Omega Cross-Section

Martin Sobotzik

Institute for Nuclear Physics
Johannes Gutenberg University of Mainz

Mainz, March 2019

Starting Point

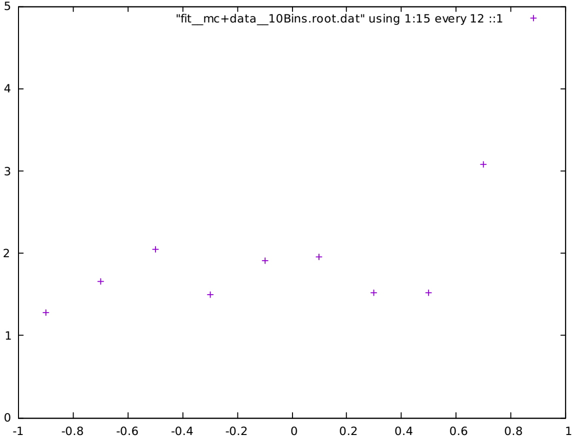

Figure 1: Olis Cross Section; Dip at about $\cos(\theta) = -0.3$

Increasing the Number of Bins

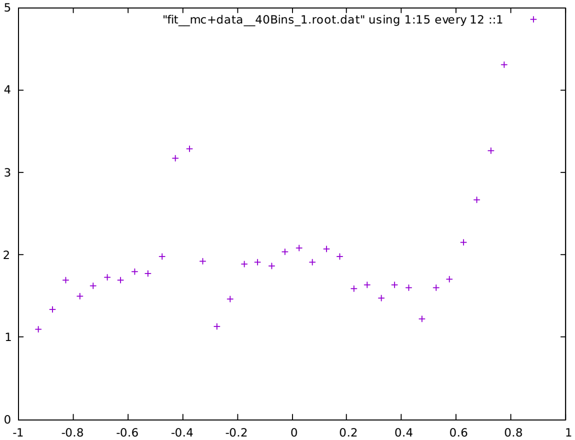

Figure 2: Increased number of bins to 40; now there is still a dip at $\cos(\theta) = -0.3$ but also a peak at $\cos(\theta) = -0.5$

Comparing 10 Bin to 40 Bin Cross Section

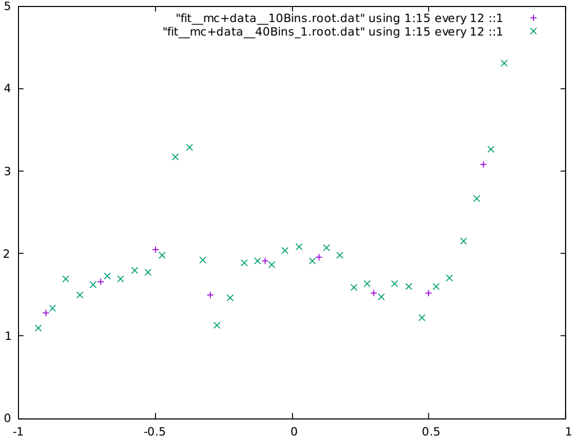

Figure 3: Both Cross Sections are shown.

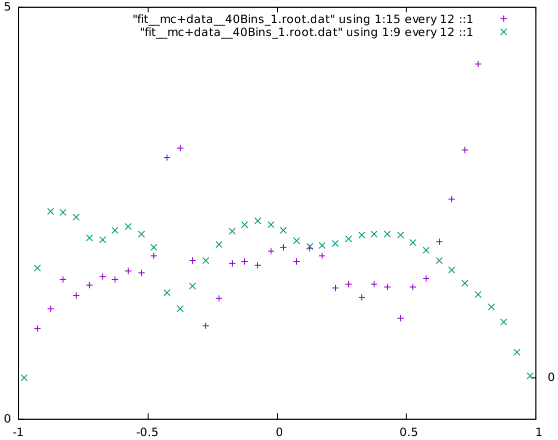

Figure 4: Cross Section and efficiency. There is an efficiency drop at $\cos(\theta) \approx -0.3$

Taking a closer Look

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

Closer look at:

- ω
- Bachelor Photon
- π^0
- $\gamma\gamma$
- Proton
- $\cos(\theta) = [-0.35, -0.25]$ Dip
- $\cos(\theta) = [-0.45, -0.35]$ Peak

and compare MC with Beamtime Data (both reconstructed)

What was used?:

- Prompt Random Subtraktion
- w_taggW ("TaggW");
- w_mass_Cut("ggg.M()>700");
- cut_KCut("KinFitProb > 0.2 && nCandsInput == 4 && copl_angle < 0.05");

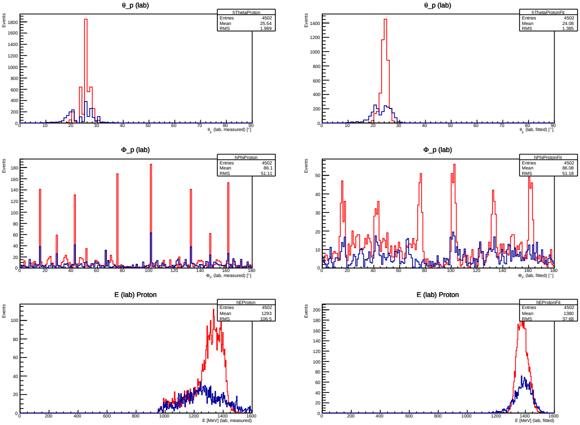

Figure 5: Red: MC; Blue Beamtime Data; Protons for $\cos(\theta_\omega) = [-0.35, -0.25]$; Right Side are fitted data

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

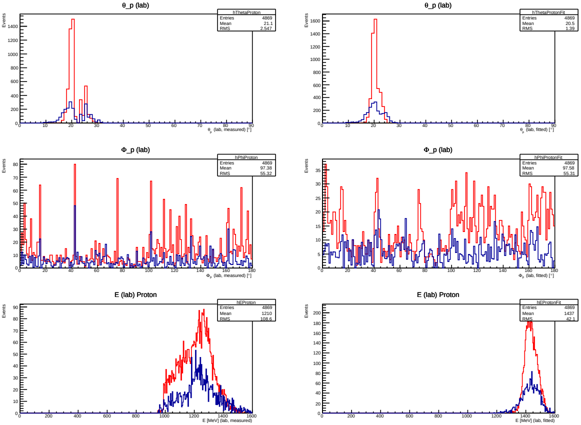

Figure 6: Red: MC; Blue Beamtime Data; Protons for $\cos(\theta_\omega) = [-0.45, -0.35]$; Right Side are fitted data

Proton: θ_{fit} vs. θ_{gen}

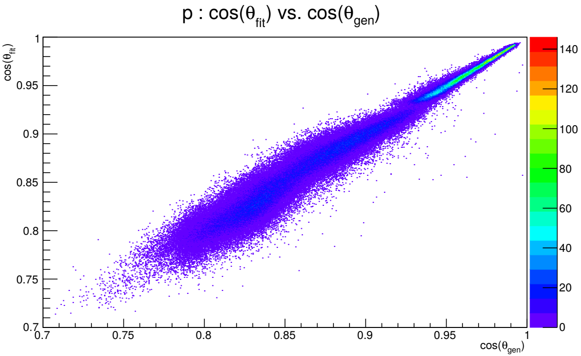

Figure 7: $\cos(\theta_{fit})$ vs. $\cos(\theta_{gen})$ for all protons.

ω: θ_{fit} vs. θ_{gen}

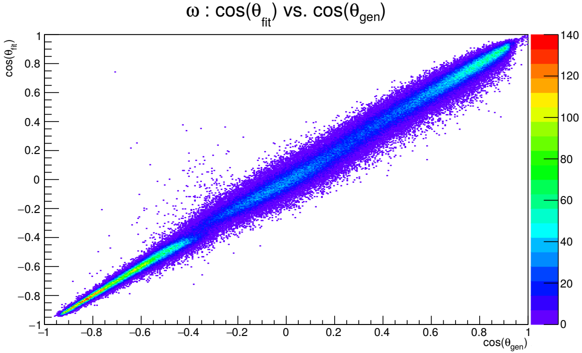

Figure 8: $\cos(\theta_{fit})$ vs. $\cos(\theta_{gen})$ for all ω.

Unfolding

Motivation

- μ is the *true* distribution given by nature
- detector effects are then described by the response function 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 response matrix

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

What is Unfolding?

- Using MC we can train the unfolding algorithm
- Create a 2D-Hist with $\cos(\theta_\omega)$ of all generated and all reconstructed ω (ω which are generated but not reconstructed are label *miss*)
- Then we can solve for μ iteratively

Example with Gaussian

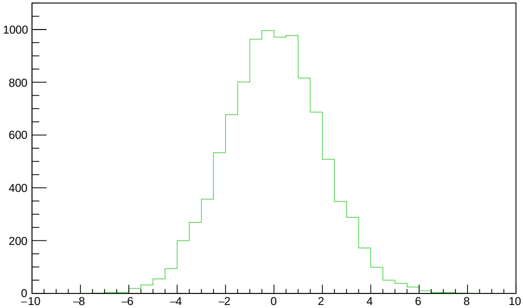

Figure 9: Example for a working Unfolding Algorithm

Example with Gaussian

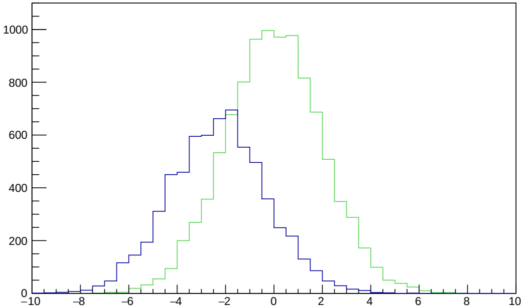

Figure 9: Example for a working Unfolding Algorithm

Example with Gaussian

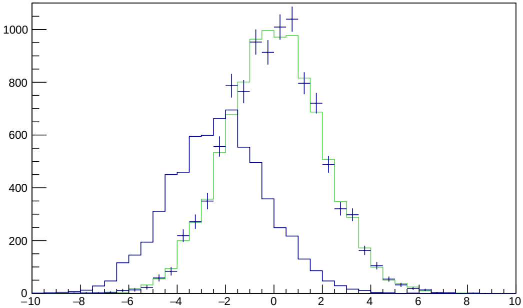

Figure 9: Example for a working Unfolding Algorithm

Folded

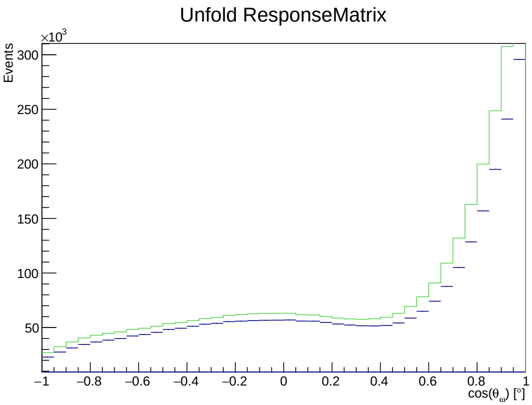

Figure 10: Folded; same cuts

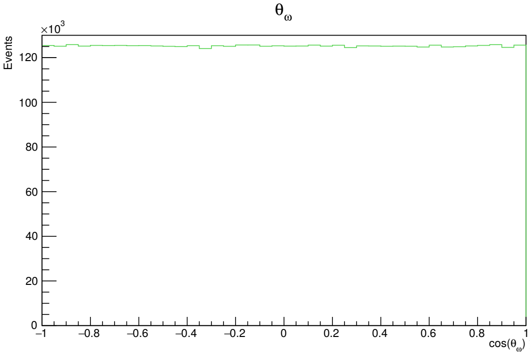

Figure 11: Distribution of the ω in center of mass frame

Flat ω; Folded MC Data

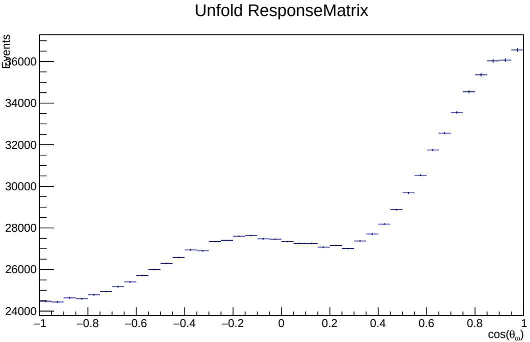

Figure 12: Flat ω was used. MC fitted data were folded.