Measuring the Target Asymmetry in $p\pi^0\eta$ Photoproduction

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Collaboration Meeting

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Outline

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1. Target Asymmetry P_z
2. Calculating P_z for $\gamma p \longrightarrow p\pi^0\eta$
   - Selecting the Reaction $\gamma p \longrightarrow p\pi^0\eta$
   - Factoring in Target Polarization
   - Photon Flux
   - Results
3. Things to Improve

Polarization Observables (November 2007 Beamtime)

November 2007 Beamtime

Circularly Polarized Photons, Longitudinally Polarized Target

Polarization Observables possible

(Two Mesons in the final state)

$$\frac{\partial\sigma}{\partial x_i} = \frac{\partial\sigma_0}{\partial x_i}(1 + \Lambda_z P_z + \delta_{\odot} I^{\odot} + \delta_{\odot}\Lambda_z E)$$

Ultimate Goal $\Rightarrow$ E

First Attempt $\Rightarrow$ P_z

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Calculating P_z

After Solving for P_z: ($\Rightarrow$ means Positive Target Polarization)

$$\longrightarrow P_z(x_i) = \frac{1}{2\,\Lambda_z}\frac{\frac{\partial\sigma_\Rightarrow}{\partial x_i} - \frac{\partial\sigma_\Leftarrow}{\partial x_i}}{\frac{\partial\sigma_\Rightarrow}{\partial x_i} + \frac{\partial\sigma_\Leftarrow}{\partial x_i}} = \frac{1}{2}\frac{\frac{N_\Rightarrow}{\Lambda_z^\Rightarrow}\frac{1}{Flux_\Rightarrow} - \frac{N_\Leftarrow}{\Lambda_z^\Leftarrow}\frac{1}{Flux_\Leftarrow}}{\frac{N_\Rightarrow}{Flux_\Rightarrow} + \frac{N_\Leftarrow}{Flux_\Leftarrow}}$$

Need

- Number of Reconstructed $p\pi^0\eta$ events under each polarization.
- Photon Flux under each polarization.
- Target Polarization for each event.

Only binning in CM Energy
(Integrating over all other Kinematic Variables)

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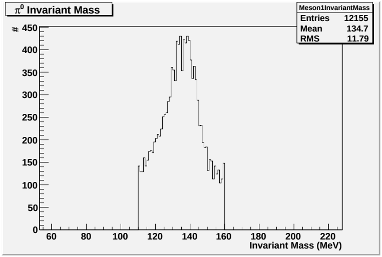
Reaction Selection Cuts

Data	November 2007 Beamtime (Nov 24, 2007 - Dec 19, 2007)
Particles	1 charged, 4 uncharged
π^0 mass	{110,160} MeV
η mass	{500,600} MeV
Missing Mass (proton)	{750,1150} MeV
Coplanarity	$\pm 20^\circ$
Reaction Time	{-5,5} ns

$\Rightarrow$ 12,155 events

π^0*Mass*



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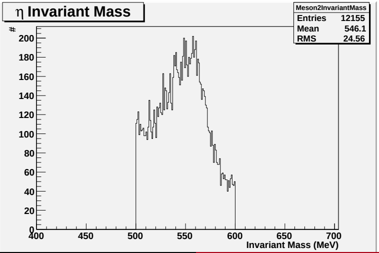

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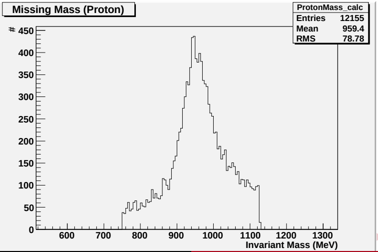

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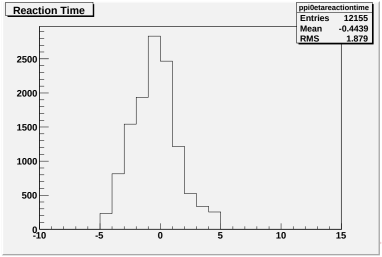
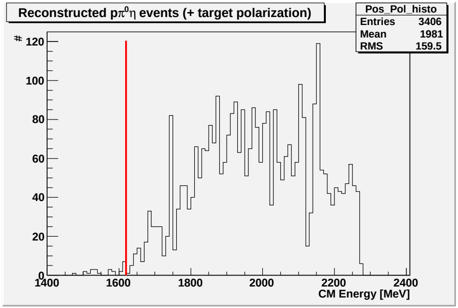
Reaction Time



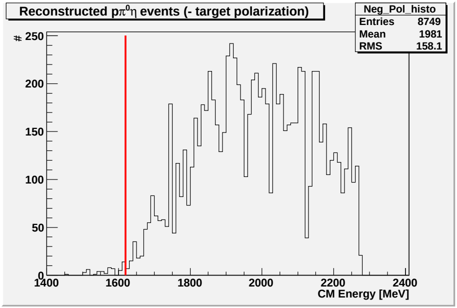
Reconstructed $p\pi^0\eta$ Events

Positive Target Polarization ($N_{\Rightarrow}$)



3406 events

Negative Target Polarization ($N_{\Leftarrow}$)



8749 events

$p\pi^0\eta$ Threshold $\approx$ 1620 MeV (red line)

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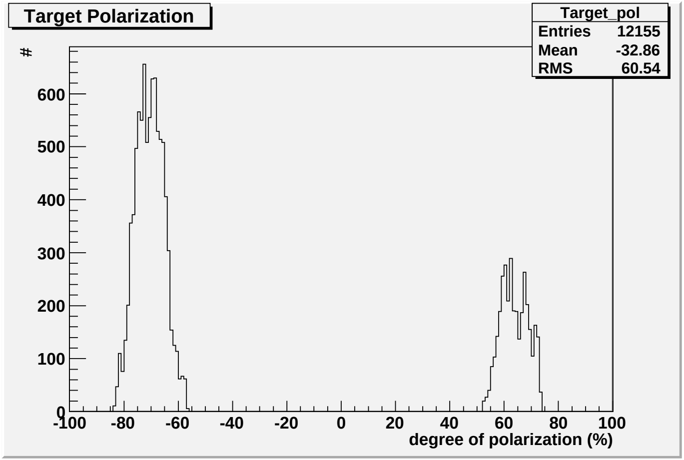
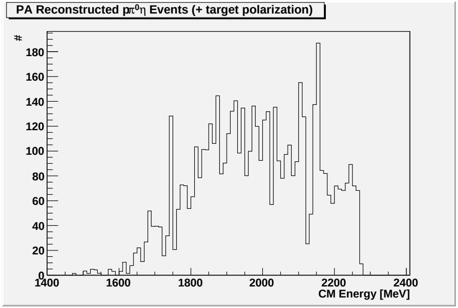
Target Polarization



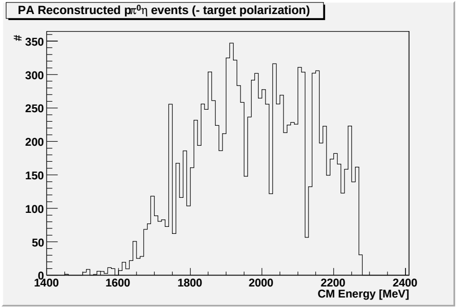
Unequal Beamtime from each Target Polarization Setting

Polarization Adjusted Reconstructed $p\pi^0\eta$ Events

Positive Target Polarization ($\frac{N_{\Rrightarrow}}{\Lambda_z^{\Rrightarrow}}$)



Negative Target Polarization ($\frac{N_{\Lleftarrow}}{\Lambda_z^{\Rrightarrow}}$)



Histograms filled with each event divided by its degree of polarization.

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Photon Flux Quick Fix

Need a Normalization Factor

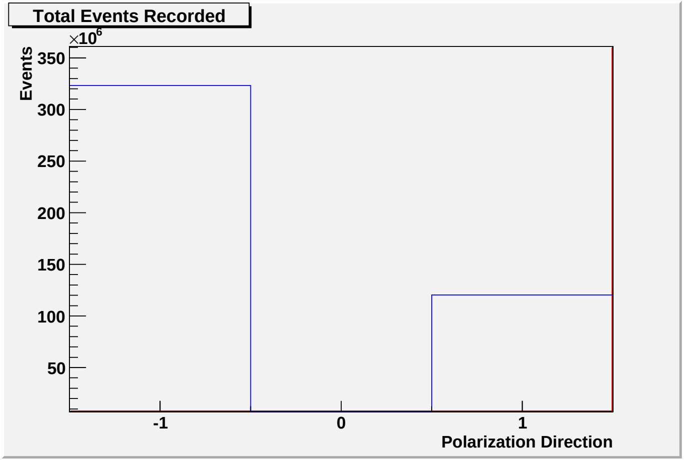
Perfect world $\longrightarrow$ Photon Flux.
My World $\longrightarrow$ Total Events Recorded.

Total Events Recorded

Dominated by 2 body final state reactions and unpolarized events (unpolarized nucleons).

Largely invariant to change in target polarization.

Total Events Recorded



Positive Polarization 1.20×10^8 events recorded
Negative Polarization 3.23×10^8 events recorded

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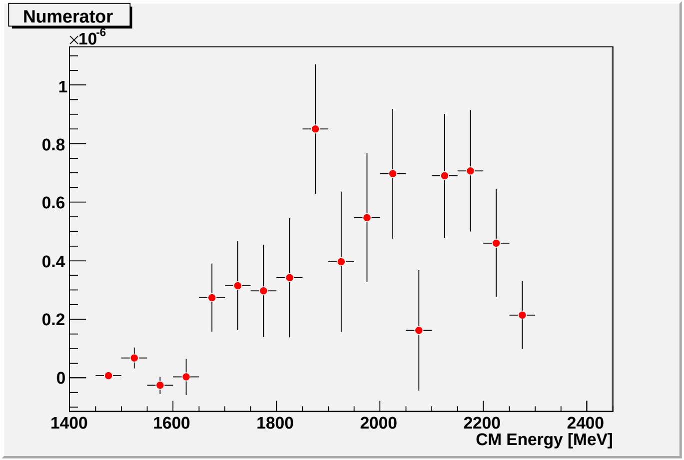
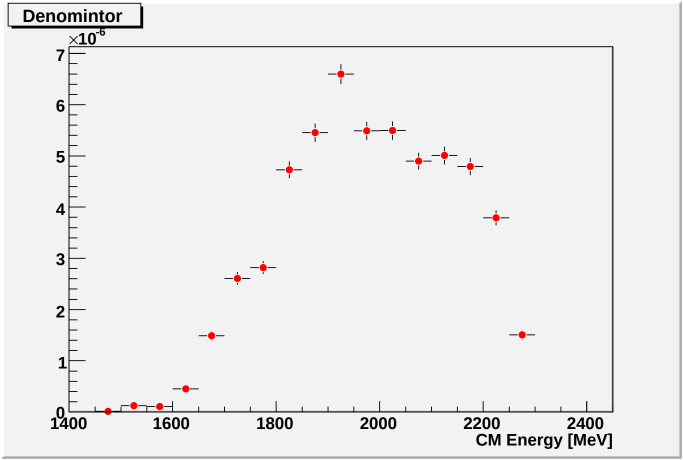
Numerator

$$Numerator = \frac{N_{\Rightarrow}}{\Lambda_z^{\Rightarrow}}\frac{1}{Flux_{\Rightarrow}} - \frac{N_{\Leftarrow}}{\Lambda_z^{\Leftarrow}}\frac{1}{Flux_{\Leftarrow}}$$



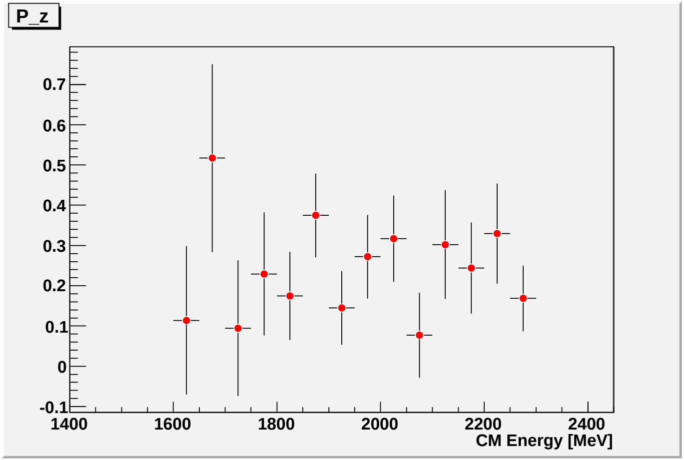
Denominator

$$Denominator = \frac{N_{\Rightarrow}}{Flux_{\Rightarrow}} + \frac{N_{\Leftarrow}}{Flux_{\Leftarrow}}$$



P_z

$$P_z = \frac{1}{2}\frac{\frac{N_{\Rightarrow}}{\Lambda_z^{\Rightarrow}}\frac{1}{Flux_{\Rightarrow}} - \frac{N_{\Leftarrow}}{\Lambda_z^{\Leftarrow}}\frac{1}{Flux_{\Leftarrow}}}{\frac{N_{\Rightarrow}}{Flux_{\Rightarrow}} + \frac{N_{\Leftarrow}}{Flux_{\Leftarrow}}}$$



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Work to be done

- Include the Correct Photon Flux
- Improve the Reconstruction Efficiency
- Include the Summer? 2009 Data
- Include Acceptance and Efficiency Effects
- Incorporate Beam Polarization to Calculate the Helicity Difference (E)