

$\pi^0 \rightarrow e^+ e^-$ Update

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KTeV Meeting

Outline

- Result presented at PANIC
- Background level analyzed
 - Software clusters
 - Veto energies
 - Other cuts
- Remaining issues & comments

Shown at PANIC

From 714 signal events and an estimated 39.9 background events the following preliminary result was found:

$$\text{BR}(\pi^0 \rightarrow e^+e^-, \mathbf{x} > 0.95) = (6.56 \pm 0.26(\text{stat}) \pm 0.23(\text{sys})) \times 10^{-8}$$

All the main systematic error sources come from problems with the background estimate.

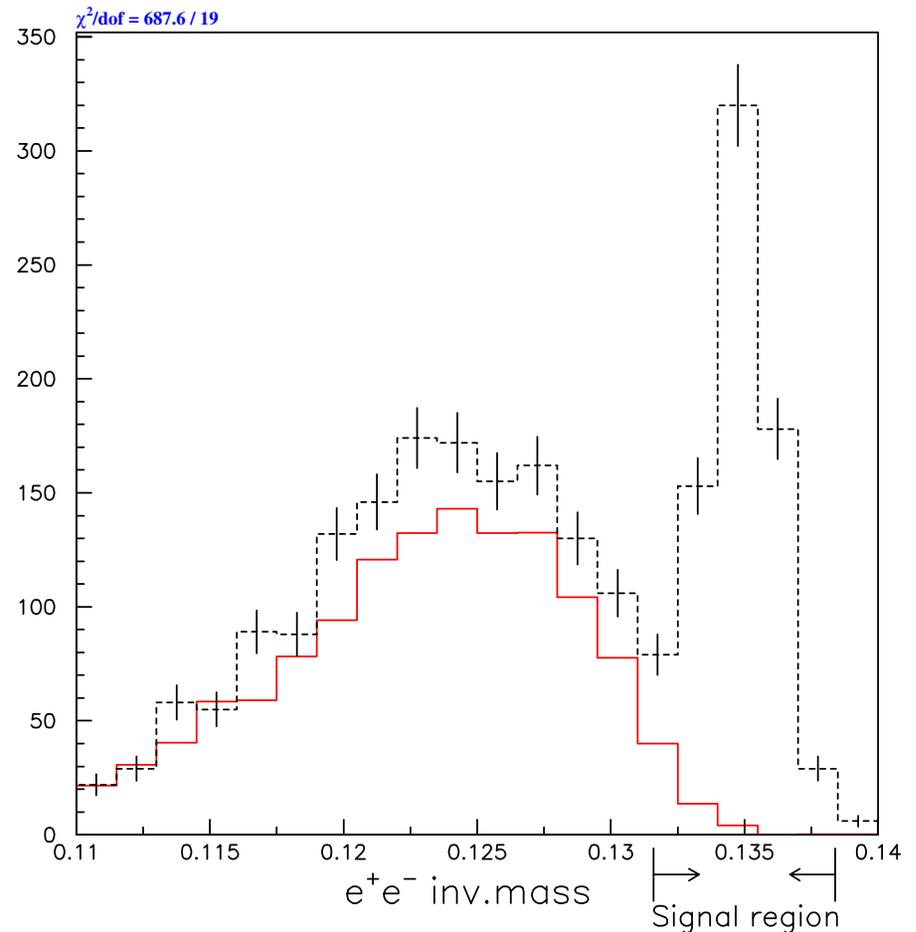
The modeling of the pairing χ^2 being the only exception.

Of course the Dalitz branching ratio dominates the overall error.

Source	Uncertainty
Dalitz branching ratio	2.7%
Background normalization	1.4%
e^+e^- mass modeling	1.0%
Background MC statistics	0.8%
Pairing χ^2 modeling	0.7%
Total internal systematic	2.1%
Total systematic	3.4%

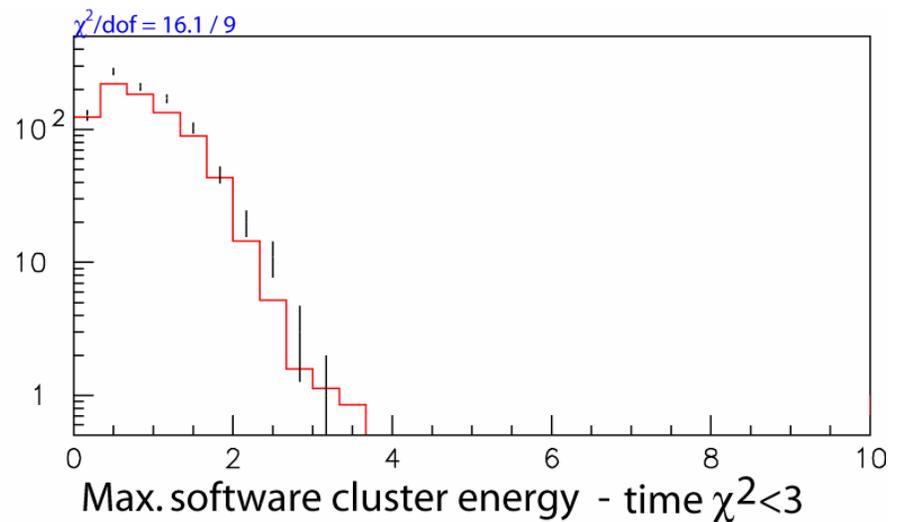
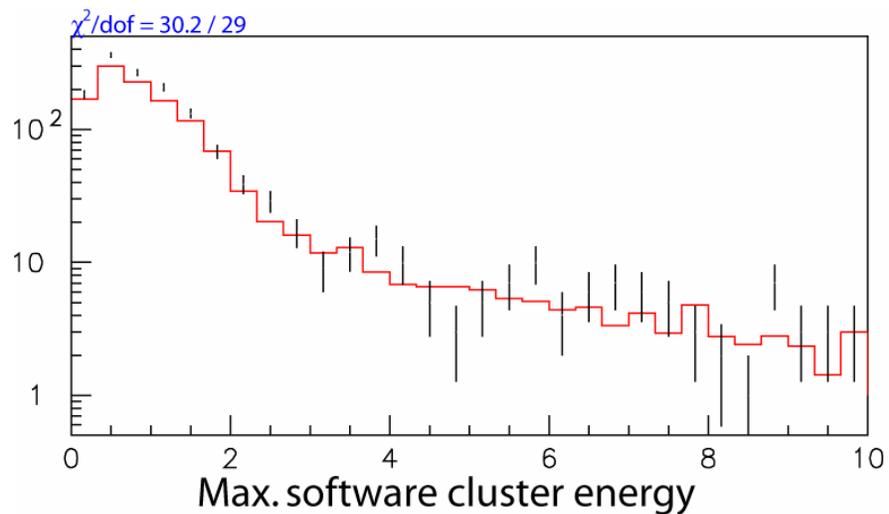
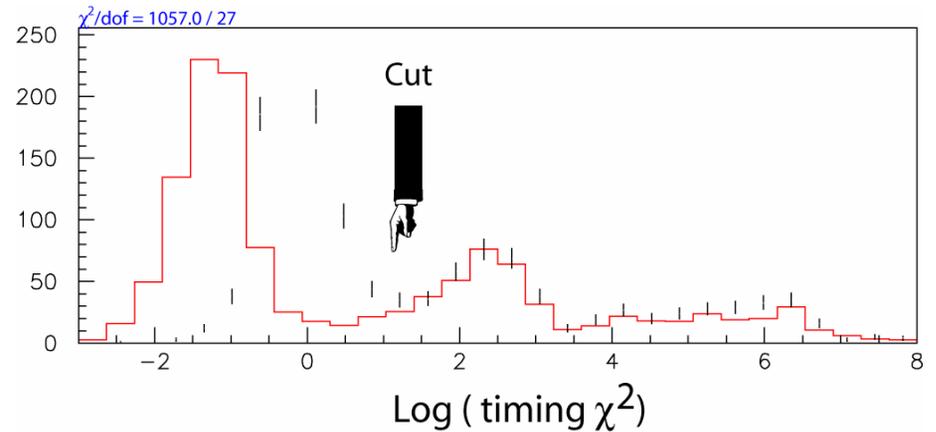
Background Normalization

- A comparison of the reconstructed e^+e^- mass for data and background MC.
- Background is normalized to the “flux” measured in the $K_L \rightarrow 3\pi_D^0$ analysis.
- Why is the background level off by 20 %?



Software Clusters

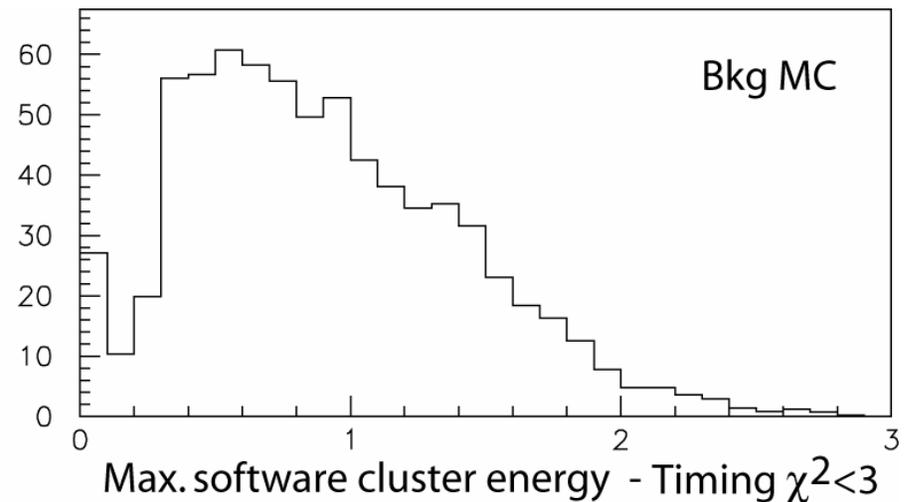
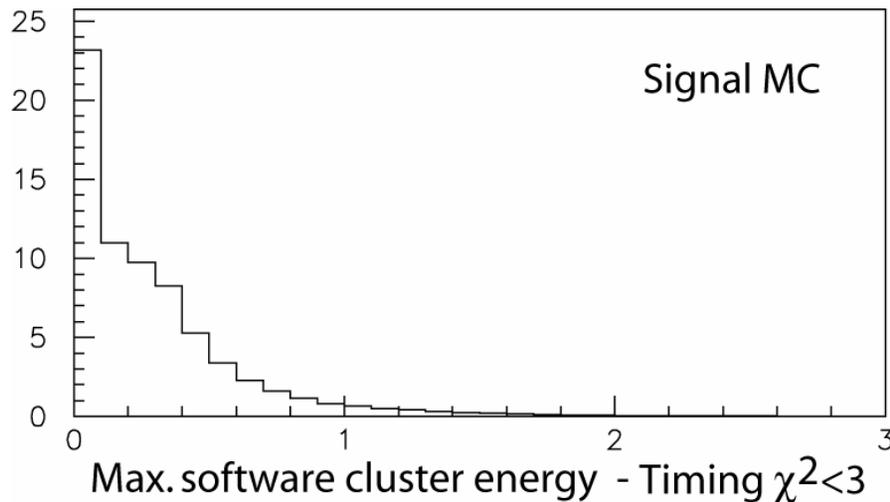
- First consider timing χ^2 and maximum software cluster energy.
- A cut on timing χ^2 at 3 ($\ln(3) \sim 1$) removes all the high energy software clusters.



Software Clusters

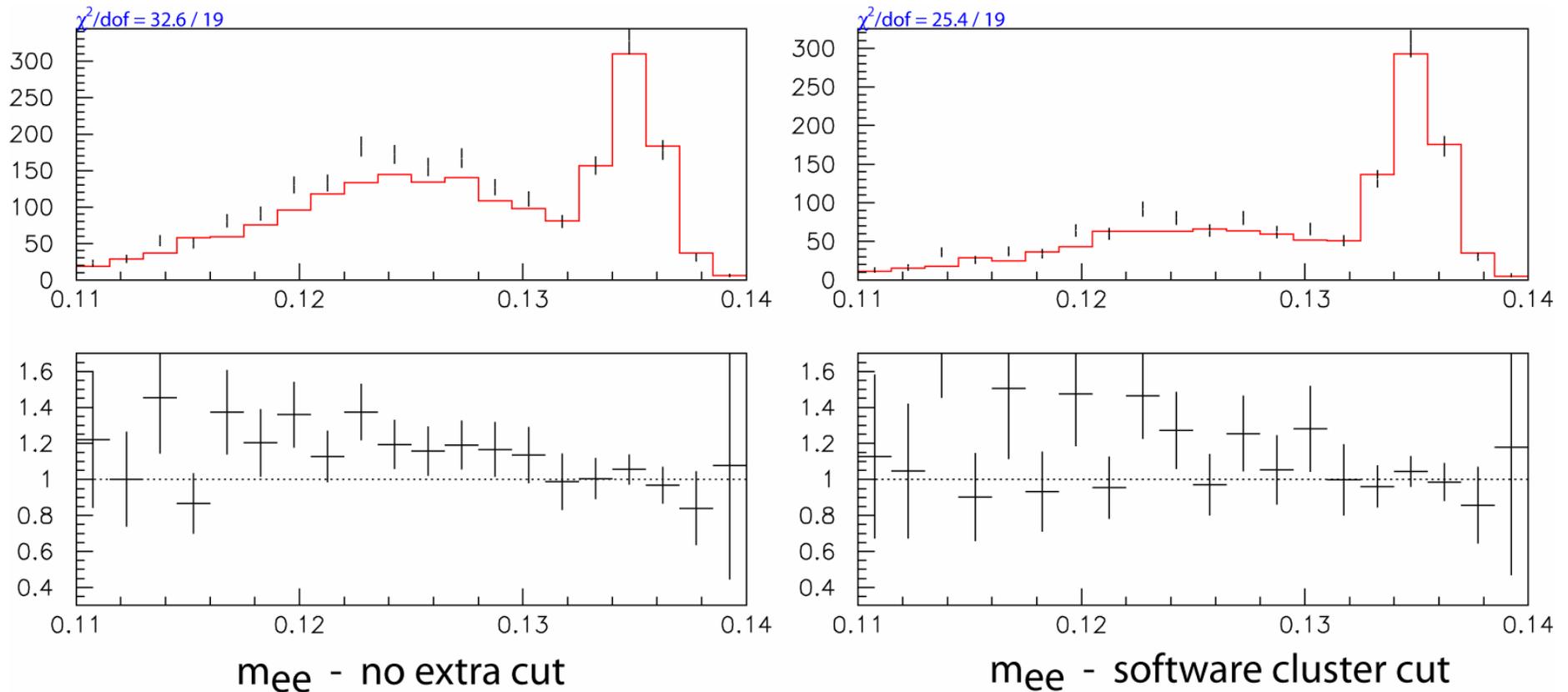
Signal and background MC clearly have different cluster energy distributions so lets try cutting on it and see the effect.

I cut out events that have a software cluster with energy $> 0.1\text{GeV}$ and timing $\chi^2 < 3$.



The software cluster cut appears to have some impact on the side band level discrepancy but it is not completely convincing.

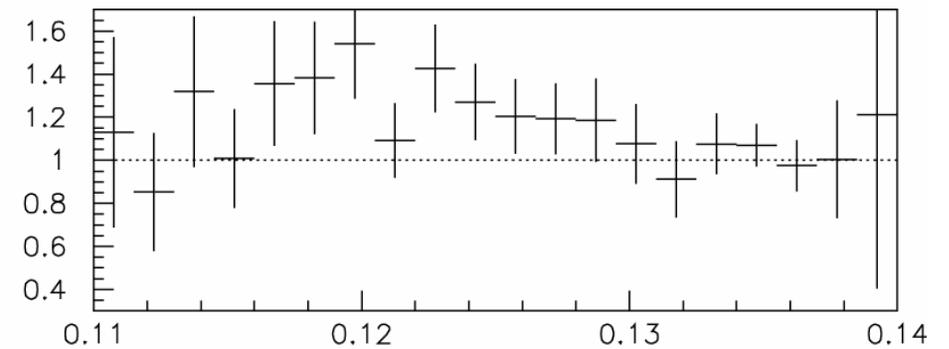
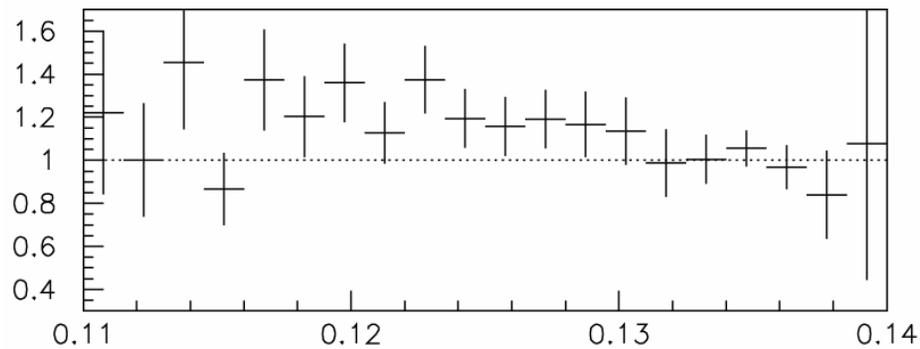
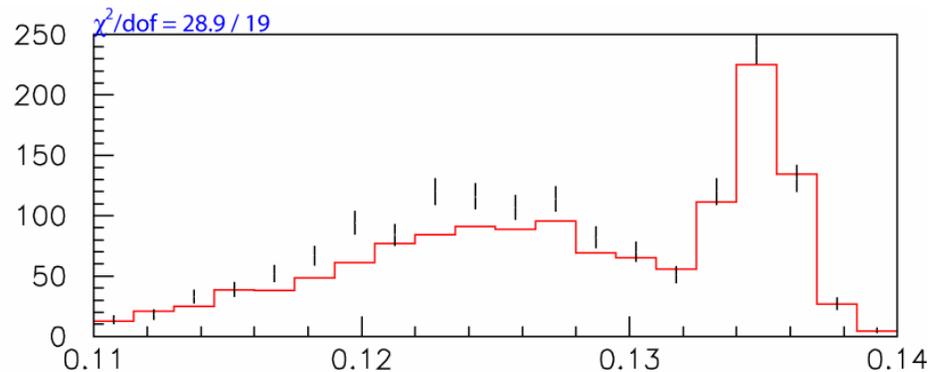
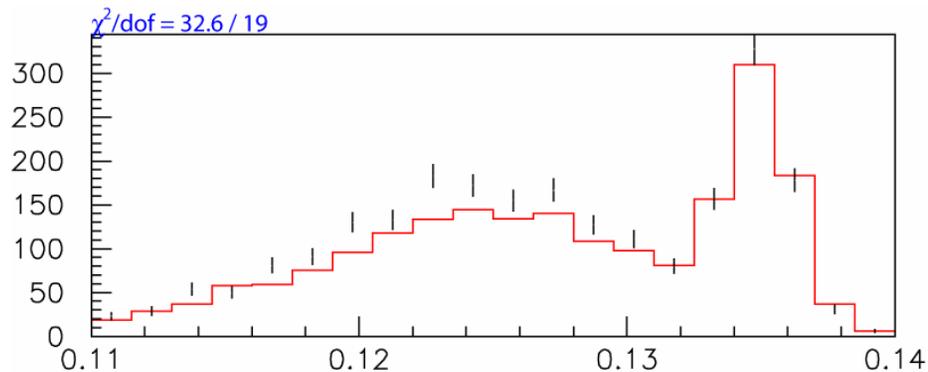
It decreases the background about 50%.



Photon vetoes

If we cut on the photon vetoes we see the following picture (RC, SA, CIA < 0.03GeV):

No improvement...



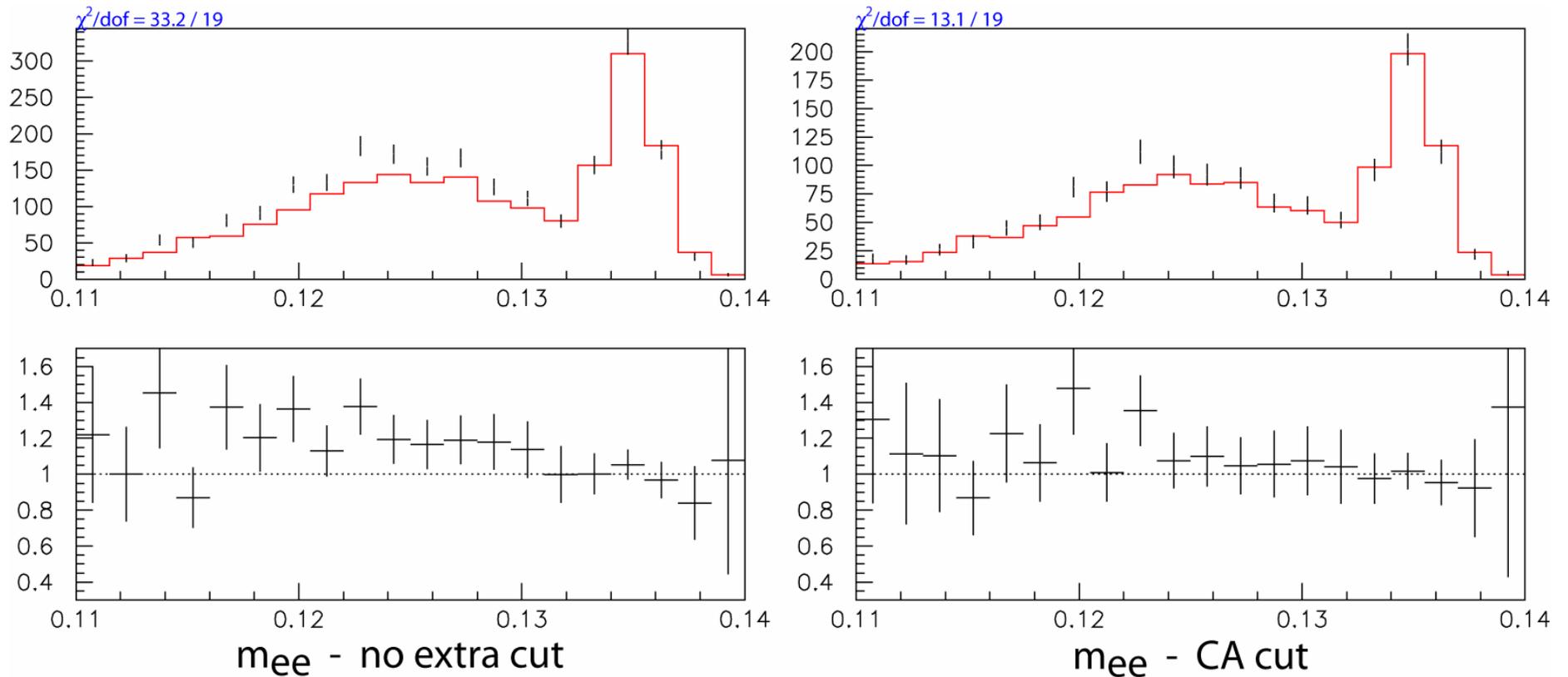
m_{ee} - no extra cut

m_{ee} - RC, SA, CIA cut

The CA

Cutting on the CA shows more promise!

With a cut at 0.15 GeV on the CA energy I see the following:



Background level - Conclusions

- Dalitz decays with the Dalitz photon hitting close to the beam holes are poorly modeled and causes the MC to underestimate the background.
- A tight CA cut gets rid of this kind of events.
- I find no reason that the background under the peak should not also be affected in the same way.
Background estimate should be scaled up accordingly.
- Other attempts to control the background level discrepancy between data and MC has failed.
 - Tightening and widening the kaon mass cut and the pairing χ^2 cut.
 - Varying total cluster cut and minimum cluster cut.
 - Tightening RC, SA, CIA cuts.

Remaining issues & comments

- Cut on block energy removed as suggested at the last meeting. Does not have a big effect anyway.
- The analysis is basically done. No more work in progress.
- Paper writing.
 - I have started a paper draft.
 - I'm writing my thesis at the moment (for graduation in March).
 - Getting together a god parent committee would be very helpful.