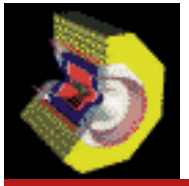

Cornell University
Laboratory for
Elementary-Particle Physics

$D_S^{*+} \to D_S^+ e^+ e^-$

Souvik Das, Anders Ryd
Cornell University

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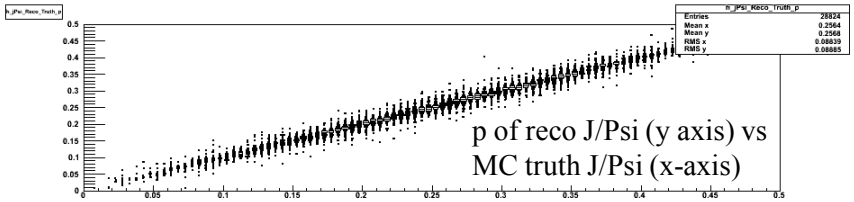
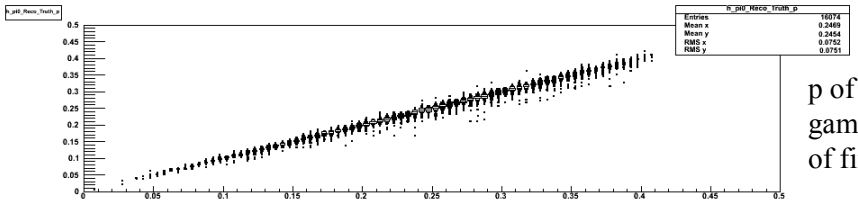
- Low Energy Electron Reconstruction Efficiency Woes
- Vertex Fitting Suggestion

8 June 2010

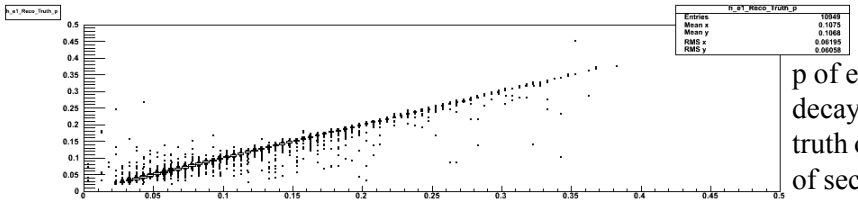
Low Energy Electron Reconstruction Efficiency



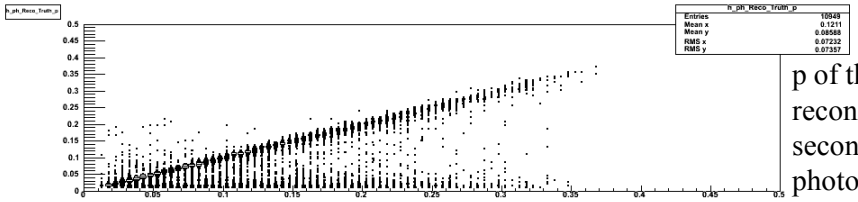
p of reco J/Psi (y axis) vs MC truth J/Psi (x-axis)



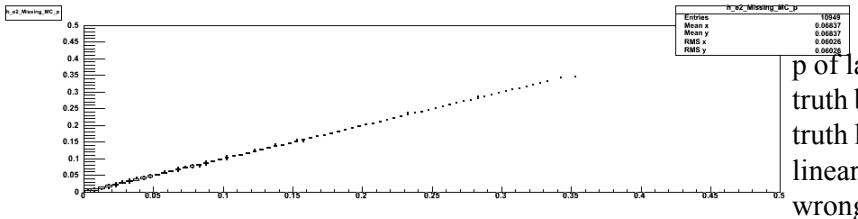
p of pi0 reconstructed from gamma, gamma vs MC truth of first pi0



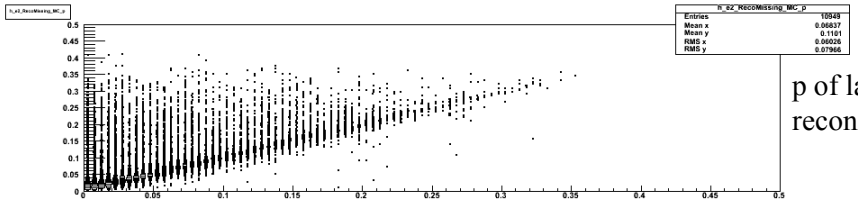
p of electron in reconstructed decay of second pi0 vs MC truth of electron from decay of second pi0



p of the photon in reconstructed decay of second pi0 vs MC truth of photon



p of last electron according to MC truth by vector addition vs the MC truth last electron. (This had to be linear or I'd be doing my math wrong)



p of last, missing electron according to reconstruction vs MC truth.

$$\psi(2S) \to J/\psi\pi^0\pi^0;$$

$$J/\psi \to e^+e^-; J/\psi \to \mu^+\mu^-$$

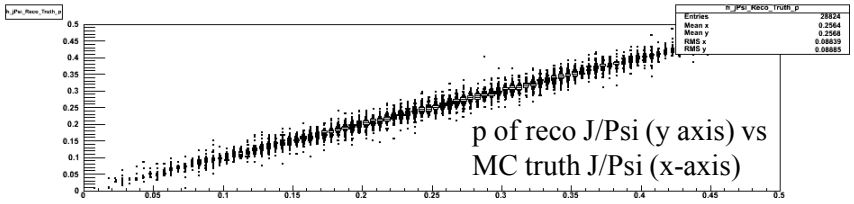
$$\pi^0 \to \gamma\gamma$$

$$\pi^0 \to \gamma e^+e^-$$

Unable to pin-point why we were getting such large inefficiencies for tracking the last electron, we resorted to looking at the MC truth and matching reconstructed objects to the truth.

We require each candidate to be MC matched in making these plots.

Low Energy Electron Reconstruction Efficiency



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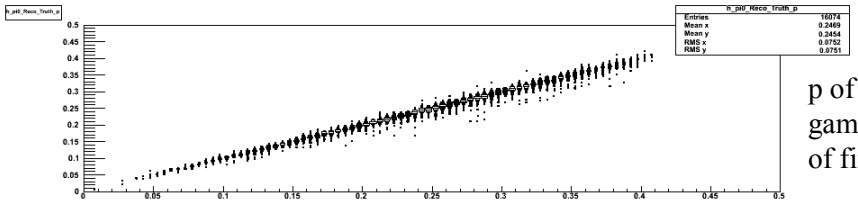
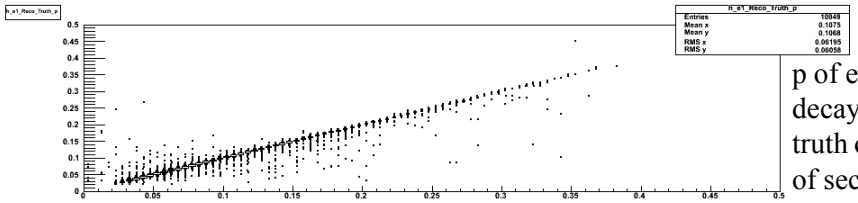
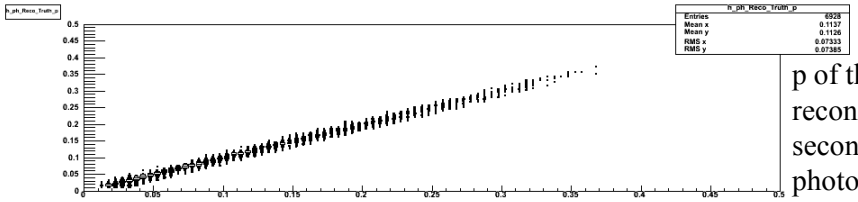


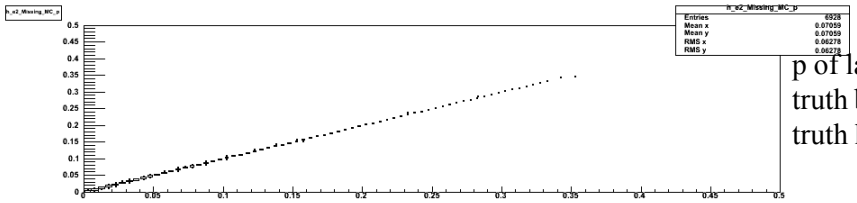
p of pi0 reconstructed from gamma, gamma vs MC truth of first pi0



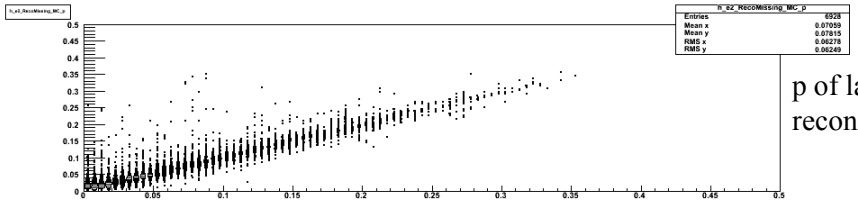
p of electron in reconstructed decay of second pi0 vs MC truth of electron from decay of second pi0



p of the photon in reconstructed decay of second pi0 vs MC truth of photon



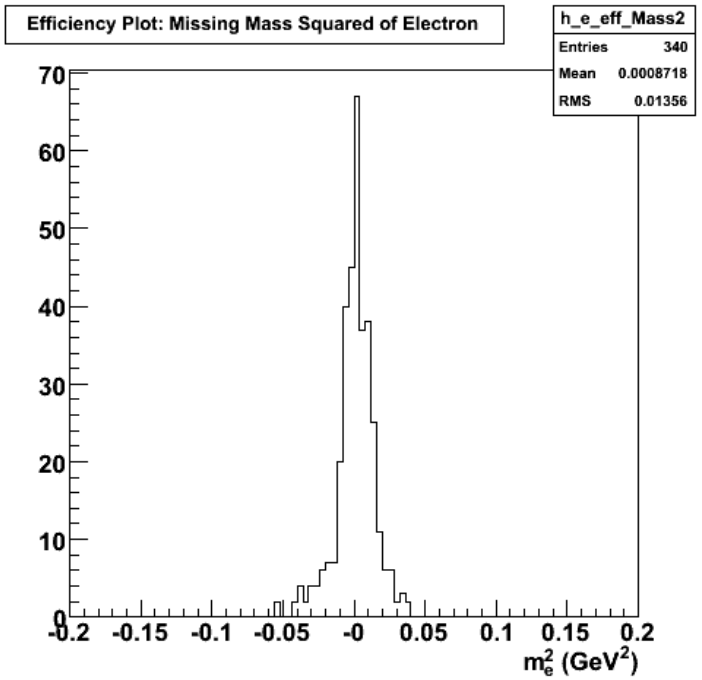
p of last electron according to MC truth by vector addition vs the MC truth last electron.

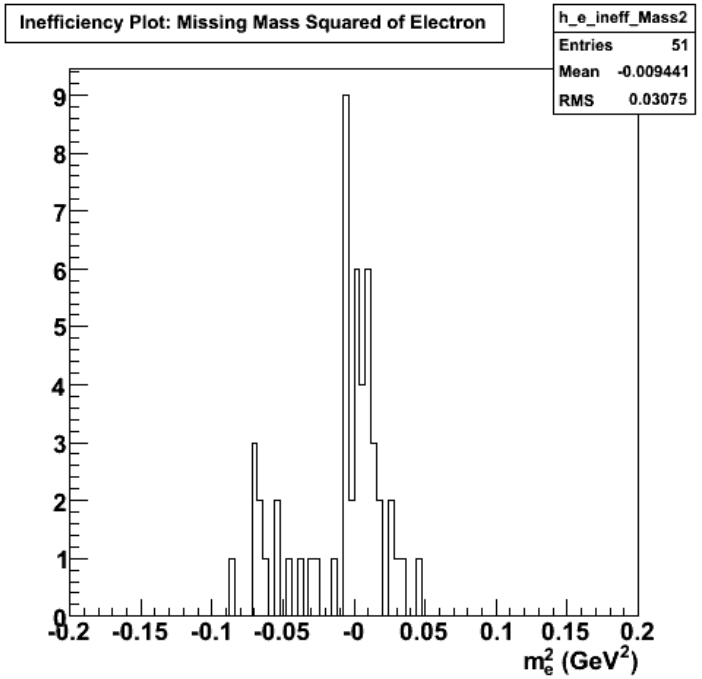


p of last, missing electron according to reconstruction vs MC truth.

Now we artificially clean up the energy of the second pi0's photon by requiring reconstructed energy to be within 20 MeV of the MC photon.

Everything improves!





Low Energy Electron Reconstruction Efficiency

Having artificially cleaned up the energy of the second pi0's photon by requiring reconstructed energy to be within 20 MeV of the MC photon, the efficiency plots seem reasonable.

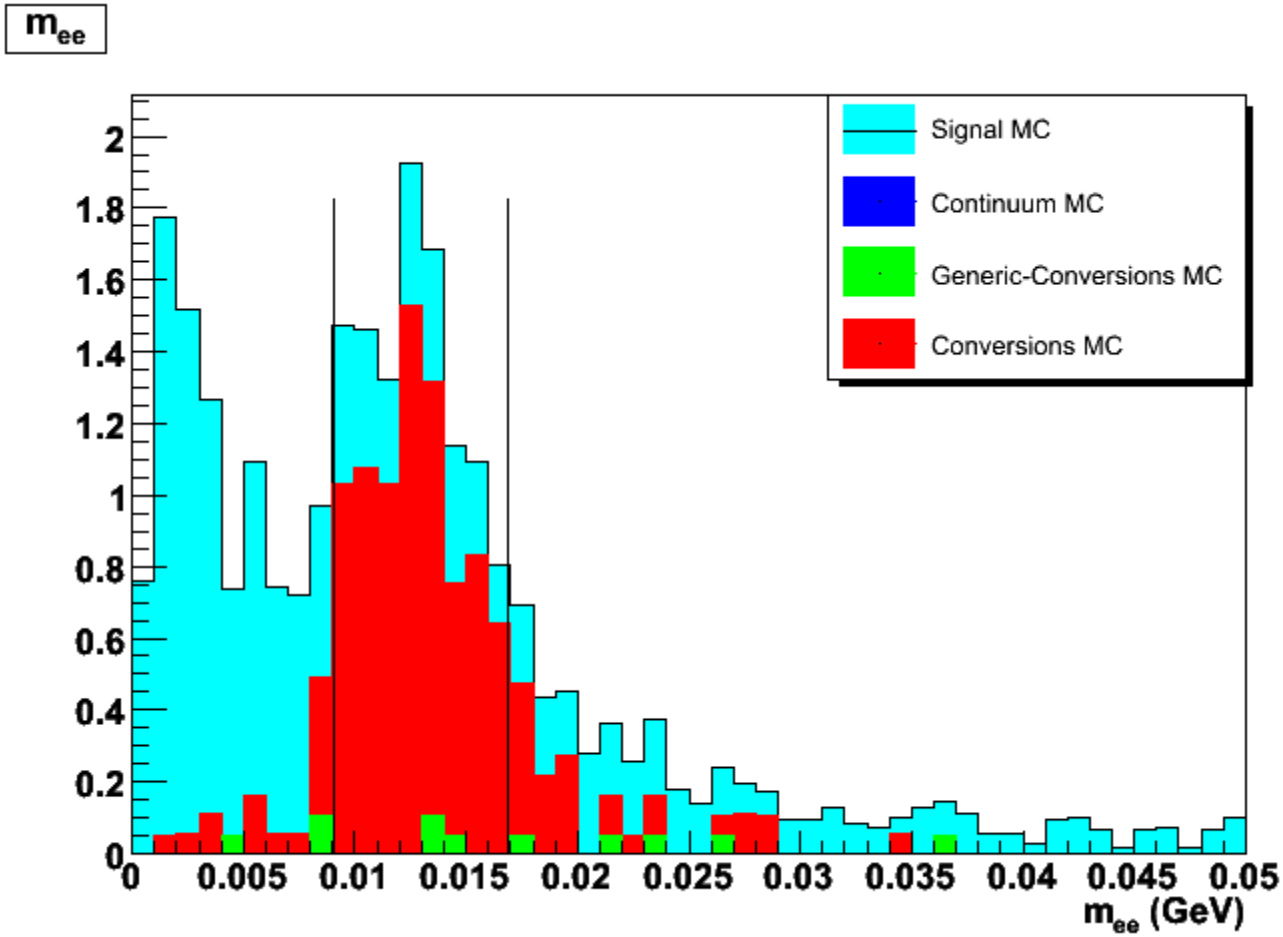
But how can we improve the reconstruction of the last photon? Our code:

```
static DChainBoolean photonSelector(CDPhoton& iPhoton)
{
 const CcShowerAttributes &atts=iPhoton.photon().attributes();
 return (0.01 < atts.energy() && atts.energy() < 2.0
        && !atts.hot() // not use hot crystals
        && atts.e9oe25UnfOK() // E9/E25 unfolded
        && iPhoton.photon().noTrackMatch()
        && (atts.goodBarrel() || atts.goodEndcap())); // might want to take away for
doing a veto... doesn't use the overlap of the calorimeters
}
```

1. We have not required the photon to exclude photons used to reconstruct the first pi0,

2. We have not required any pi0 Dalitz decay specific checks on the last pi0.

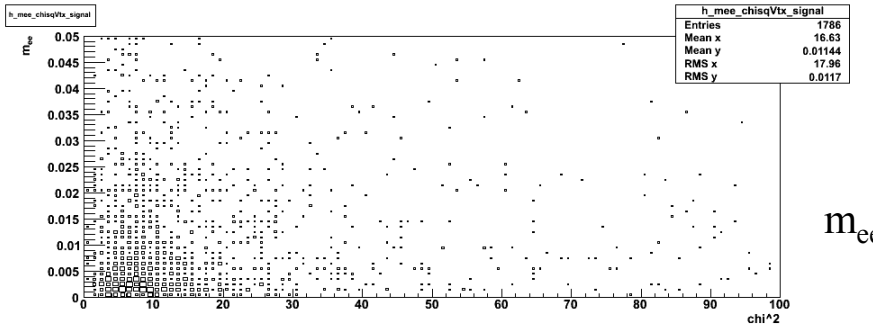
m_{ee} versus Vertex Fitting χ^2



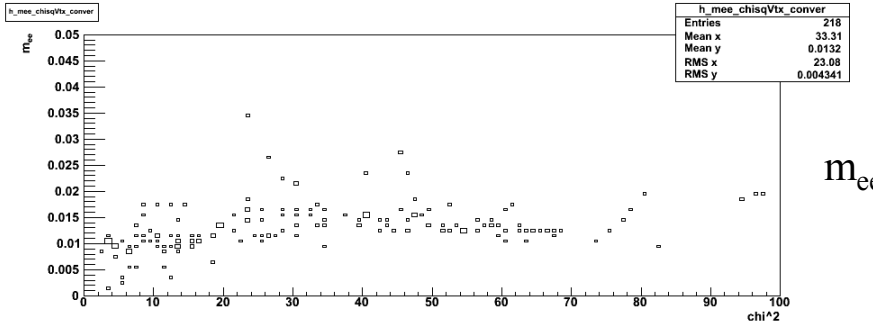
We were veto-ing the peak in m_{ee} [$|m_{ee} - 0.013| > 0.00389$ GeV] found in the conversion MC after we did a vertex fit of all tracks in the KKpi mode, and requiring $\chi^2 > 0$. It was shown to be not as powerful as the Δd_0 and $\Delta \varphi_0$ cuts in our analysis, and also unable to add significant power on top of our cuts.

We were asked, could a $\chi^2 >$ non-zero number help in improving the power?

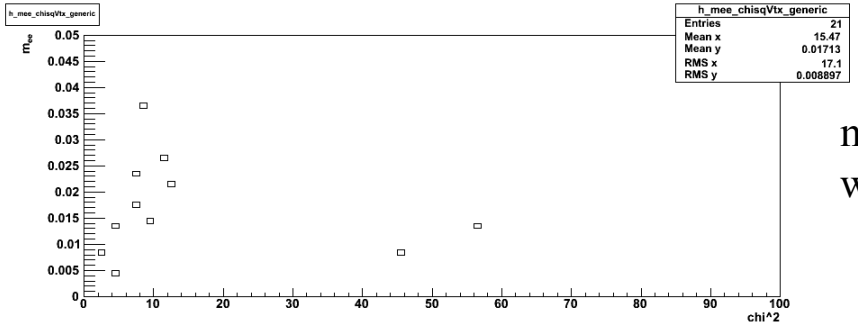
m_{ee} versus Vertex Fitting χ^2



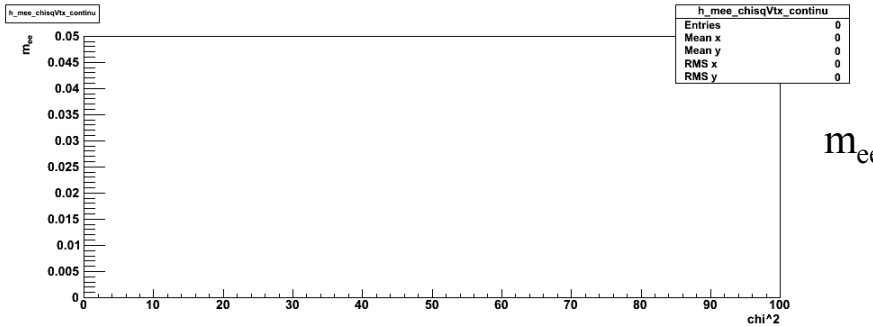
m_{ee} vs χ^2 in signal MC



m_{ee} vs χ^2 in conversion MC



m_{ee} vs χ^2 in generic MC with conversions vetoed



m_{ee} vs χ^2 in continuum MC

The peak in the conversion MC's m_{ee} around 13 MeV can be improved by increasing χ^2 to > 10

But by then we'll have lost most of our signal events!

Alternatively we might want to require $\chi^2 < 10$ or 15!