Measurement of the $\Xi^- p \rightarrow \Lambda\Lambda$ Cross Section at $p_{\Xi} = 0.2 \sim 0.8$ GeV/c with a Scintillating Fiber Active Target

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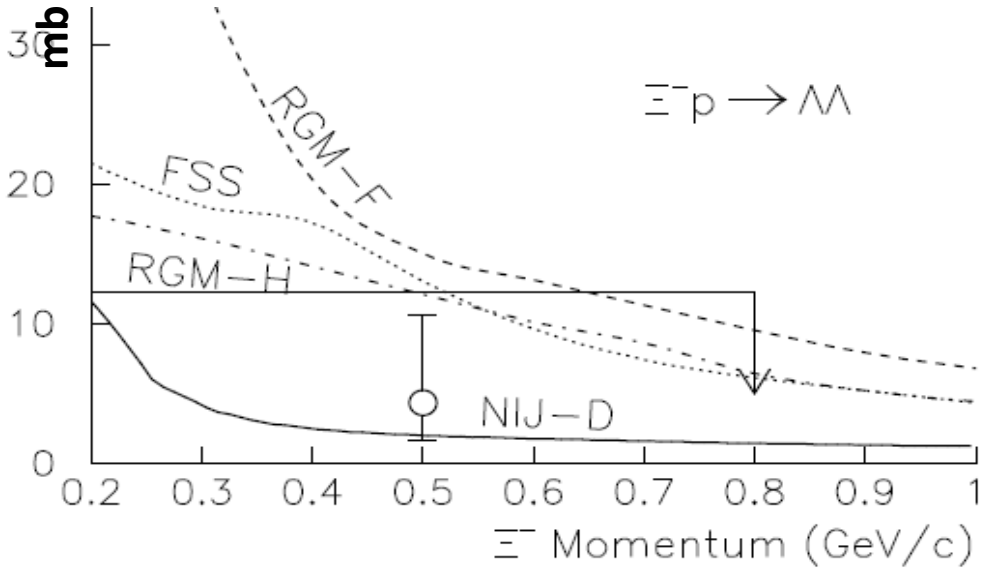
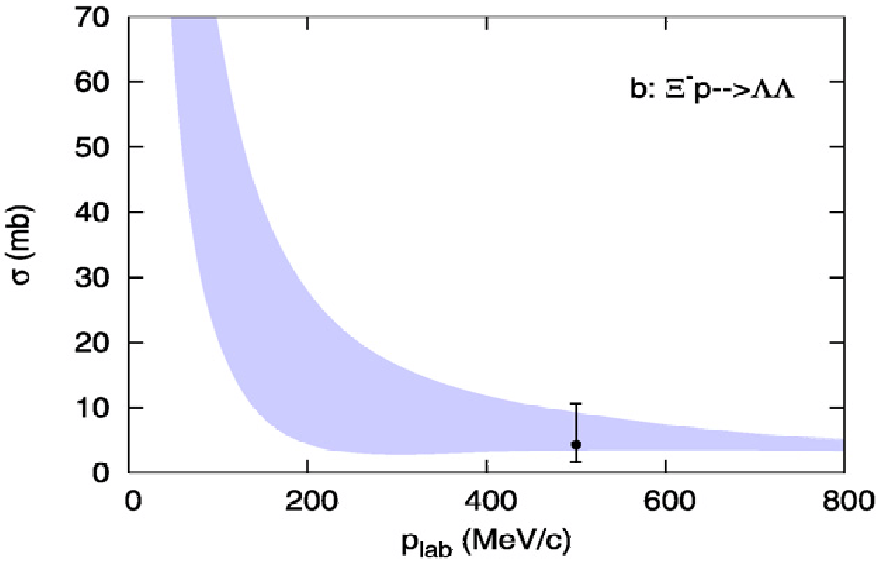
Theoretical Approach and old experimental Result





RGM description for three-quark clusters

→effective one-gluon exchange
scalar (ε, S*, δ, κ), pseudo-scalar (π, K), and vector (ω, ϕ, ρ, K*) meson exchanges between quarks

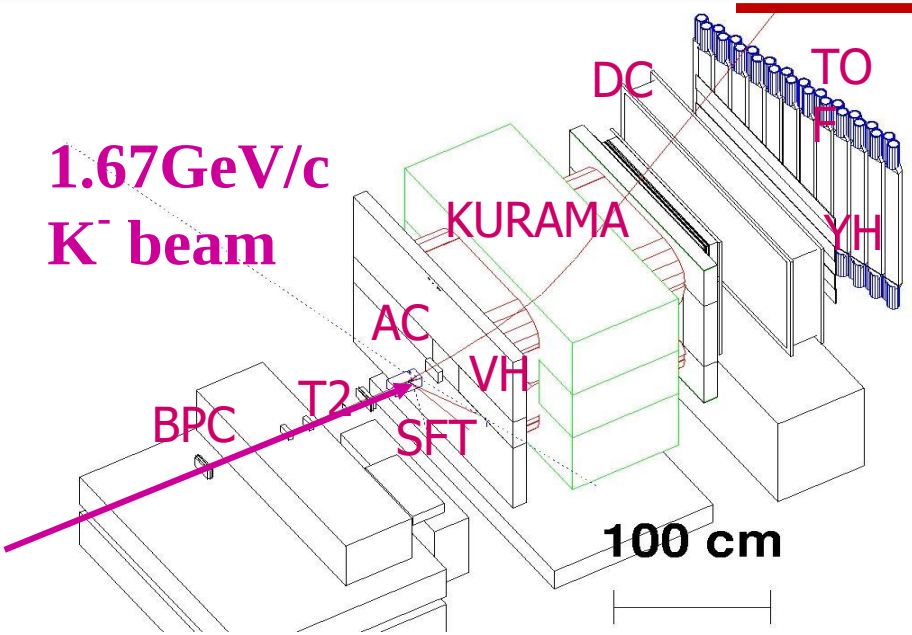
Baryon-Baryon interactions in chiral effective field theory

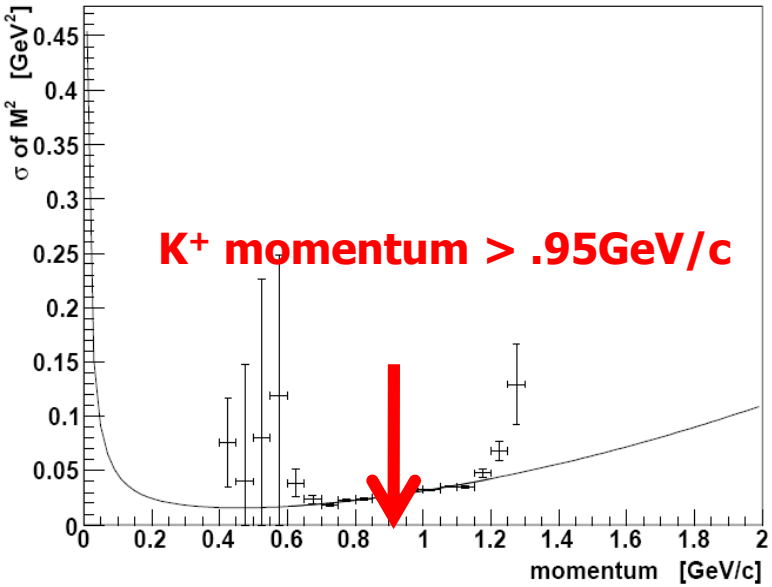
→H. Polinder, J. Haidenbauer, and Ulf-G. Meissner, Nucl. Phys. A779,244 (2006); Phys. Lett. B653, 29 (2007).

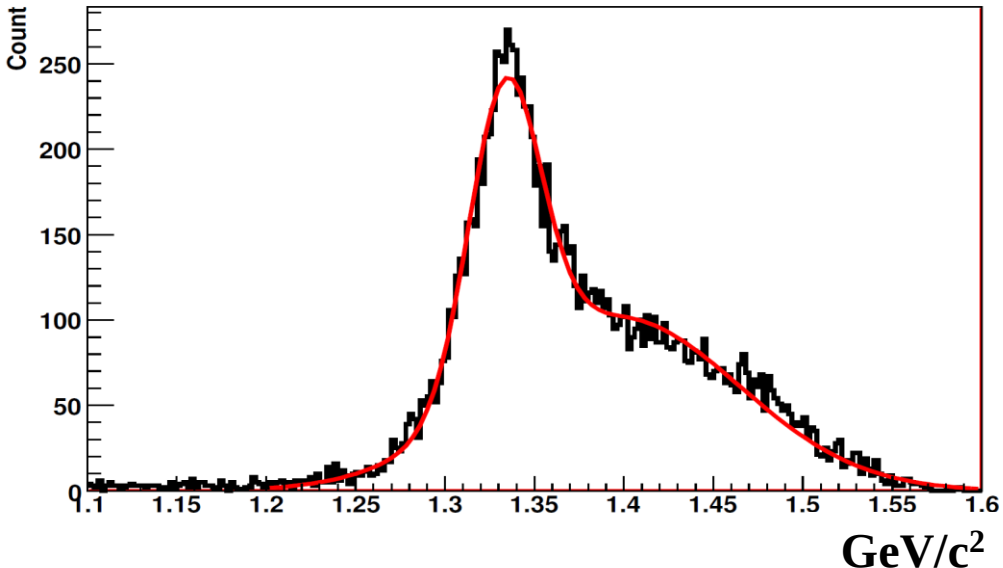
Theoretical models play an important role

→constituent quark model, chiral EFT, and …..

(K^-,K^+) Event





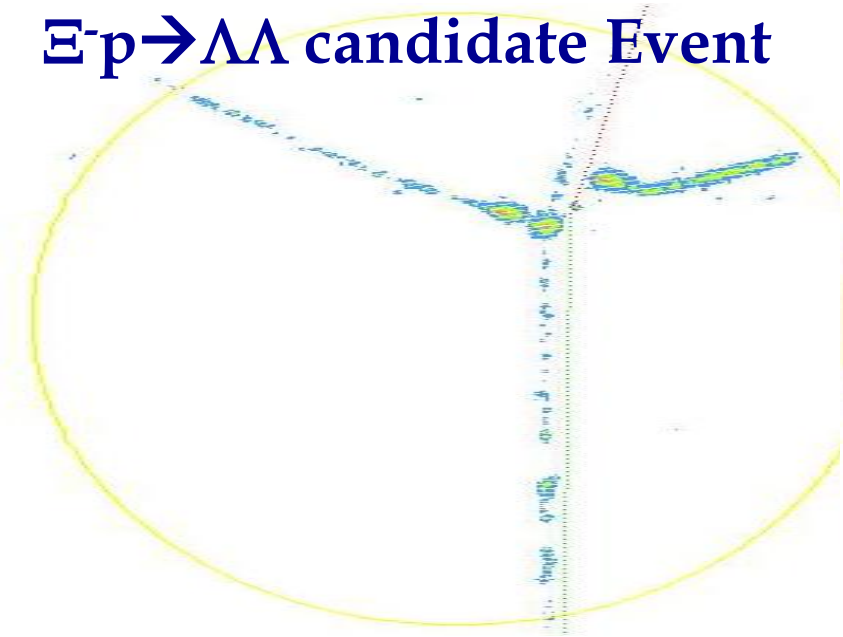


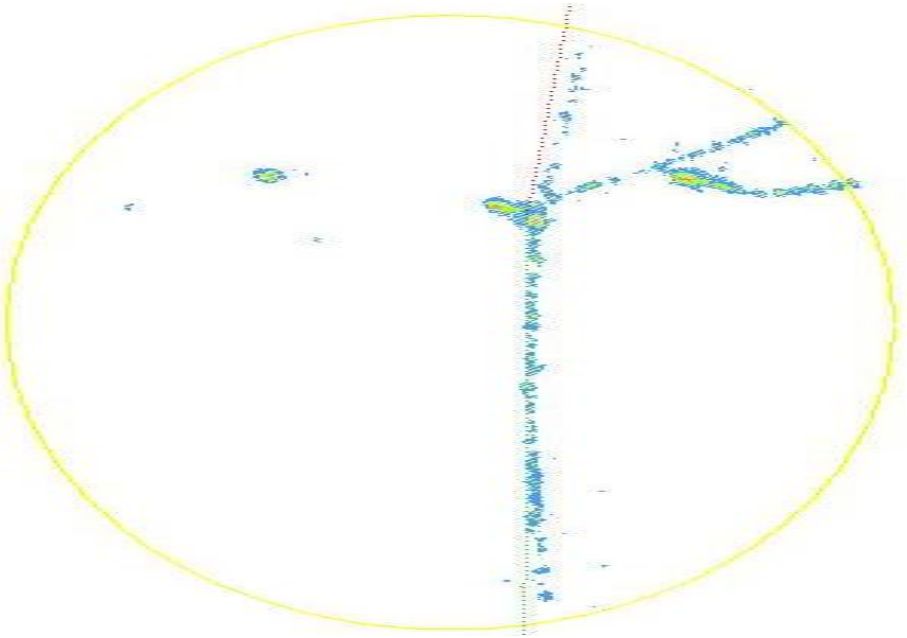
target material
^{12}C and H

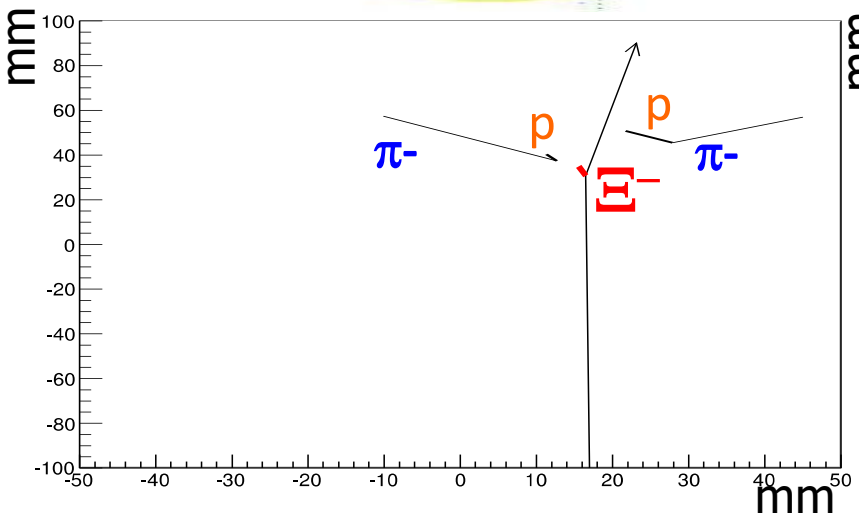
Image data analysis

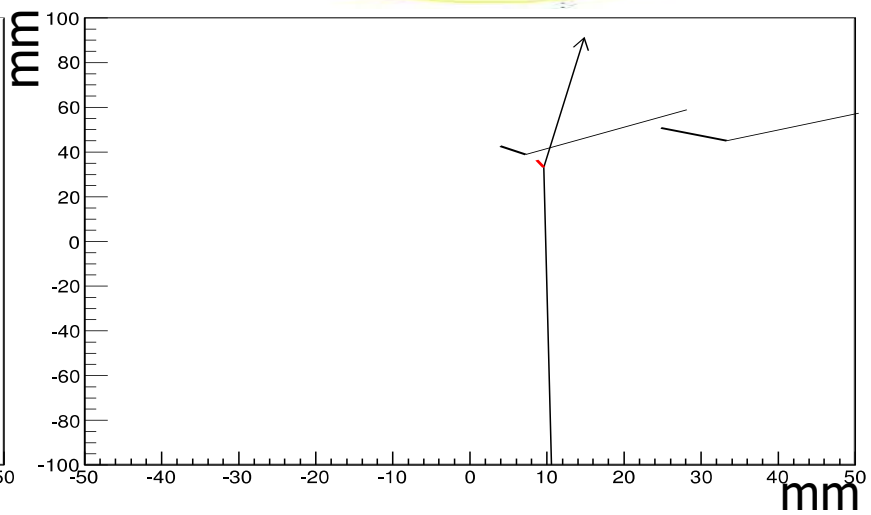
$\Xi^- p \rightarrow \Lambda\Lambda$ Event Configuration

$\Xi^- p \rightarrow \Lambda\Lambda$ candidate Event

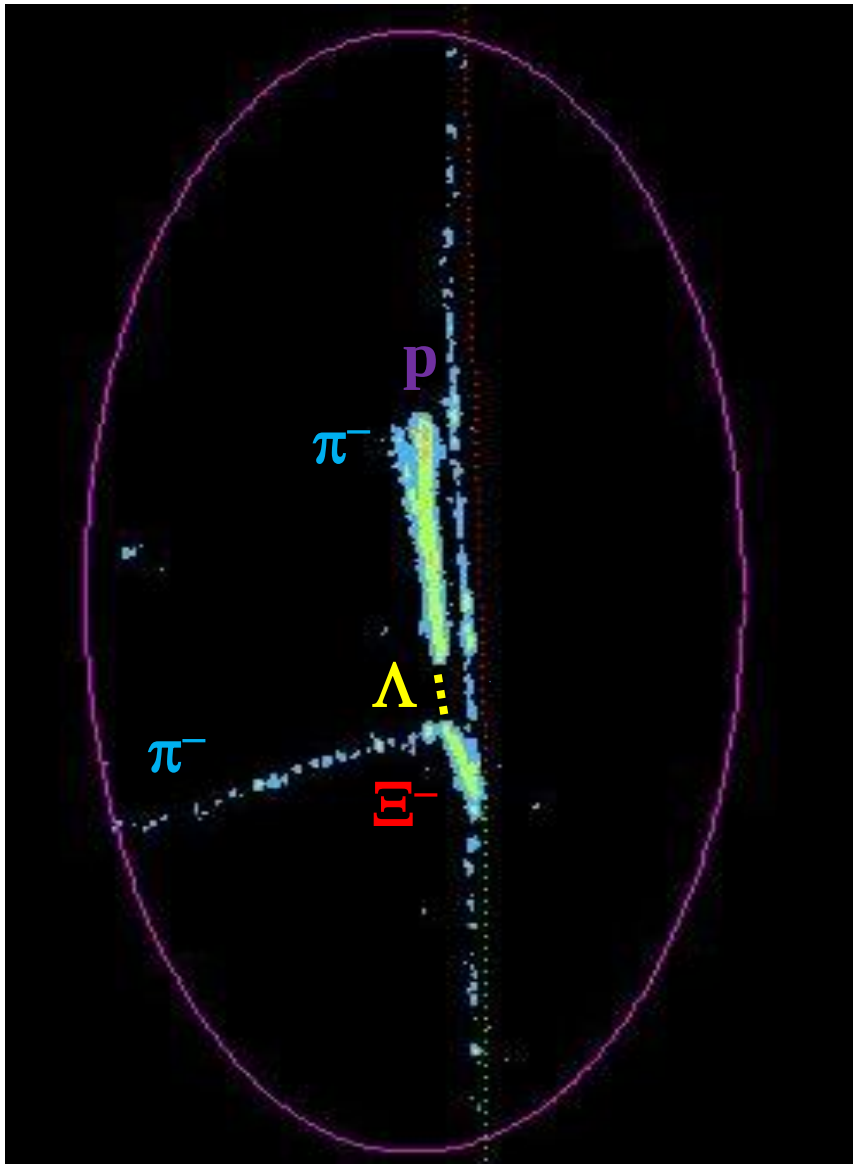


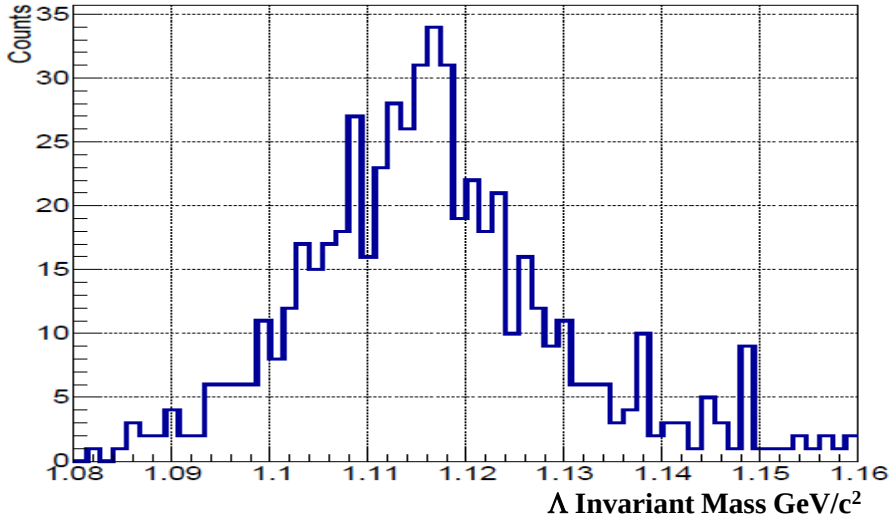


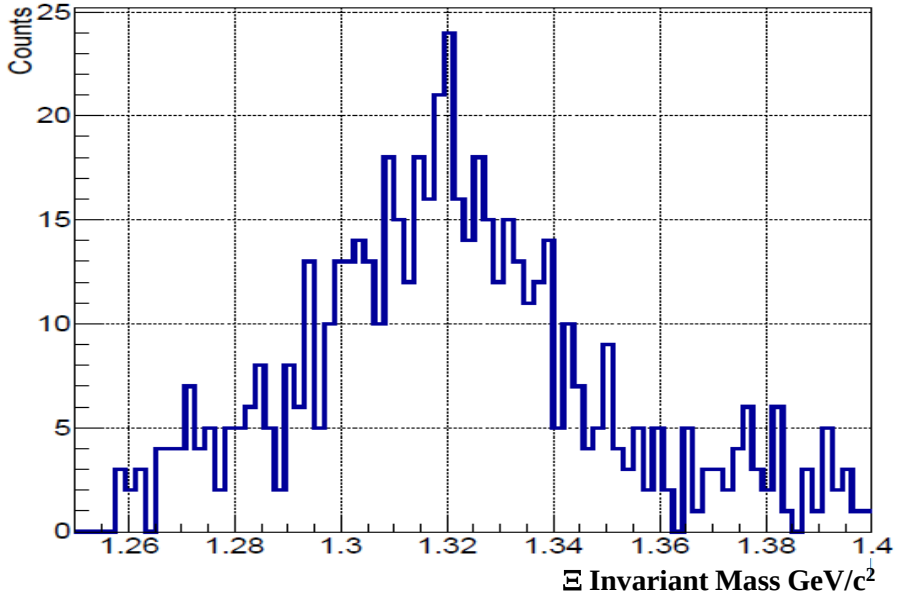




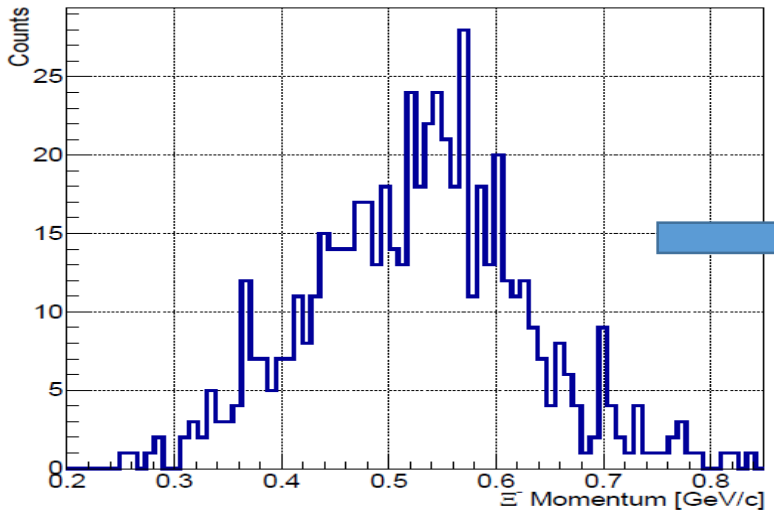
Invariant Mass(Λ,Ξ)

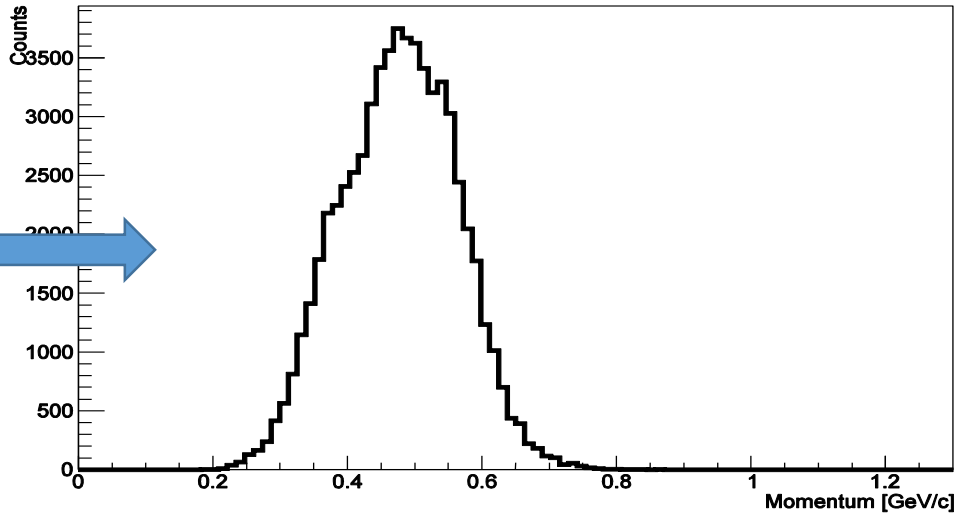


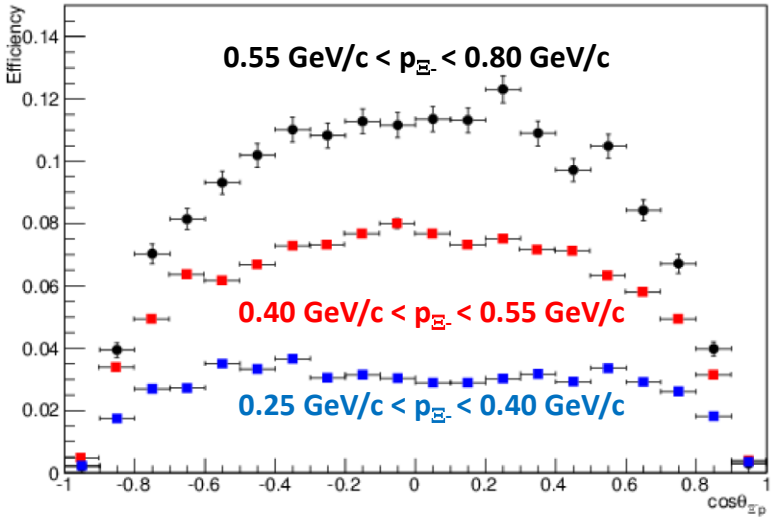


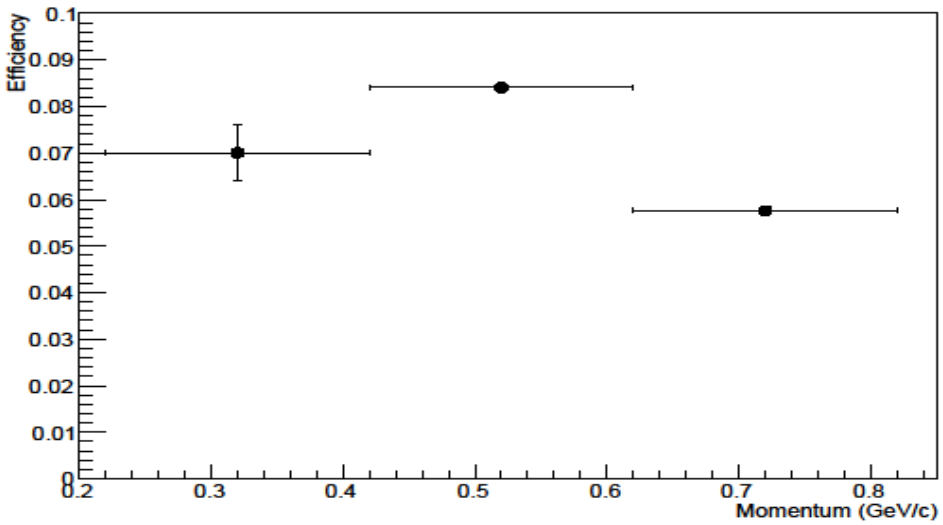


Detection Efficiency

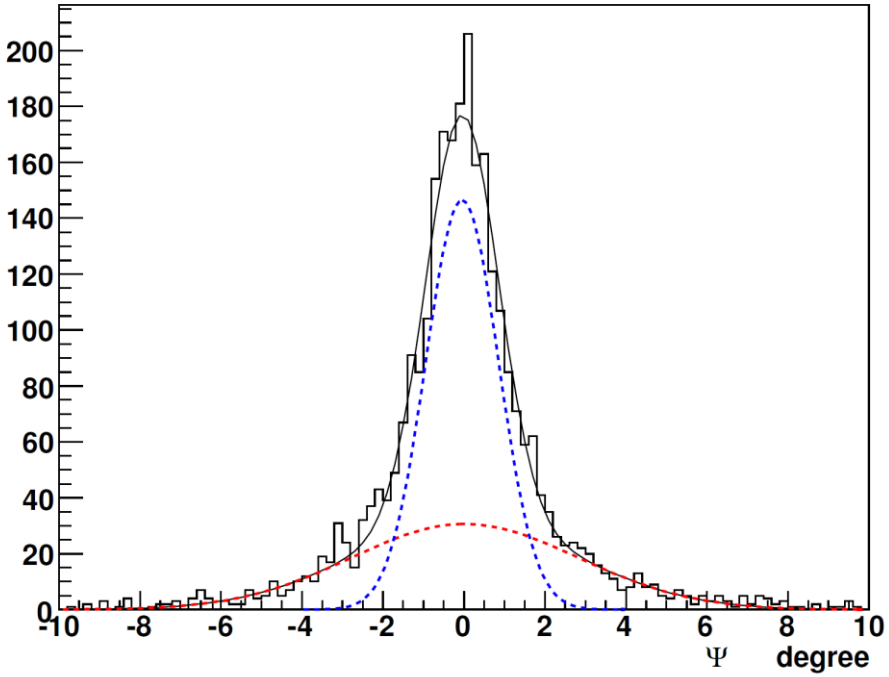


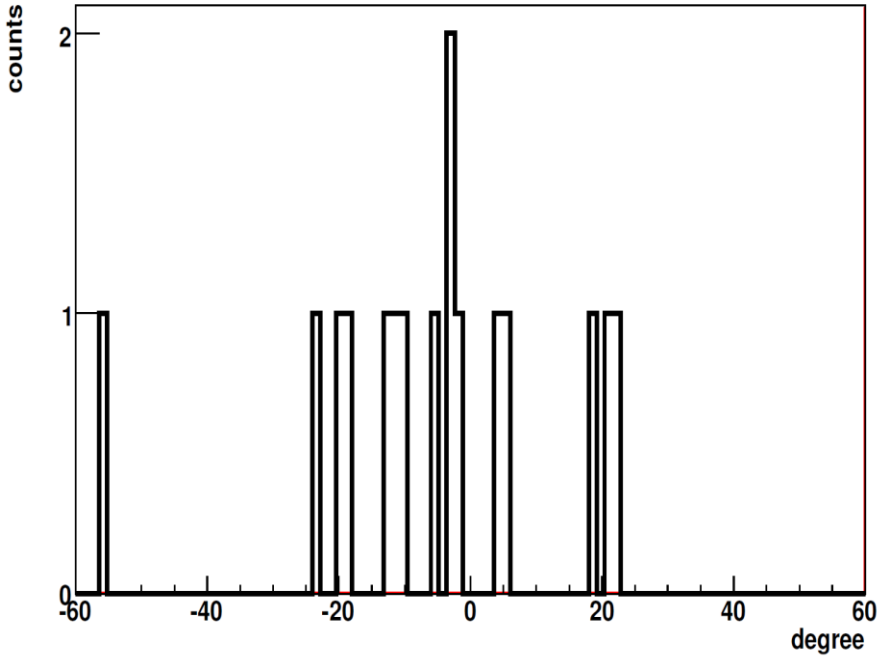


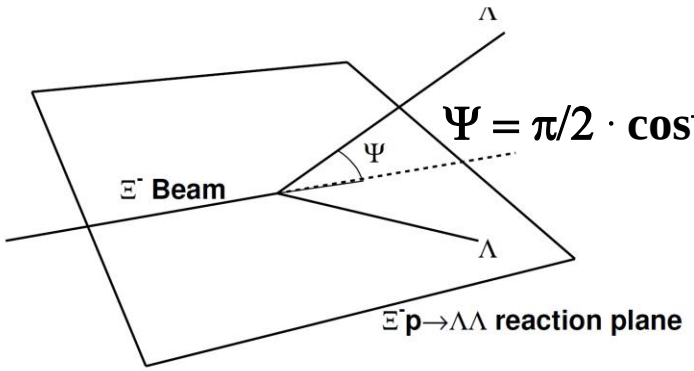




Coplanarity Angle



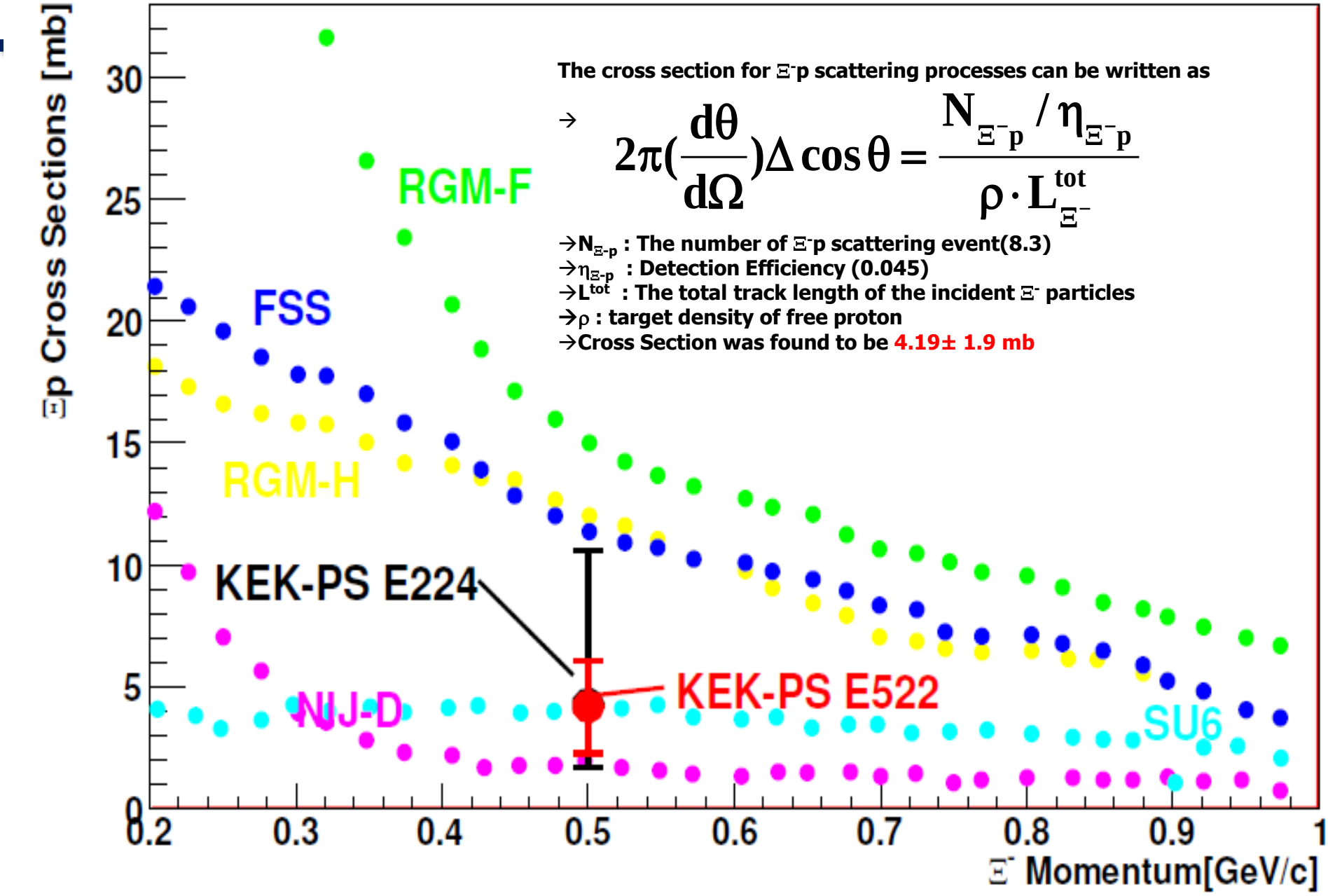




$$\Psi = \pi/2 \cdot \cos^{-1}(\Xi - \Lambda x \Lambda)$$

→ 1^0 degree angle

→ 16 events of Ξ^-p → ΛΛ was reduced to 8.3



The cross section for Ξ^-p scattering processes can be written as

→
$$2\pi\left(\frac{d\theta}{d\Omega}\right)\Delta\cos\theta = \frac{N_{\Xi^-p} / \eta_{\Xi^-p}}{\rho \cdot L^{tot}_{\Xi^-}}$$

→$N_{\Xi\text{-}p}$: The number of Ξ^-p scattering event(8.3)
→$\eta_{\Xi\text{-}p}$: Detection Efficiency (0.045)
→L^{tot} : The total track length of the incident Ξ^- particles
→ρ : target density of free proton
→Cross Section was found to be 4.19± 1.9 mb

summary

→Total 14,000 (K^-,K^+) missing mass events for the ^{12}C and H target.

→The Ξ- momentum was reconstructed from $\Xi^- \rightarrow \Lambda\pi^-$ event.

→$\Xi^-p \rightarrow \Lambda\Lambda$ event candidate was 16 counts

→Considering the coplanar angle distribution, cross section was found to be 4.19 ± 1.9 mb..

→This result was estimated to be consistent with the Nijmegen-D model and the chiral effective field theory predction(H. Polinder, J. Haidenbuer , U-G. Meiβner Phys. Lett. B653, 29-37(2007)).