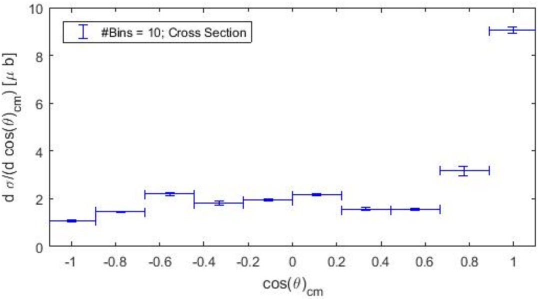
Omega Cross-Section

Martin Sobotzik

Institute for Nuclear Physics
Johannes Gutenberg-University of Mainz

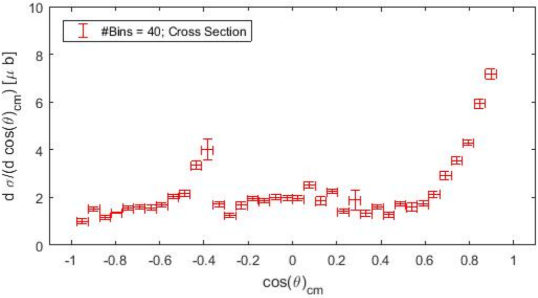
Mainz, March 2019

Starting Point



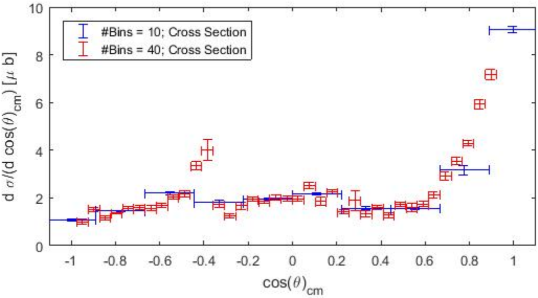
Olis Cross Section; Dip at about $\cos(\theta) = -0.3$

Increasing the Number of Bins



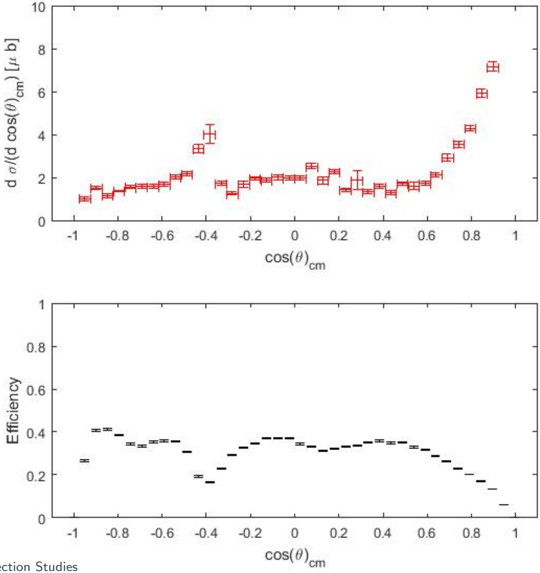
Increased number of bins to 40; now there is still a dip at $\cos(\theta) = -0.3$ but also a peak at $\cos(\theta) = -0.4$

Comparing 10 Bin to 40 Bin Cross Section



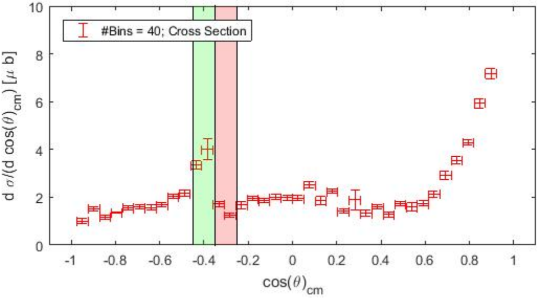
Both Cross Sections are shown.

Efficiency



$$\gamma p \rightarrow \omega \; p$$
$$\hookrightarrow \gamma\pi^0$$
$$\hookrightarrow \gamma\gamma$$

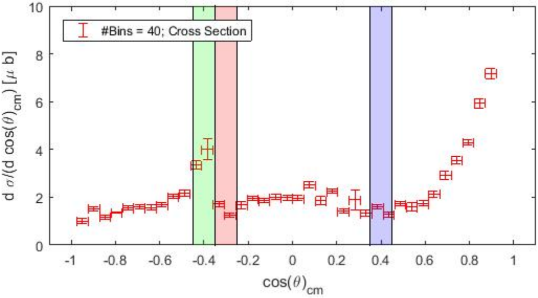
There is a 1:1 correlation between the polar angle of p and ω for fixed $E(\gamma)$!



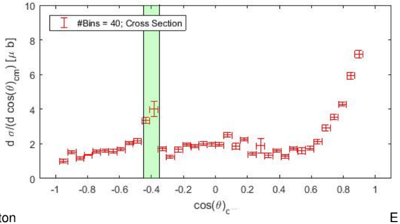
Taking a closer Look

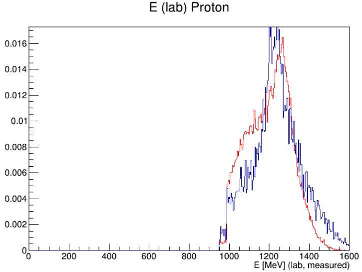
$$\gamma p \rightarrow \omega \; p$$
$$\hookrightarrow \gamma\pi^0$$
$$\hookrightarrow \gamma\gamma$$

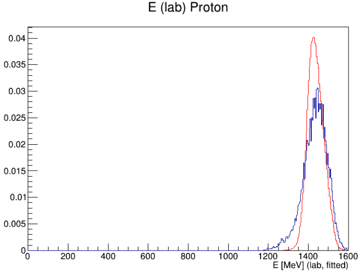
There is a 1:1 correlation between the polar angle of p and ω for fixed $E(\gamma)$!



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

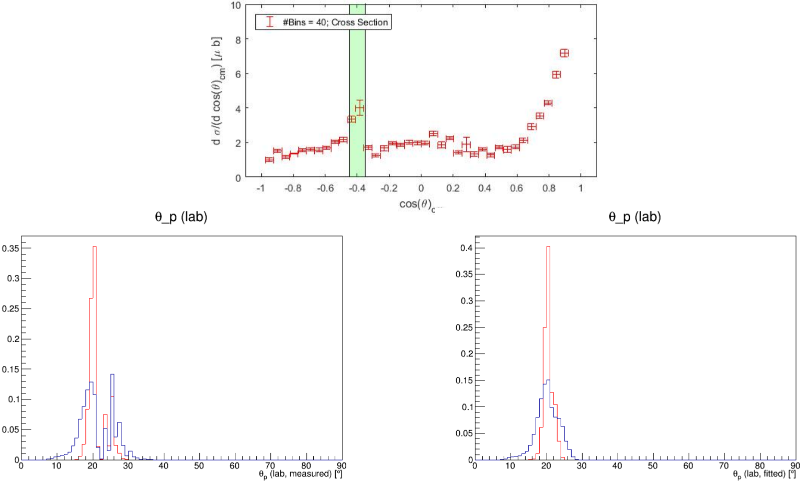






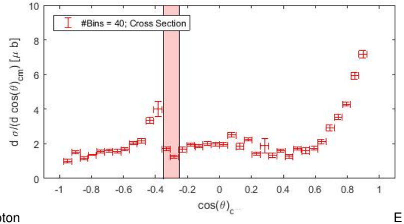
Energy of protons for $\cos(\theta_\omega) = [-0.45, -0.35]$. Red are MC and blue are beamtime data. Left side is just measured, right side is after KFit.

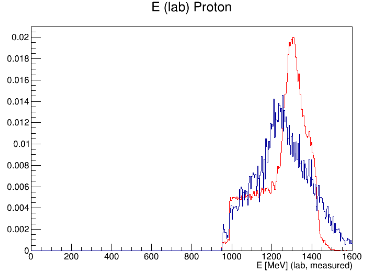
θ of Proton for $\cos(\theta_\omega) = [-0.45, -0.35]$ (Peak)

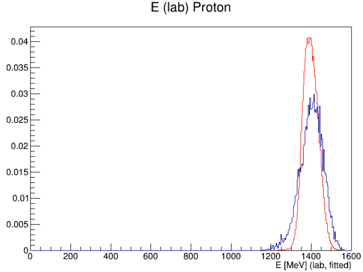


θ of protons for $\cos(\theta_\omega) = [-0.45, -0.35]$. Red are MC and blue are beamtime data. Left side is just measured, right side is after KFit.

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

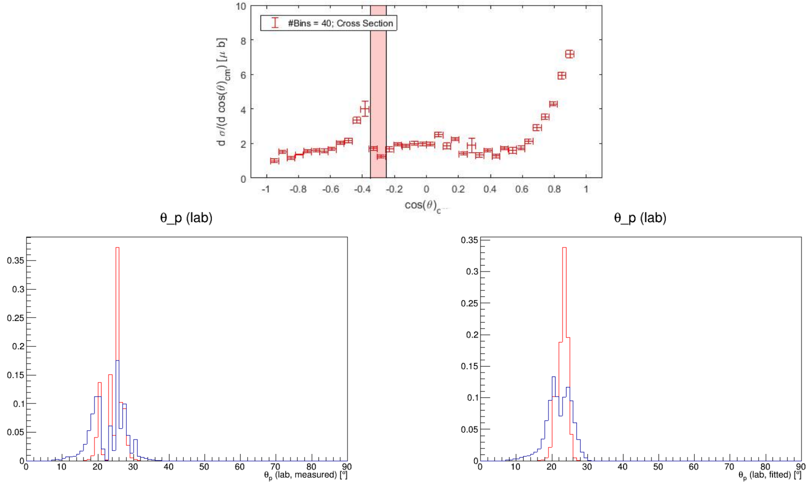






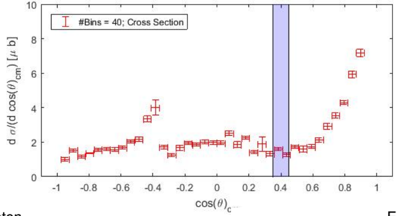
Energy of protons for $\cos(\theta_\omega) = [-0.35, -0.25]$. Red are MC and blue are beamtime data. Left side is just measured, right side is after KFit.

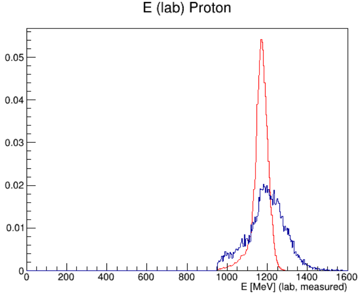
θ of Proton for $\cos(\theta_\omega) = [-0.35, -0.25]$ (Dip)

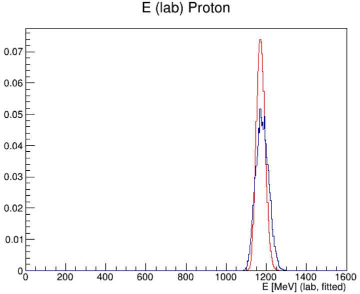


θ of protons for $\cos(\theta_\omega) = [-0.35, -0.25]$. Red are MC and blue are beamtime data. Left side is just measured, right side is after KFit.

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

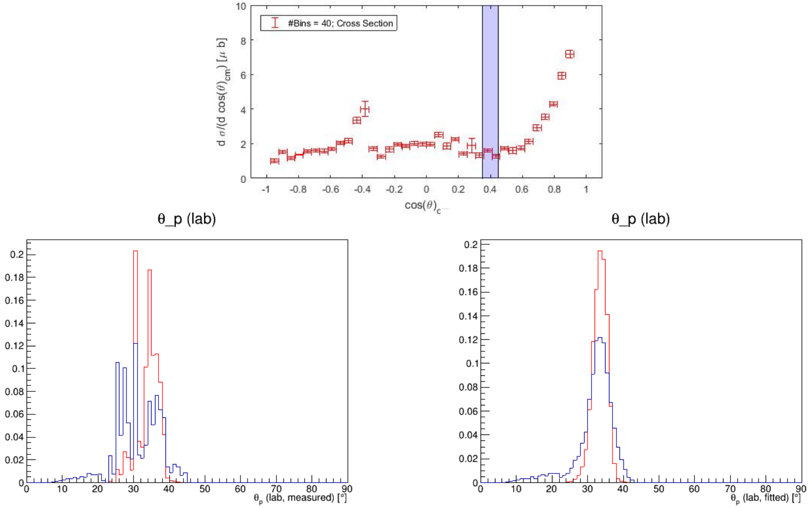






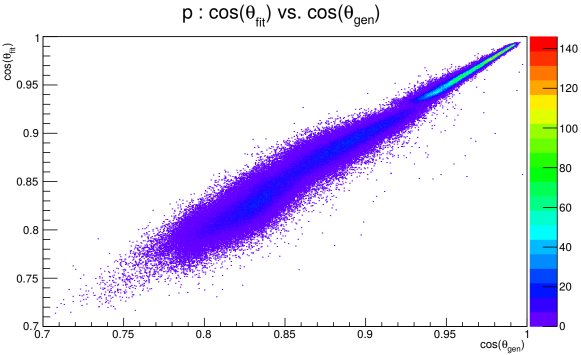
Energy of protons for $\cos(\theta_\omega) = [0.35, 0.45]$. Red are MC and blue are beamtime data. Left side is just measured, right side is after KFit.

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



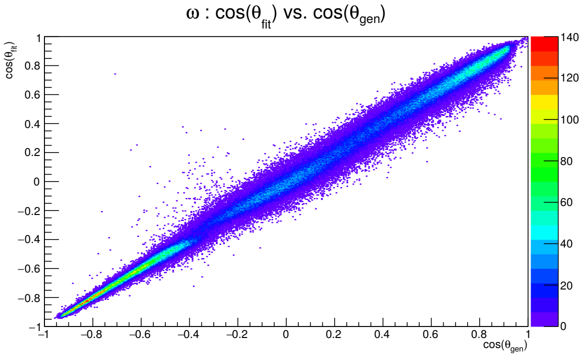
θ of protons for $\cos(\theta_\omega) = [0.35, 0.45]$. Red are MC and blue are beamtime data. Left side is just measured, right side is after KFit.

Proton: θ_{fit} vs. θ_{gen}



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

ω: θ_{fit} vs. θ_{gen}



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

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.

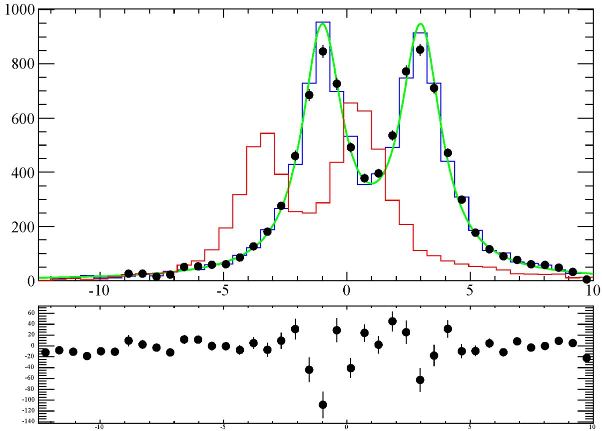
$$\nu_i = \sum_{j=1}^{M} R_{ij}\mu_j$$

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

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

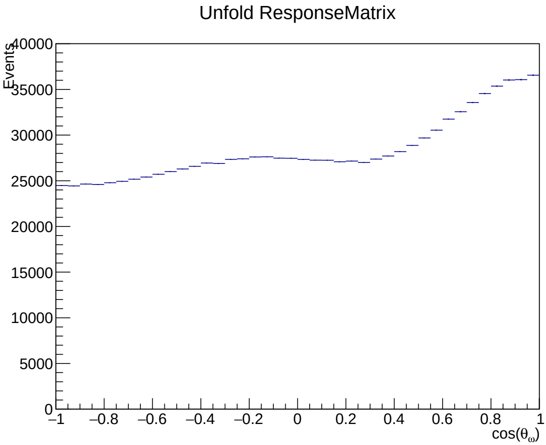
- Use numerical methods to invert the migration matrix

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

Flat ω; Folded MC Data



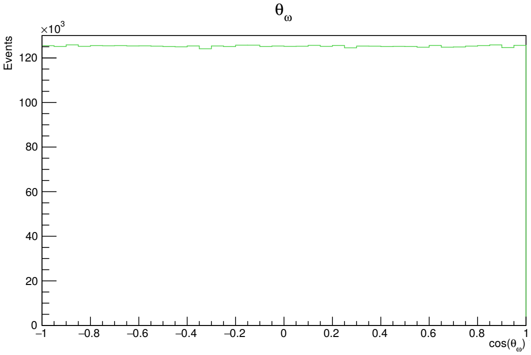
Flat ω was used. MC fitted data were unfolded.

- 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

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

Backup



Flat generated ω