

EXCITED HYPERON SPECTROSCOPY AT THE PROPOSED K-LONG FACILITY

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On behalf of the KLF collaboration

Motivation

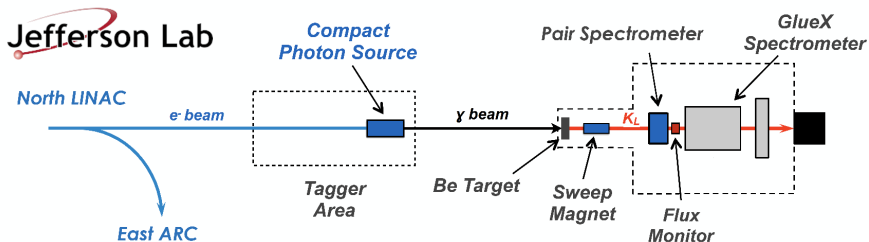
- Electromagnetic decay of baryons: probe of wave functions
- Radiative decays discriminate between theoretical models
- K-Long Facility will provide high-statistics and high-quality data
- In this talk, simulation of $\Sigma(1670)^+ \rightarrow \Lambda\pi^+$ as a first step

Outline

- K-Long Facility Beamline
- Simulation and Reconstruction
- Results
- Summary and Outlook

KLF Beamline

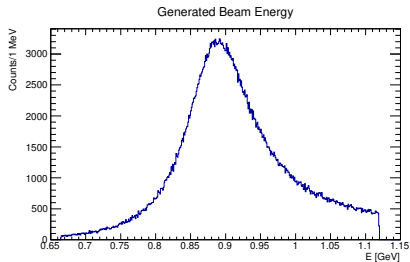
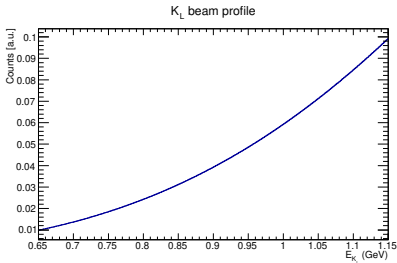
- Compact Photon Source → Untagged photon beam
- Beryllium target → production of K_L^0 via decay of forward emitted ϕ
- LH_2/LD_2 target → Secondary target
- GlueX spectrometer → Measuring final state



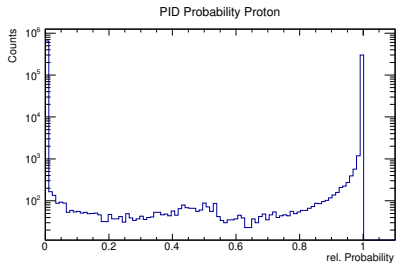
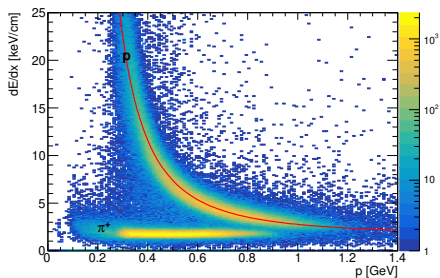
GLUEX

Event Generator

- Specialized generator based on momentum distribution of K_L^0 from beam simulations
- Reaction $K_L^0 p \rightarrow \Sigma(1670)^+ \rightarrow \Lambda \pi^+ \rightarrow \pi^- \pi^+ p$
- Breit-Wigner resonance for $\Sigma(1670)^+$
($M = 1670 \text{ MeV}$, $\Gamma = 60 \text{ MeV}$)



- Particle ID based on dE/dX and timing

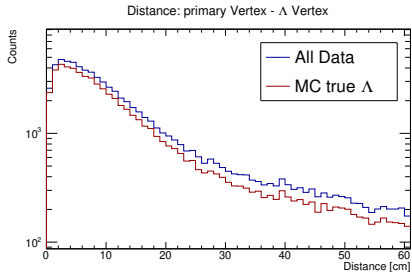
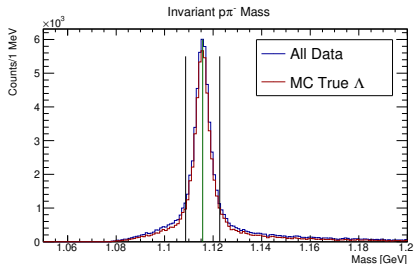


PID criterion

- Determine the probability for all charged hypotheses
- Keep all PIDs for which probability is above 40 %

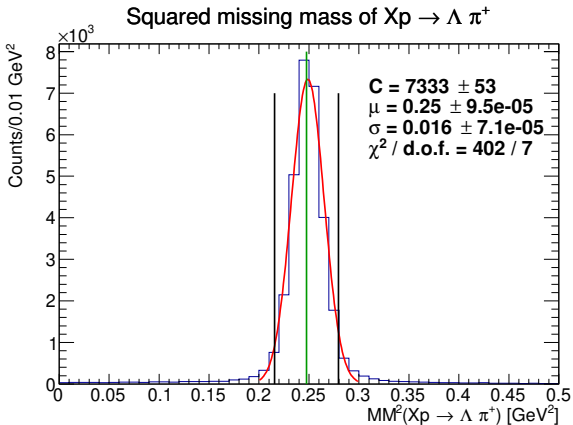
Reconstruction of the Λ ($M = 1115$ MeV)

- Combine all π^- and p candidates
- Apply a mass cut with total width 14 MeV



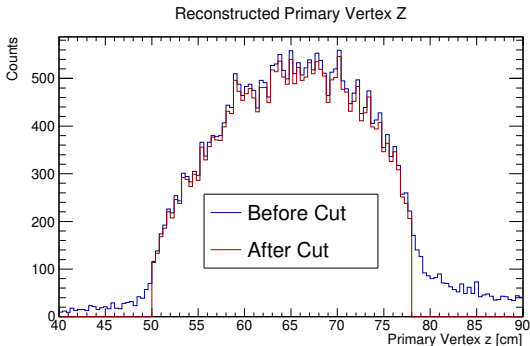
Missing Mass

- Need to distinguish Kaon and γ beam
- Combine Λ with π^+ , determine $MM^2(Xp \rightarrow \Lambda\pi^+)$
- Cut with total width of 0.064 GeV^2 centered around $M_{K_L^0}^2$



Target Volume

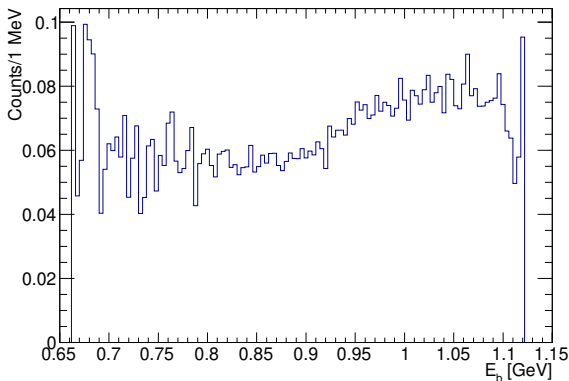
- Kinematic Fit not yet performed
- Primary Vertex is calculated from the measured charged tracks and reconstructed Λ
- Apply selection such that this vertex lies within the target volume
- If more than one valid combination, keep only the one closest to beamline



Overall efficiency

- Reconstructed and generated beam energy agree
- Overall reconstruction efficiency of approximately 6 %

Overall reconstruction efficiency



Main source of losses

Study of individual particle efficiencies
→ losses due to soft pions from Λ decay

Summary

- Custom generator for $K_L^0 p \rightarrow \Sigma(1670)^+ \rightarrow \Lambda \pi^+ \rightarrow \pi^- \pi^+ p$
- Reconstructed the final and intermediate state particles with the GlueX spectrometer
- Achieved an overall reconstruction efficiency of 6 %
- Efficiency dominated by losses due to low momentum pion

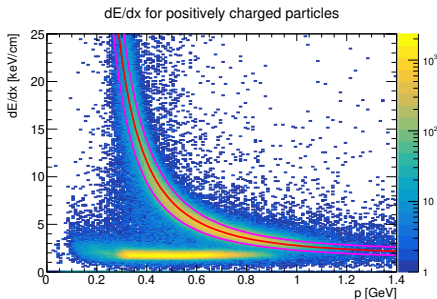
Outlook

- Analysis of radiative hyperon decays based on GlueX data
- Currently working on analyses of the final states $\Lambda \gamma$ and $\Lambda e^+ e^-$

Thank you for your attention and take care !

BACKUP

PARTICLE IDENTIFICATION



Definition of Probability

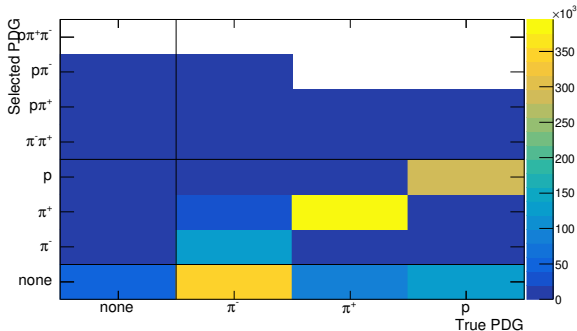
- $\left\langle \frac{dE}{dx} \right\rangle_{\alpha}$ and $\sigma \left\langle \frac{dE}{dx} \right\rangle_{\alpha}$ predicted
- Define $\Gamma_{\alpha} = \frac{\frac{dE}{dx} - \left\langle \frac{dE}{dx} \right\rangle_{\alpha}}{\sigma \left\langle \frac{dE}{dx} \right\rangle_{\alpha}}$
- $\mathbb{P}_{\alpha} = \mathbb{P} \left(\chi_{\text{real}}^2 < \Gamma_{\alpha}^2 \right)$
- Same is done for the BCAL and TOF time distributions

PID criterion

- Determine the probability for all hypotheses
- Keep all PIDs where rel. probability is above 40 %

EFFICIENCIES

- Efficiency determined from “confusion matrix”
- Optimal case: Only Diagonal filled



Overview

	ρ^-	π^+	π^-
ϵ	68 %	81 %	25 %

- π^- efficiency is significantly smaller
- Misidentification as π^+

π^+ - EFFICIENCY

