

ρ^0 Single Spin Asymmetries (SSAs) in $ep \rightarrow epX$

By: Blake Williams,

Max Buckner, Nathan Carpenter, Dr. Fatiha Benmokhtar,

RGA Fall 2018 – Spring 2019 inbending data

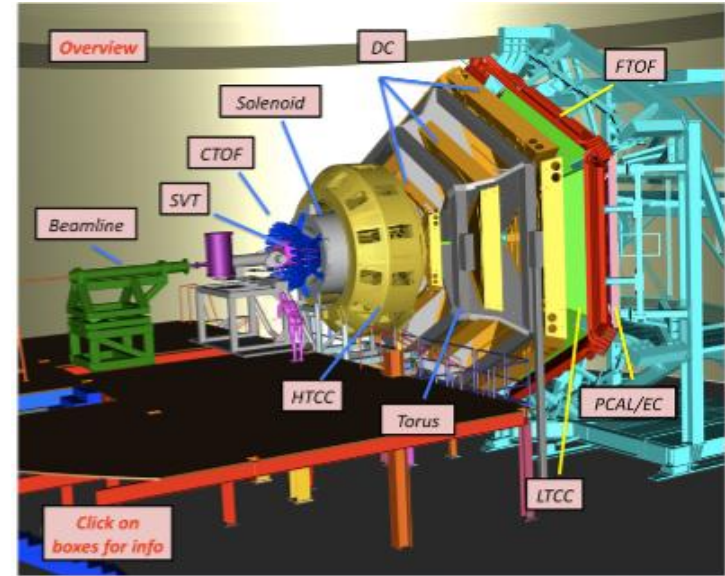
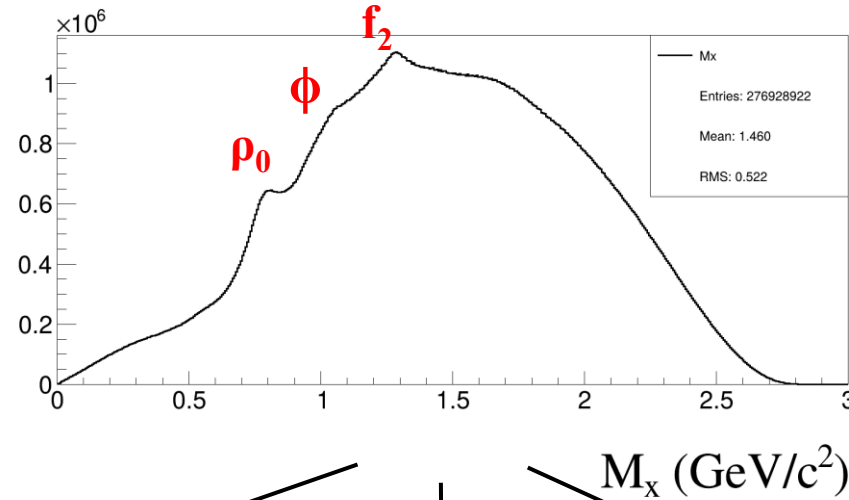
10.6 GeV Polarized electron beams, unpolarized hydrogen target, pass2 analysis

With T. Hayward and H. Avakian

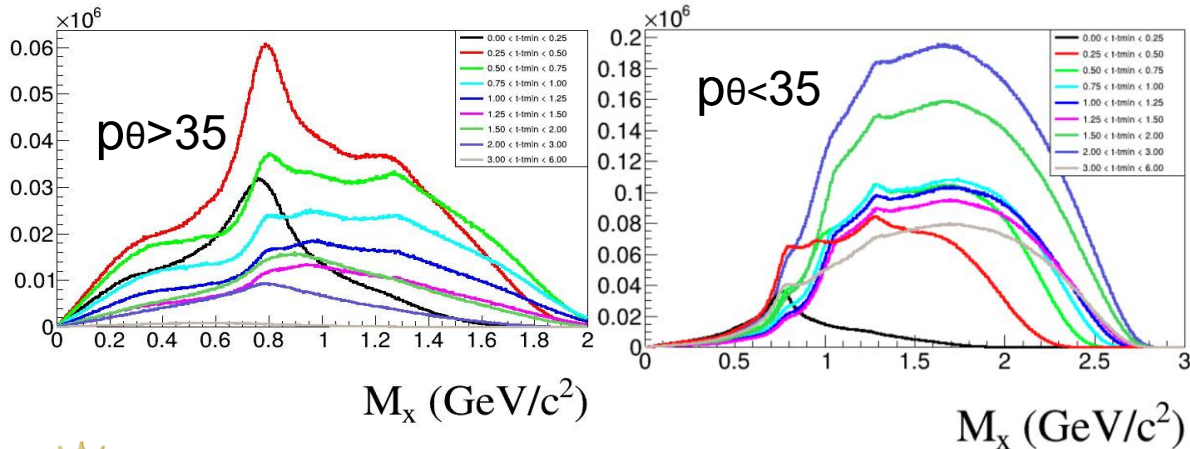


Origins of the resonances (In the detector)

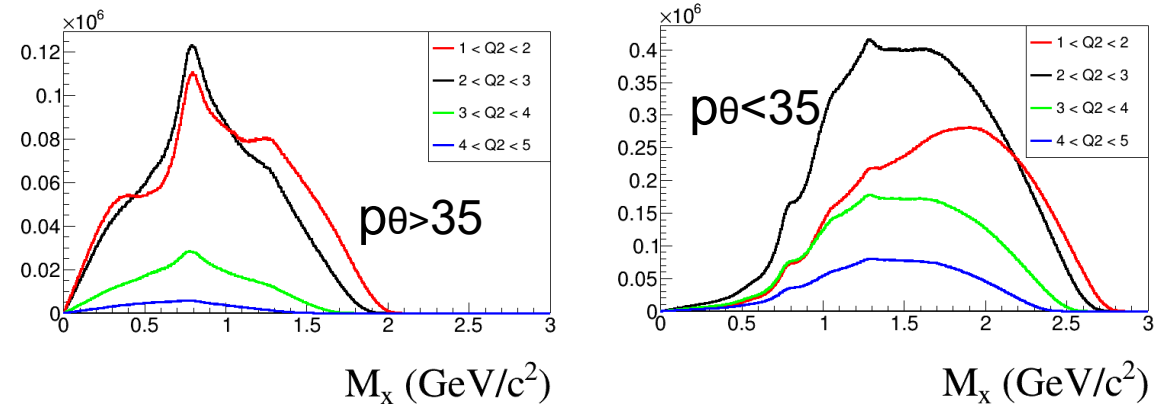
$$ep \rightarrow epX$$



Scans on $-t-t_{min}$



Scans on Q^2



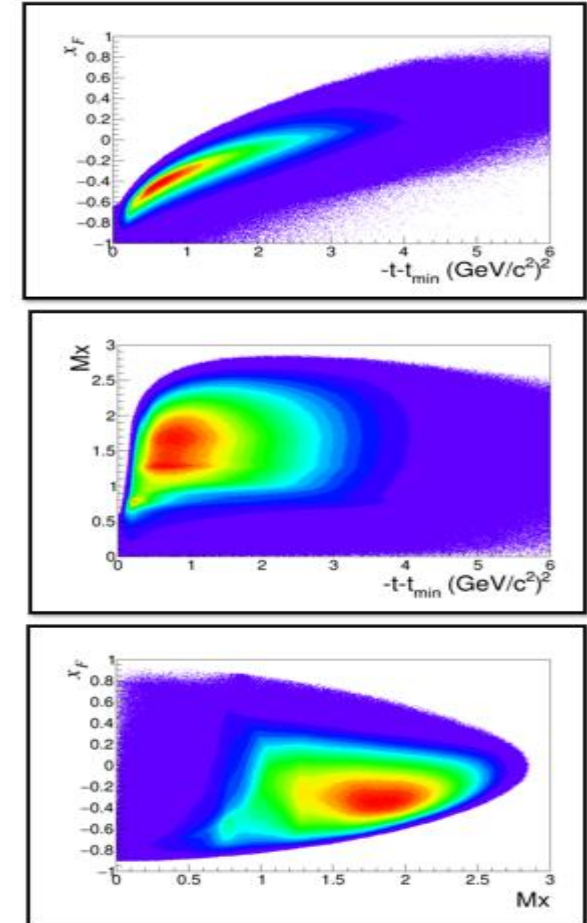
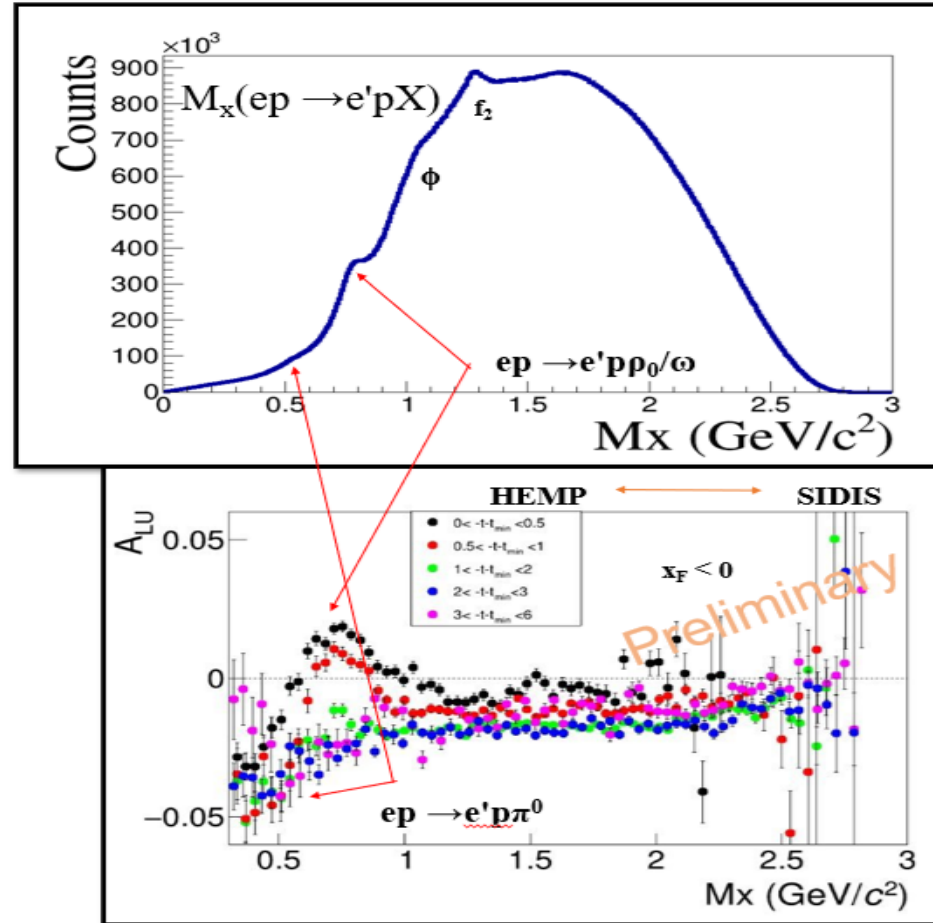
What is ρ^0 ? And how can we extract it?

No channel selection here

Mx-dependent asymmetries were plotted over bins of $-t-t_{\min}$ to investigate the contributions of the resonance, ρ_0 . ρ_0 is an uncharged particle detected in the scattering experiment. It consists of a quark and antiquark and is a mixture of quantum states given by

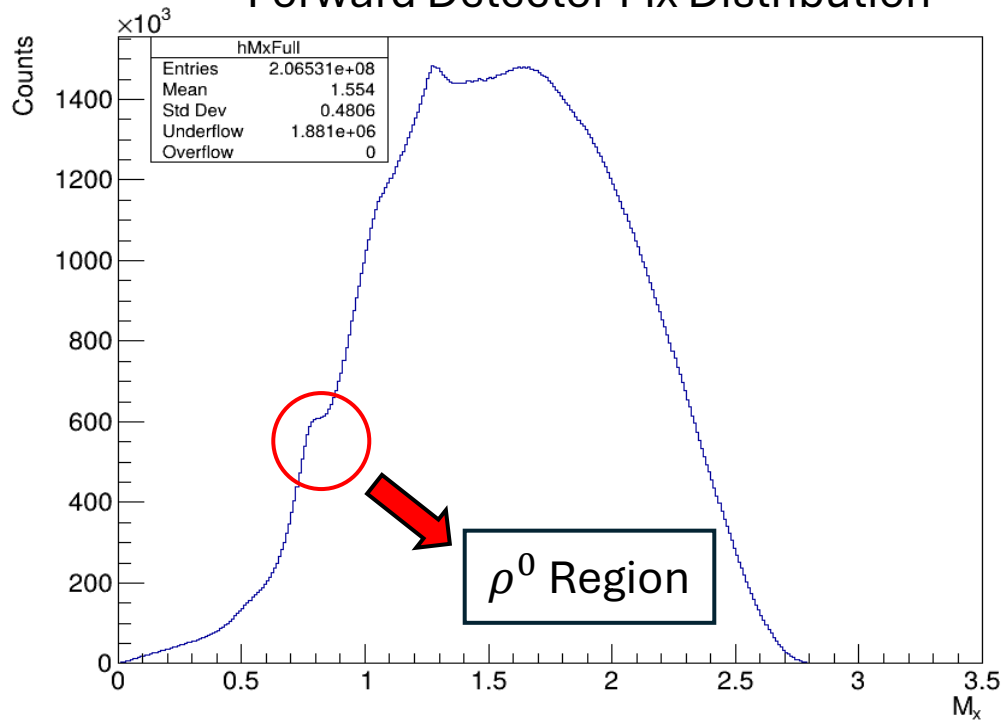
$$\rho_0 = \frac{u\bar{u} - d\bar{d}}{\sqrt{2}}$$

t_{\min} is the minimum four-momentum transfer.



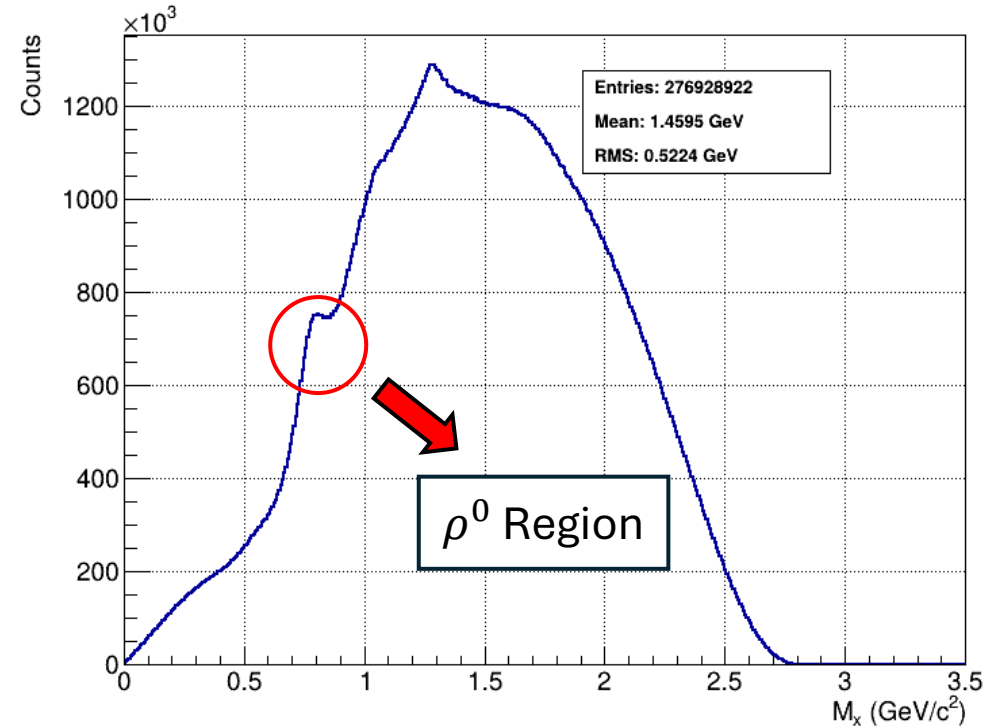
Missing Mass (M_x) Distribution

Forward Detector Mx Distribution



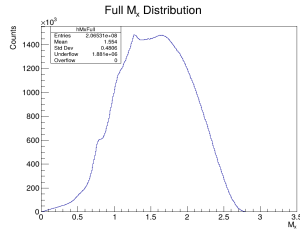
- Forward Detector Mx Distribution
- ρ^0 is noticeable, but not very pronounced

Open Detector Mx Distribution

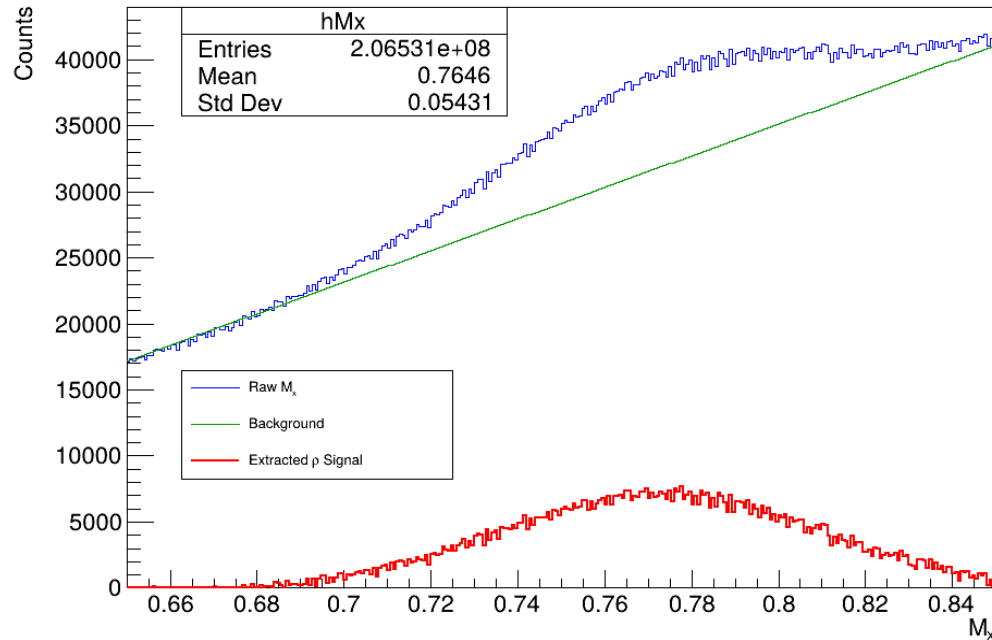


- Open Detector Mx Distribution
- ρ^0 becomes more pronounced with full detector dataset

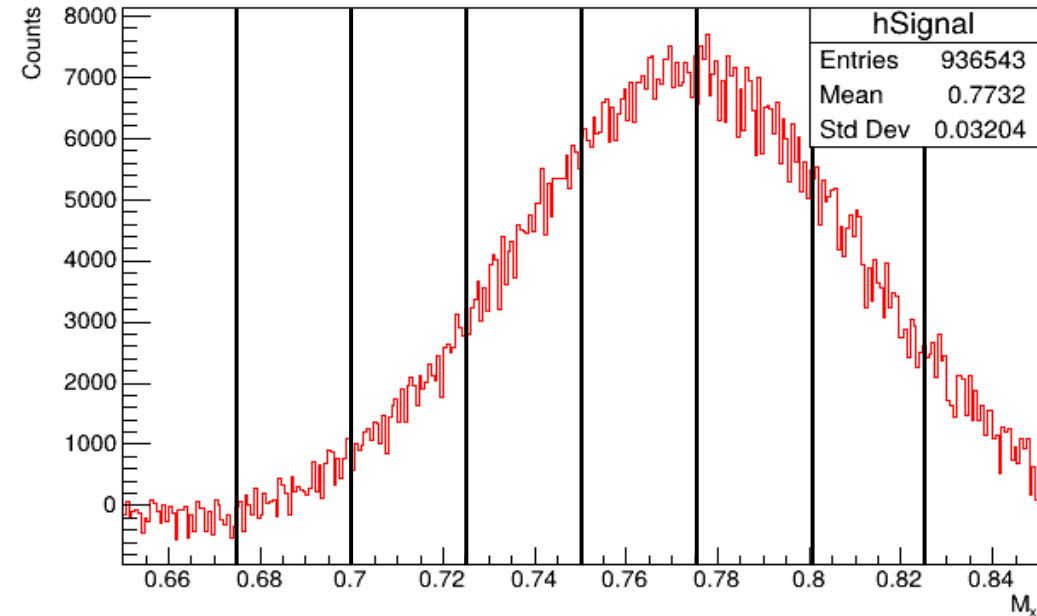
Linear ρ^0 Extraction (Forward Detector)



Overlay



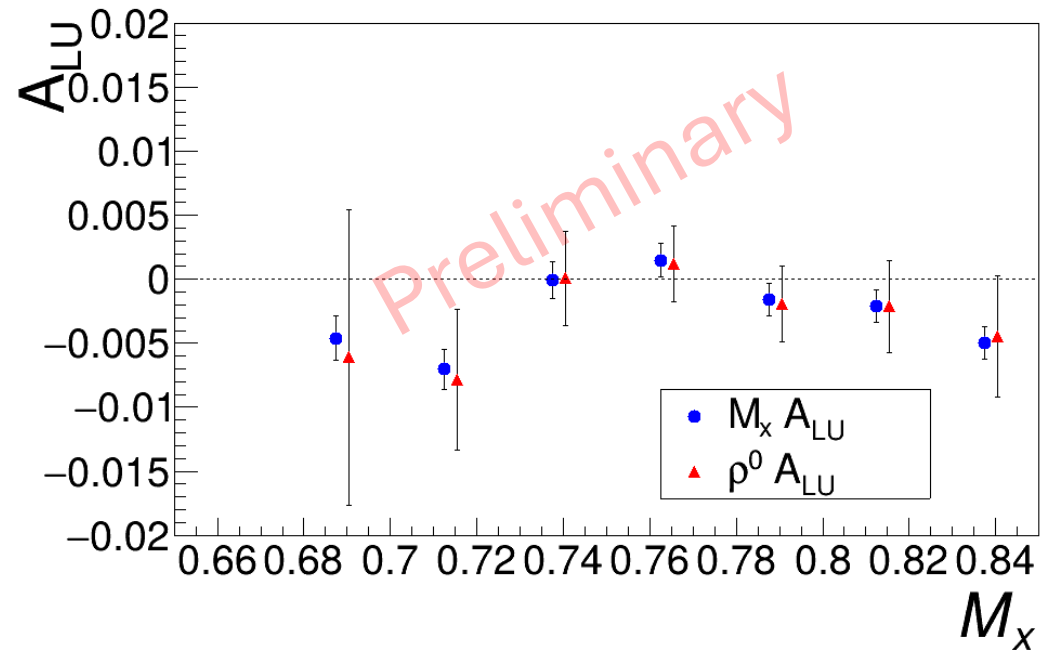
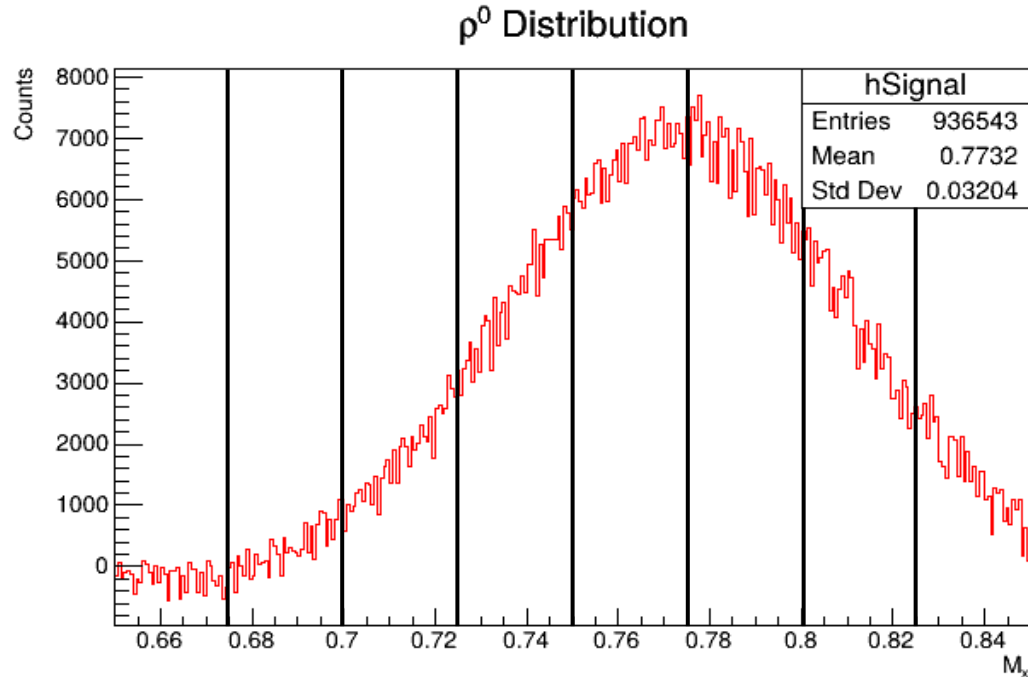
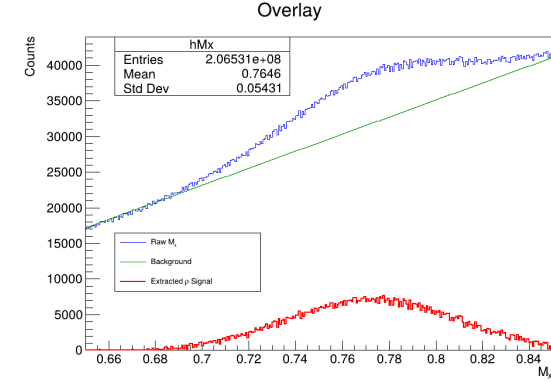
ρ^0 Distribution



- To extract ρ^0 cuts were made along M_x from 0.65-0.85
- A linear extraction is conducted which subtracts the background from the M_x region
- 8 Bins were taken across the ρ^0 distribution to take asymmetries

$\rho(770)$ Mass = 0.77526 ± 0.00023 GeV
 0.206% Difference Between Masses

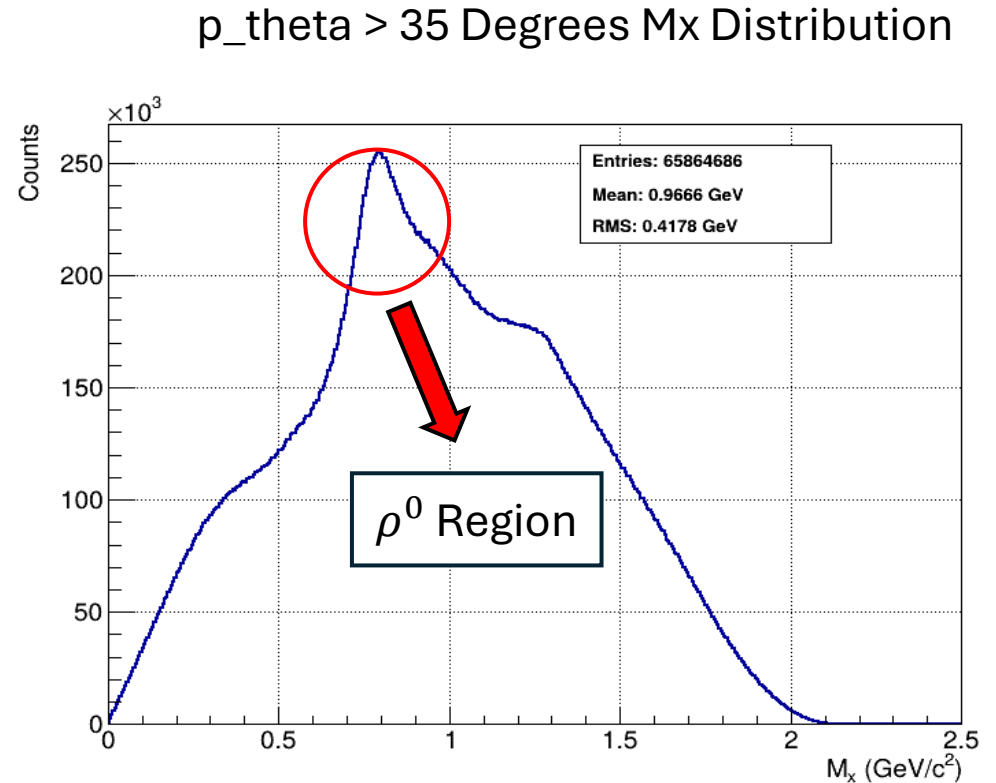
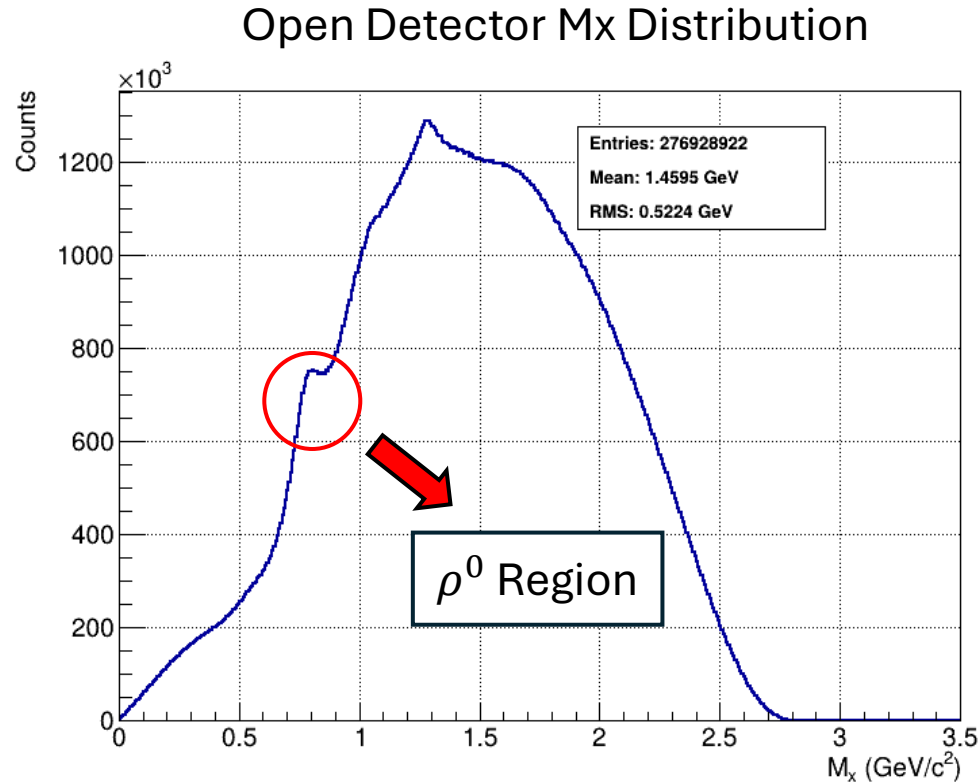
Linear ρ^0 Asymmetry



- The 1st of the 8 bins was removed due to having low statistics
- When compared against Mx both asymmetries follow the same shape

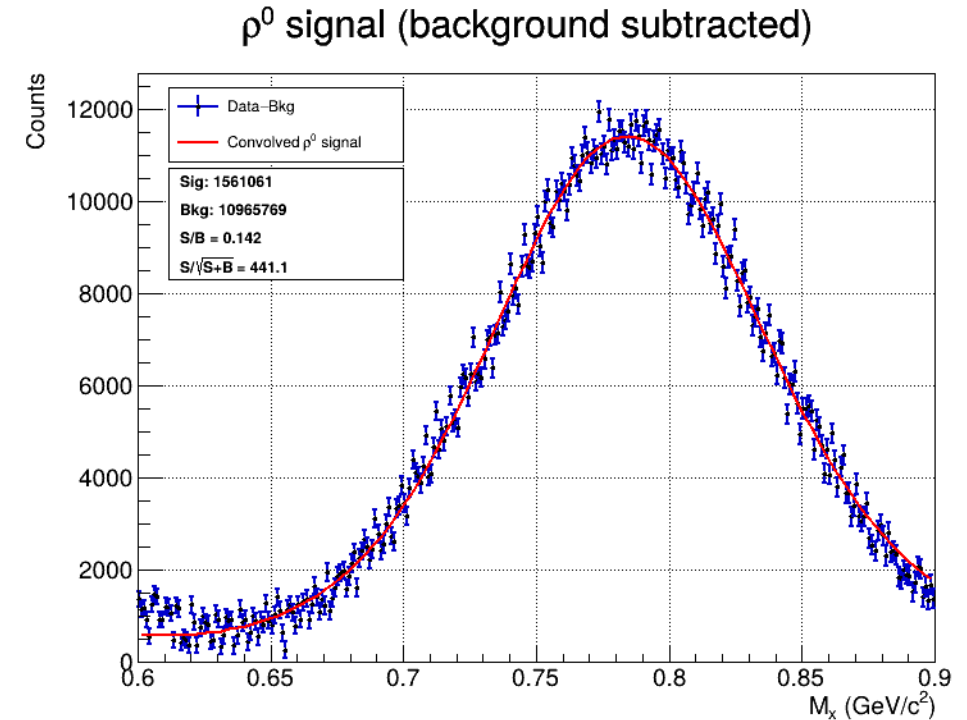
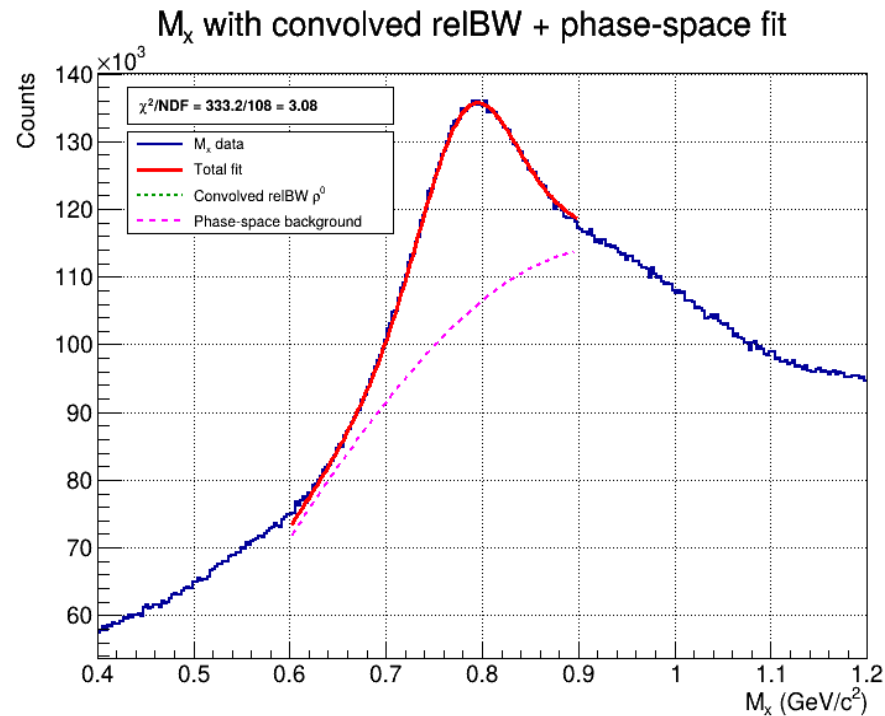
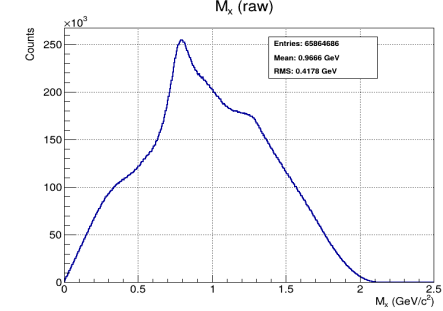
$$A(\phi)_{LU} = \frac{1}{p} \left(\frac{N^+ - N^-}{N^+ + N^-} \right)$$

Missing Mass (M_x) Distribution (Continued)



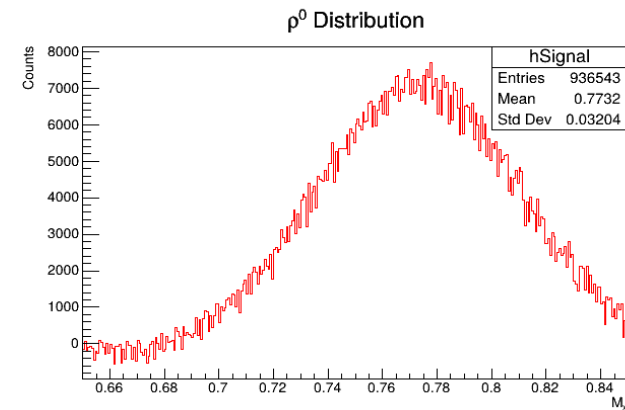
- When applying a cut along p_{theta} for greater than 35 degrees the ρ^0 region becomes more pronounced

ρ^0 Extraction

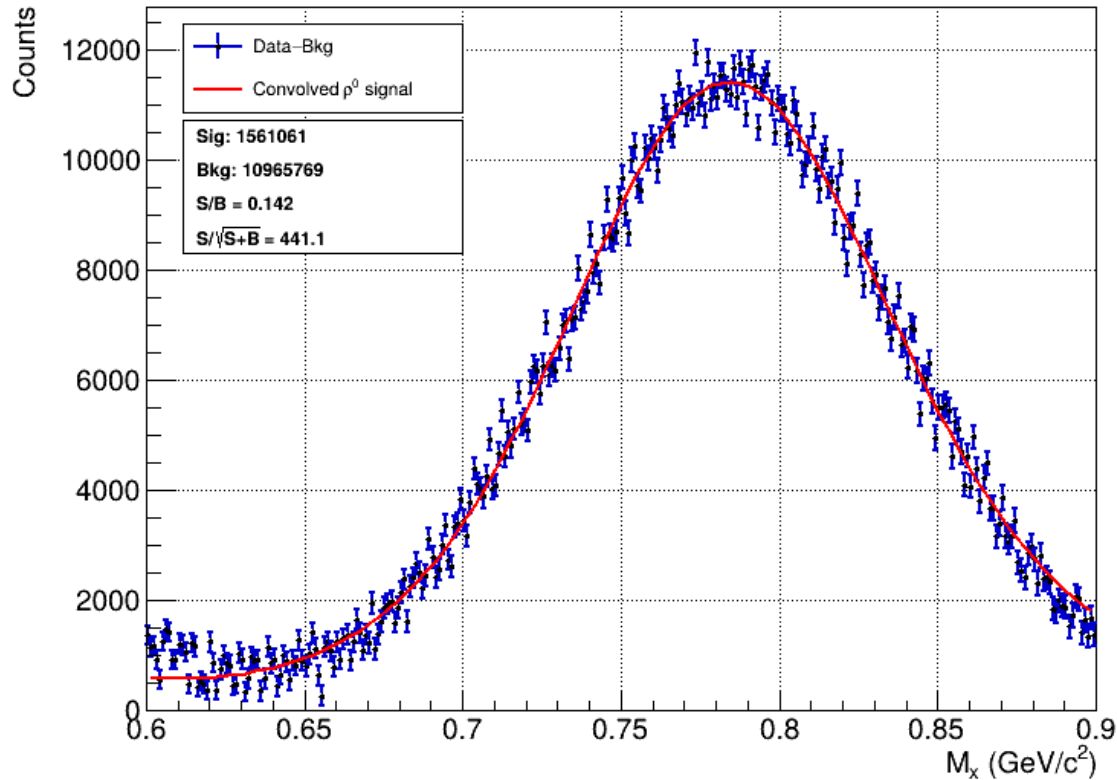


- To extract ρ^0 cuts were made along M_x from 0.6-0.9 (Cuts less limited than linear subtraction)
- A Breit-Wigner function fits the data
- A model utilizing phase space, second degree polynomial, and a Gaussian creates a background function

ρ^0 Extraction (Continued)



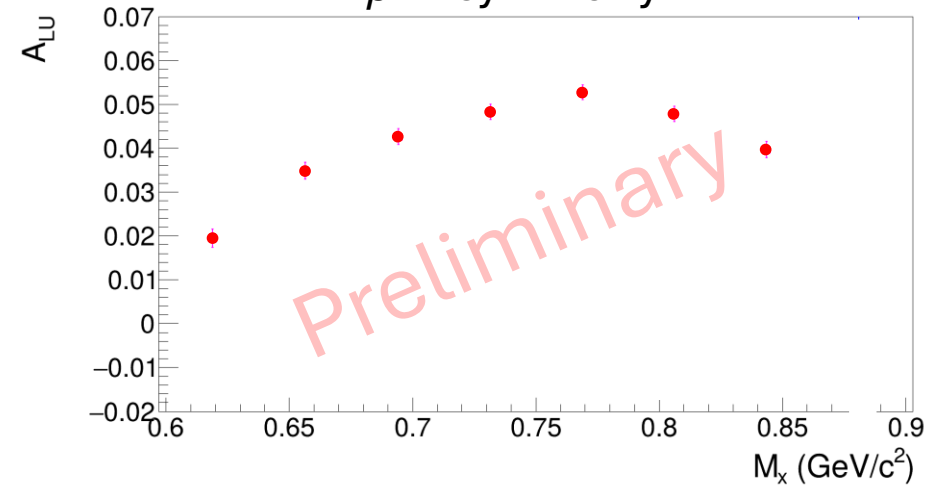
ρ^0 signal (background subtracted)



ρ^0 Mass = 0.7842 ± 0.00029976 (limited)
 Fit mass = $0.7842 \text{ GeV}/c^2$ (PDG: 0.7753)

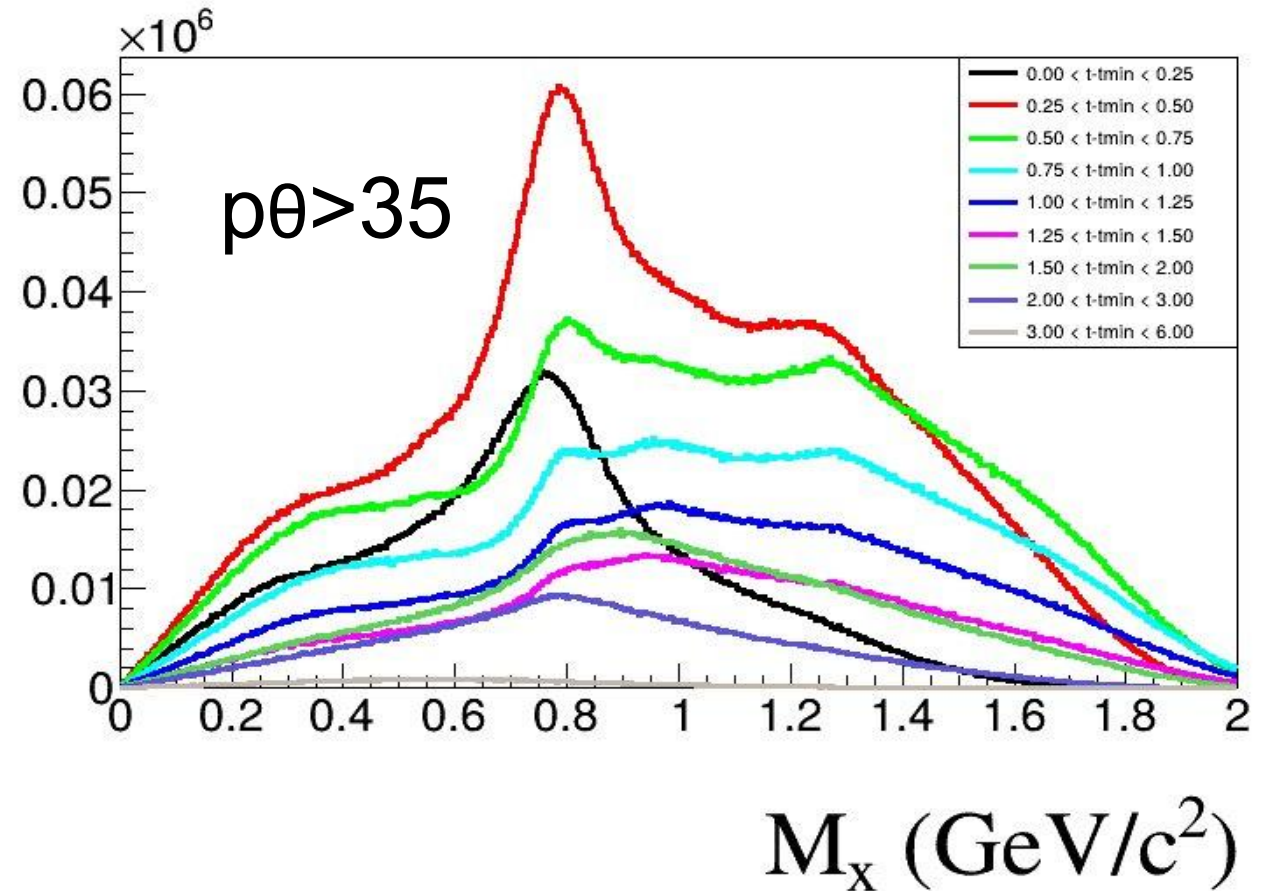
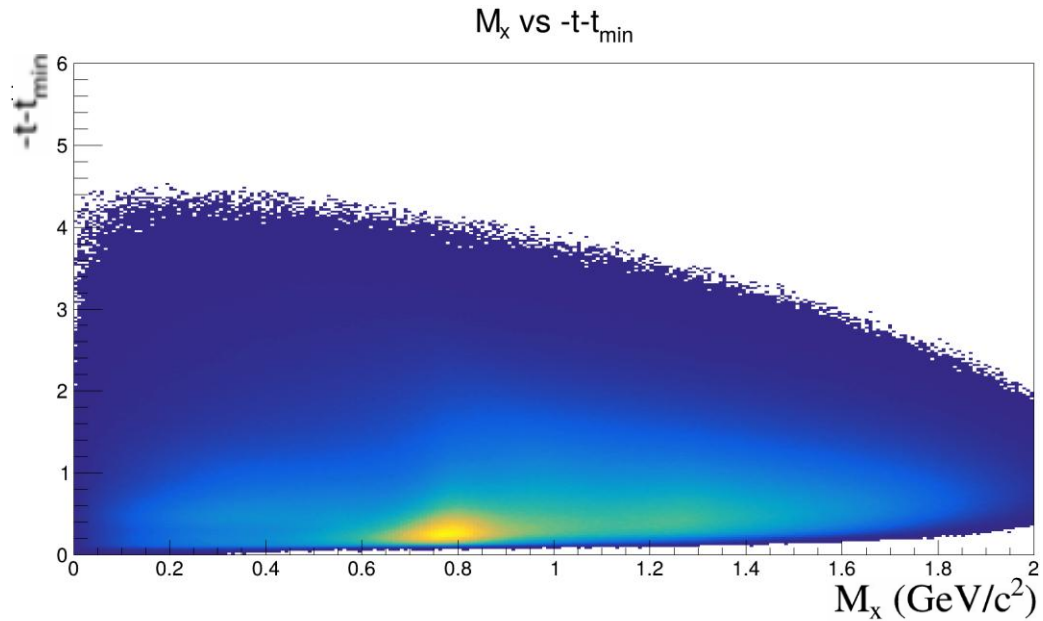
$\rho(770)$ Mass = $0.77526 \pm 0.00023 \text{ GeV}$
0.894% Difference Between Masses
622,806 Event Increase V.S. Linear Subtraction

ρ^0 Asymmetry



Next steps: T-Variable Distributions

Promising stats for at least 3 bins.

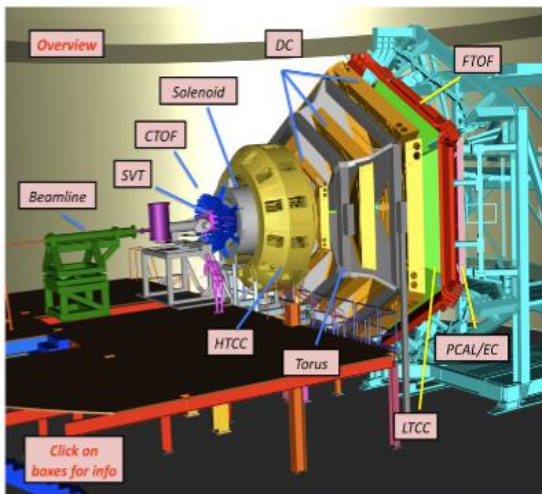
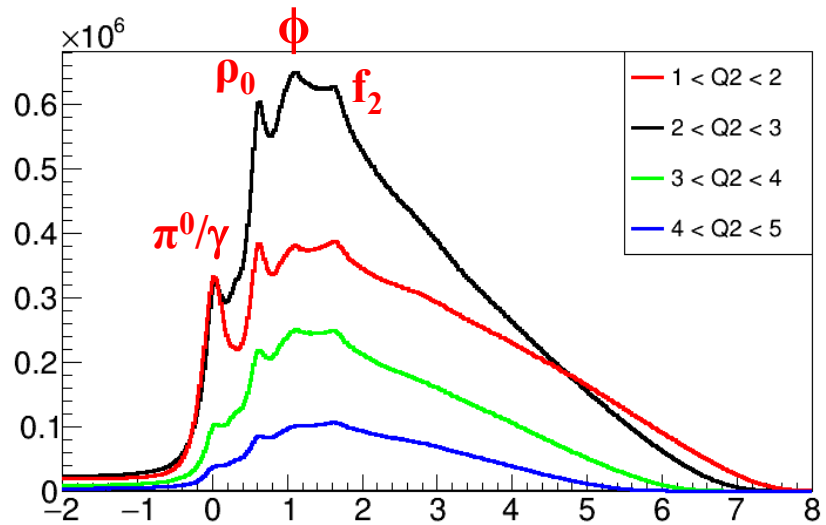


Next steps: Asymmetry scans!
We will have Very exciting results!

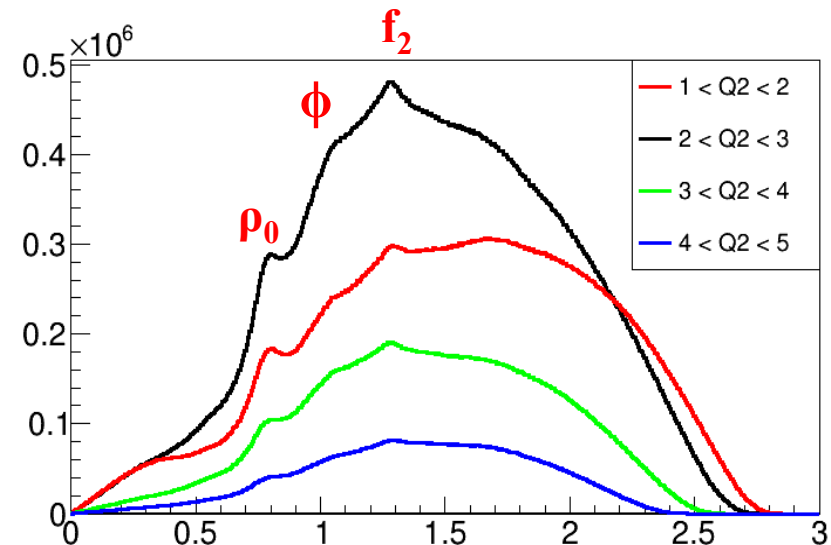
Thank you!
Any Questions?



Origins of the resonances (In the detector)

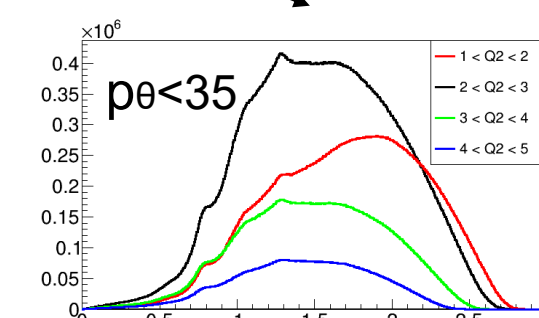
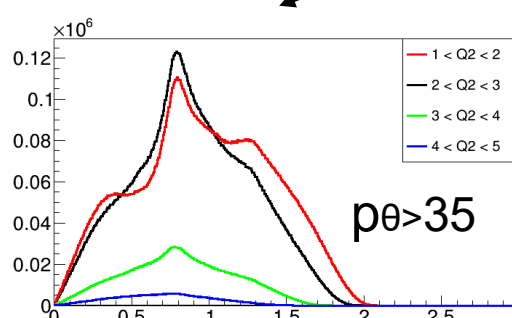
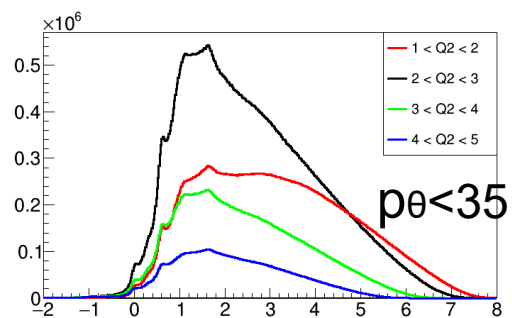
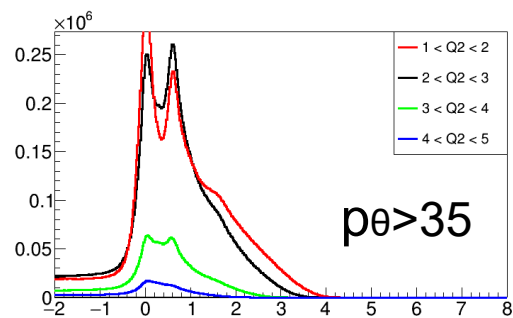


$ep \rightarrow epX$



M_x^2 (GeV/c²)²

M_x (GeV/c²)



M_x^2 (GeV/c²)²

M_x^2 (GeV/c²)²

M_x (GeV/c²)

M_x (GeV/c²)

