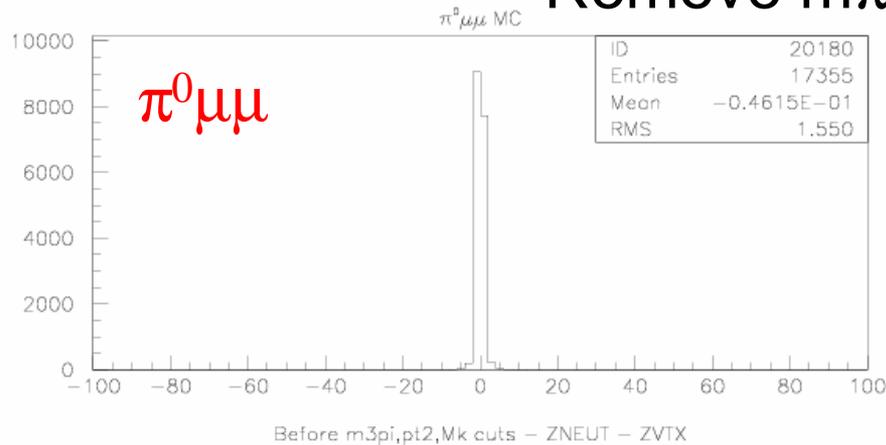
- Possible problem estimating backgrounds due to re-used accidentals in kmu3 MC
 - Signal: $K_L \rightarrow \pi^0 \mu \mu$
 - Backgrounds: kmu3, k3pi, $\mu \mu \gamma \gamma$
- Use (zneut – zchg) distribution in data to estimate background

1. Charged vertex from decay in flight pion (muon accidental) charged vertex can reconstruct away from neutral vertex (if real π^0)
2. Neutral vertex from 2 photons not coming from π^0 can reconstruct away from charged vertex
3. Charged and neutral vertices can come from different kaon decays



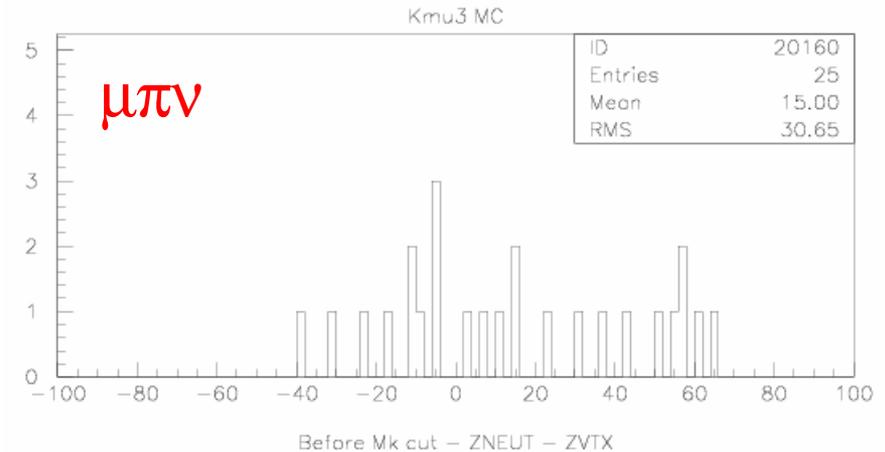
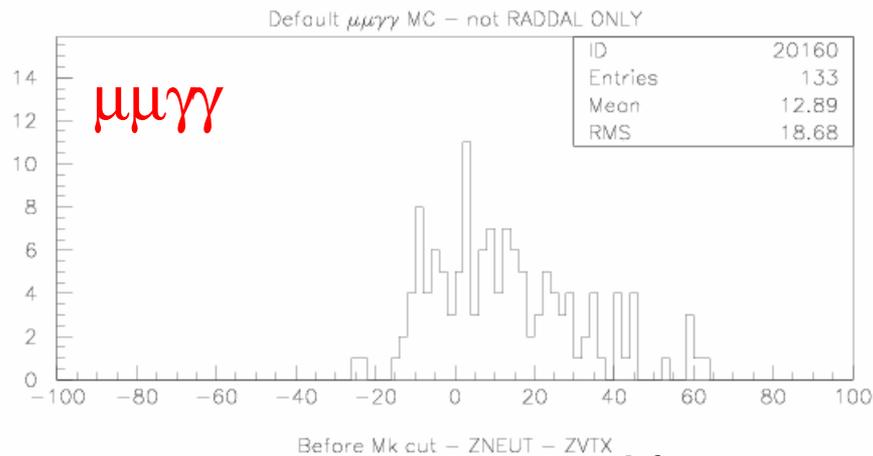
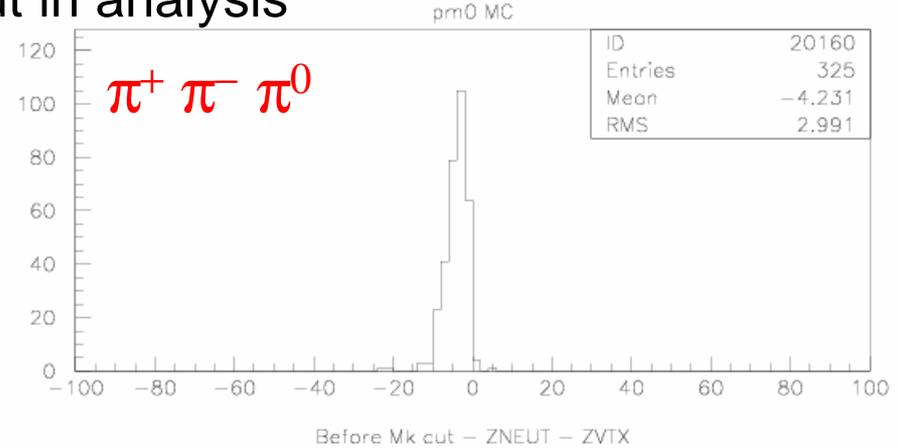
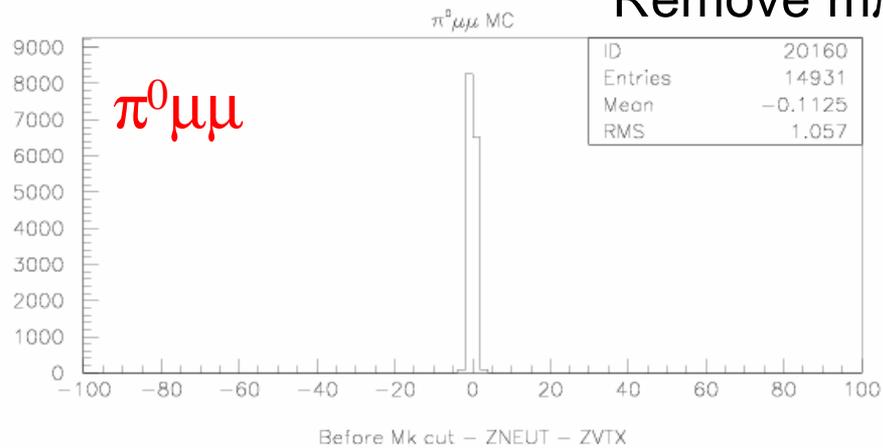
MC zneut-zchg: Before final cuts

Remove $m\pi^0$ cut in analysis



MC zneut-zchg: After all cuts

Remove $m\pi^0$ cut in analysis

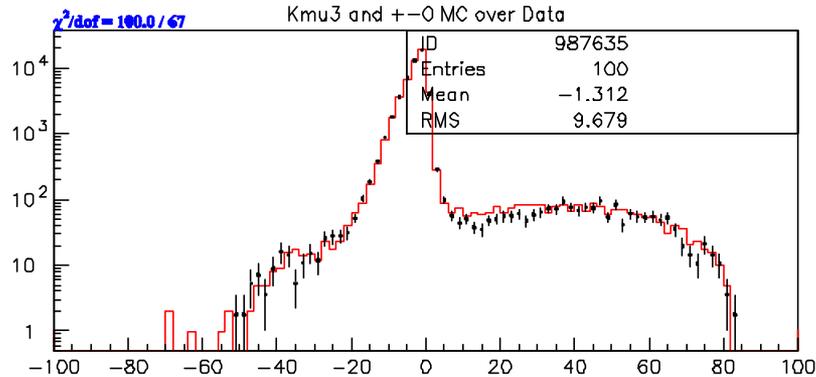


After all cuts except M_k cut

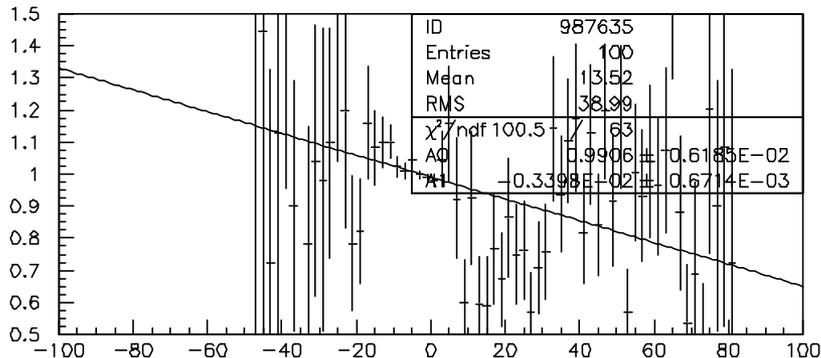
Data/MC Overlay: zneut - zchg

Remove $m\pi^0$ cut in analysis

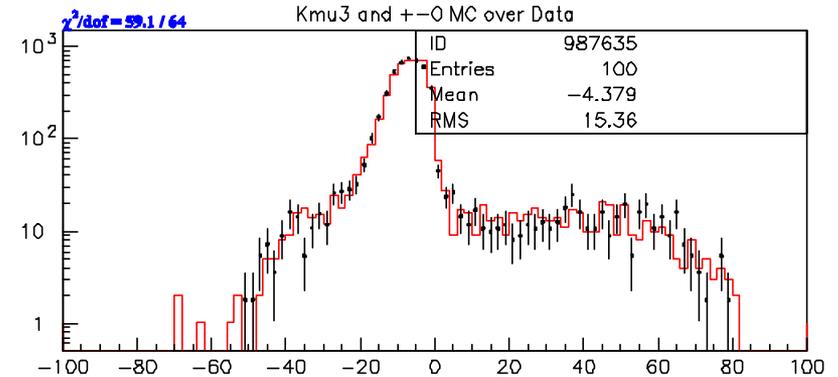
MC Norm: from inv mass dist



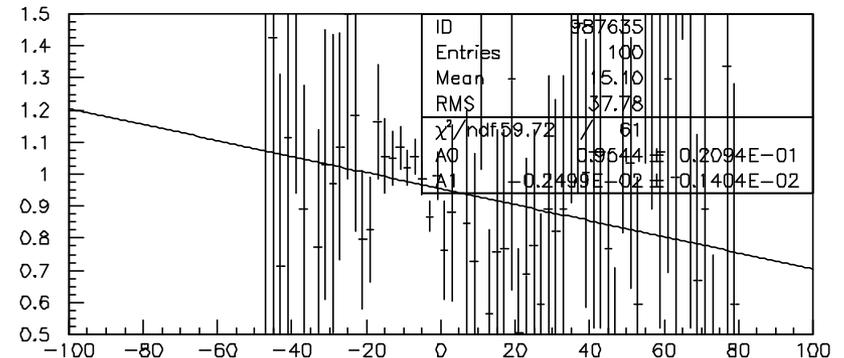
(0.95)+(1.79) * Before m3pi,pt2,Mk cuts - ZNEUT - ZVTX



(0.95)+(1.79) * Before m3pi,pt2,Mk cuts - ZNEUT - ZVTX



(0.95)+(1.79) * Before pt2 and Mk cuts - ZNEUT - ZVTX



(0.95)+(1.79) * Before pt2 and Mk cuts - ZNEUT - ZVTX

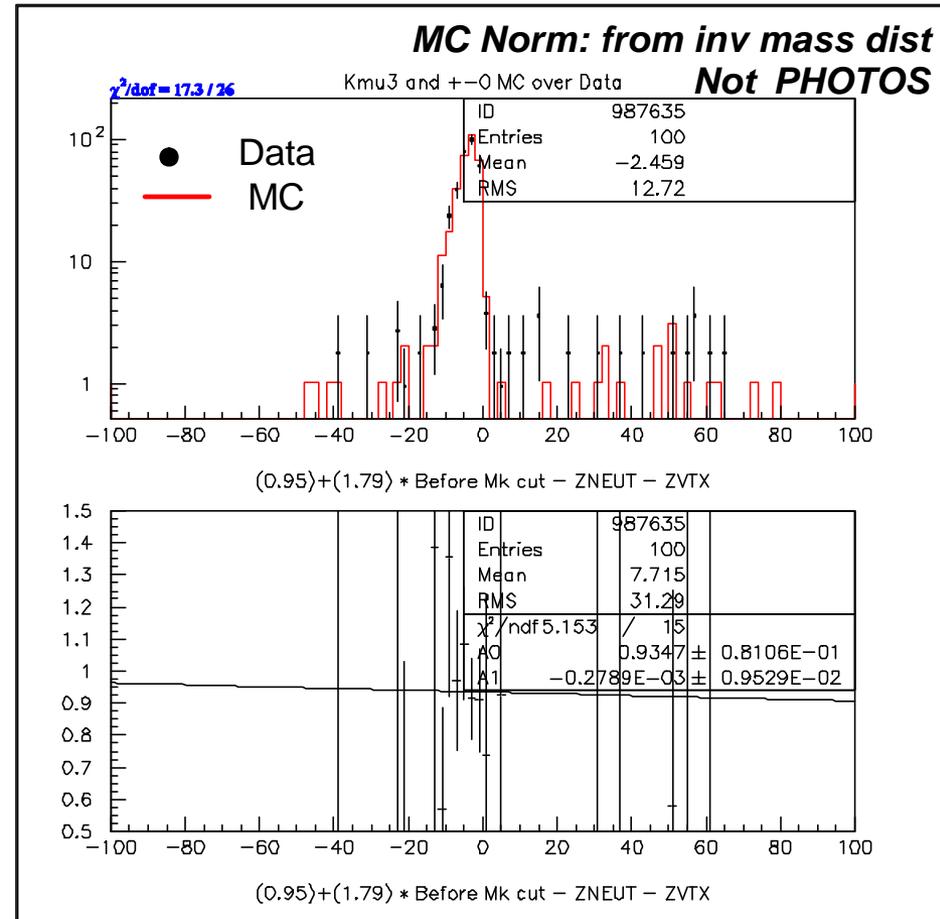
After all cuts except $M_{3\pi^0}$, pt^2 , M_K cut

After all cuts except pt^2 , M_K cut

Overlay after cuts: zneut - zchg

- Zdiff distribution is well modeled
- Estimate background under peak
 - Estimate background
 - Cut at $-2m < zdiff < +2m$ (signal region)
 - Need to reduce background
 - Try track quality cuts: $dist(zneut - \text{nearest track})$,
 - Track straightness in y-view
 - Timing X^2 on software clusters

Remove $m\pi^0$ cut in analysis



After all cuts except M_K cut

Current Issues & Plans

- MC reproduces zneut - zchg
- Background estimate from data, with MC estimate X-check
 - Currently looks like at least 1-2 events in “box”
 - Would like to reduce background
- Unfortunately, ntuples - did not save fundamental track/Csl info
 - MC Files – kept raw data files
 - MC tally: $\pi^+\pi^-\pi^0$: 2880 files
 - kmu3 standard KTeVVMC: 3344 files
 - kmu3 with PHOTOS: 1424
 - Need to run through ~7650 MC files
 - Copy from enstore and analyze
 - Data Files
 - Reprocess ~60 files