Status of $K+\Sigma -$ analysis from g13

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Previous work

- **g2**: Both inclusive and exclusive analysis.  
  - Very low statistics!

- **g10**: Exclusive cross-section-measurement.  
  - High statistics  
  - Non-polarized beam!

- **LEPS spring 8**: Inclusive analysis.  
  - Cross section and beam asymmetry  
  - Very small angular coverage!
g13 Features

- Polarized photon beam: circular (g13a) and linear (g13b) polarization
- Photon energy range: 0.8-2.5 GeV
- Target: Liquid Deuterium (40-cm-length)
- Magnetic field negatively polarized
- About 52 billion triggers
Analysis: Goal

- Measurement of the cross section \((g13a)\)
- Determination of the beam asymmetry \((g13b)\)

That’s all what can be determined:
- Experimental issue \(\alpha = -0.068\) (PDG)
Analysis: \( \gamma d \rightarrow K^+ \Sigma^- (p) \rightarrow K^+ \pi^- n(p) \)

- K+, \pi-, n are detected. (p) is reconstructed by MM
- Events with “at least” 1(+), 1(-), 1(0)
- All possible track combinations for \( \gamma d \rightarrow K^+ \Sigma^- (p) \)
  - All (+) \( \rightarrow \) kaons
  - All (-) \( \rightarrow \) pions
  - All (0) \( \rightarrow \) neutrons
  - 5\( \sigma \) cut around \( M(\pi^-,n) \)
  - \( |\Delta T(\gamma,K^+)| < 5.0 \) ns
  - 5\( \sigma \) cut around MM\( (K^+\pi^-,n) \)
Analysis: Bad SC paddles (P. Mattione)

Positives

Negatives
Analysis: Particle ID (pion)

Negative pions:

\[ \Delta \beta = \beta_c - \beta_m \]

- \( \beta_c \) from \(|p|\)
- \( \beta_m \) from EVNT
Analysis: Particle ID (kaon)

Positive kaons:

\[ \Delta \beta = \beta_c - \beta_m \]

- \( \beta_c \) from \( |p| \)
- \( \beta_m \) from EVNT

\[ \Delta \beta \text{ vs momentum } K^+ \]

\( \Delta \beta \) vs Momentum K^+ (GeV/c)

Entries 123115

0.05
Analysis: Particle ID (neutron)

- Neutron path has to be corrected on both edges:
  - **Vertex (detached vertex from Σ-):**
    - VT(neutron) = VT(Kaon)
    - Vertex(neutron) = Vertex(Kaon)
  - **EC hit coordinates (z-axis):**
    - γd→π+π-pn is studied to find a global EC hit coord. corrections

- With the above corrections, β and p are re-calculated for the neutron
Analysis: Particle ID (neutron)
Analysis: After particle ID

Kaon

Pion

Neutron

\( \beta \) vs Momentum \( K^* \)
Entries 16906

\( \beta \) vs Momentum \( \pi^* \)
Entries 16906

\( \beta \) for neutrons
Entries 16906
Mean 0.7234

\( \theta \) vs \( \phi \) \( K^* \)

\( \phi \) vs \( \theta \) \( \pi^* \)

\( \phi \) vs \( \theta \) neutron
Analysis: ONE combination

Number of "good" combinations

Counts

Combinations/event

- 97.79%
- 2.19%
- 0.012%
Analysis: Photon selection

- The best photon is selected within $\pm 1.0\text{ns}$.

One photon = 96.81%
Two photons = 3.14%
Three photons = 0.044%
Spectator Proton

Momentum

Mass

\[ \pi^0 + p \]
Spectator Proton

- Proton momentum cut (0.2 GeV/c)
- Quasi-free vs re-scattering
Spectator Proton

- $\text{MM}(\Sigma^-) \ vs \ \text{Momentum } K^+ \ helps \ getting \ rid \ of \ most \ of \ the \ background \ from \ \pi_0 + p$
Spectator Proton Mass

Isolated events
Final $\Sigma^-$ Mass

![Final $\Sigma^-$ Distribution Graph](image)

- Entries: 6108
Conclusions

- Analysis of the $K+\Sigma^-$ is in progress, focused on the determination of beam asymmetry and cross section.

- The current data look very promising. Based on this analysis (22 runs with 2.3 GeV in photon energy), it is predicted to end up having about 400,000 $\Sigma^-$ events in total.