Perspectives on Investigating the ΛN Interactions by the Electron Beam at JLab

Liguang Tang

Hampton University / JLab

- *Improving the data quality of Λp elastic scattering*

- *Investigating the missing Λn interaction*

ΛN interaction is the central goal for Hypernuclear Physics and it is still at large. It affects on understanding CSB, hypernuclear structure, fundamental BB model for EOS on mass of neutron stars…

Λp Elastic Scattering

- All existing data were taken from bubble chamber experiments from 1959 to 1975

- Statistics is very low, ~1200 events overall, ~±20-25% uncertainty

- It needs to be improved, but can we do better?
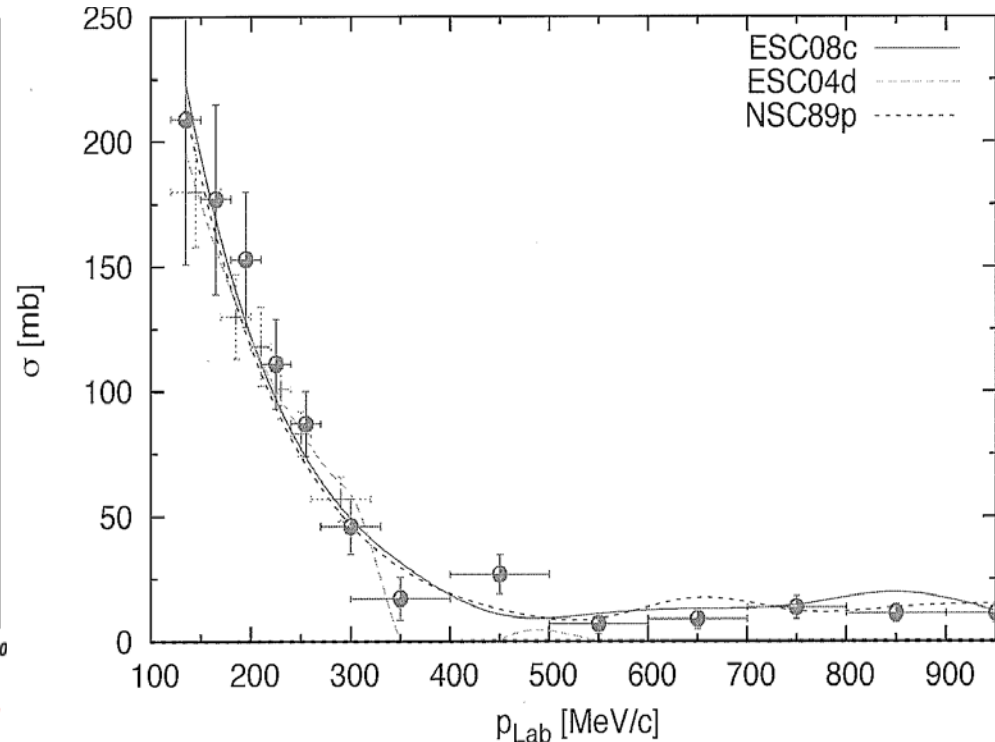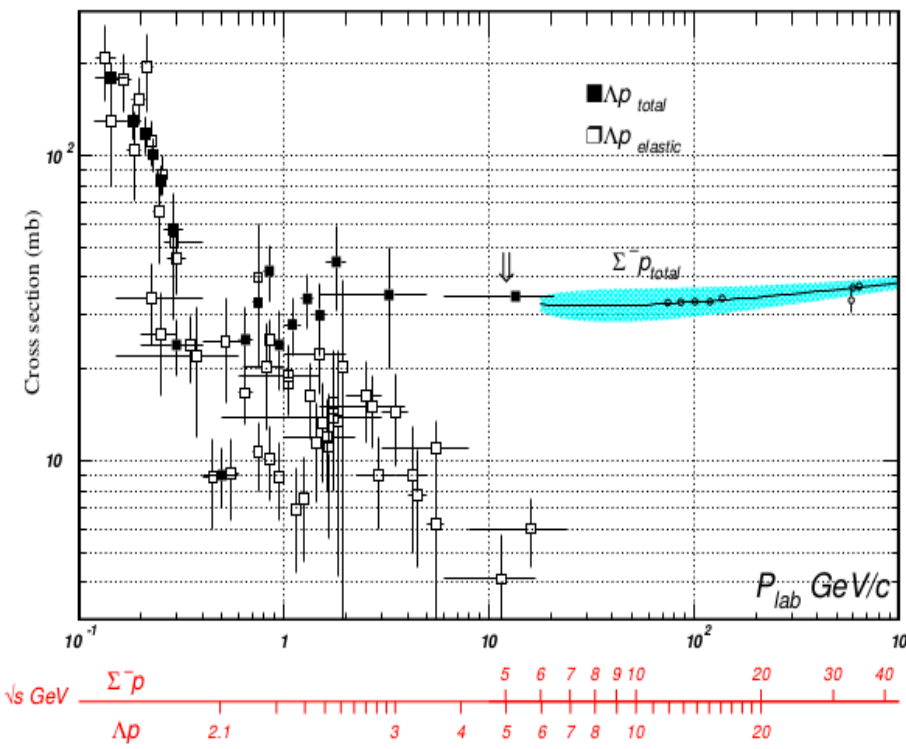
Λ*p* Elastic Scattering at JLab: Basic Technique

- Electro-production of Λ by the *p*(e, e'K$^+$)Λ reaction

- Gate on Λ missing mass

- Λ *4-momentum* is fully determined

- Number of Λ's is known

- Detect scattered *p*'s (momentum and θ$_p$)

- Identify elastic scattering by correlation of P$_p$ and θ$_p$

- Background: free Λ mesonic decay
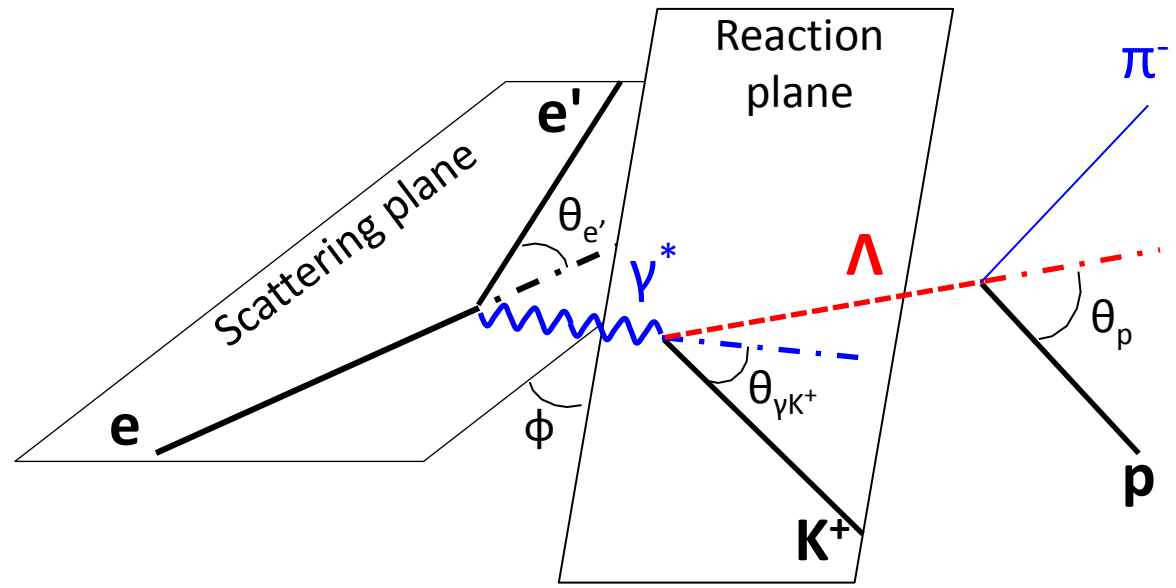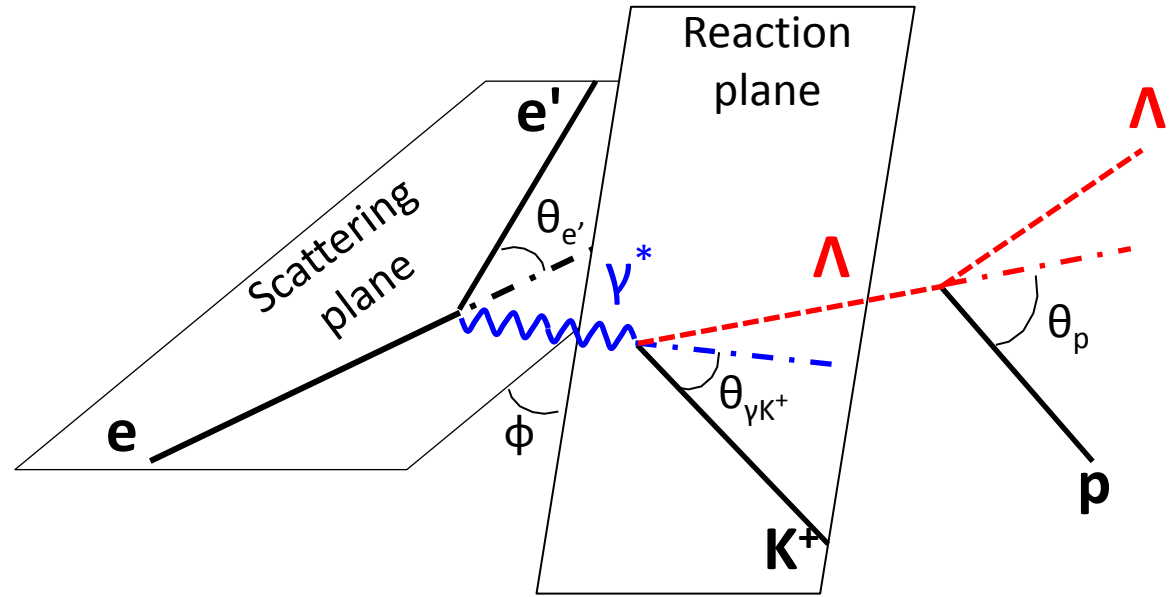
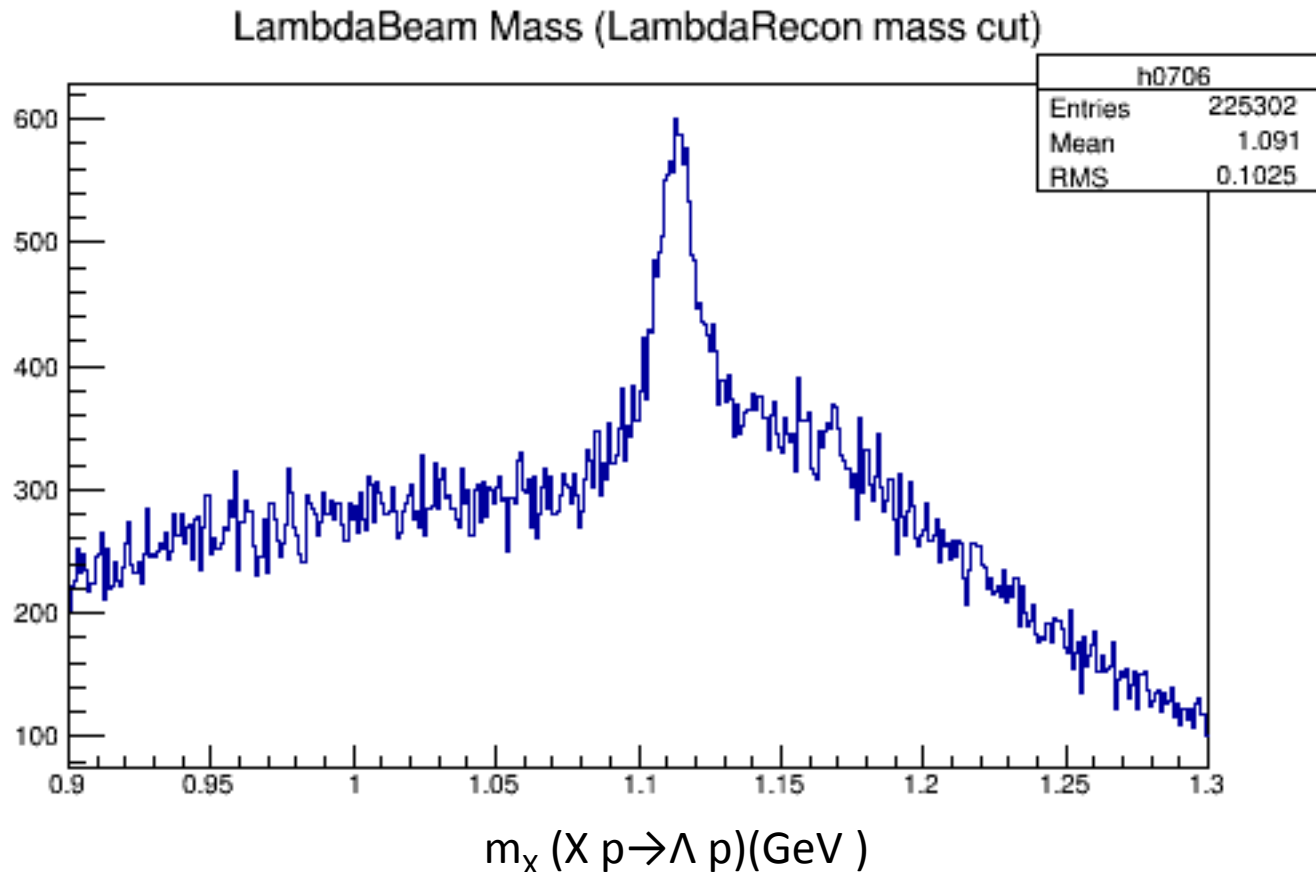# Considerations in Hall B (*Past*, J. Price)

- Could not see in missing mass, thus Λ "beam" undetermined, (*impressively unimpressive by John Price*)

- Λ's were identified by their decays, ~2000 events (production yield was low but there)
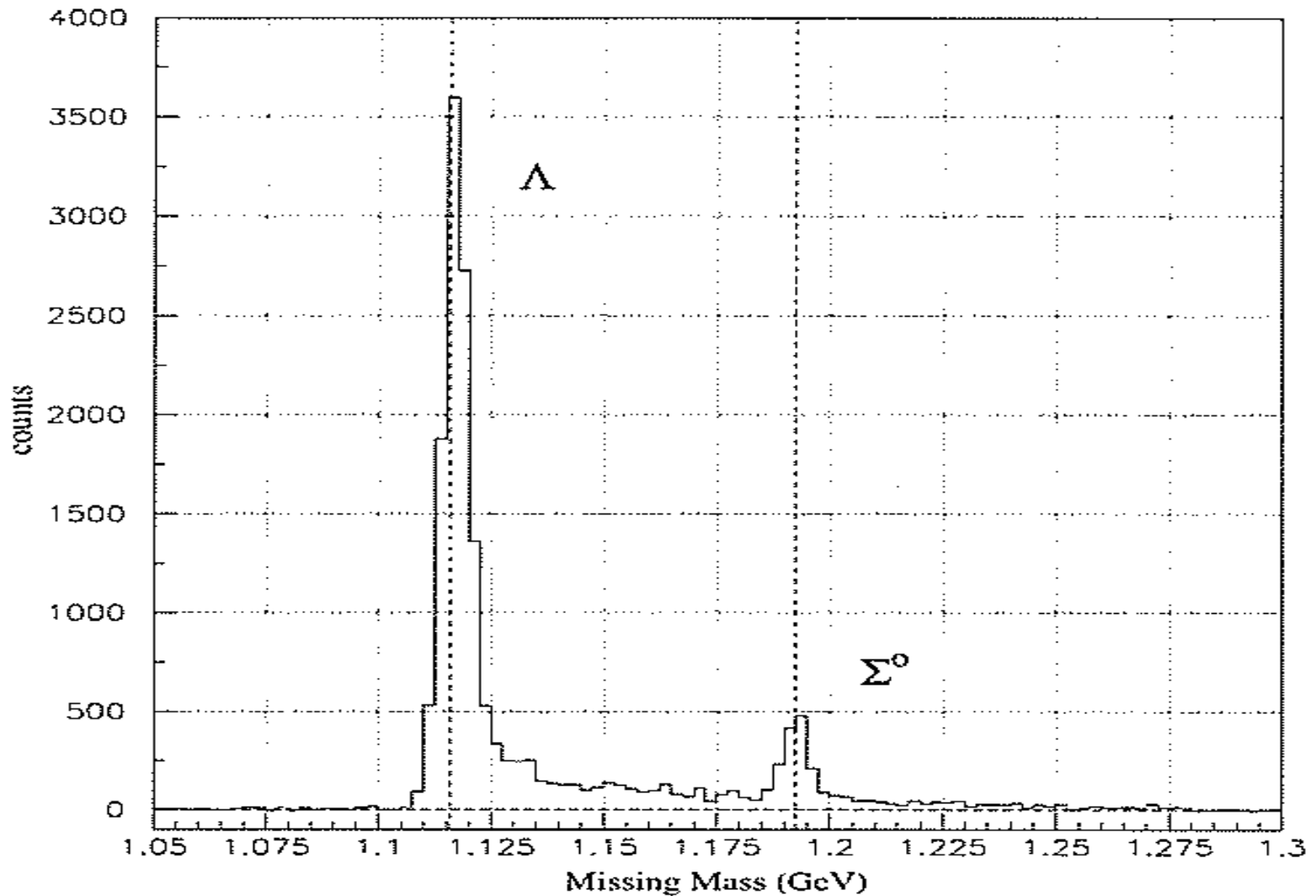
- Thus, scattering could not be determined

gp->K+X missing mass

Λ peak?

m_X (γ p→K^+ X)(GeV)

Best LambdaRecon Mass

Λ

m_X (X→$π^-$ p)(GeV)
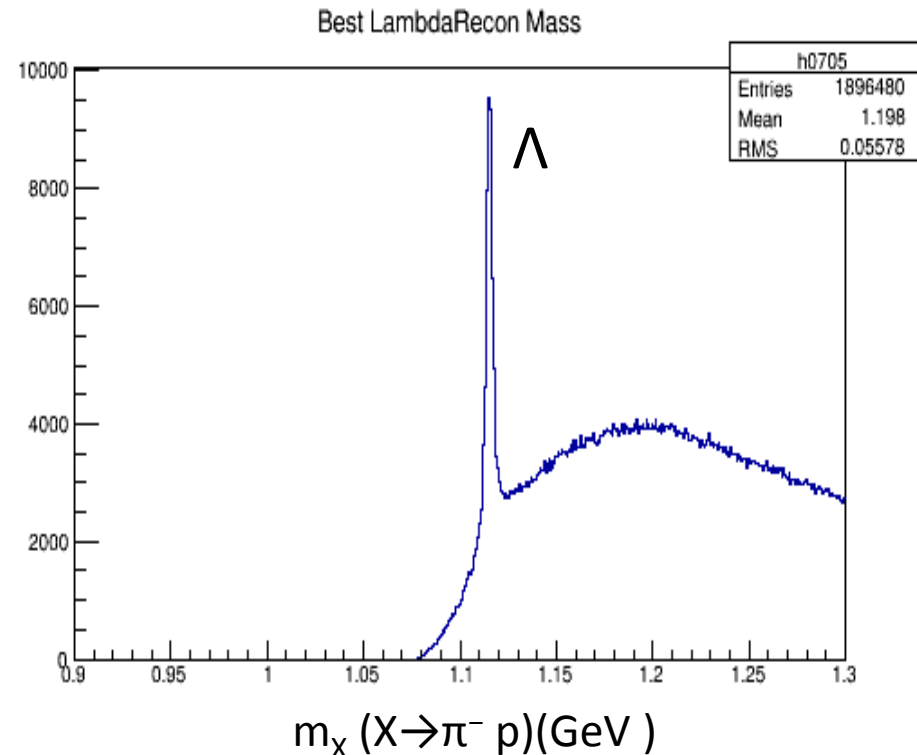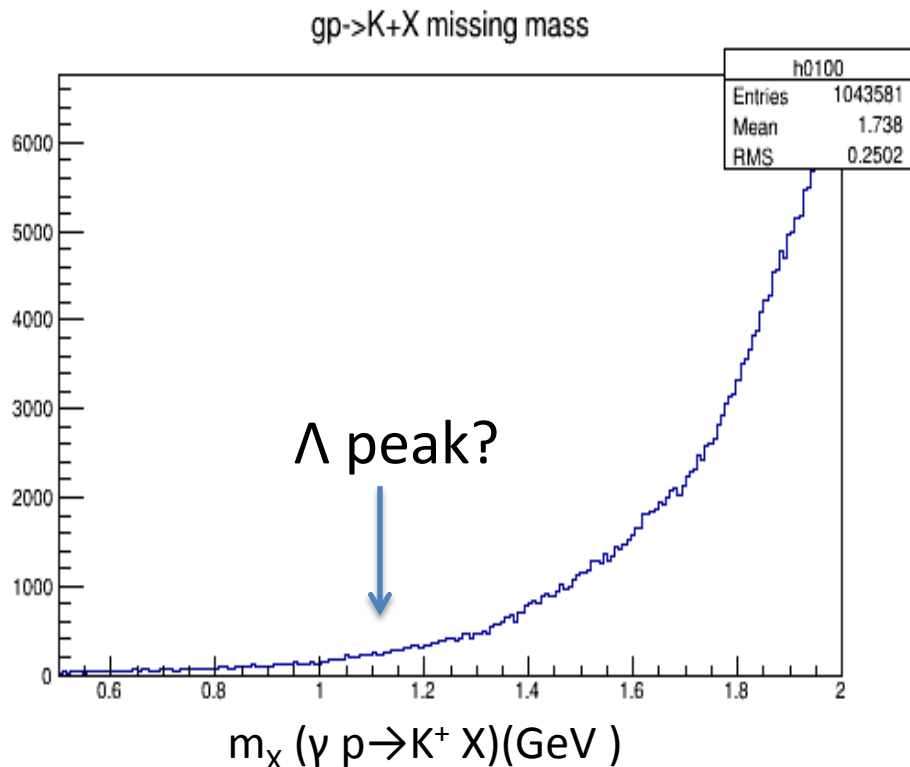
Considerations in Hall B (*Past*, J. Price)

- But evidence is there: *Baryon number "violating" events – Reconstructed Λ but with two protons at final state (ppπ⁻).*
- Signal is well above background

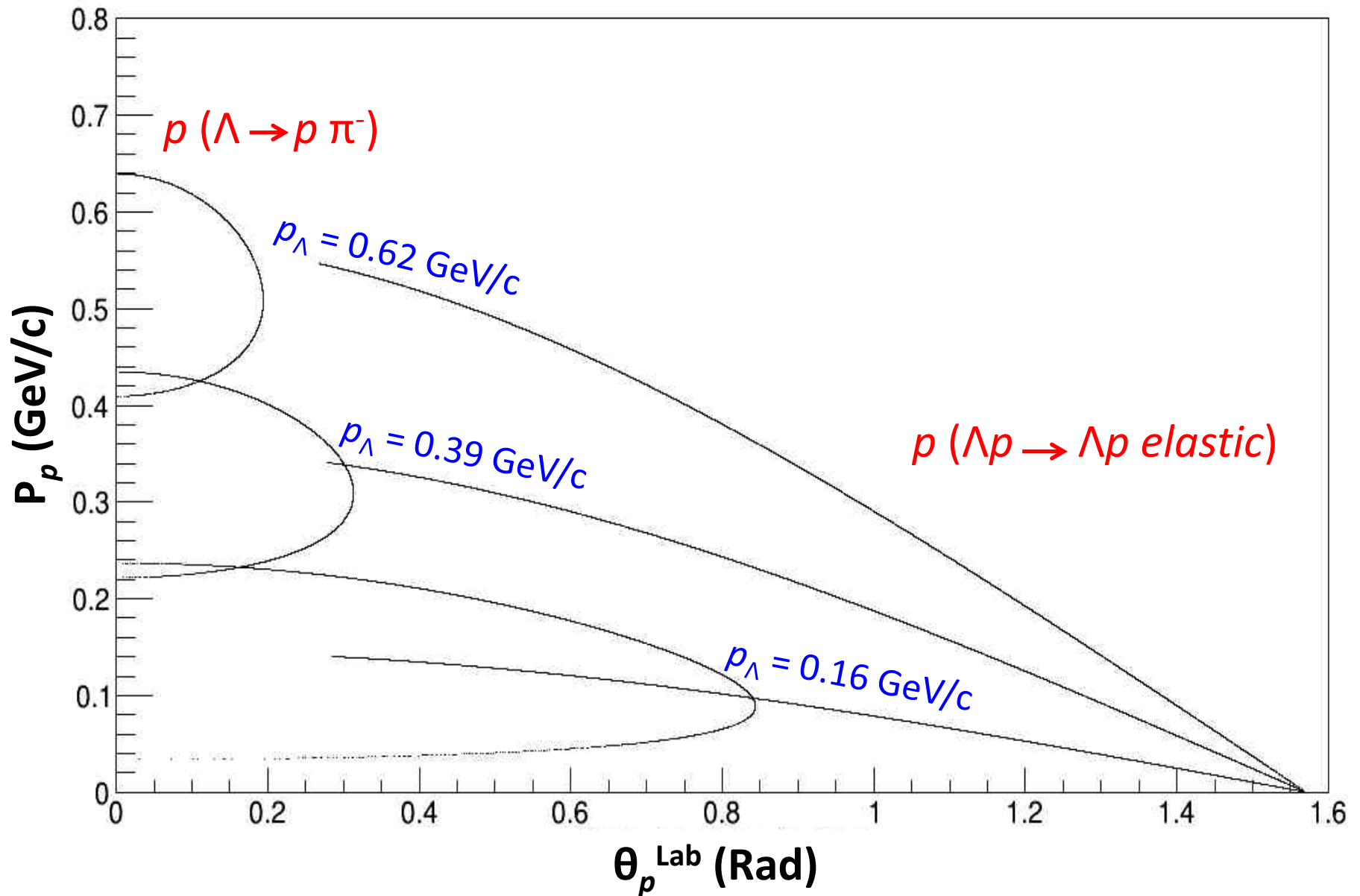LambdaBeam Mass (LambdaRecon mass cut)

h0706	
Entries	225302
Mean	1.091
RMS	0.1025

m_X (X p→Λ p)(GeV)

Example of p(e,e'K⁺) Reaction (Hall C)

- Clean sample of Λ's

Scattering vs Decay

Λ*p* Elastic Scattering by H(e,e'K⁺*p*) Reaction

- Advantages:
  - Can produce millions of "*tagged*" Λ's with known P_Λ^μ within a reasonable beam time period.
  - Elastic scattering events can be identified by p vs θ correlation of the scattered protons after gating on specific Λ momentum p_Λ.
- Challenges:
  - Proton detection (measuring both momentum and angles)
  - Simulations on proton energy loss, multiple scattering, average target "thickness" for systematic uncertainty.
- Overall:
  - May be a doable experiment which can significantly improve the quality of Λ*p* scattering data.

Investigation on Λ*n* Interaction at JLab

- No experimental information at all.

- May hold an important key for many issues on baryonic interactions.

- Study the Λnn system may provide a chance to explore experimentally on Λn interaction. Need to understand Gibson's suggestion.

- This may only be done at JLab.

- Experiment can be done relatively straight forward as regular (e,e'K$^+$) experiments.

- The most and extreme issue: *Tritium target* !