Update on Systematic Study of Λ-N Elastic Scattering
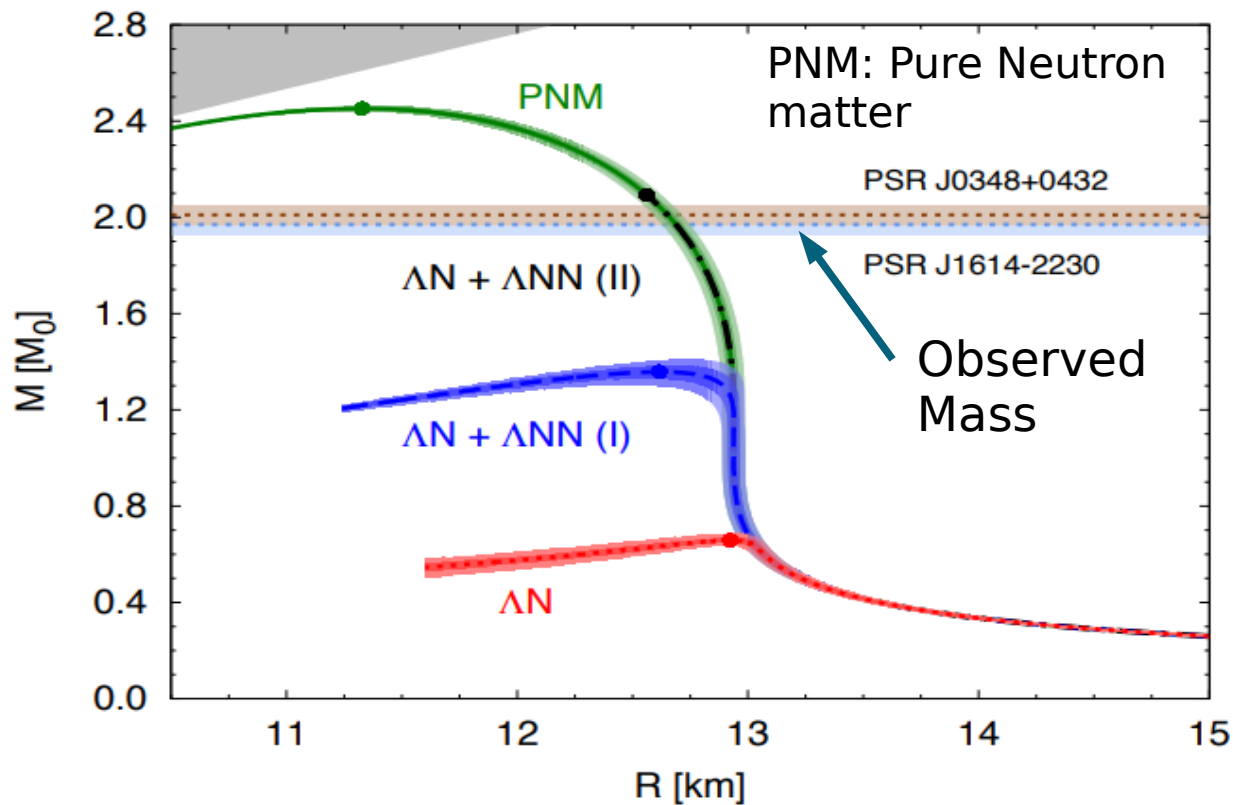
CLAS Collaboration

Joey Rowley, Ken Hicks (Ohio University), John Price (CSUDH)
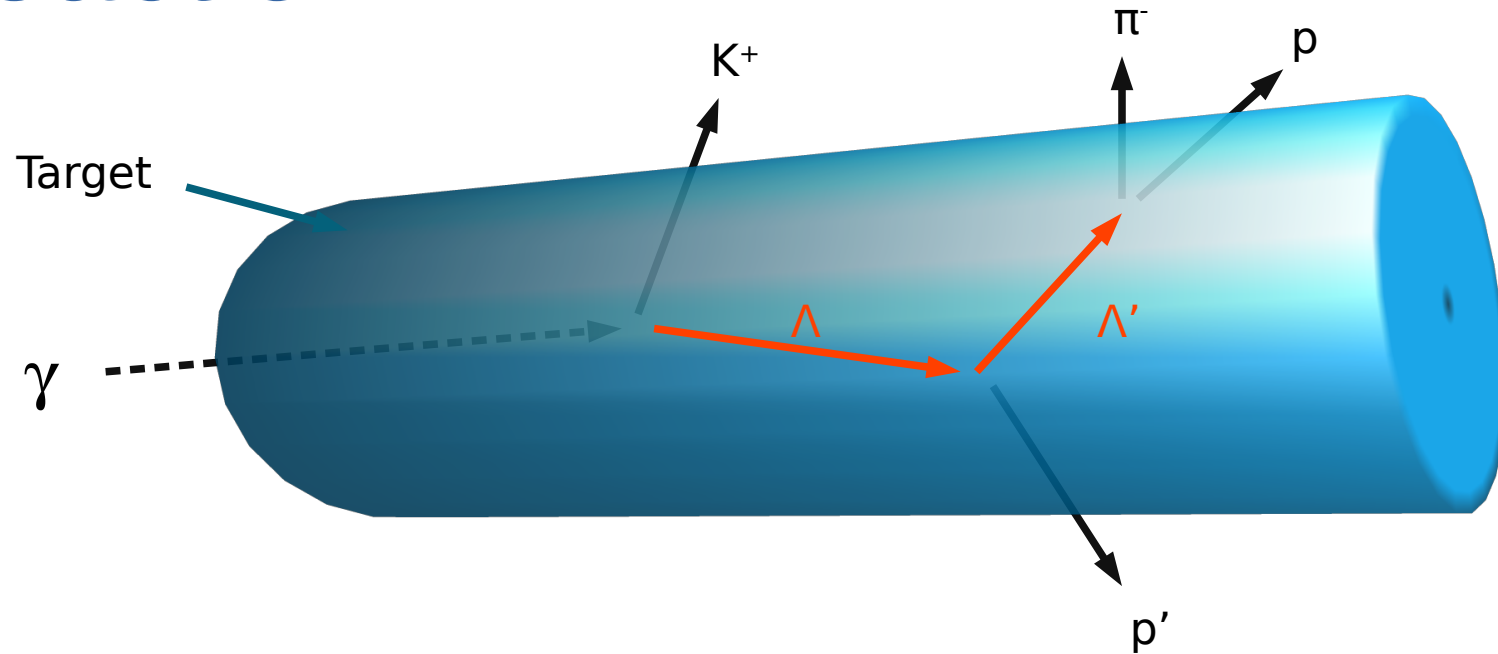
Motivation – Neutron Stars

- Hyperons may exist inside neutron stars

  – results in a softened Equation of State

- Better data for ΛN and ΛNN is needed

Reaction

- Liquid Hydrogen Target
- p, p', π- detected
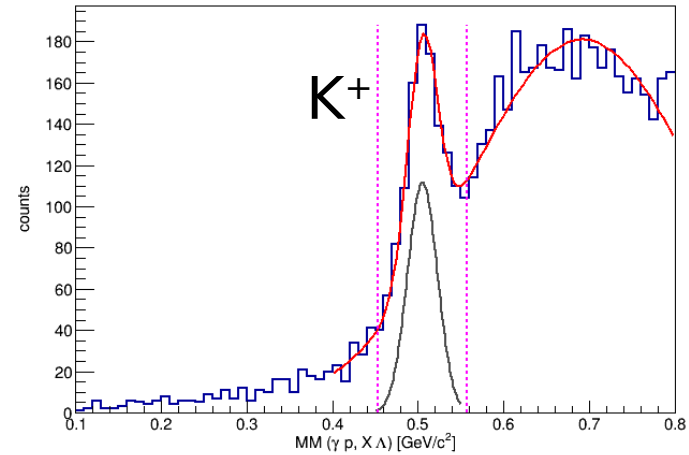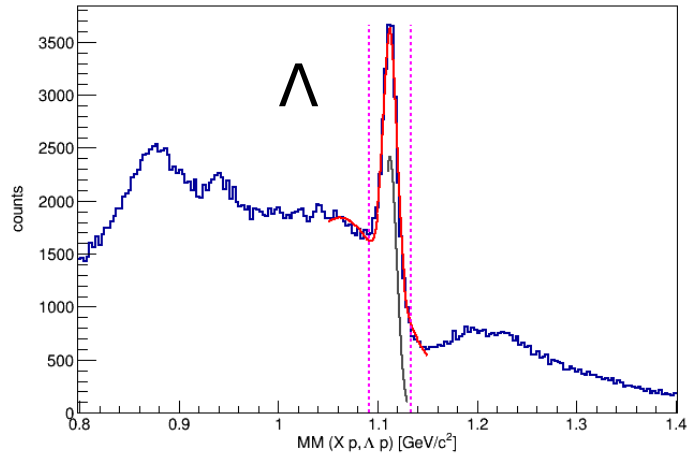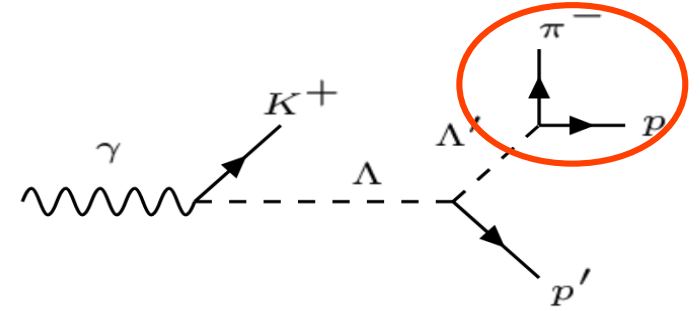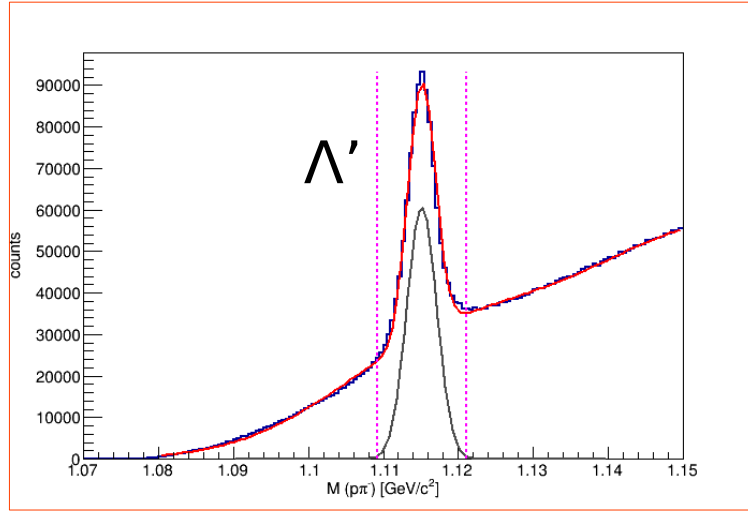- Λp scatter elastically

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Standard Analysis

- All standard g12 procedural cuts and corrections are included
  - PID
  - Fiducial
  - Photon beam energy corrections
  - Efficiency corrections
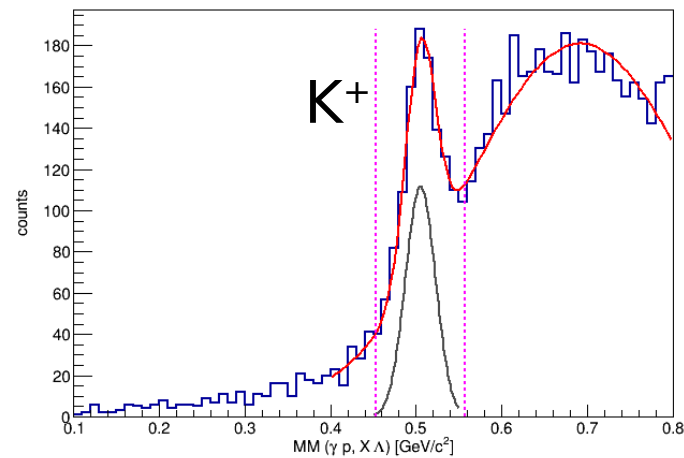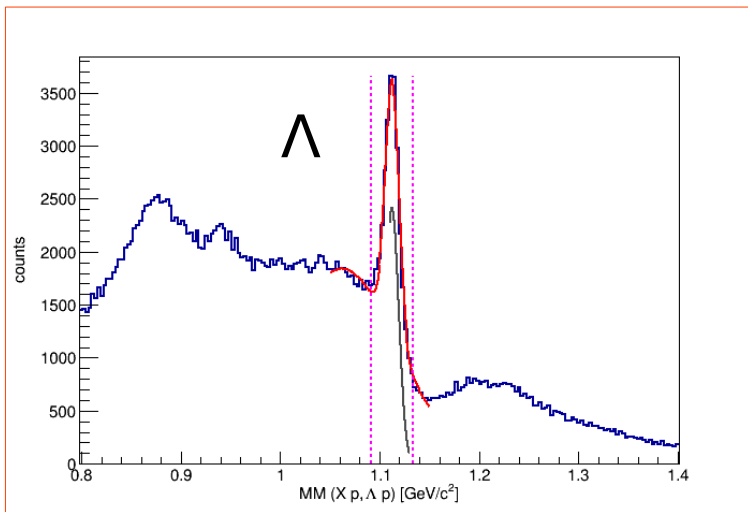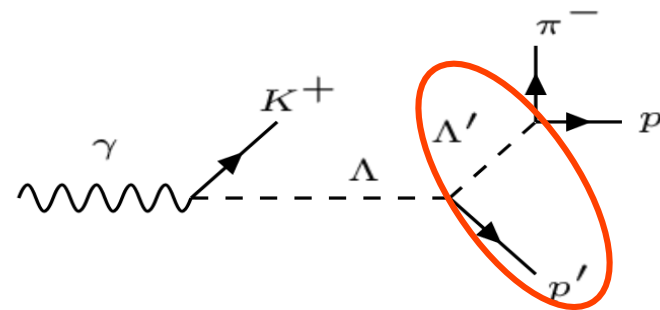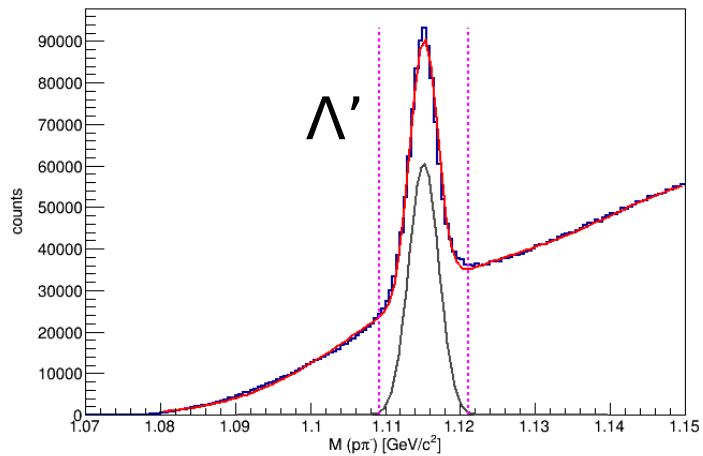 - Etc….

Reaction Specific Analysis

$$\gamma p \rightarrow K^+ \Lambda$$
$$\Lambda p \rightarrow \Lambda' p' \rightarrow p' p \pi^-$$

- Data from g12
- Reconstruct the Λ' mass: M(Λ') = M(pπ-)
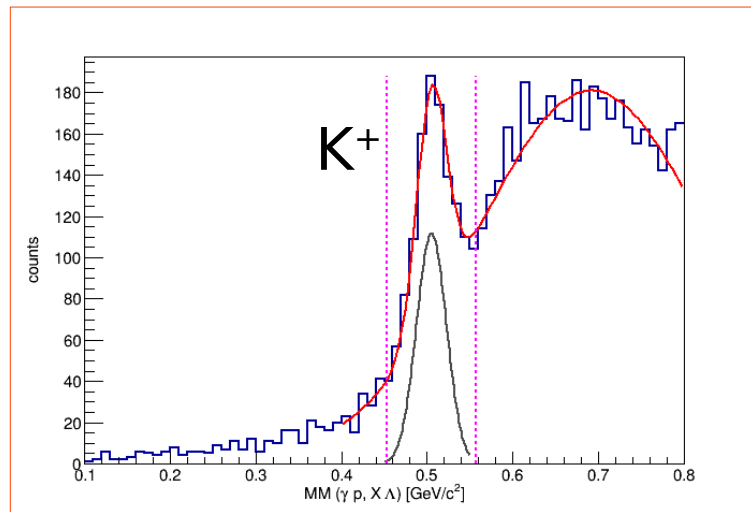- Reconstruct incident Λ
- Identify K+ by missing mass

Data

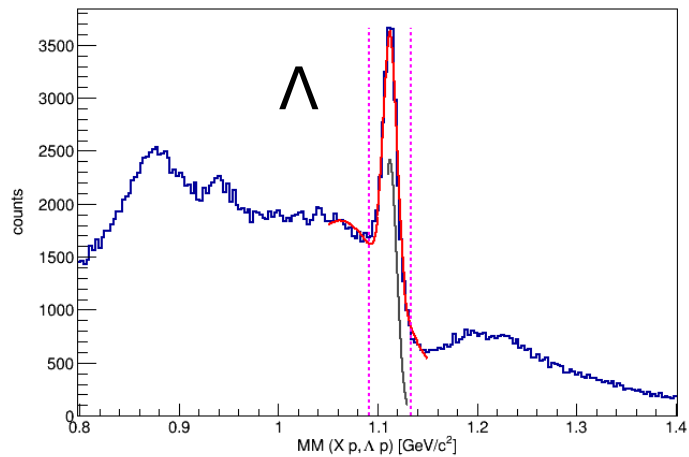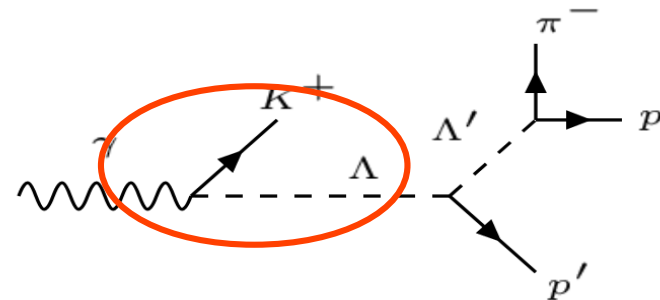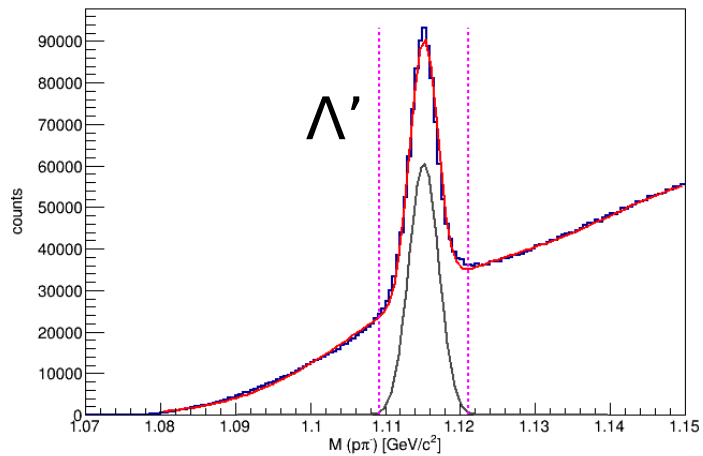# Data

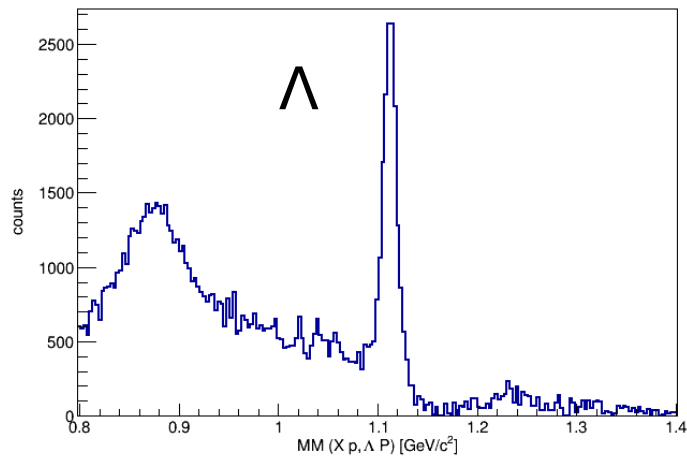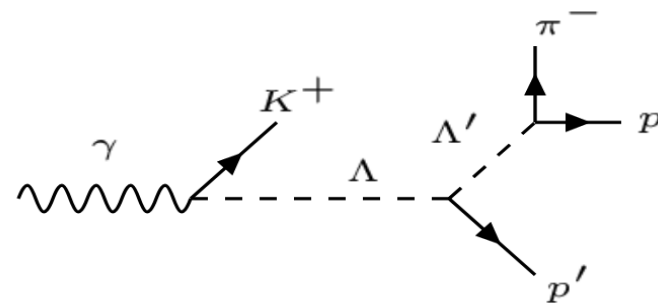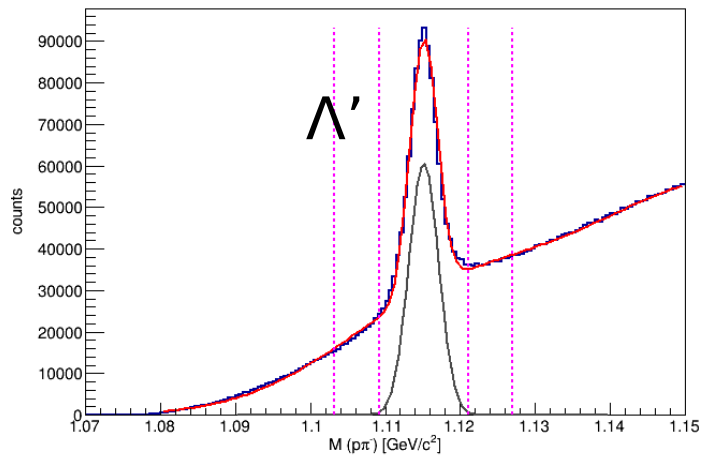# Data

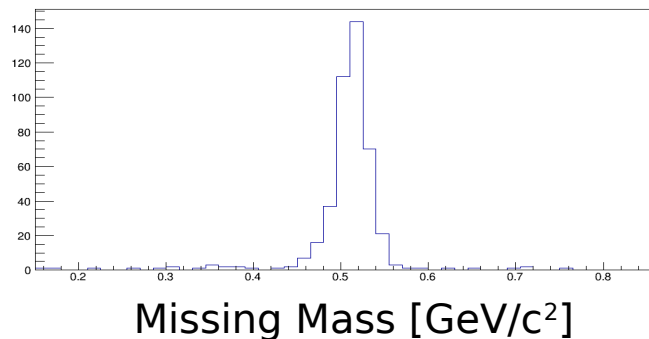# Sideband Subtraction
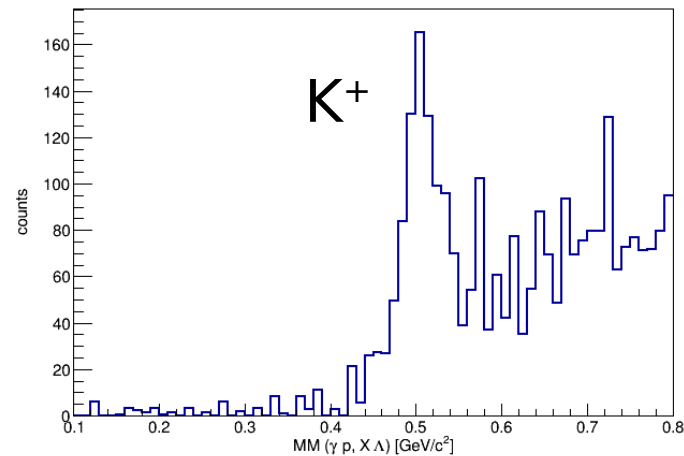
Acceptance

$$Acceptance = \frac{Accepted\ pp\pi^-}{Generated\ \Lambda p\ scattering}$$

Accepted Events:

Missing Mass [GeV/c²]

Generate Events:

Missing Mass [GeV/c²]

$P_{\Lambda\ Lab}$

Missing Mass [GeV/c²]
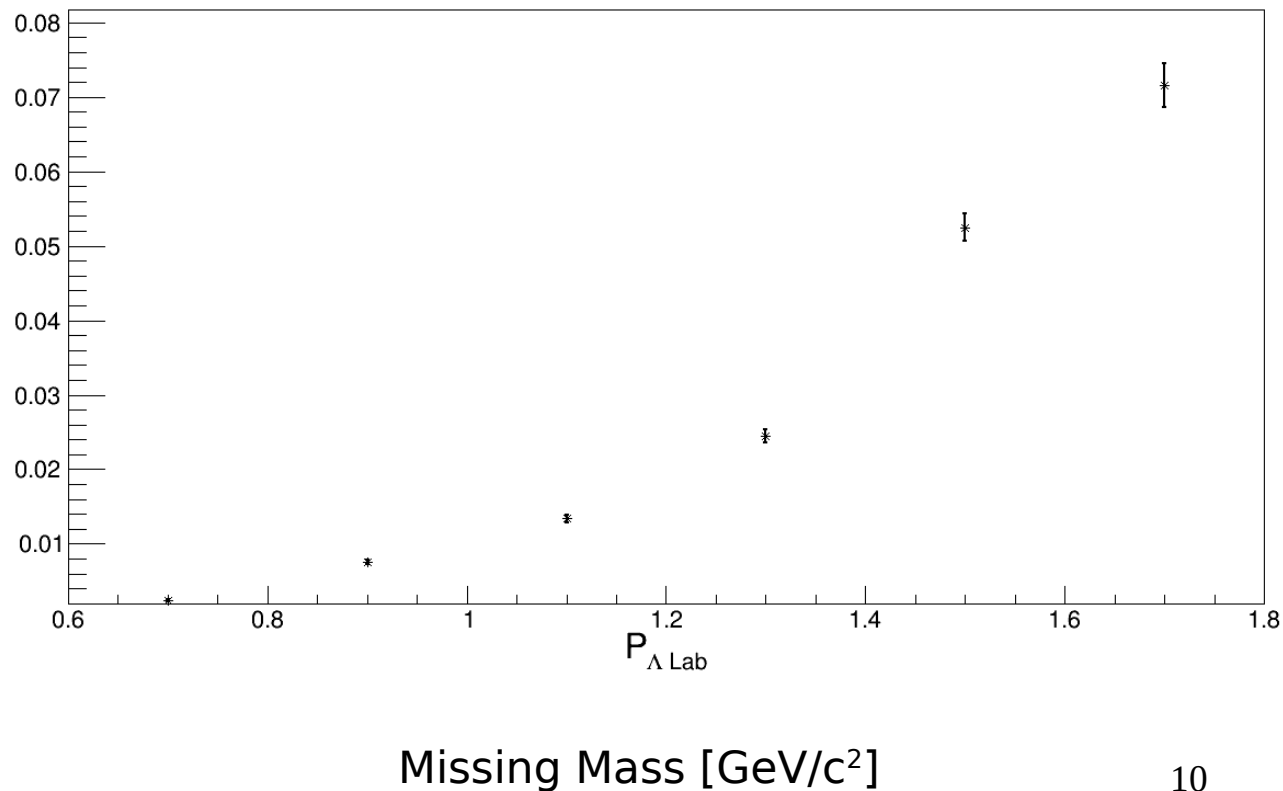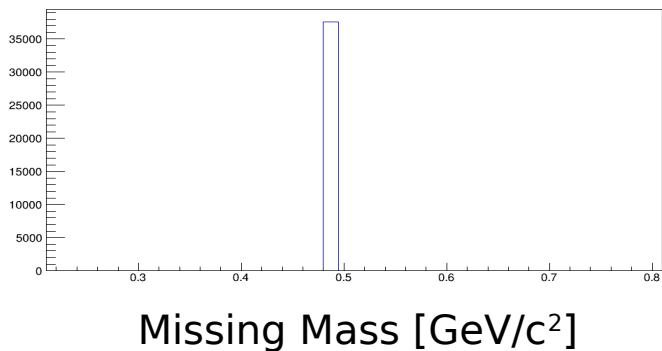
Luminosity

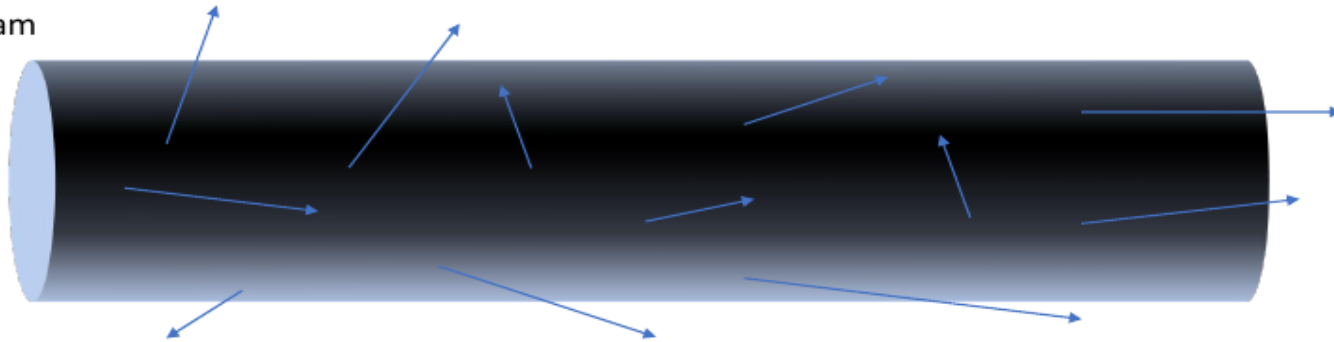$$L_\Lambda(E_\Lambda) = \frac{\rho_T * N_A * l}{M} * N_\Lambda(E_\Lambda)$$

- ρ_T: density of the target
- N_A: Avogadro's number
- M: molar mass of Hydrogen
- l: travel distance of Λ
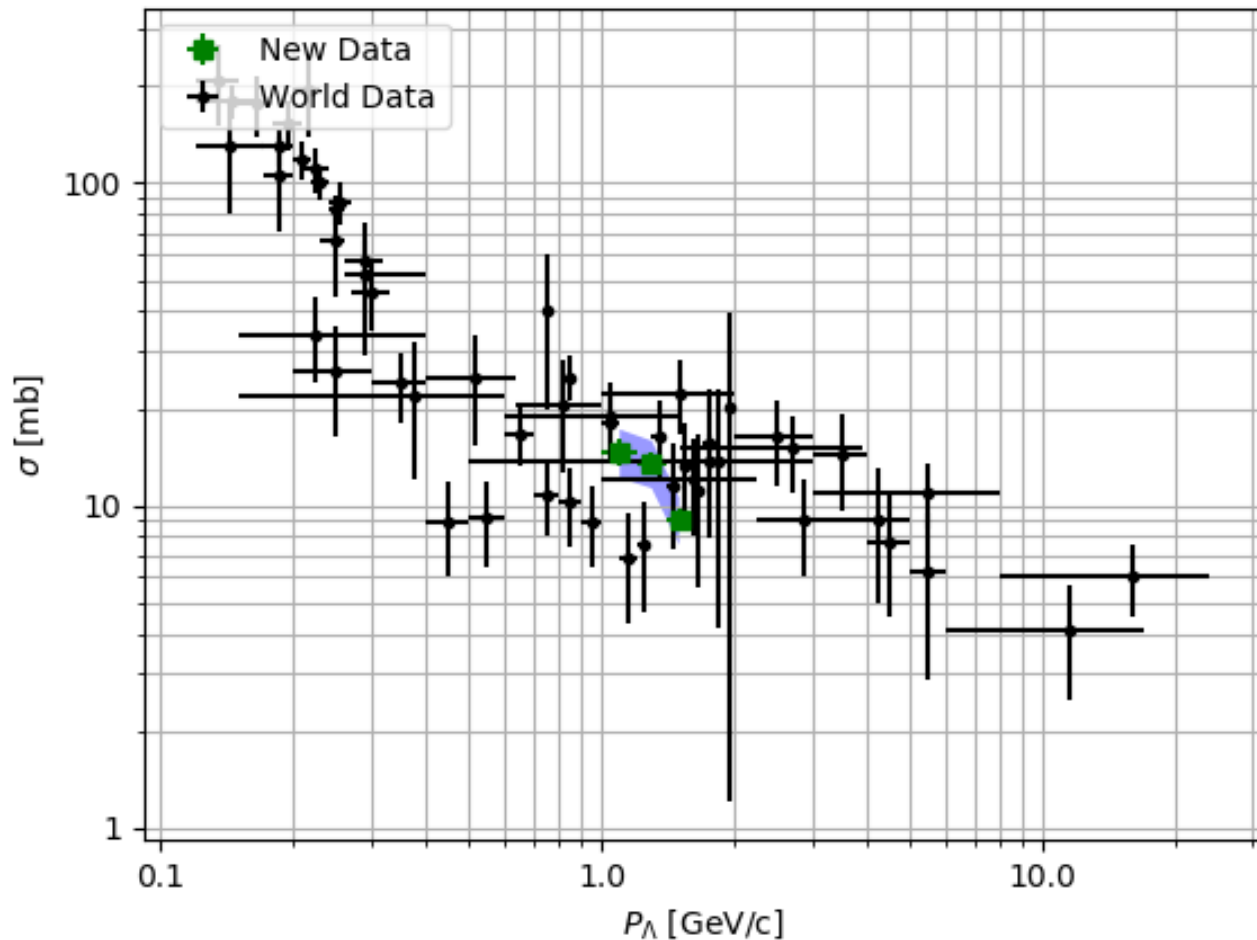- $N_\Lambda(E_\Lambda)$: yield in a certain energy range

$$\frac{d\sigma}{d\Omega} = \frac{N_\Lambda}{2\pi * L_\gamma * \Delta\cos(\theta)}$$
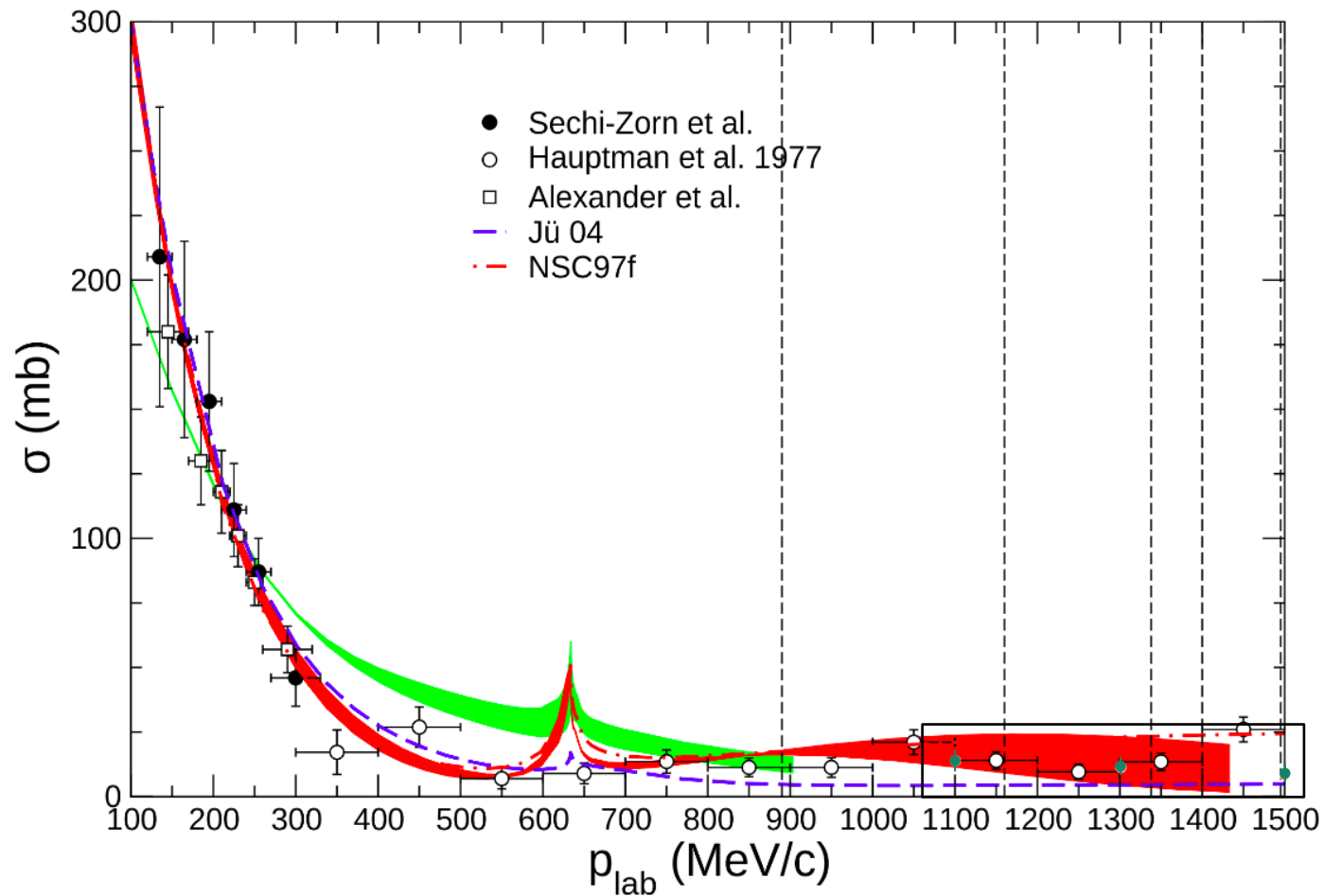
Photon Beam

Λ Beam

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Preliminary Results

Cross Section Compared to Existing Data

- Black: Existing data from PDG
- Green: Measurements from this study
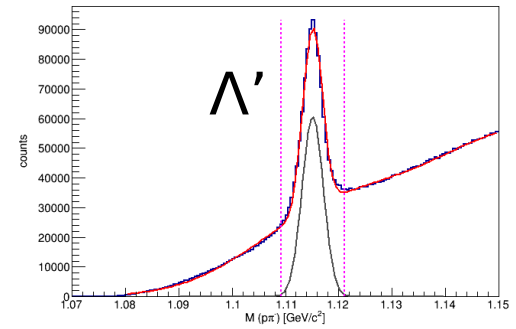- Blue: Systematic Errors

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Preliminary Results

- Results are consistent with theoretical prediction and most recent measurements

Theoretical prediction from Haidenbauer extended to our momentum range (unpublished).
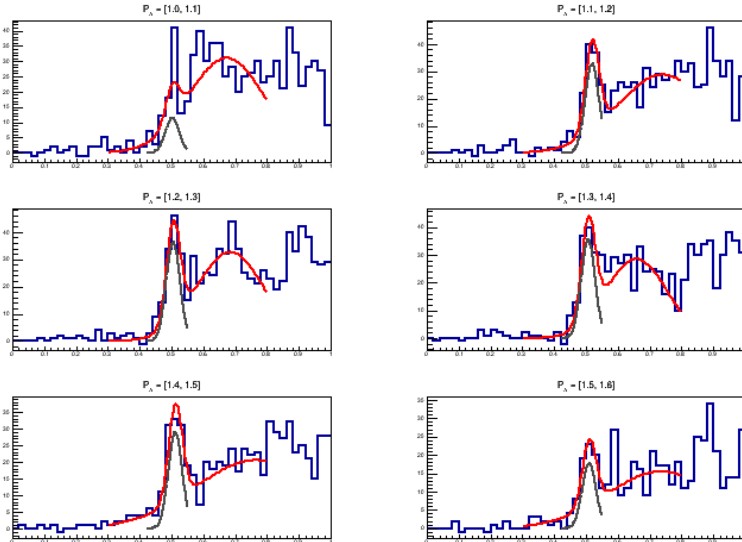
Systematics (recoil Λ)

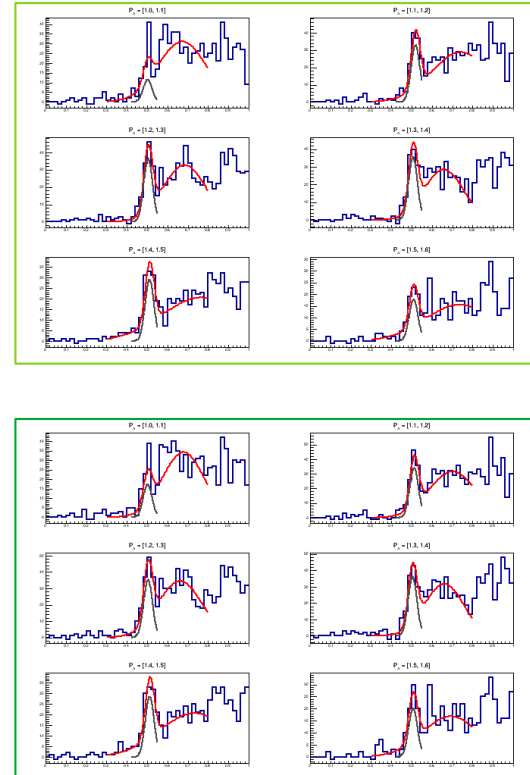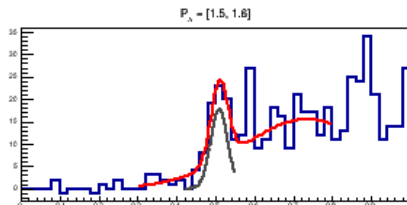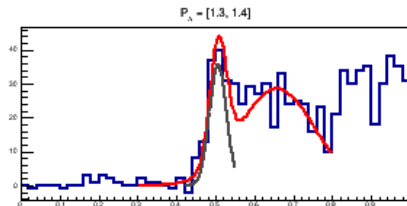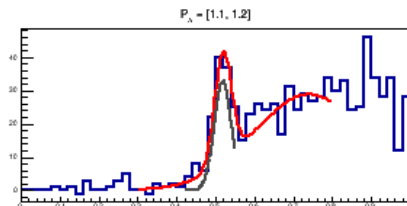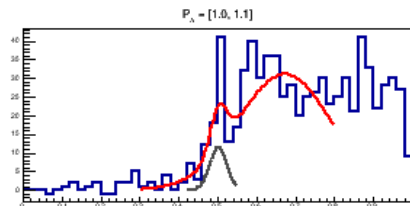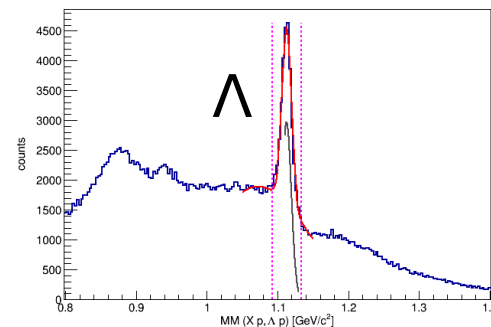In order to study the systematics, the 3 previous bins were divided by 2.
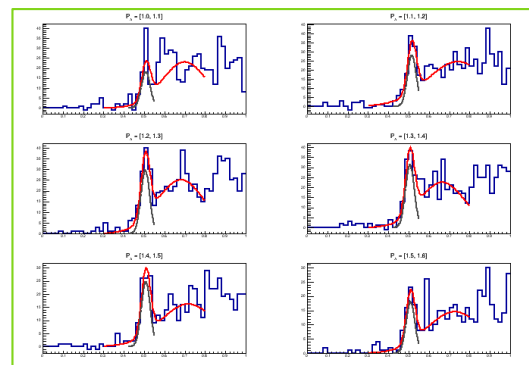

Λ'

Nominal (3 σ)

2 σ

4 σ

Error = 4.0%

Incident Λ

Nominal (3 σ)

2 σ

4 σ

Error = 6.5%

15

PID

Nominal (3 σ)

2 σ

4 σ

Error = 5.5%

16
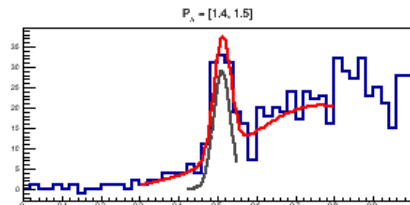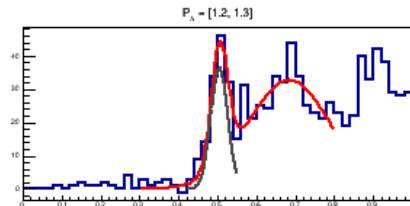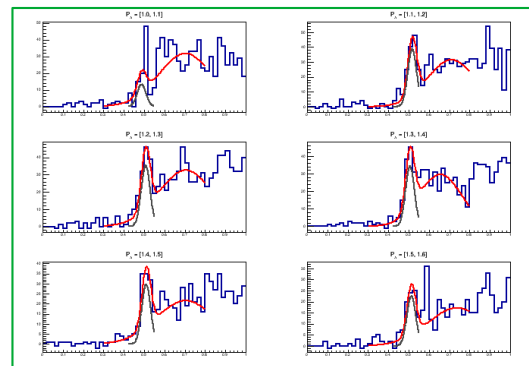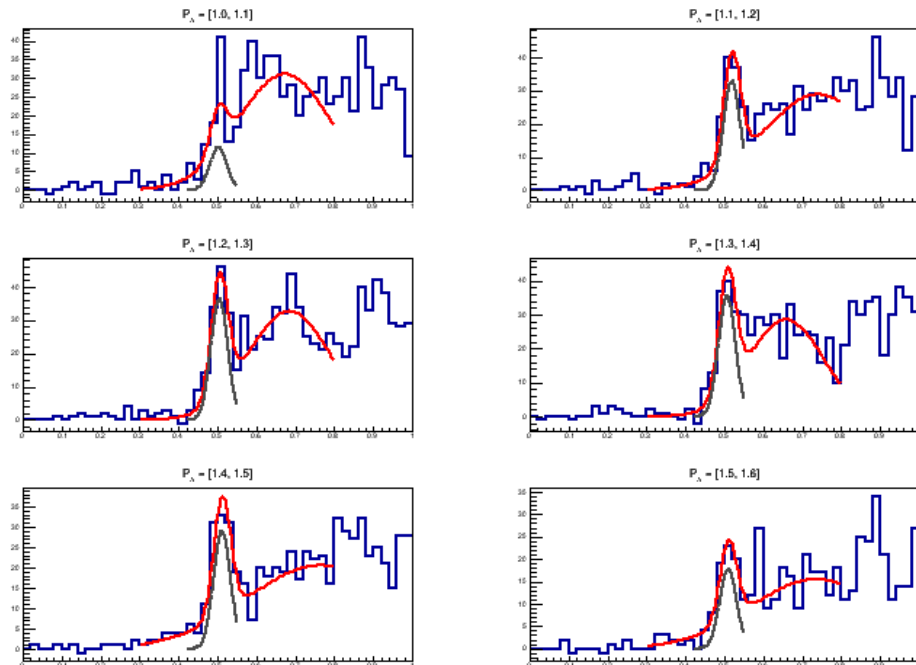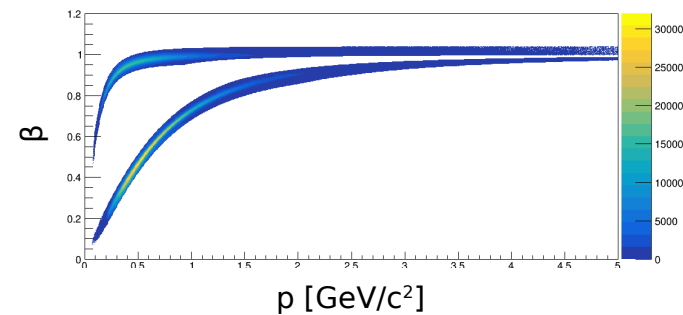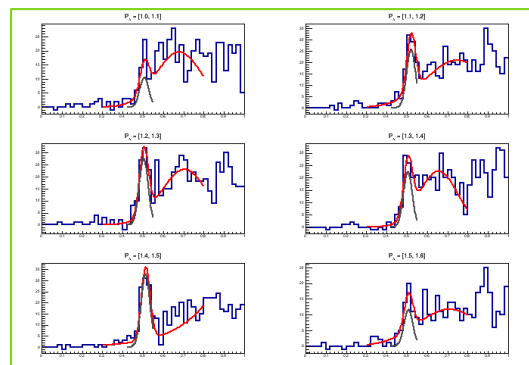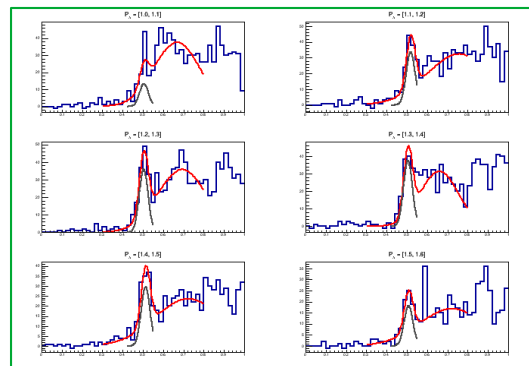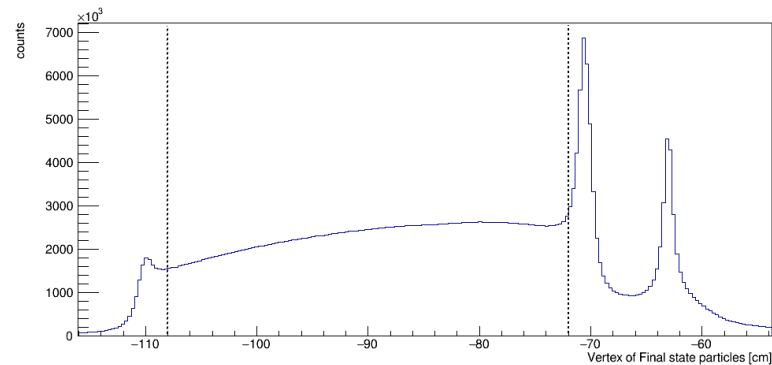
Vertex

Nominal (-108 < x < -72)

Systematic (-100 < x < -80)
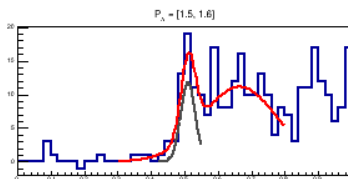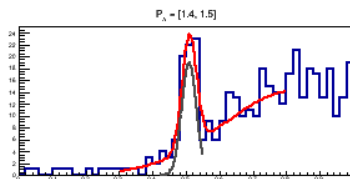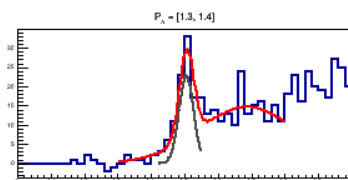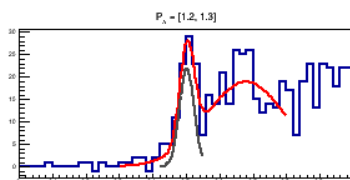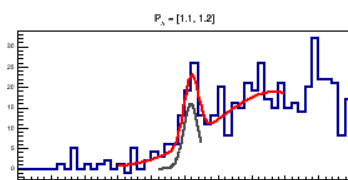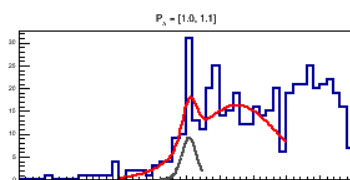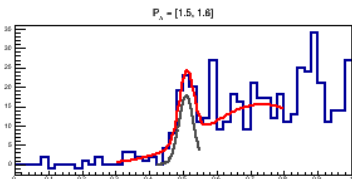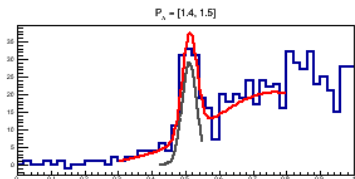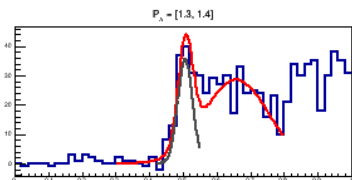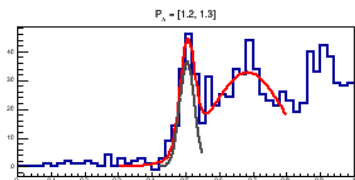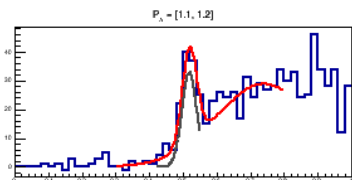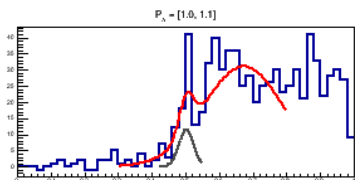
Error = 0.9%

Fit Function

Nominal (Gaussian Background)

Pol1

Error = 8.7%

Pol2

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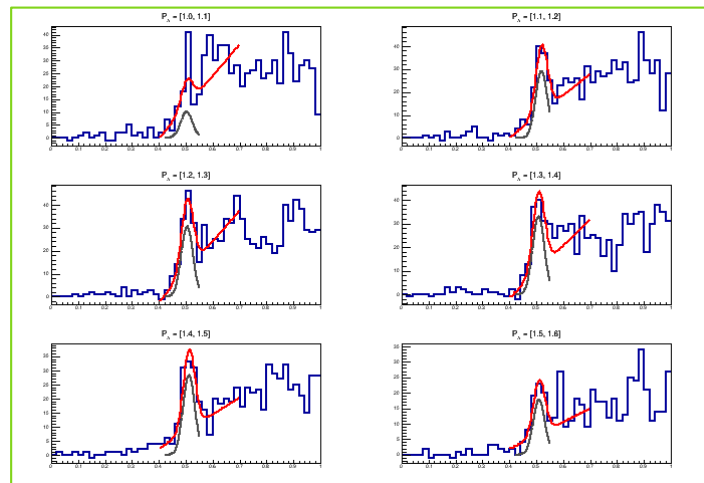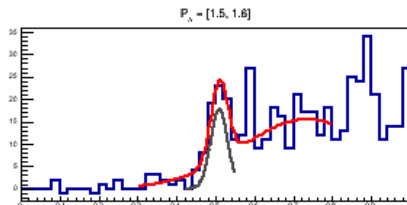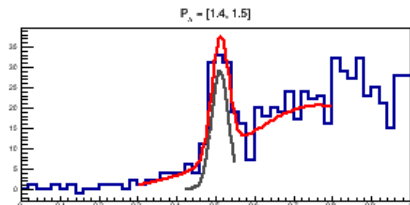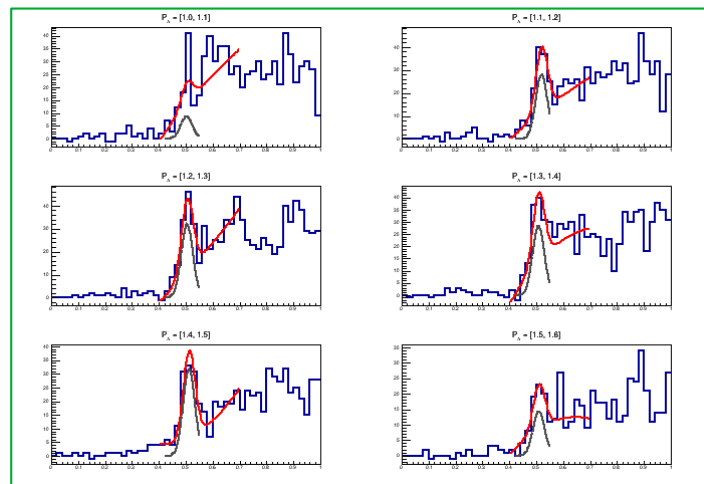
Systematic Study Results (preliminary)

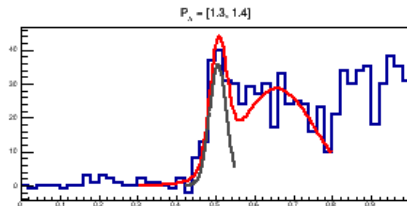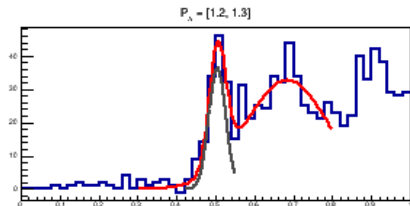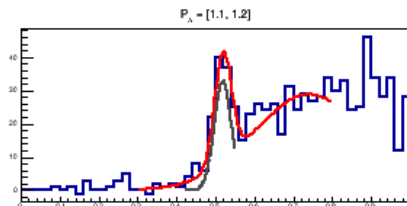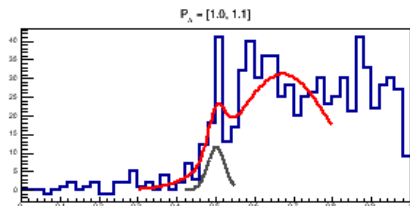| Cuts	Error (%)
Vertex	0.9
M (p π⁻) (Scattered proton)	4.0
MM (Xp, Λp) (Incident proton)	6.5
PID	5.5
Fit Function	8.7

Total Systematic = 12.8%

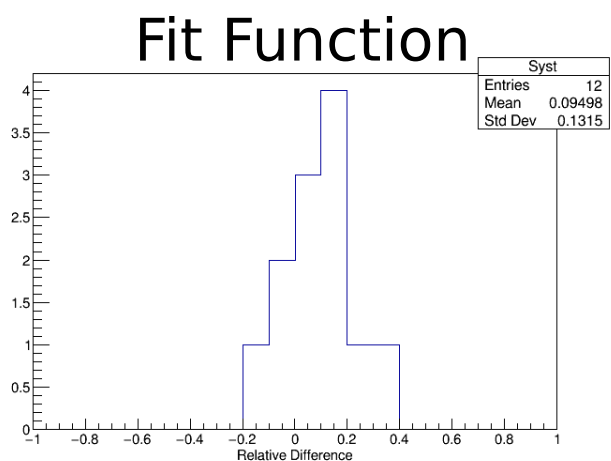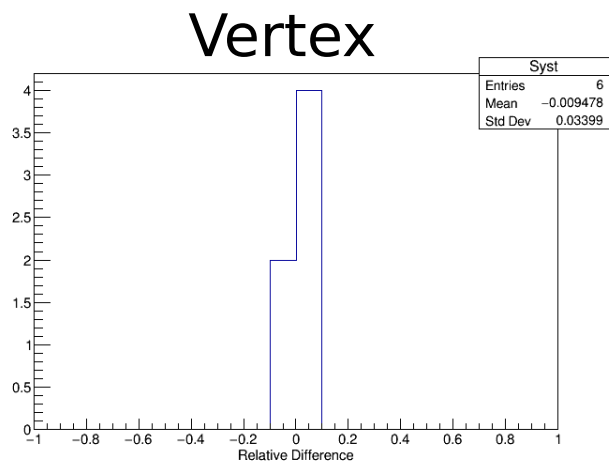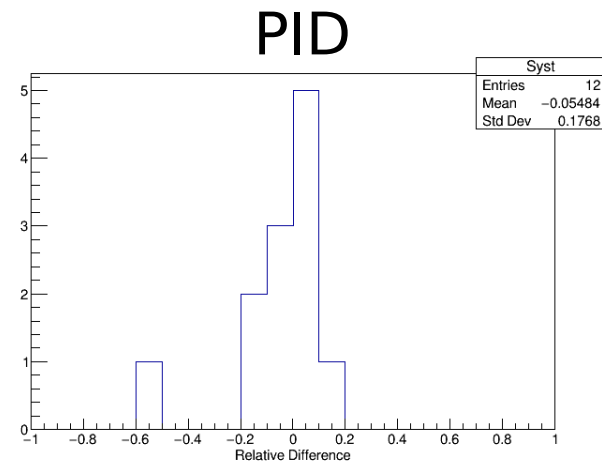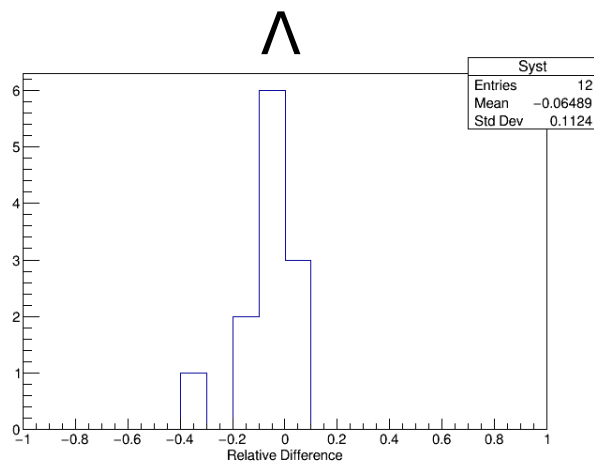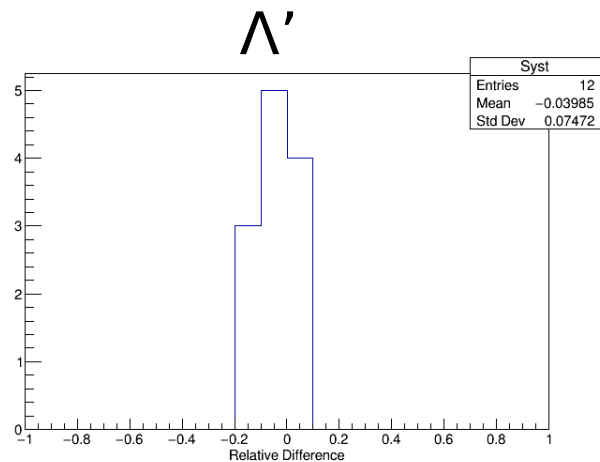Not an inclusive list of all the systematics. More work needs to be done.

Summary

- Systematic studies are ongoing

- Currently updating analysis note

- Submitting for CLAS review shortly

Questions?

Extra Slides

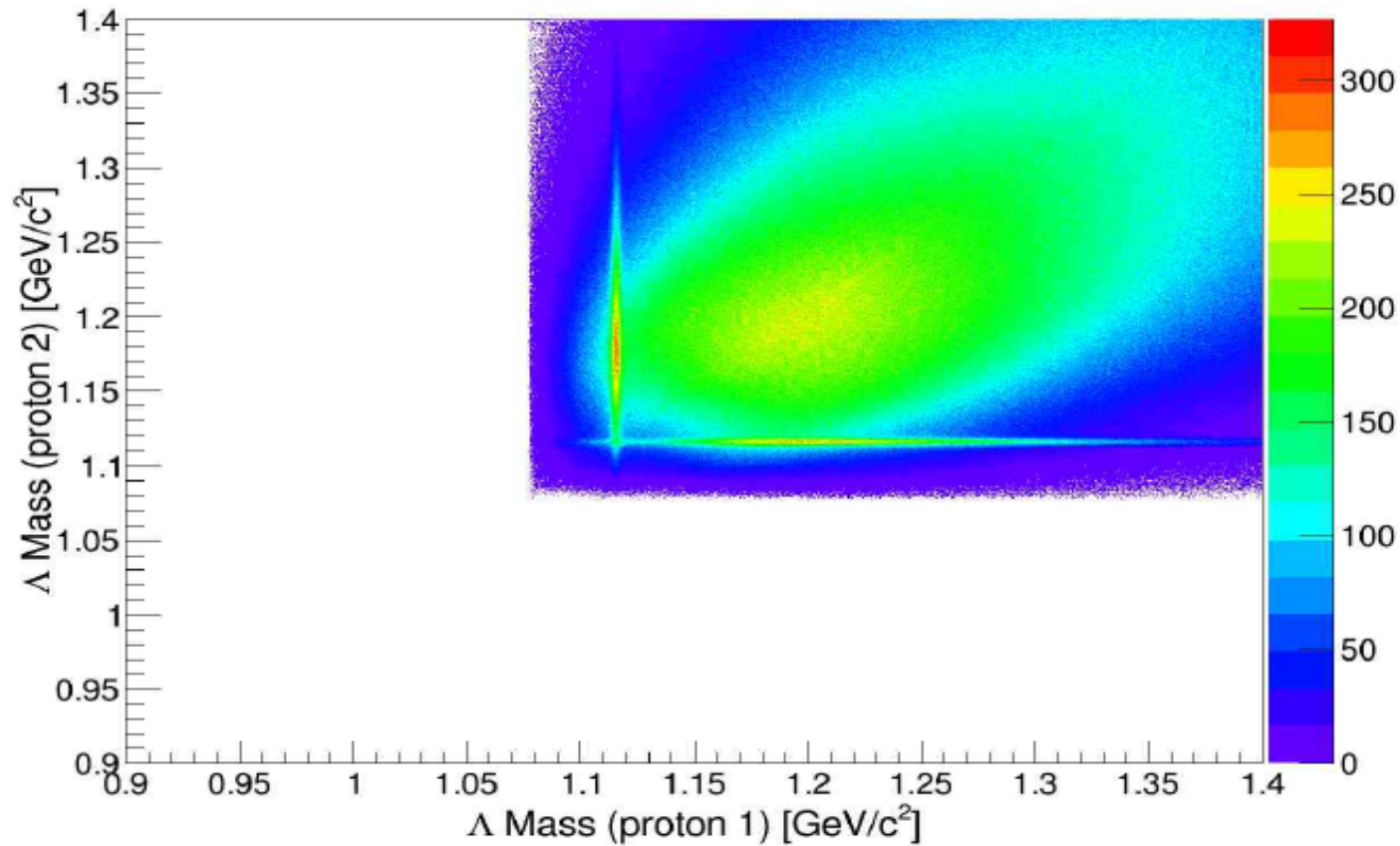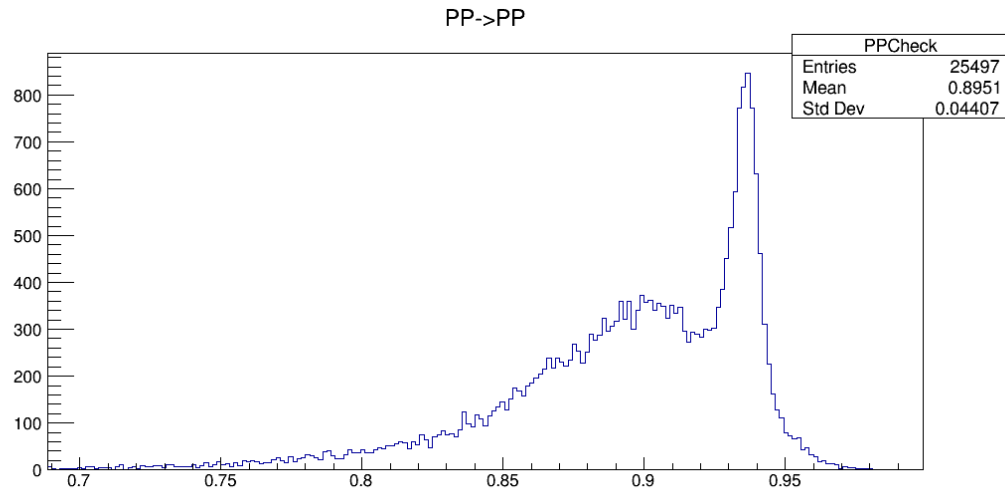# Systematic Summary

Total Systematic = 12.8%

P1, P2

pp → pp events

PP->PP

PPCheck	
Entries	25497
Mean	0.8951
Std Dev	0.04407

Events need to be removed
for incident p events but not
for incident π⁻