A Study of Λ-N Scattering using the CLAS Detector

Joey Rowley, Ken Hicks (Ohio University)
John Price (Cal State Univ Dominguez Hills)
Motivation

- Currently very little data for $\Lambda N$ < 1300 events
- Entirely from Bubble Chamber
- SU(3) suggests a relationship between NN and $\Lambda N$ interactions.
  - we need more data because we can’t use pure SU(3)
Motivation - Hyperon Puzzle

- Hyperons may exist inside neutron stars
  - results in a softened Equation of State

- “We conclude that stronger constraints on the hyperon-neutron force are necessary in order to properly assess the role of hyperons in neutron stars.”
CLAS Detector

- LH$_2$ target
- Length: 40 cm
- Width: 4 cm
- -90 cm from center of detector
Reaction

- Liquid Hydrogen Target
- $p, p', \pi$ detected
- $\Lambda p$ scatter elastically
Data
Data
Data
Cross Section

\[
\frac{d\sigma}{d\cos(\theta)}(E) = \frac{Y}{A \times \mathcal{L} \times \text{b. r.} \times \Delta \cos(\theta)}
\]

\(Y\): Yield
\(A\): Acceptance
\(\mathcal{L}\): Luminosity
\(\text{b. r.}\): Branching ratio (for \(p\pi^-\))

\[
\frac{d\sigma}{d\cos(\theta)}(E)\): Energy dependent cross section
Yield

~2622 events
Yield

\[ \sim 2622 \text{ events} \]
Yields

- Yield is taken from Missing Mass (K+ peak)
- Binned in Λ Momentum
Acceptance

Accepted Events:

\[
\text{Acceptance} = \frac{\text{Accepted } pp\pi^-}{\text{Generated } \Lambda p \text{ scattering}}
\]

Acceptance \((E_\gamma [1.2, 1.6])\)

Generate Events:

Missing Mass [GeV/c²]
Luminosity

\[ L_\Lambda(E_\Lambda) = \frac{\rho_T \times N_A \times l}{M} \times N_\Lambda(E_\Lambda) \]

- \( \rho_T \): density of the target
- \( N_A \): Avogadro’s number
- \( M \): molar mass of Hydrogen
- \( l \): travel distance of \( \Lambda \)
- \( N_\Lambda(E_\Lambda) \): yield in a certain energy range
Preliminary Results

- Black: Existing data from
- Red: Measurements from this study (~30% of total data set)
Questions?
pp → pp events

• pp → pp events can also result in the same final state.
Events need to be removed for incident p events but not for incident π⁻
pp → pp events
P1, P2
θ Distribution