$K_L \to e^+e^-\gamma$ Final Results?

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KTeV Collaboration Meeting

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Overview

- Reproducing Jason's Numbers
- Normalization Mode ($3\pi^0_D$) Pairing χ^2 cut
- Energy Reweighting / Smearing
- Data / MC comparisons
- Results
- Comparisons to Jason's Thesis

Reproducing Jason's Numbers

		Jason's Thesis	My result	difference	% difference
K->eeg data	winter	50487	50467	-20	-0.040%
	summer	41468	41452	-16	-0.039%
	total	91955	91919	-36	-0.039%
K->eeg mc	winter	257453	257507	54	0.021%
	summer	215930	215929	-1	0.000%
	total	473383	473436	53	0.011%
3pi0d data	winter	2778007	2810189	32182	1.158%
	summer	2023181	2023461	280	0.014%
	total	4801188	4833650	32462	0.676%
3pi0d mc	winter	1371152	1371379	227	0.017%
	summer	1019088	1019154	66	0.006%
	total	2390240	2390533	293	0.012%

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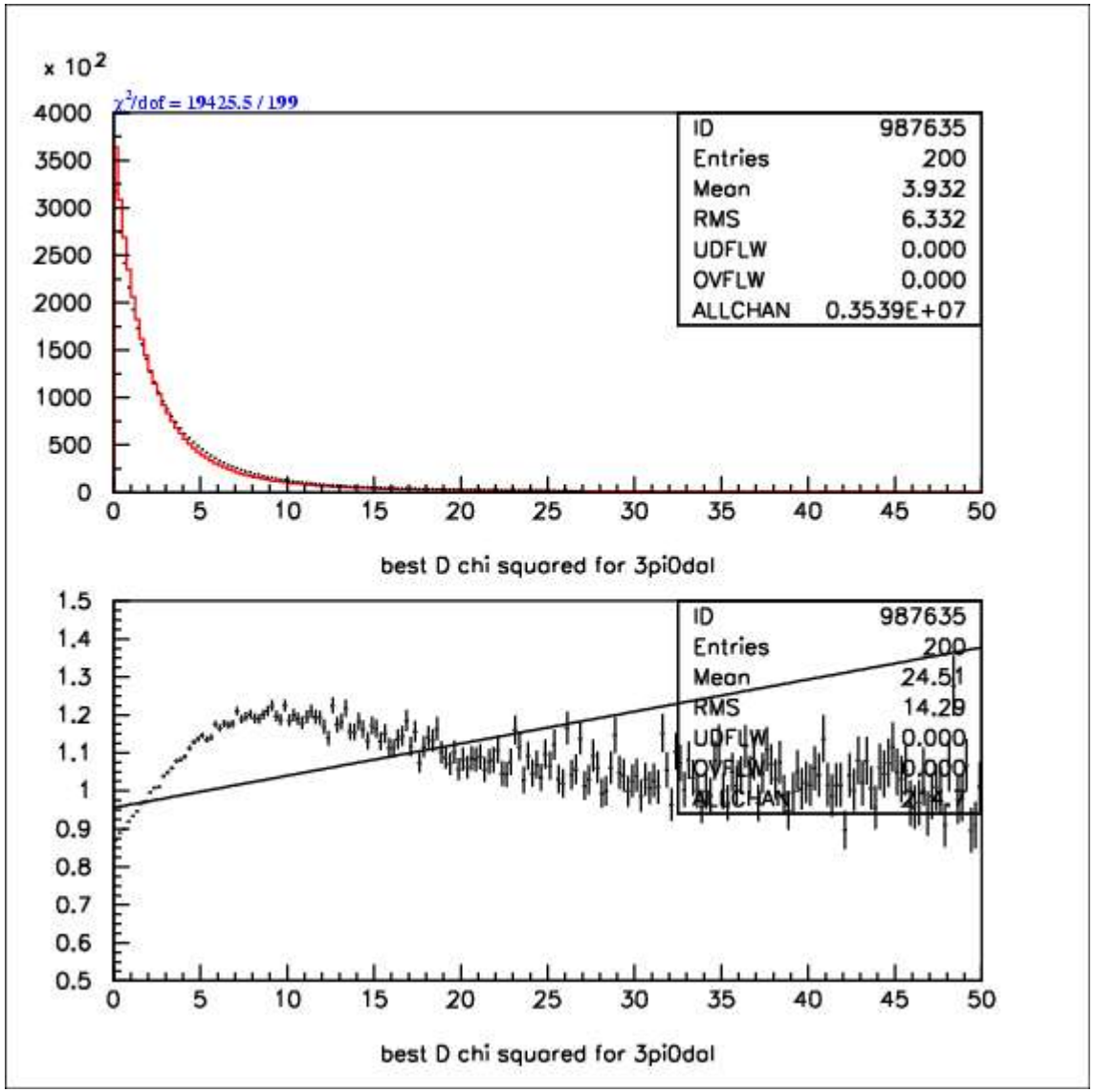
- There is a discrepancy in the winter $3\pi^0_D$ data due to a missing normalization run in Jason's analysis
- I am able to reproduce the numbers in Jason's thesis

Energy Smearing / Reweighting

- The analysis I used to reproduce Jason's thesis numbers did not including energy smearing or reweighting
- It should have
- Using the non-energy-reweighted Monte Carlo changes the branching ratio by 0.23%
- non-energy-smeared Monte Carlo retains 1% more $3\pi^0_D$ events after the pairing χ^2 cut

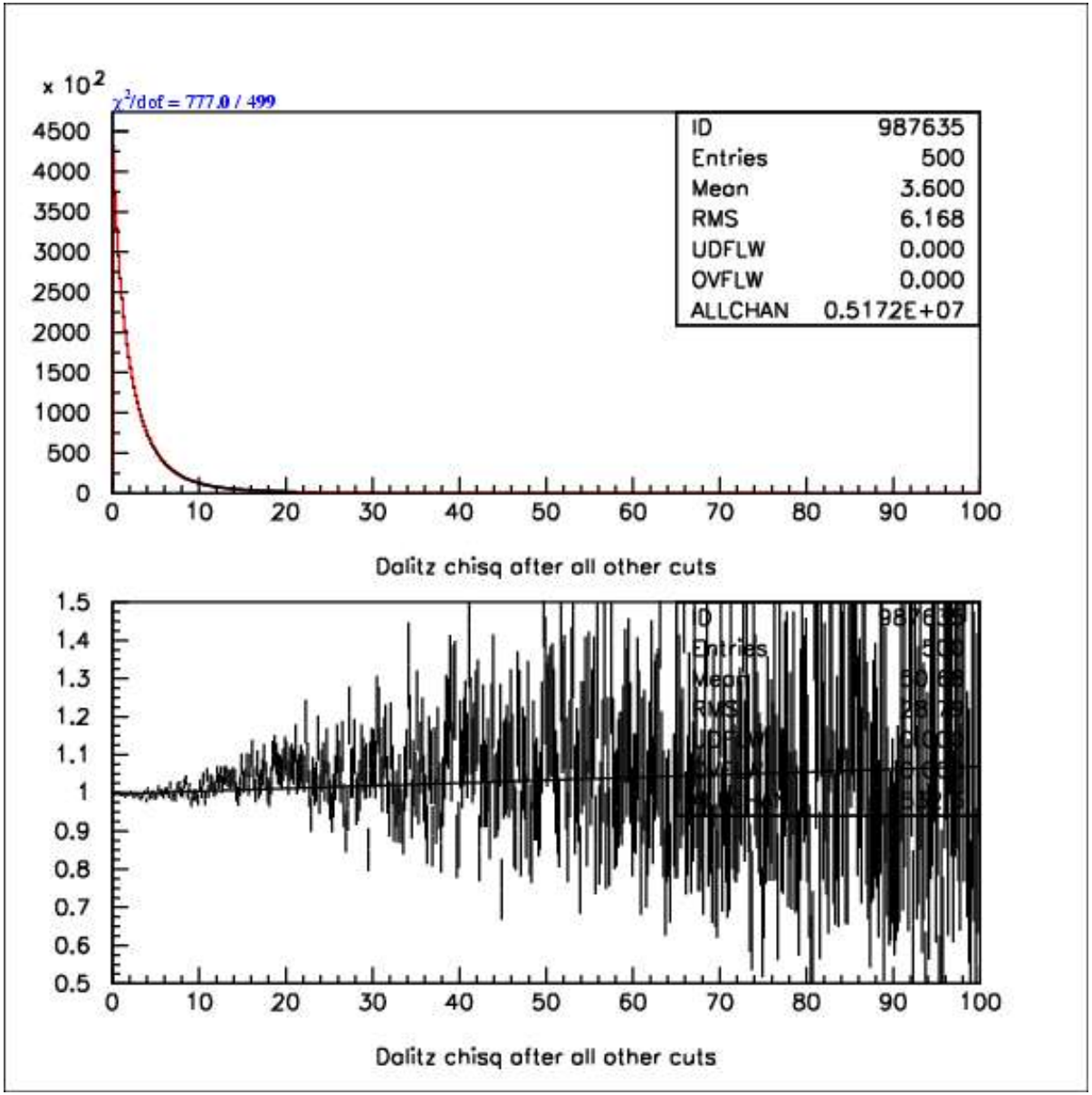
$3\pi^0$ Dalitz Pairing χ^2

- Dots: smeared Monte Carlo
- Histogram: unsmeared Monte Carlo
- Jason's cut is at 10



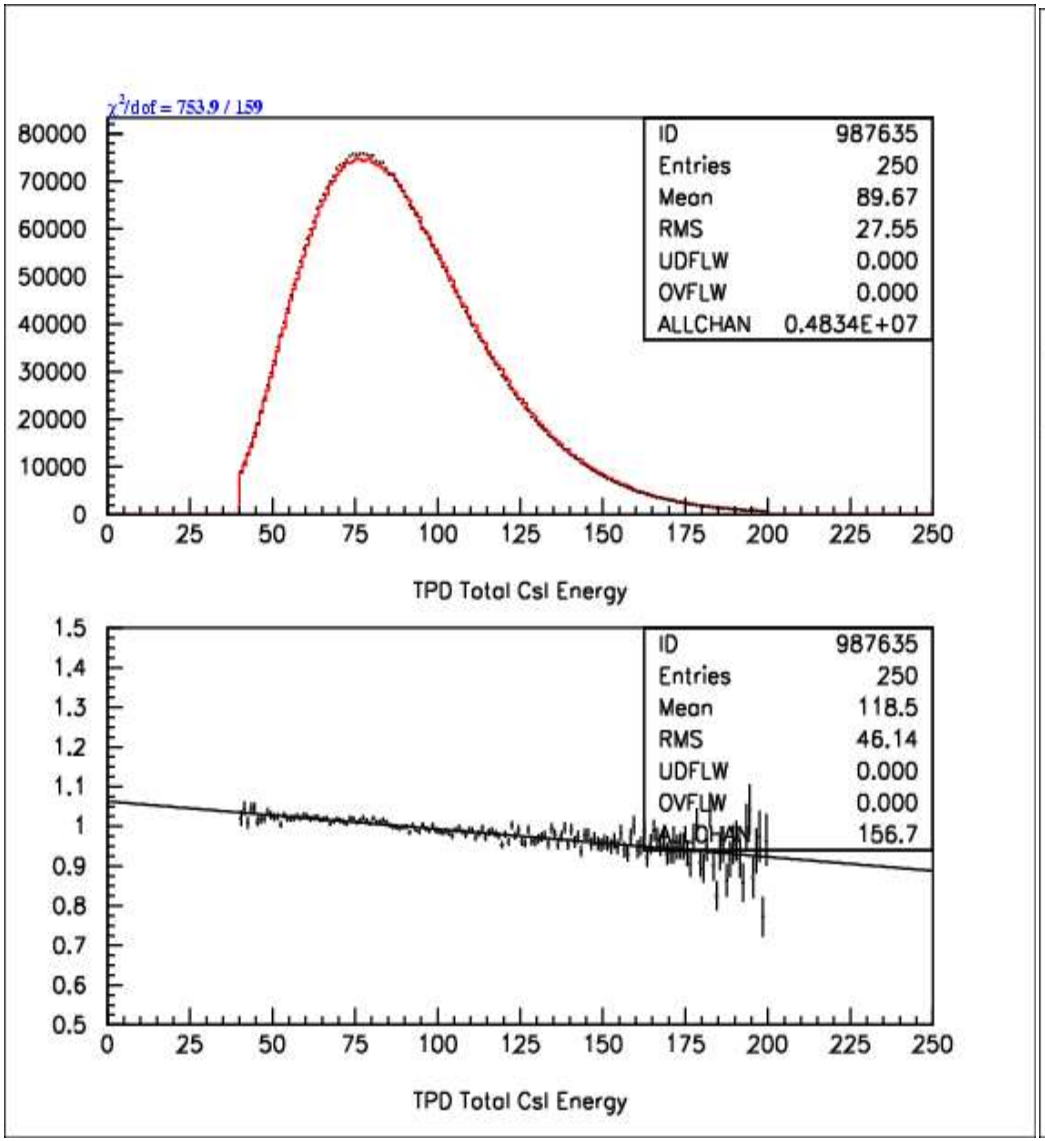
$3\pi^0$ Dalitz Pairing χ^2

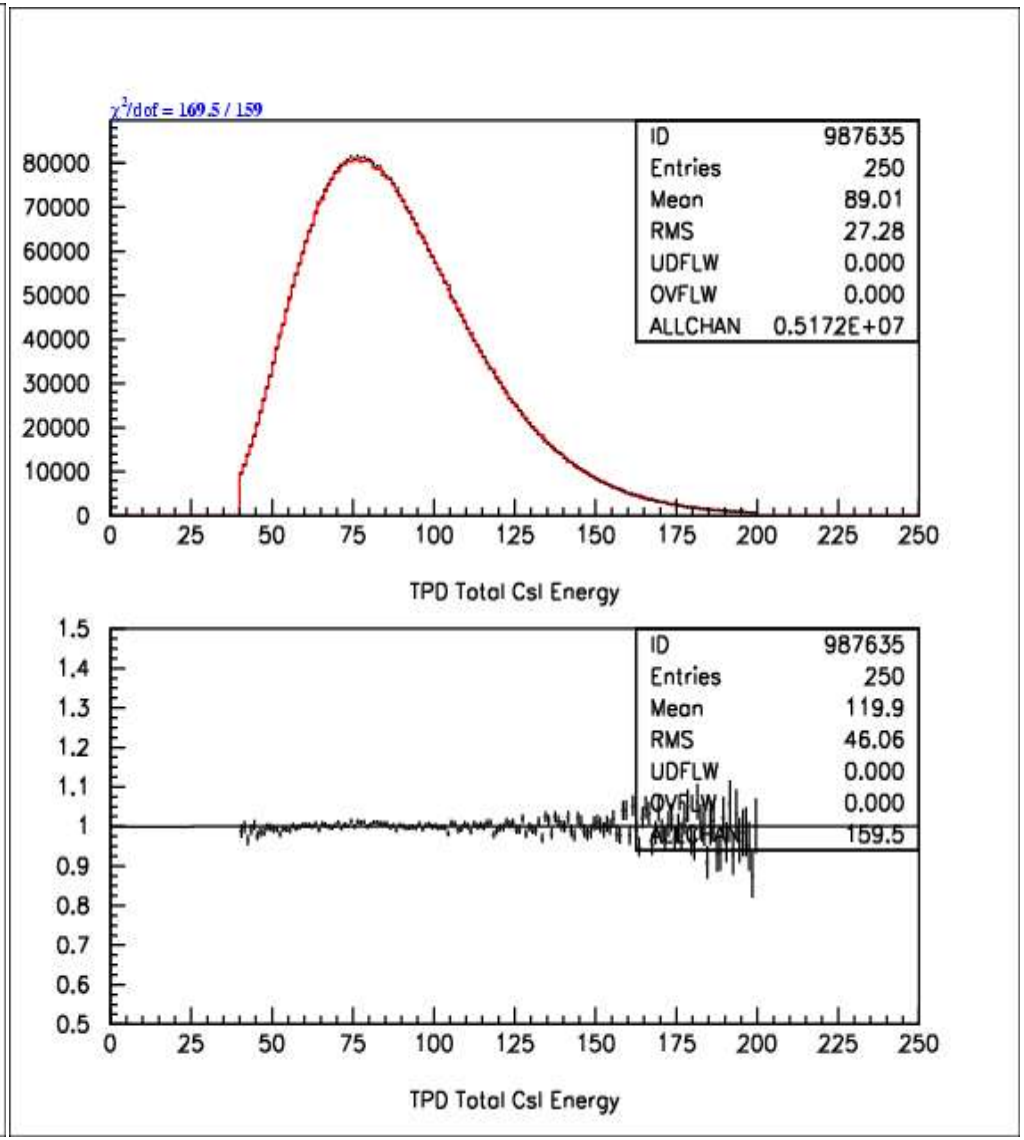
- Dots: Data
- Histogram: smeared Monte Carlo
- I've moved the cut from 10 to 100
- The cut now only removes 0.12% of events



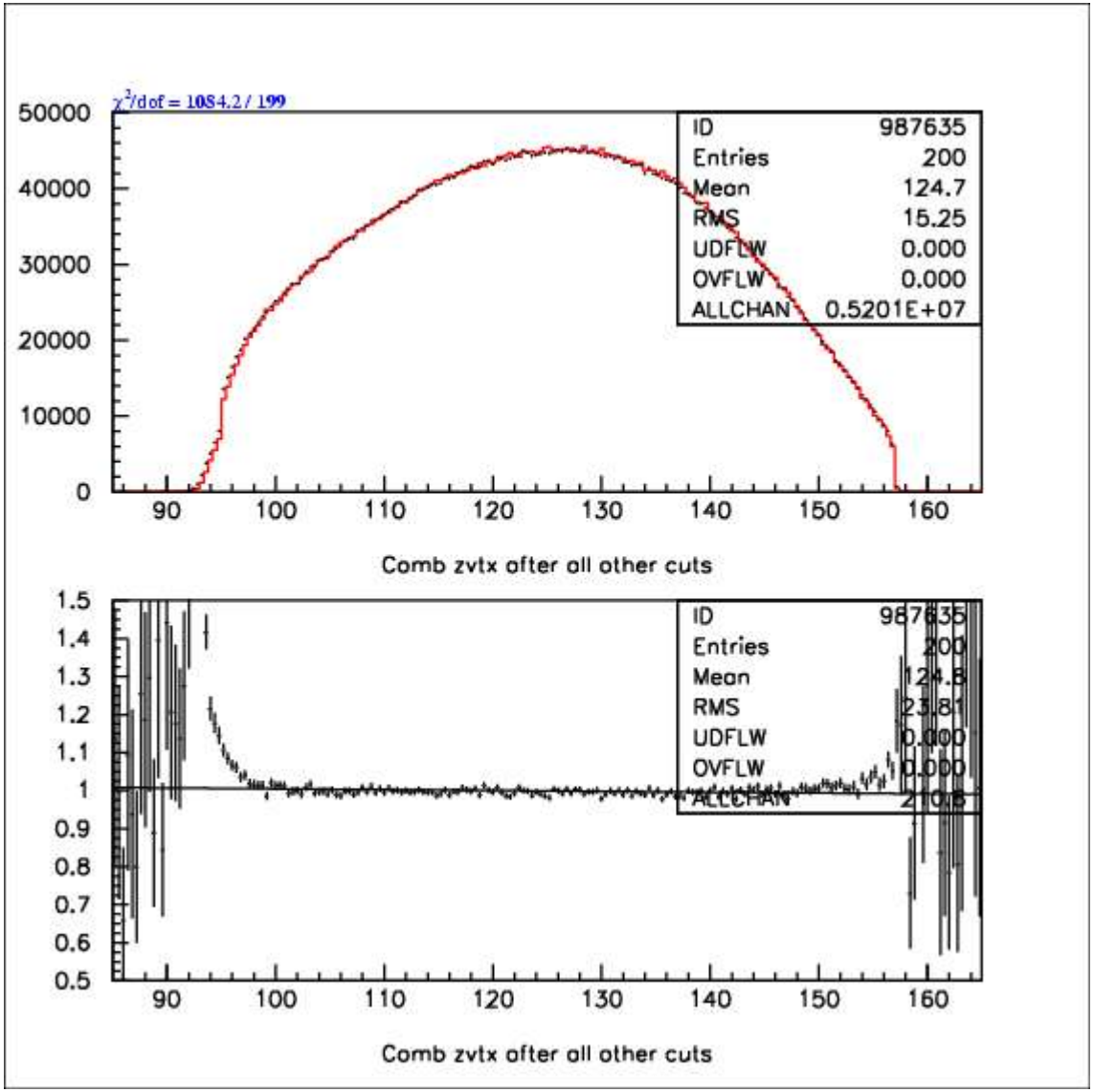
Energy Reweighting

Total Energy in $3\pi^0_D$ events before/after reweighting



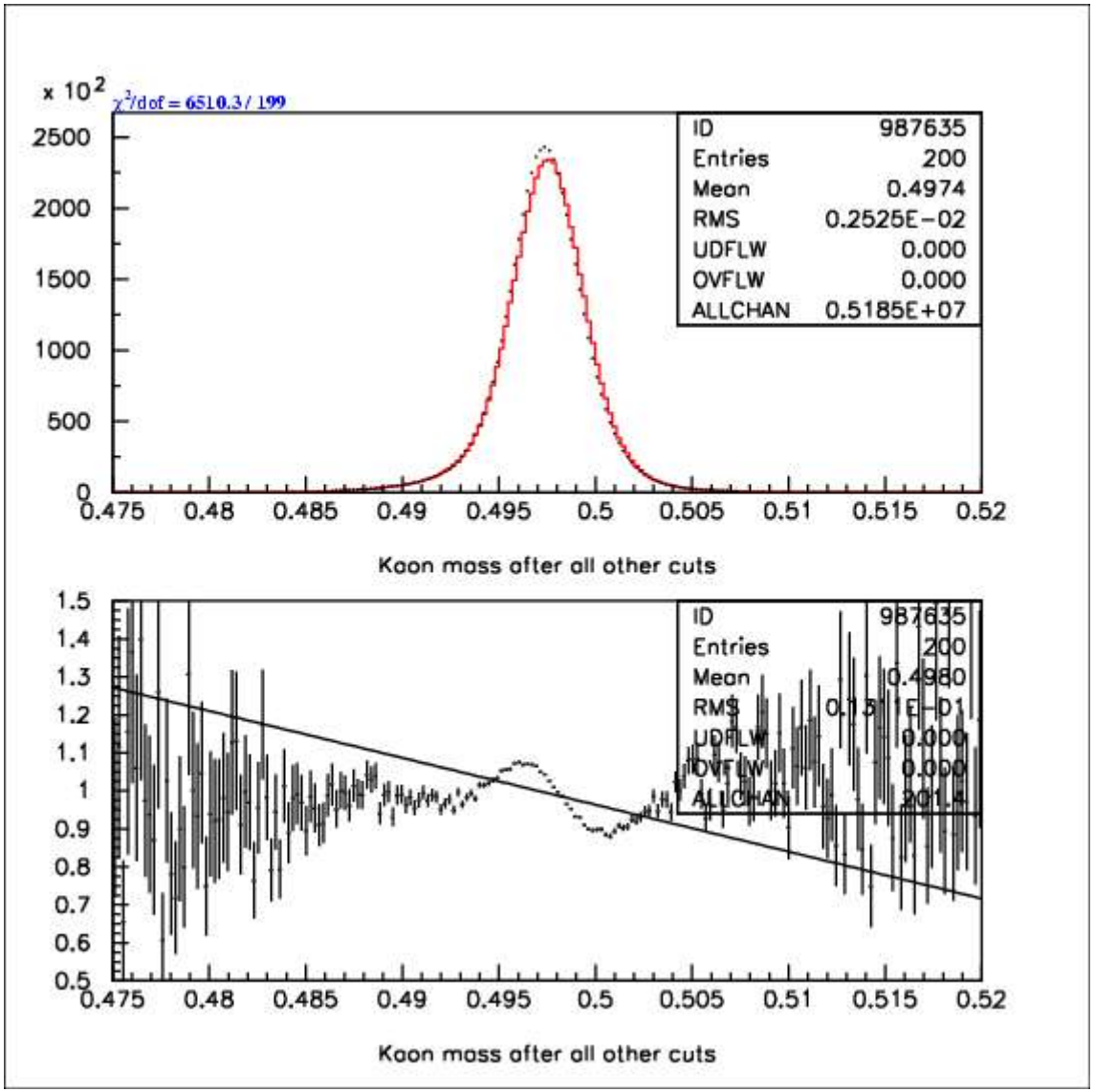


Combined $3\pi^0_D$ Z-vertex After Smearing and Reweighting

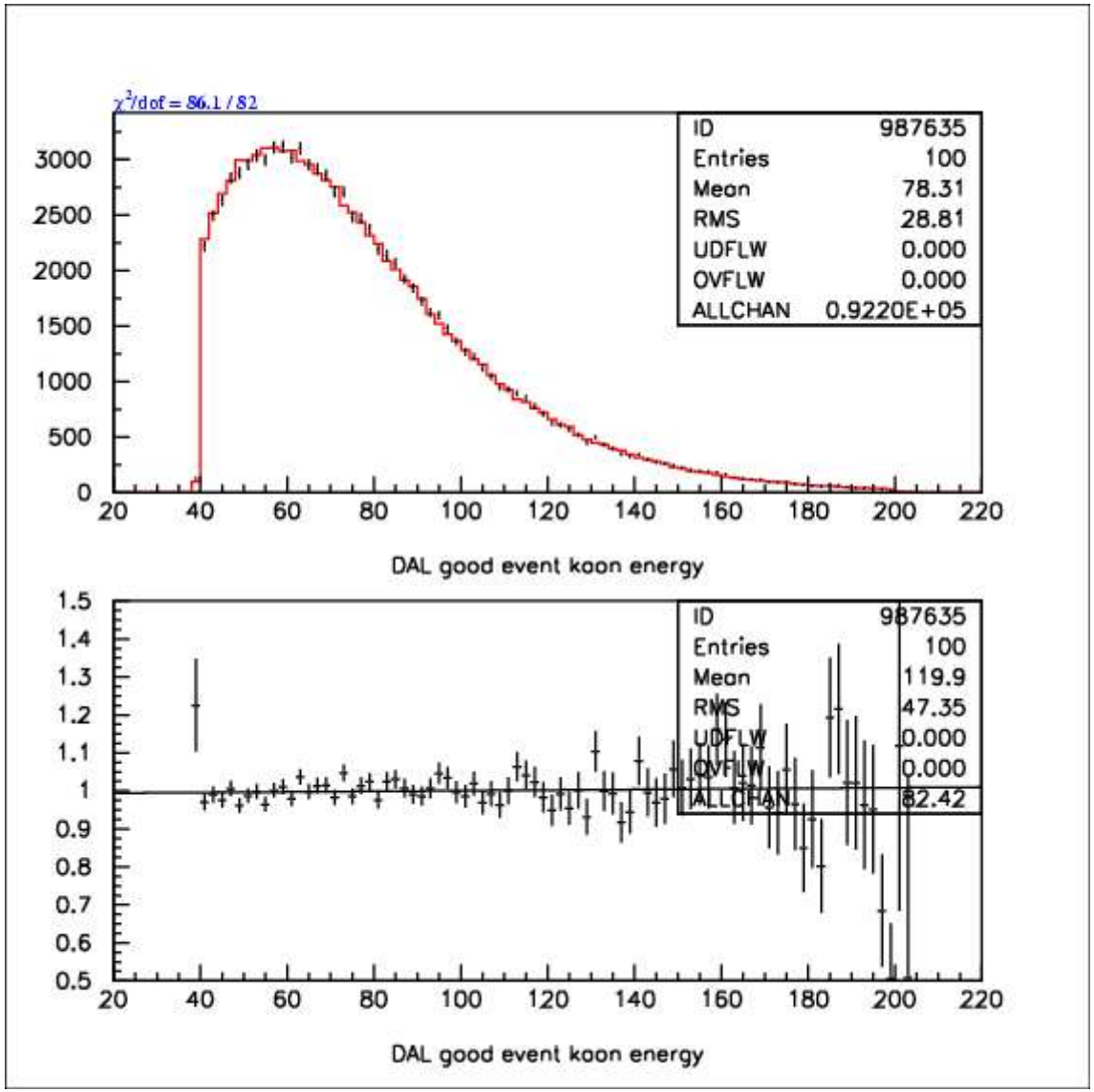


Kaon Mass after smearing/reweighting

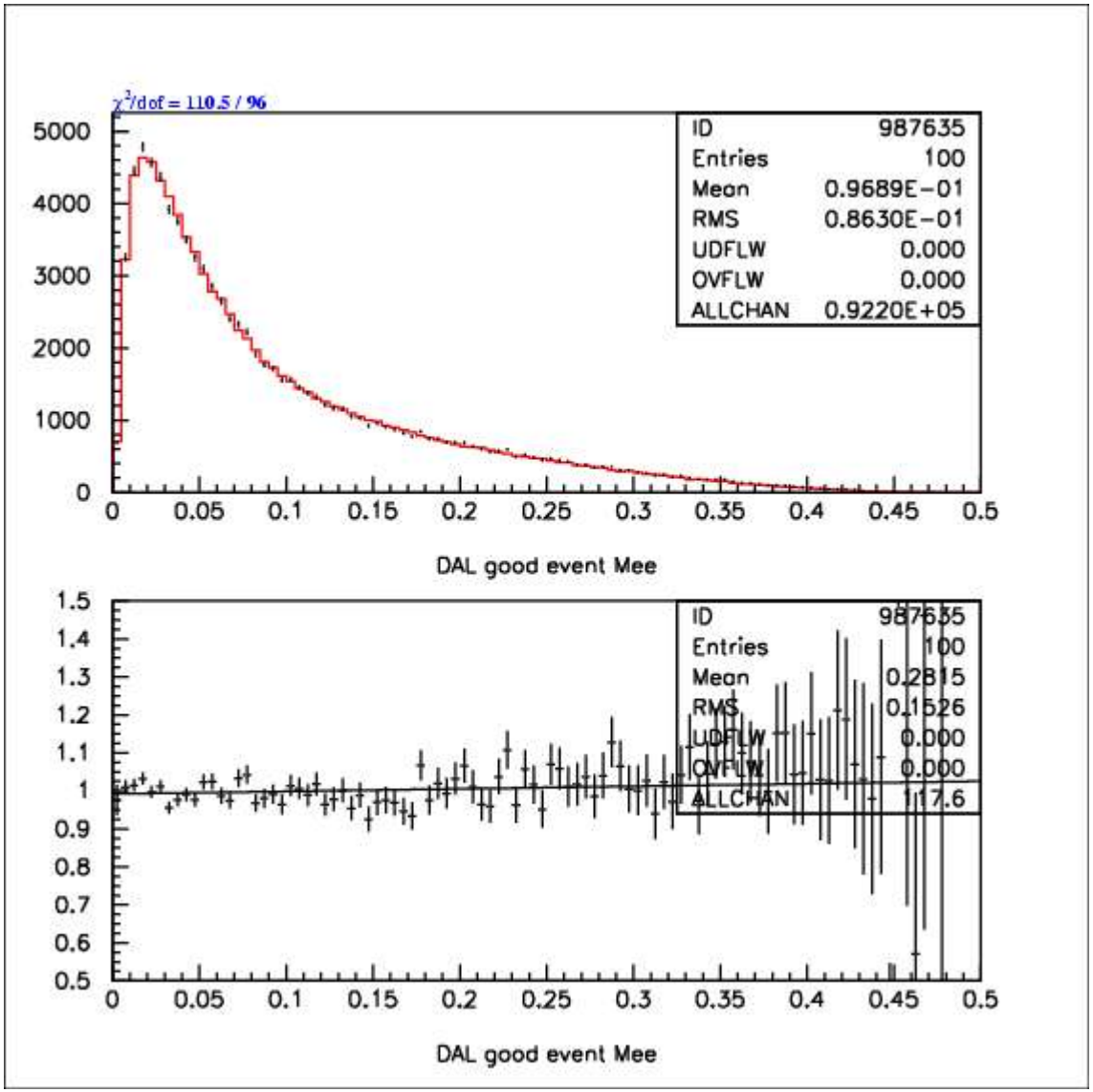
- after energy smearing and reweighting, there is still a shift in the kaon mass
- the cuts are at [0.485, 0.510]



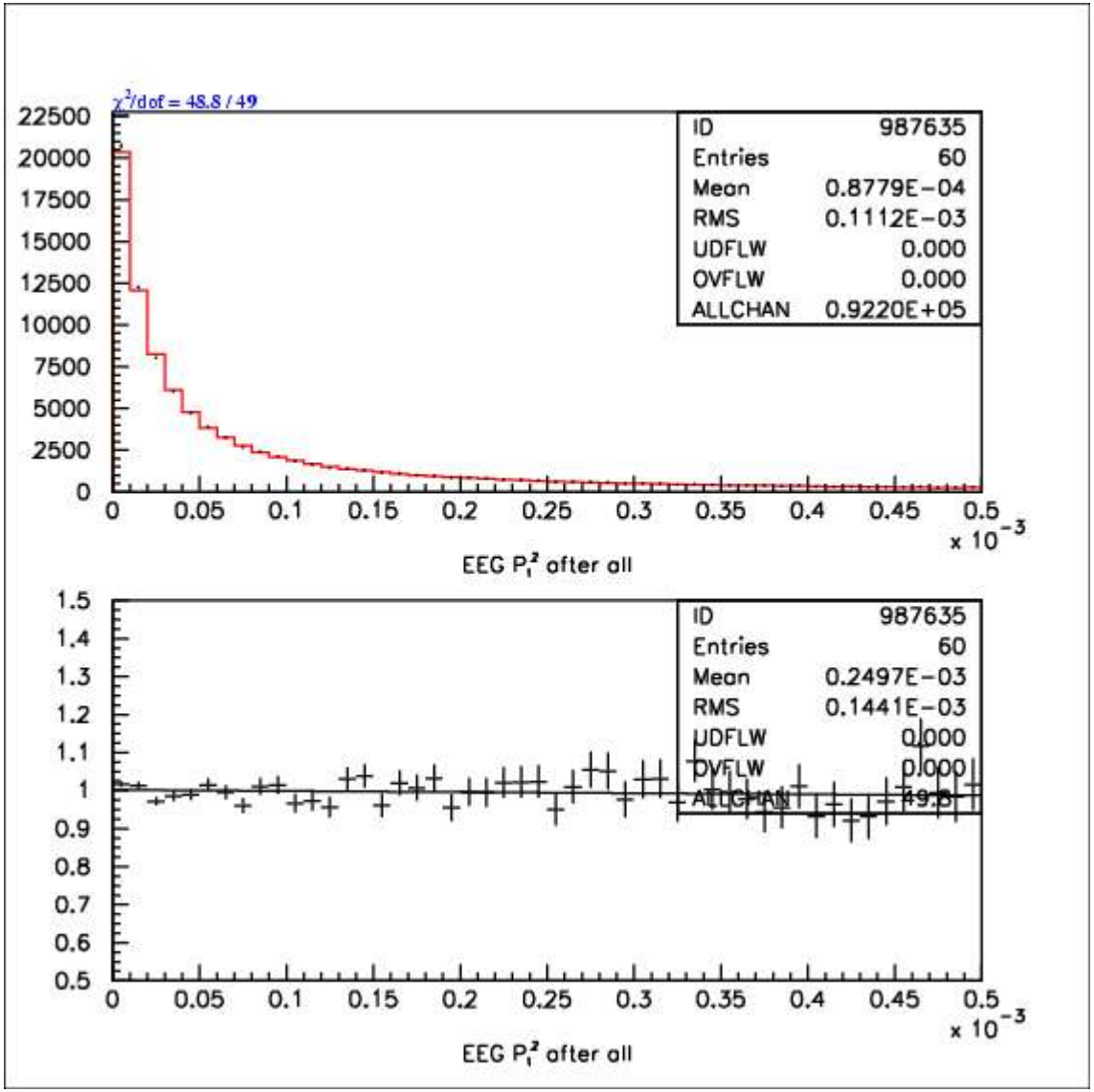
$K_L \to e^+e^-\gamma$: Total Kaon Energy



$K_L \to e^+e^-\gamma$: e^+e^- Mass



$K_L \to e^+e^-\gamma$: p_t^2



Systematics

Uncertainty Source	% of BR
Statistical	0.33
$3\pi 0D$ Branching Ratio	2.83
photon inefficiency	0.43
DC Inefficiency	0.37
Cut Variations	0.33
Energy Slope	0.23
Trigger 3 Inefficiency	0.2
MC Statistics	0.16
Energy Resolution	0.14
Backgrounds	0.08
Upstream Material	0.07
Trigger 1 Inefficiency	0.06
DC Hit Resolution	0.04
Radiative Corrections	0.03
Form Factor Dependence	0.03
Total Systematic	0.77

Results

- $BR(K_L \to e^+e^-\gamma) / BR(K_L \to 3\pi^0{}_D)$
  $= (1.346 \pm 0.004 \pm 0.010 \pm 0.038) * 10^{-3}$
- or, using the KTeV measurement of
  $BR(K_L \to 3\pi^0{}_D)$
- $BR(K_L \to e^+e^-\gamma)$
  $= (9.186 \pm 0.003 \pm 0.007 \pm 0.026) * 10^{-6}$

Comparison to Jason's Thesis

- Using the PDG value for $BR(K_L \to 3\pi^0_D)$ (as was done in Jason's thesis):
- My Result:
  $BR(K_L \to e^+e^-\gamma)$
  $= (9.941 \pm 0.033 \pm 0.076 \pm 0.287) * 10^{-6}$
- Jason's Thesis:
  $BR(K_L \to e^+e^-\gamma)$
  $= (10.192 \pm 0.036 \pm 0.073 \pm 0.285) * 10^{-6}$
- difference = 2.46% decrease

Current Status / Future Plans

- The analysis work is now complete
- I have written most of a paper draft
- I have written most of a more detailed addendum to Jason's thesis
- I'd like to hand this analysis off to a Godparent committee in the very near future