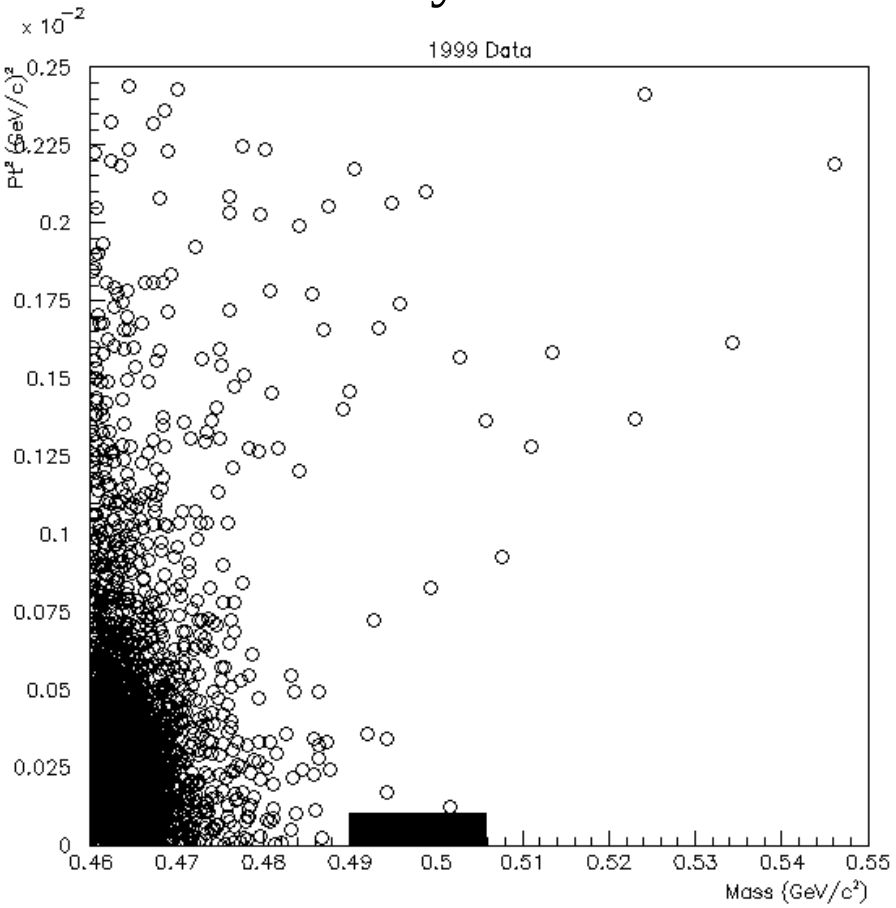
Search for $K_L \rightarrow \pi^0\mu\mu$ in 1999 Data

- Outline
  - Issues from last meeting
    - KL→$\pi^0\mu\mu$ analysis
      - Status of data analysis
      - Generate KL→$\pi^+\pi^-\pi^0$ MC-forced decay & punch-through
      - Understand normalizations
      - MC/Data matching
  - Plans

1999 Data: $K_L \rightarrow \pi^0\mu\mu$

- 1999 data (w/ new bad spill mask)
  - Signal acceptance = 4%
  - Background level is higher near the box than in 1997
    - More background close to box due to lowered B-field
    - Low mass background is from $K_L \rightarrow \pi^+\pi^-\pi^0$
- Largest background expected comes from $K_L \rightarrow \mu^+\mu^-\gamma\gamma$
  - Dangerous background that peaks at kaon mass

JAWS Analysis: 1999 Data



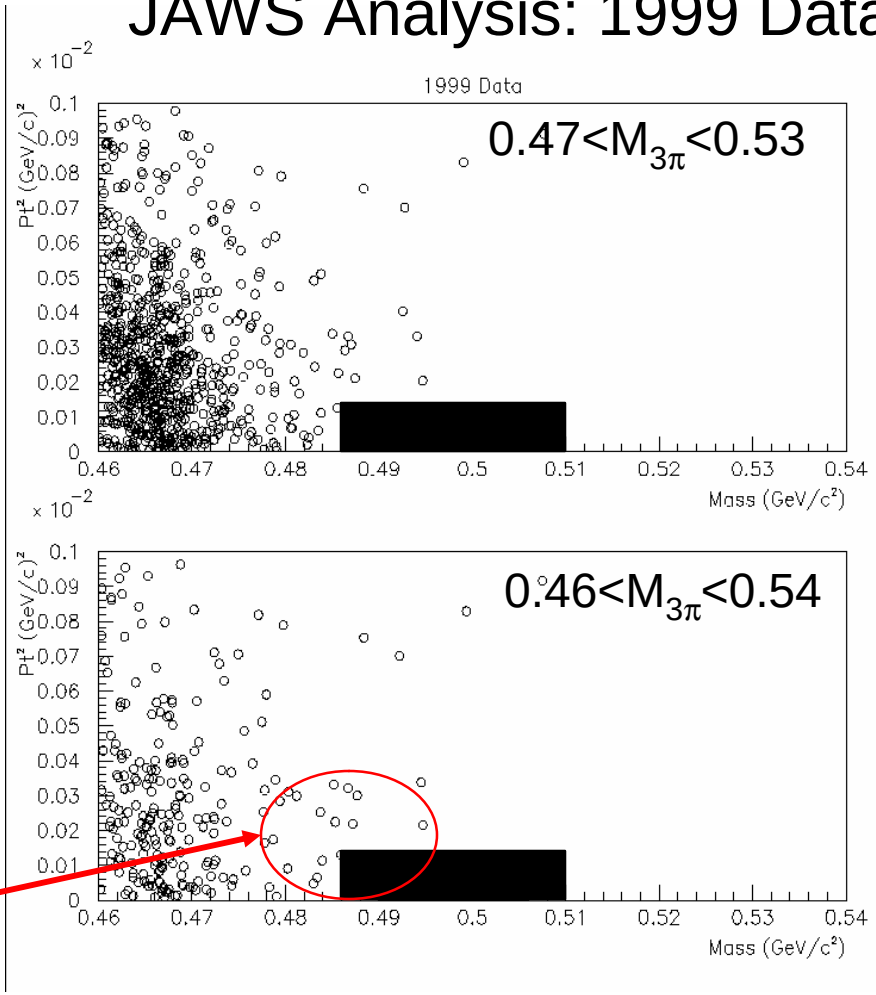
$K_L \rightarrow \pi^0\mu\mu$

$K_L \rightarrow \pi^0\mu\mu$ 1999 Data

- Cut on track inv mass assuming KL→$\pi^+\pi^-\pi^0$ event
  - $0.47 < M_{3\pi} < 0.53$ → 45% drop in background near box with no signal loss
  - $0.46 < M_{3\pi} < 0.54$ → 75% drop in background near box with ~10% signal loss
- Background MC could help our understanding of these events (and how to get rid of them)

There are still events in this region that I need to deal with

JAWS Analysis: 1999 Data



Inceased box size during cut tuning

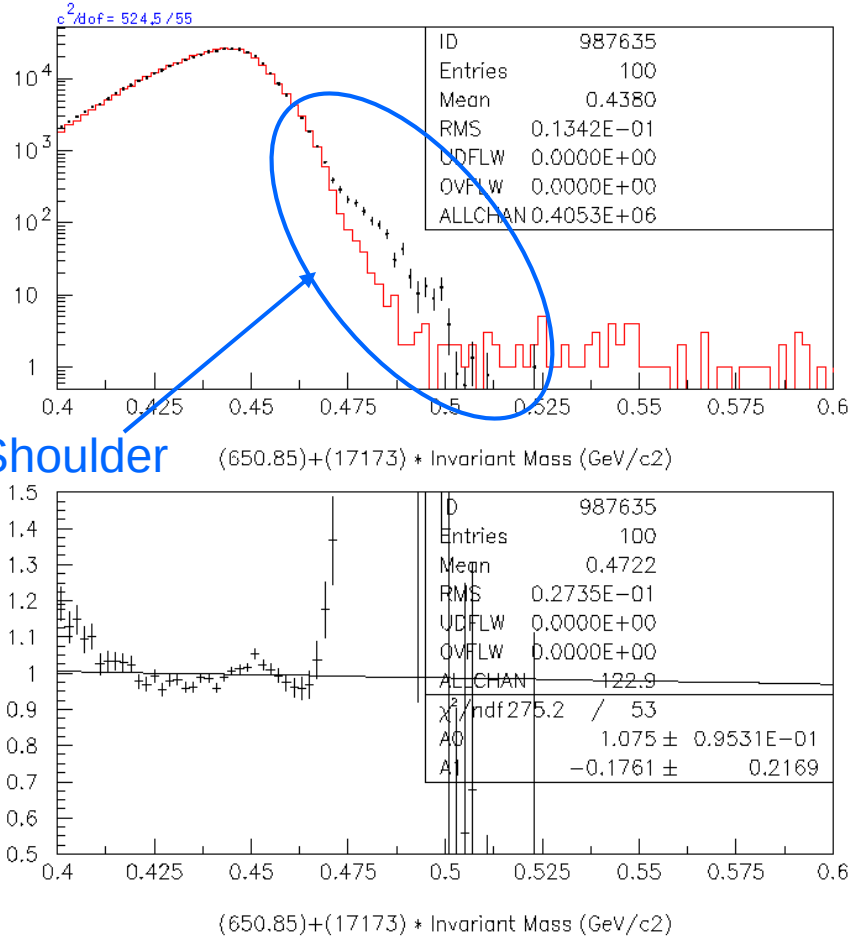
KL→$\pi^+\pi^-\pi^0$ MC

- Generated KL→$\pi^+\pi^-\pi^0$ MC
  - Forced both πs to decay
  - Forced both πs to punch through
- Normalizations
  - Pion forced decays
    - Force pions to decay between 90m-188m
    - Probability is based on lifetime and pion momentum
  - Pion punch-through
    - Use punch through probability from Masayoshi's GEANT study
  - Need event weight for correct distributions (Evt wt = Pπ+ $*$ Pπ-)
    - Normalization issue from previous analyses

1999 Data/KL→$\pi^+\pi^-\pi^0$ MC Comparison

- KL→$\pi^+\pi^-\pi^0$ MC
  - Normalizations
    - Forced decays – generated ~1 x 1999 data set
    - Punch through – generated ~35 x 1999 data set
  - Data/MC plots are from fit
    - Need to check normalizations to see if scalings from fit make sense

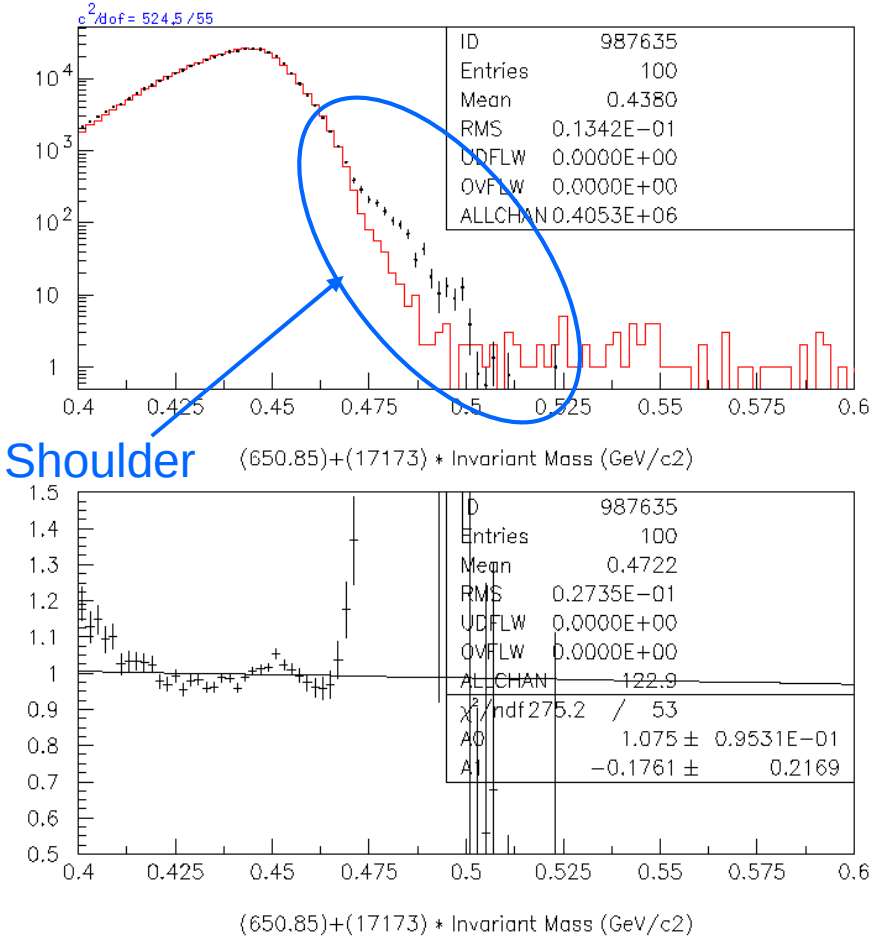
$K_L \rightarrow \pi^0\mu\mu$ Invariant Mass



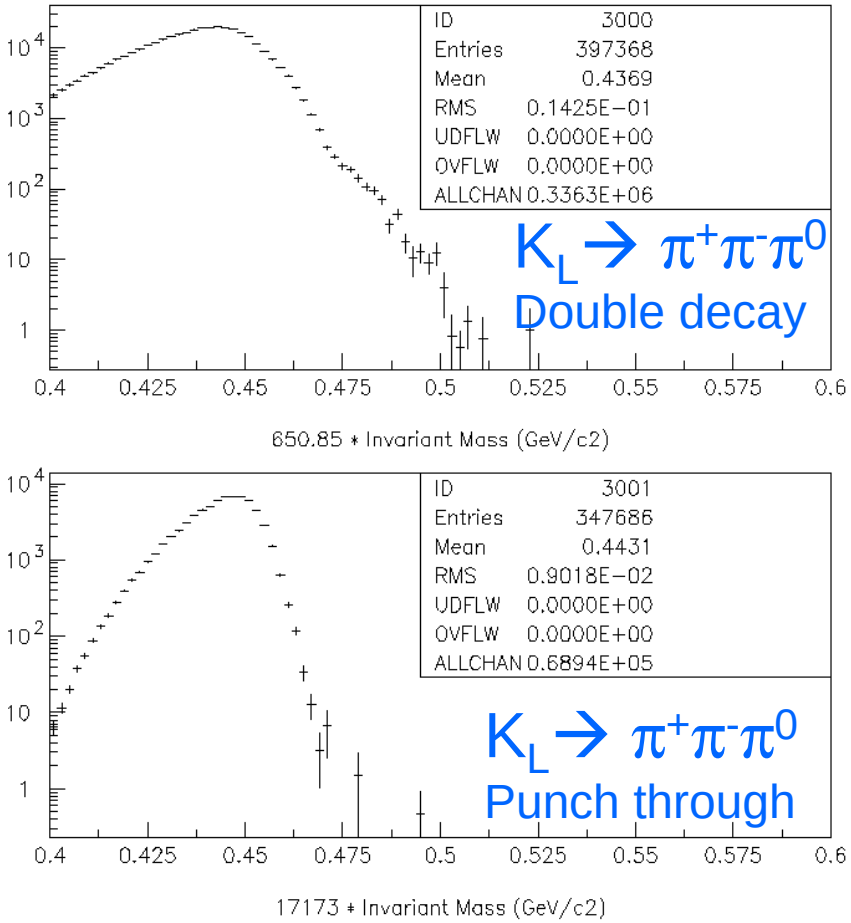
Before cuts around $M_{3\pi}$ and Pt^2 cut

Invariant Mass Contributions

Invariant Mass: Data/MC



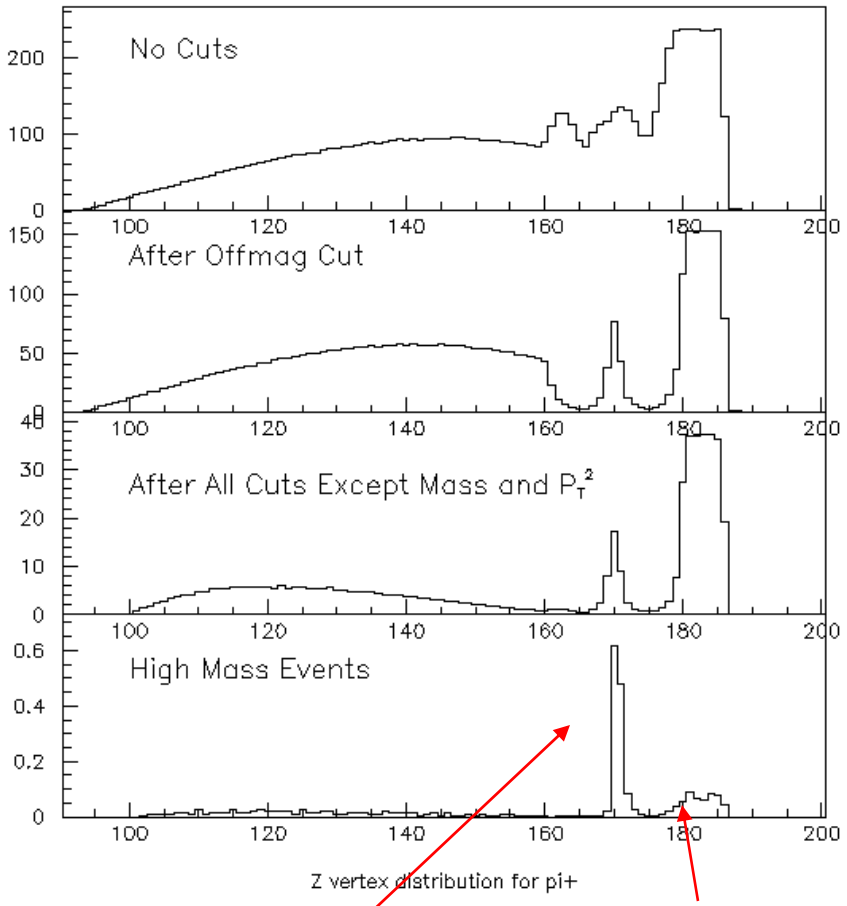
Invariant Mass: $K_L \rightarrow \pi^+\pi^-\pi^0$ MC



High Mass Events

- Trying to understand the high mass events
  - Pion decay vertex distribution of events
    - As expected offmag cut removes all but pion decays in magnet and decays downstream of DC4
    - High mass events seem to come predominantly from the magnet region
  - Data/MC comparisons of other variables could indicate what the problem is

Z vertex of π+ decay



Plans

- Understand high mass events in KL→$\pi^+\pi^-\pi^0$ forced π decays
  - Obviously there is a problem – need to understand this before estimating background contamination in the signal box
- Reduce backgrounds near box in $K_L \rightarrow \pi^0\mu\mu$
- Generate MC ($K_L \rightarrow \pi\mu\nu + \gamma$acc)
  - Reduce generation time for $K_L \rightarrow \pi\mu\nu + \gamma$acc – strip off evts with higher energy in CsI (Code from RickK/Edivaldo)
- Get background estimates (MC + data)
- Combine new 1997 result + new 1999 result