Status of $K_L \to \pi^0\gamma\gamma$

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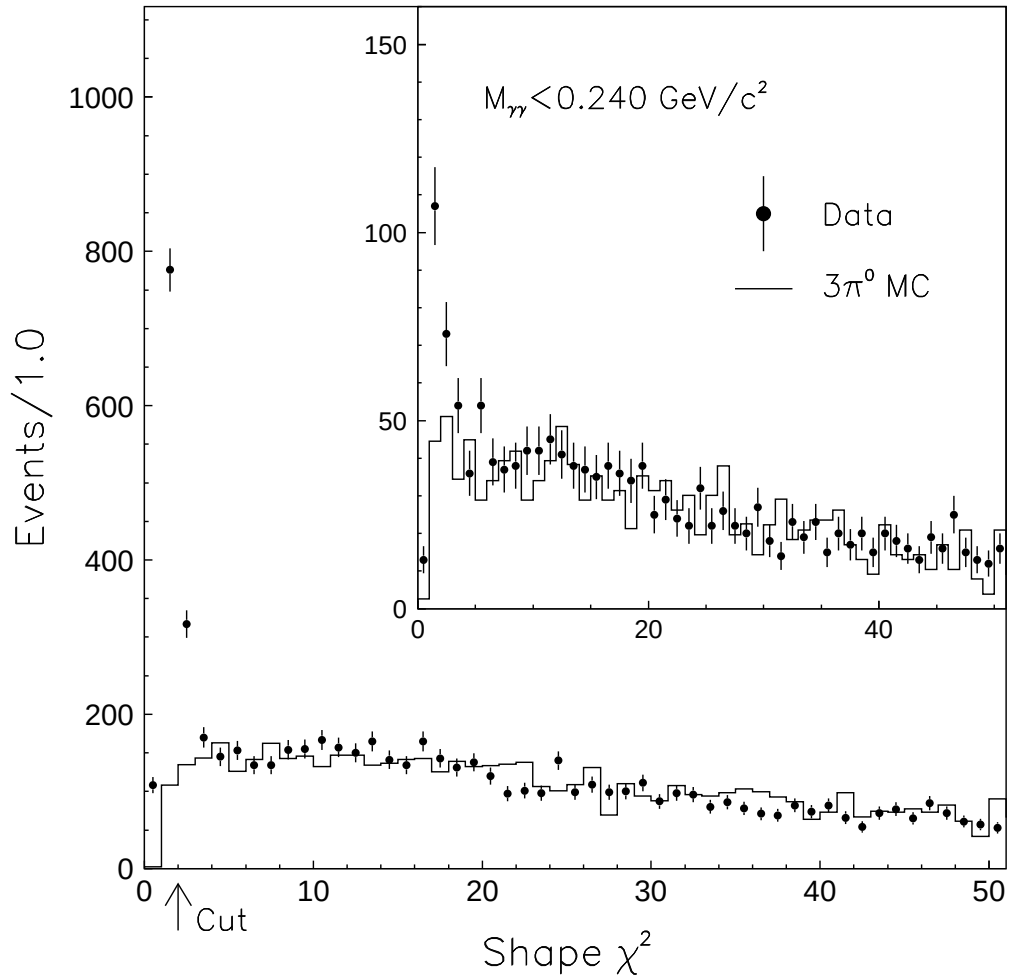
- Shower Libraries
- Branching Ratio
- Things to do

Current Situation

- NA48 result not consistent with ours.
  - $(1.68 \pm 0.07 \pm 0.08) \times 10^{-6}$ (KTeV)
  - $(1.36 \pm 0.03 \pm 0.04) \times 10^{-6}$ (NA48)
    - Note: New $K_L \to \pi^0\pi^0$ BR lowers results by 5%.
- Trying to improve fusion χ^2 agreement.
  - Data/MC mismatch could lead to underestimate of bkg.
  - Use data instead of GEANT showers.

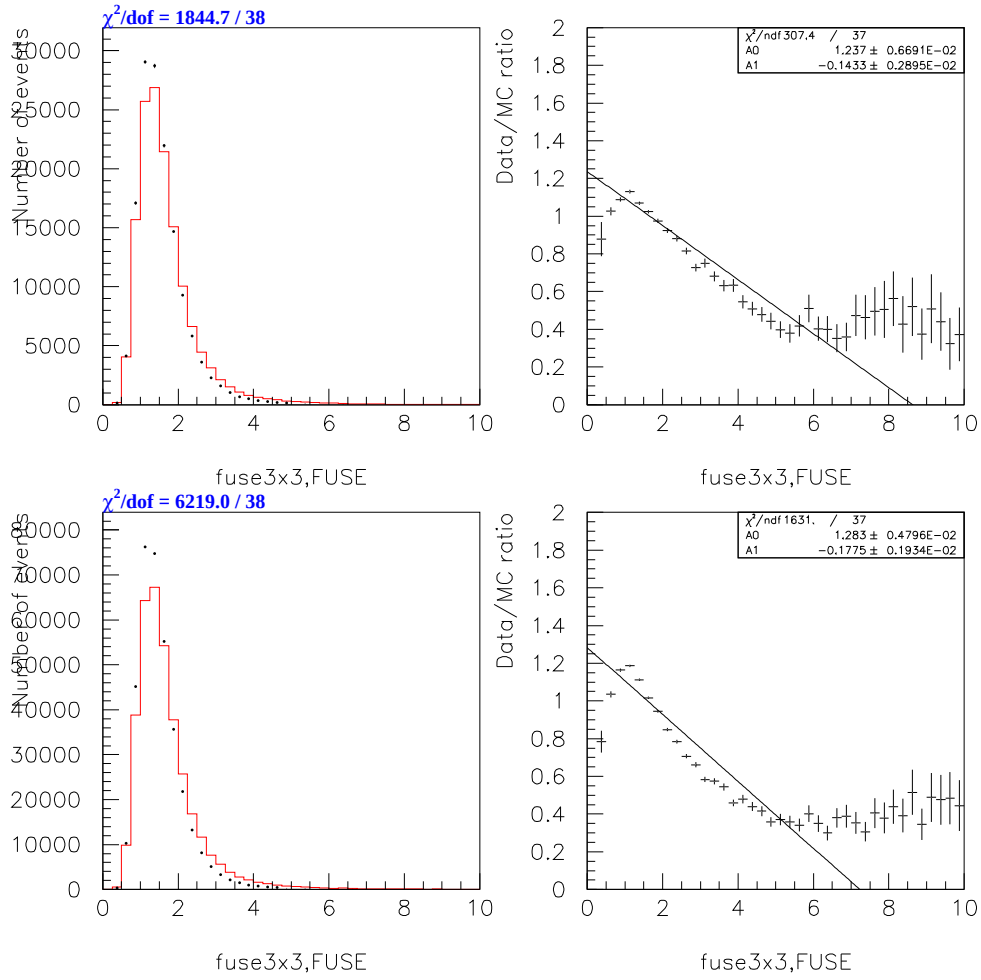
Published Result

- Reasonable agreement between Data/MC for large values of fusion χ^2.
- About 14% background.



Fusion χ^2

- Default MC.
- Shows poor agreement below 2, which is our nominal cut.
- Believed that since background is low, mismatch should not be a problem.



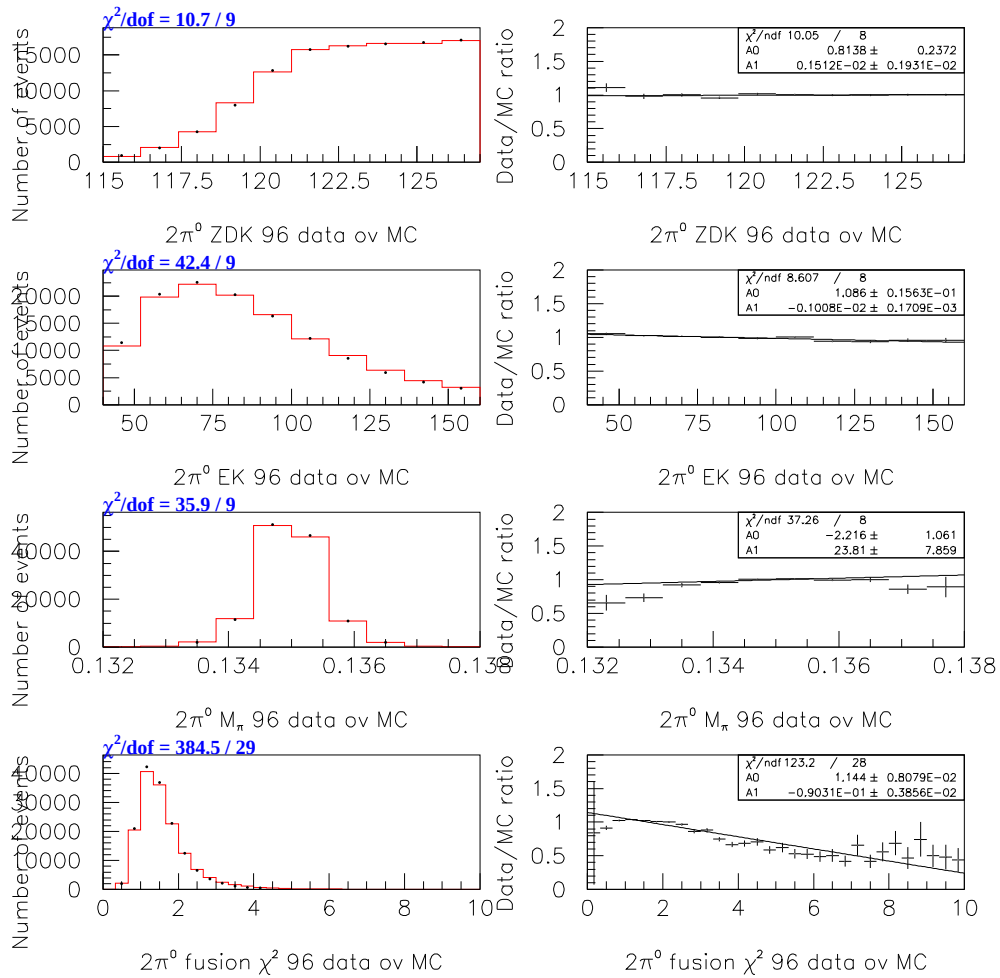
Shower Libraries

- A while ago, we showed that using data showers improves fusion χ^2 simulation.
- However, kinematic quantities showed poor agreement.
- New technique:
  - Keep two shower arrays.
  - One for kinematic quantities (GEANT).
  - One for fusion χ^2 calculation (Data).

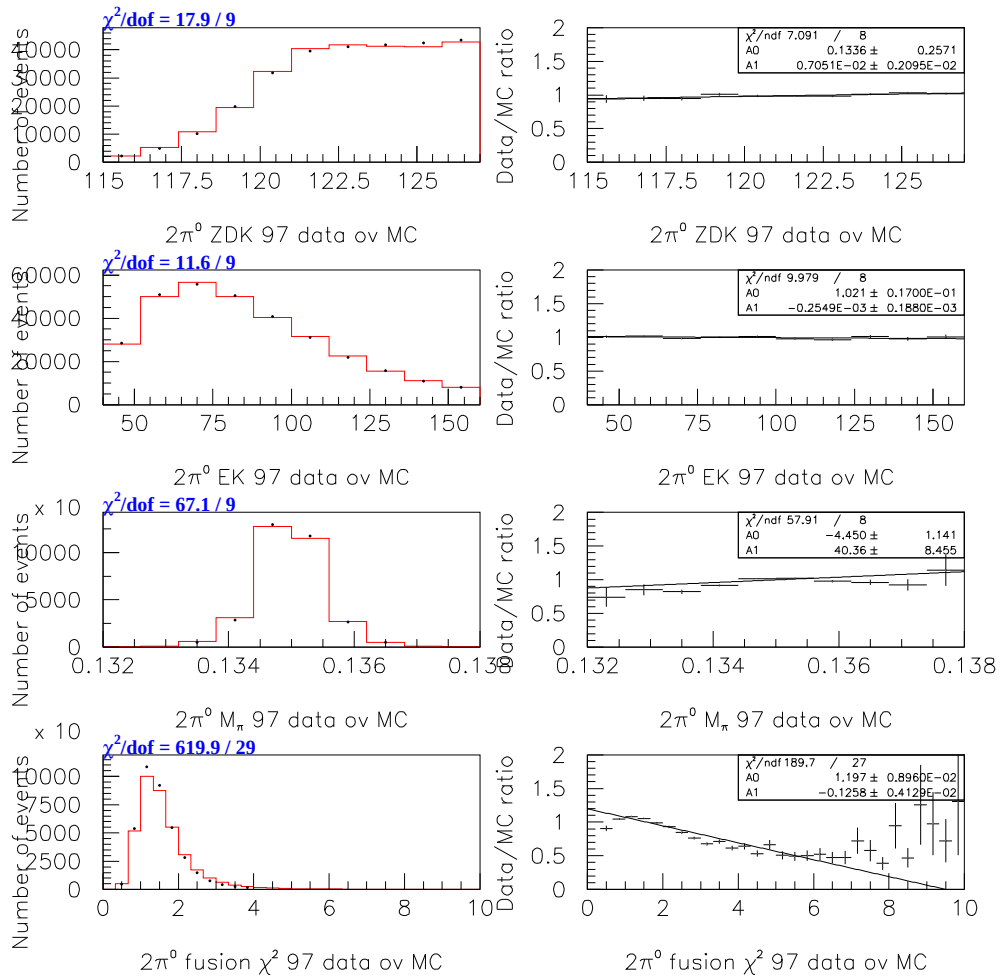
Shower Libraries

- Procedure:
  - Choose GEANT shower in usual way.
  - Choose Data shower in similar way.
    - Store energies from Data shower in ECSI.
  - In analysis, perform clustering using ECSI.
    - Store fusion χ^2 variables.
  - Unpack GEANT shower information.
    - Do clustering using GEANT showers.

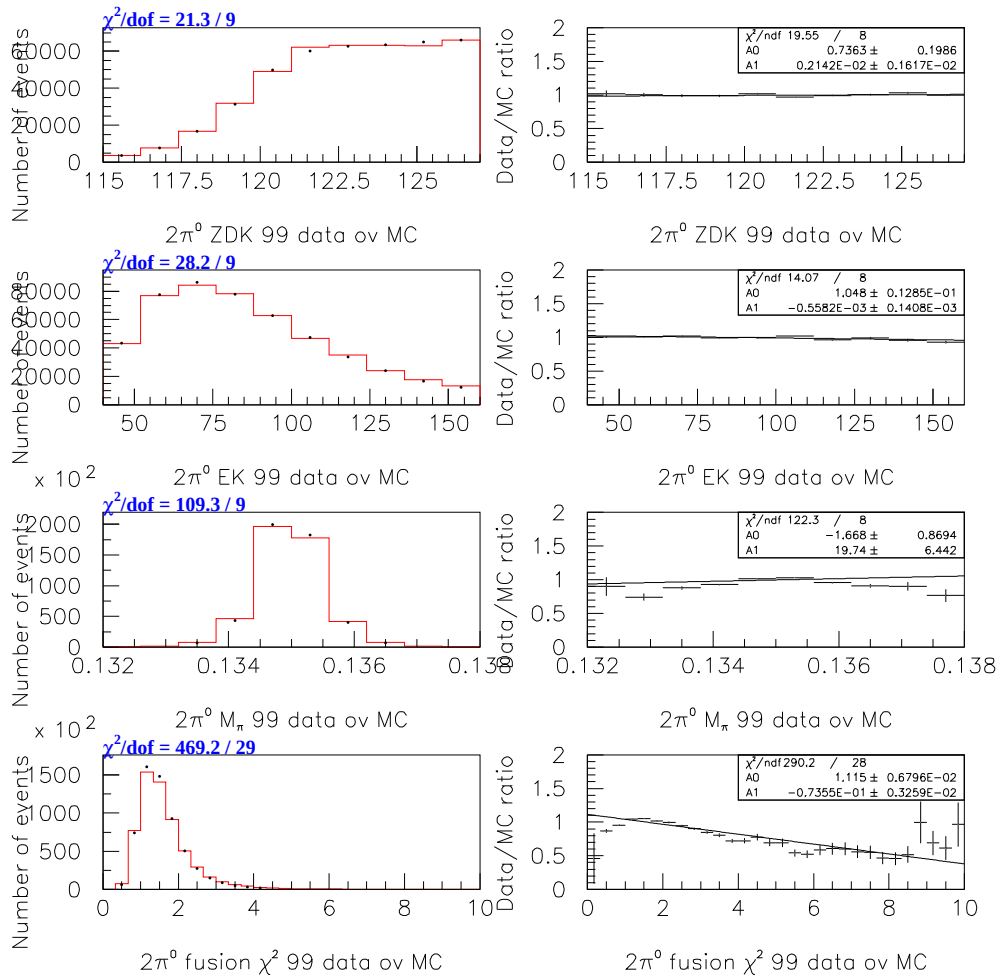
1996 $2\pi^0$ Plots



1997 $2\pi^0$ Plots

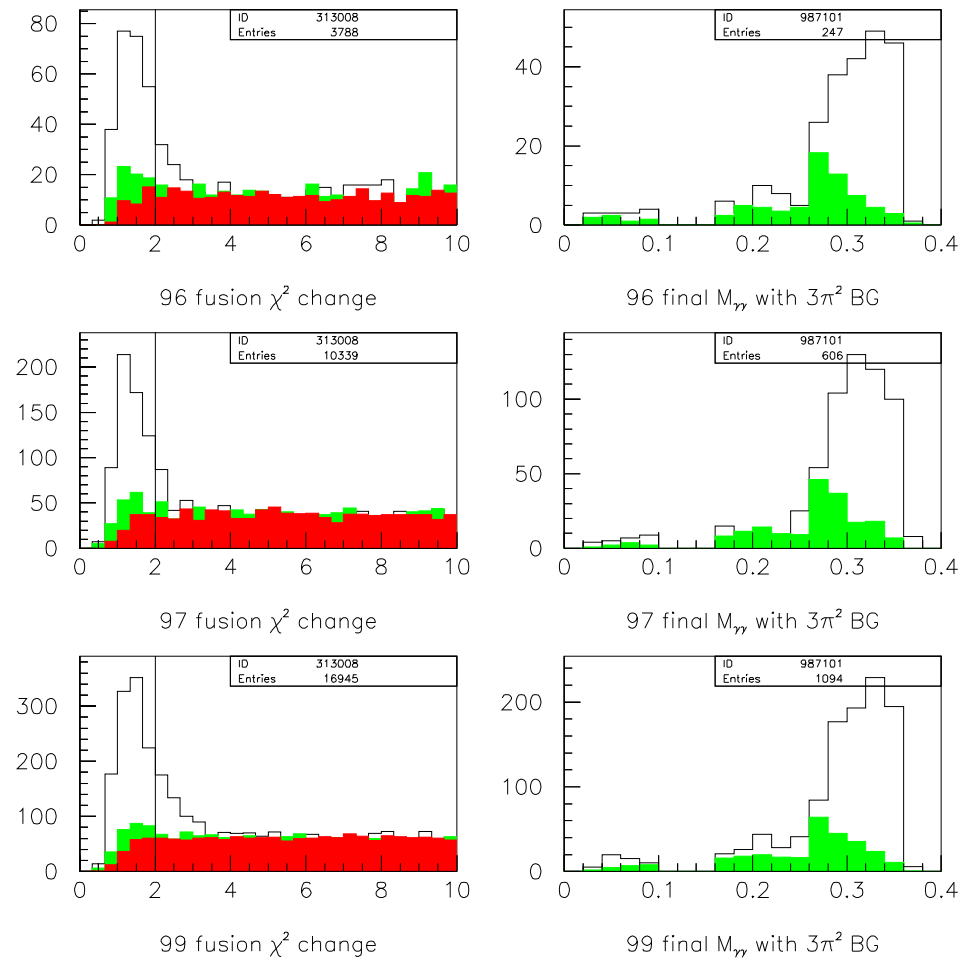


1999 $2\pi^0$ Plots



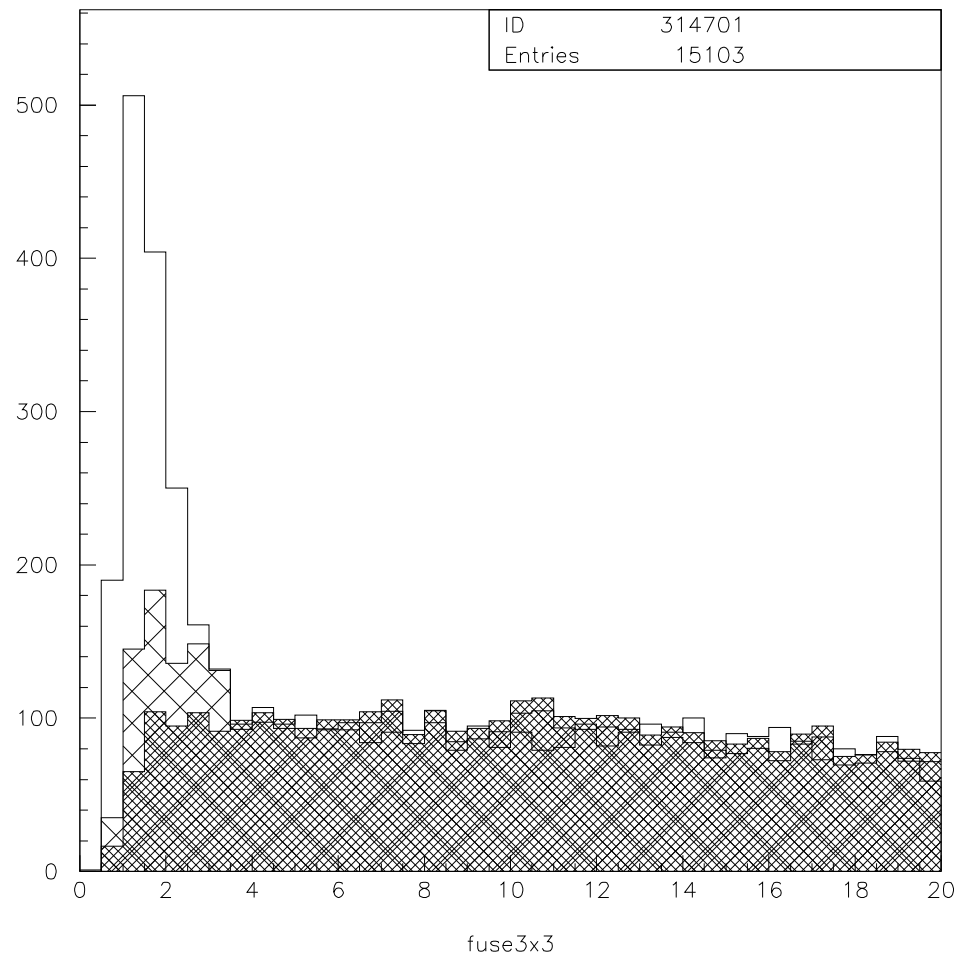
$3\pi^0$ Background

- Fusion χ^2 distributions.
  - Data showers (green)
  - GEANT showes (red)
- Background levels are higher by $2\times$.



$3\pi^0$ Background Levels

- Reweight $3\pi^0$ MC to match $\gamma\gamma$ mass distribution.
- Examine fusion χ^2 variable.
  - $3\pi^0$ MC shows similar peaking near χ^2 of two.



$3\pi^0$ Background

Year	1996	1997	1999
Relative Normalization	34%	31%	27.2%
Absolute Normalization	38.7%	30%	34%
M_{π^0} fittting	25%	23%	29%
Average	32%	28%	30.1%

- Relative: Fit fusion χ^2 at large χ^2.
- Absolute: Scale to $2\pi^0$ peak.
- M_{π^0}: Fit wings of $\gamma\gamma$ distribution.

$\pi^0\gamma\gamma$ Branching Ratio

Year	BR($K_L \to \pi^0\gamma\gamma$)
1996	$(1.264 \pm 0.083) \times 10^{-6}$
1997	$(1.232 \pm 0.054) \times 10^{-6}$
1999	$(1.397 \pm 0.045) \times 10^{-6}$
Average	$(1.32 \pm 0.03) \times 10^{-6}$

Conclusions

- Use of data shower libraries seems to improve data/MC agreement in fusion χ^2.
- Branching ratio calculations are now consistent with each other and with NA48.
- Full systematics studies needed.
- Hope to have a result out soon.