Omega Cross-Section

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Mainz, March 2019

2019-03-21

ω Cross-Section Studies

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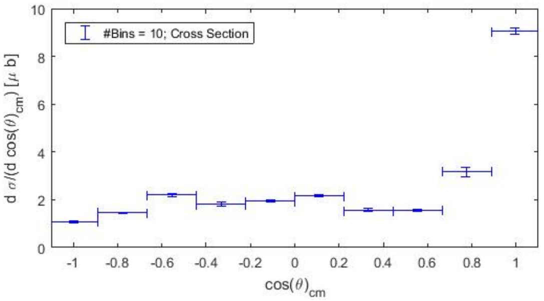
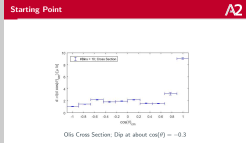
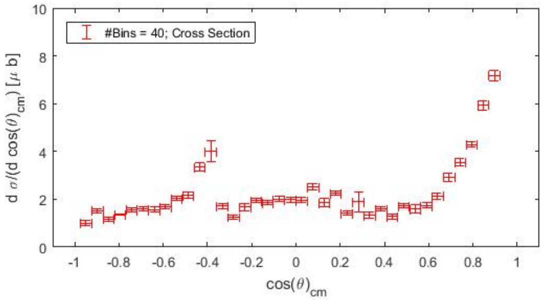


Olis Cross Section; Dip at about $\cos(\theta) = -0.3$

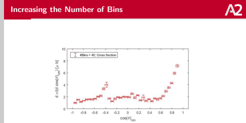


Olis Cross Section; Dip at about $\cos(\theta) = -0.3$

Increasing the Number of Bins



Increased number of bins to 40; now there is still a dip at $\cos(\theta) = -0.3$ but also a peak at $\cos(\theta) = -0.4$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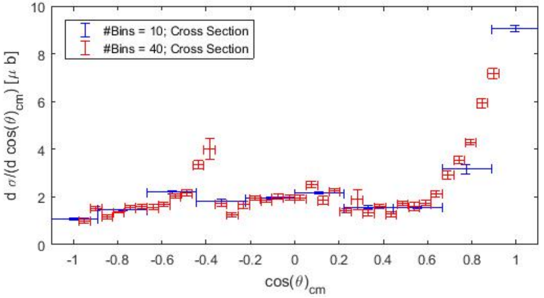
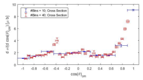


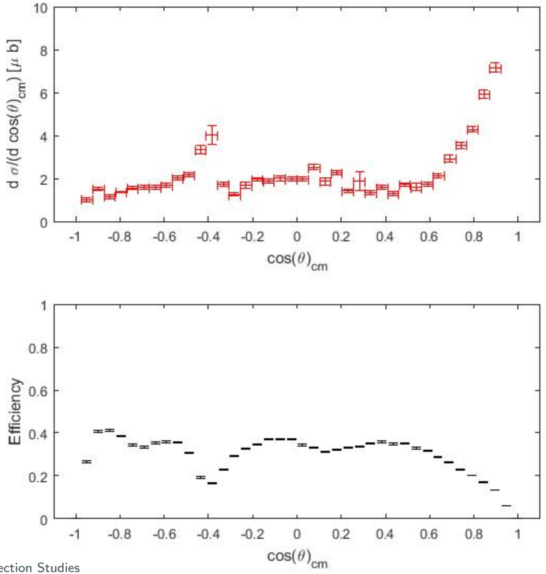
Both Cross Sections are shown.

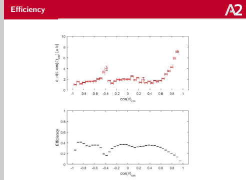
Comparing 10 Bin to 40 Bin Cross Section



Both Cross Sections are shown.

Efficiency



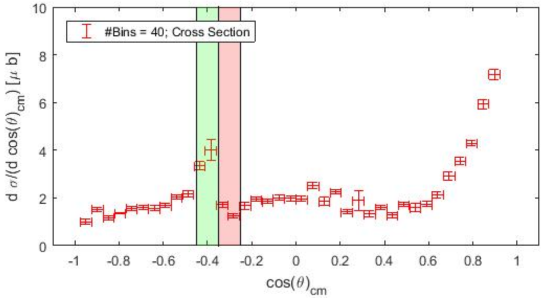


Cross Section and efficiency. There is an efficiency drop at cos(θ) ≈ -0.3

Taking a closer Look

$$\gamma p \rightarrow \underset{\hookrightarrow \gamma \underset{\hookrightarrow \gamma\gamma}{\pi^0}}{\omega} \; p$$

There is a 1:1 correlation between the polar angle of p and ω for fixed $E(\gamma)$!



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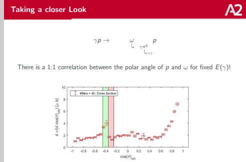
└ Taking a closer Look



$$\gamma p \to \omega \, p$$
$$\quad \hookrightarrow \gamma \pi^0$$
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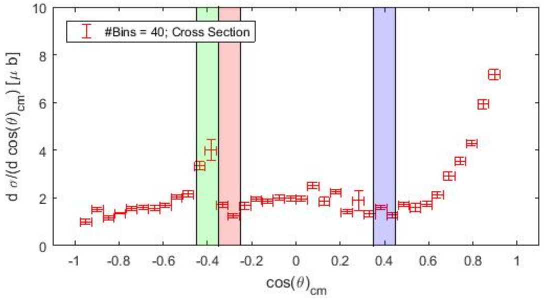

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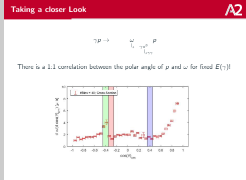
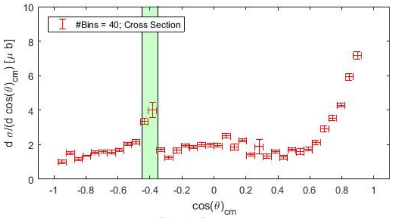
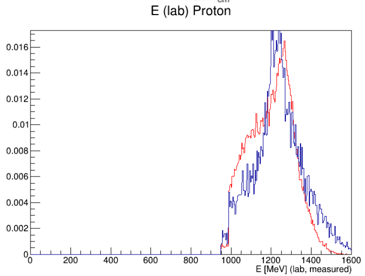
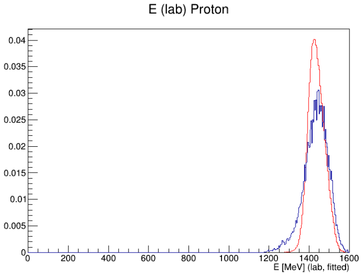


Energy of Proton for $\cos(\theta_\omega) = [-0.45, -0.35]$ (Peak)

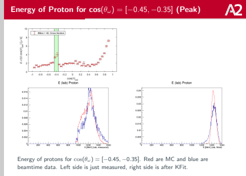


The energy of protons looks similar for MC and Data





Energy of protons for $\cos(\theta_\omega) = [-0.45, -0.35]$. Red are MC and blue are beamtime data. Left side is just measured, right side is after KFit.



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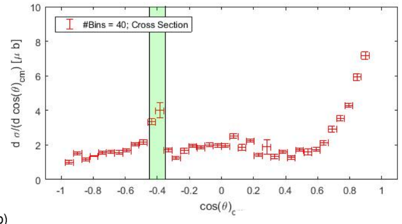

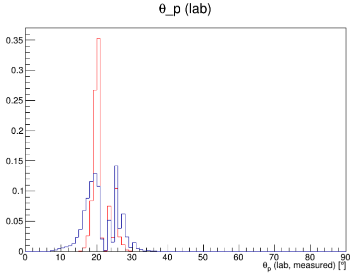

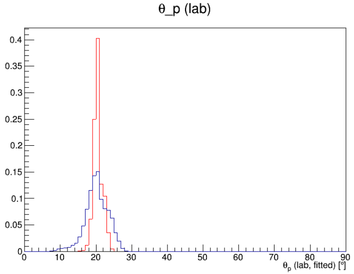

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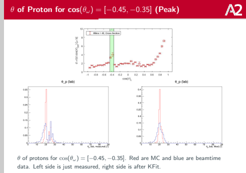
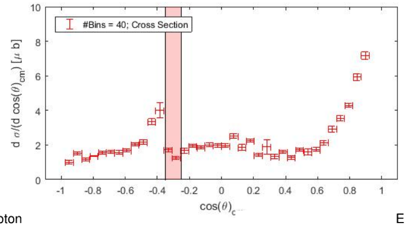
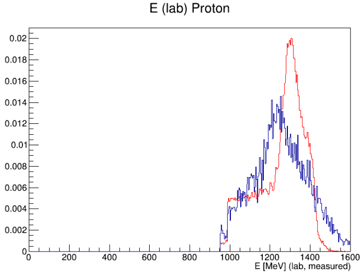
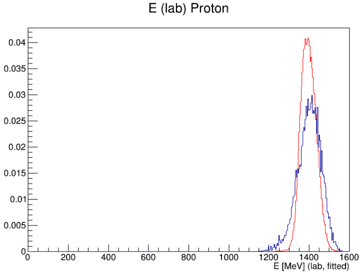


Energy of Protons for $\cos(\theta_\omega) = [-0.35, -0.25]$ (Dip)







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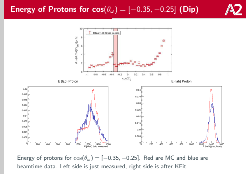

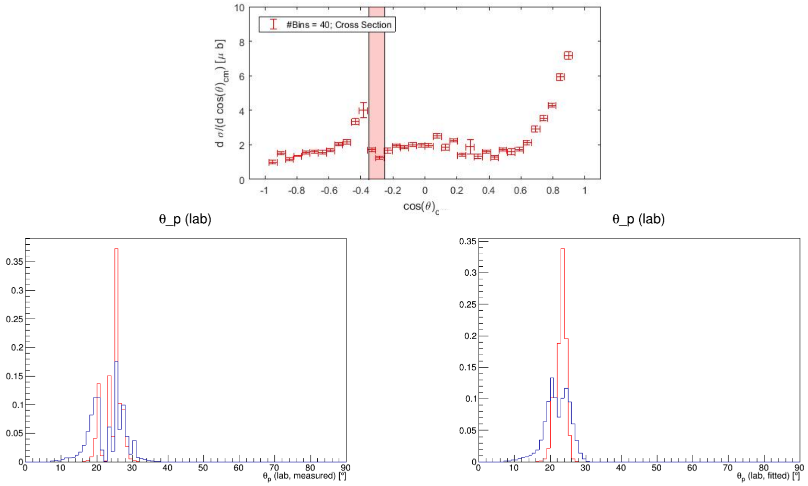

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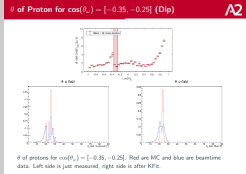
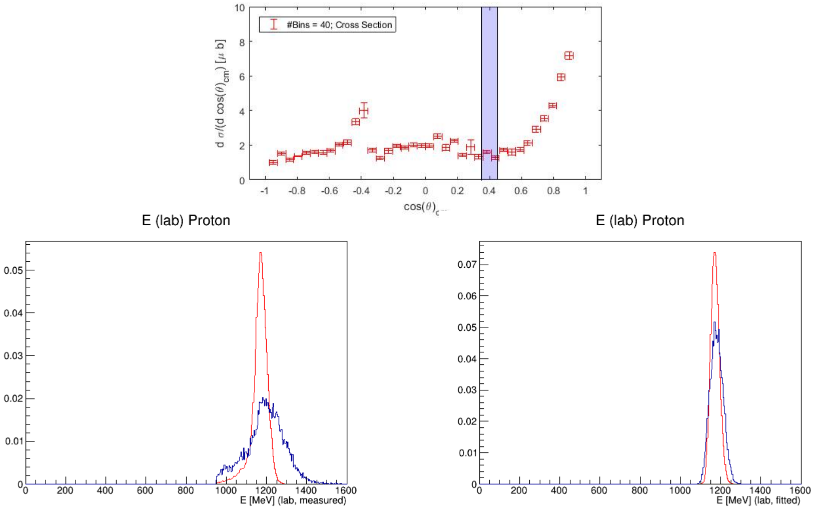


Energy of Protons for $\cos(\theta_\omega) = [0.35, 0.45]$ (Good)



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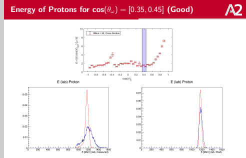

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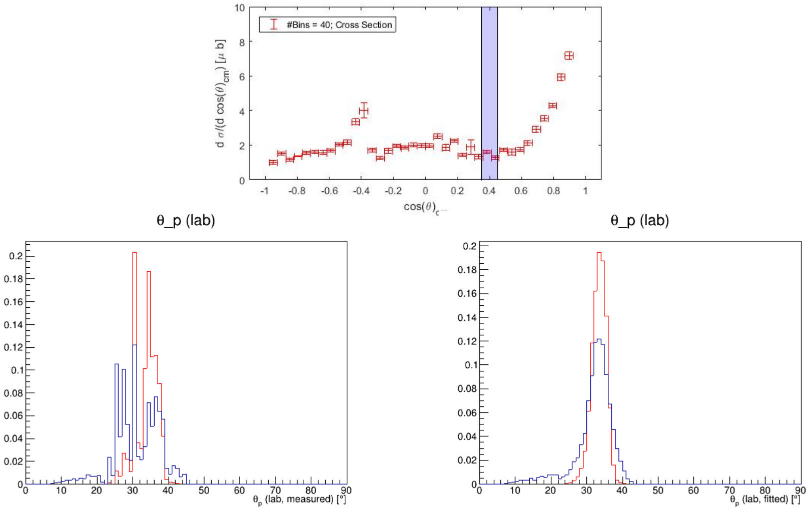

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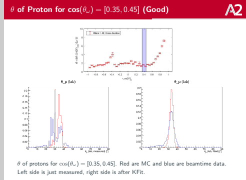

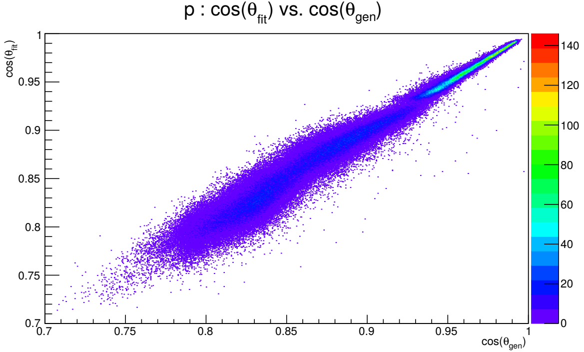

$\cos(\theta_{fit})$ vs. $\cos(\theta_{gen})$ for all protons.

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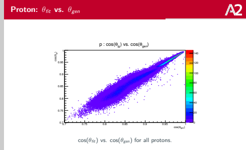
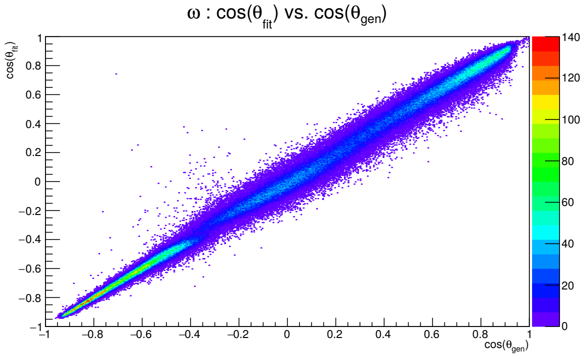
└Proton: θ_{fit} vs. θ_{gen}





$\cos(\theta_{fit})$ vs. $\cos(\theta_{gen})$ for all ω.

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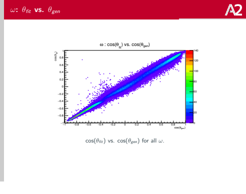
└ ω: θ_{fit} vs. θ_{gen}



Unfolding

Motivation

- μ is the *true* distribution given by nature
- detector effects are then described by the migration matrix R. (inefficiencies, bias and smearing)
- This results in the distribution ν.

$$\nu_i = \sum_{j=1}^{M} R_{ij}\mu_j$$

- With infinite statistics, it would be possible to recover the original distribution by inverting the migration matrix

$$\mu = R^{-1}\nu$$

- Use numerical methods to invert the migration matrix

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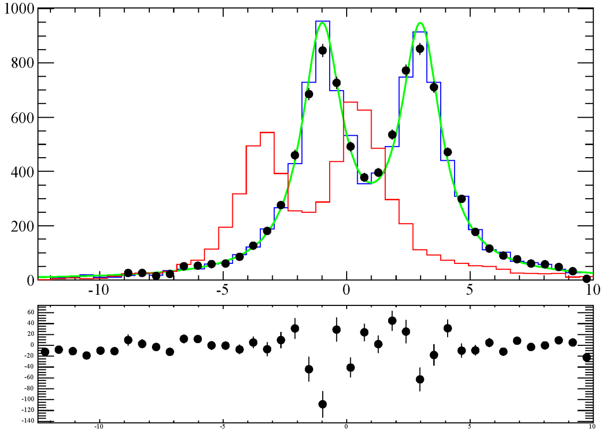
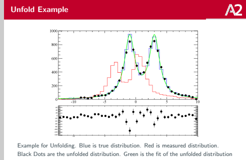
Unfold Example

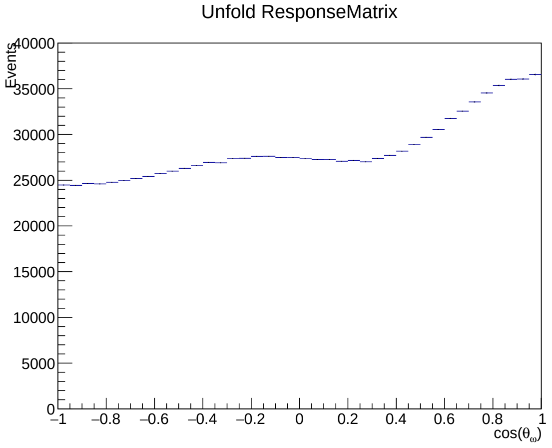


Example for Unfolding. Blue is true distribution. Red is measured distribution. Black Dots are the unfolded distribution. Green is the fit of the unfolded distribution

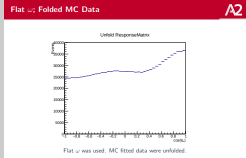


In region of $cos\theta(\omega)_{gen} \approx -0.35$, see broader distribution of $cos\theta(\omega)_{fit}$ −¿ simple 1D efficiency correction may not work well enough

Flat ω; Folded MC Data



Flat ω was used. MC fitted data were unfolded.



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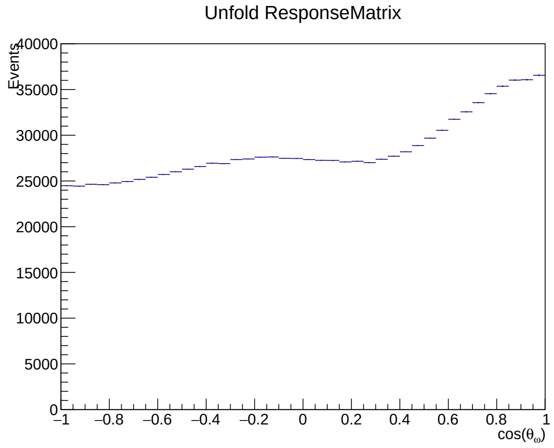

Flat ω was used. MC fitted data were unfolded.

- ω are generated with a flat phase space
- A migration matrix is calculated
- This migration matrix is than used to unfold realistic MC
- Unfortunately, the unfolded cross section does not have the desired shape
  $\rightarrow$ Unfolding was unsuccessful

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└Unfolding
└Flat ω; Folded MC Data

Flat ω; Folded MC Data

Conclusion

- Drop in the measured cross section at $\cos(\theta_\omega) \approx -0.35$ is caused by a drop in the efficiency at that region
- Inefficiency is caused by the protons hitting the edge of the CB
  $\rightarrow$ They are not reconstructed properly
- There are differences between MC and Data
- The differences are too big to make the Unfolding work

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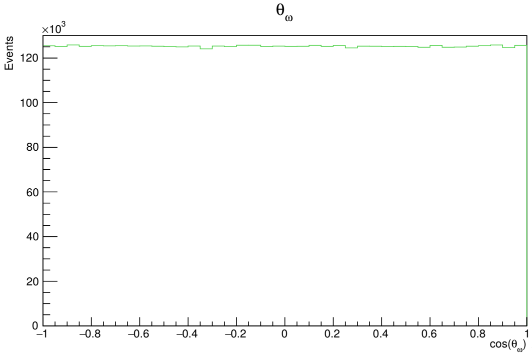
Backup



Flat generated ω

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└Backup