$K^{*0}\Lambda$ AND $K^{+}\Sigma^{*-}$ PHOTOPRODUCTION ON THE DEUTERON

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Outline

- Missing N* resonances
  - Coupling to Y and Y* decay channels to help find high mass states
- γ D->K^{*0} Λ (p) and γ D->K^{+} Σ^{*-} (p) have same final state ($pK^{+}\pi^{-}\pi^{-}$)
  - Calculate Cross Sections & Asymmetries for both
- g13a experiment data (circularly polarized photons)
- Perform reaction-specific particle ID to obtain a relatively clean K^{+} signal
- Preliminary Signals with 2% of g13a data, cooking now underway

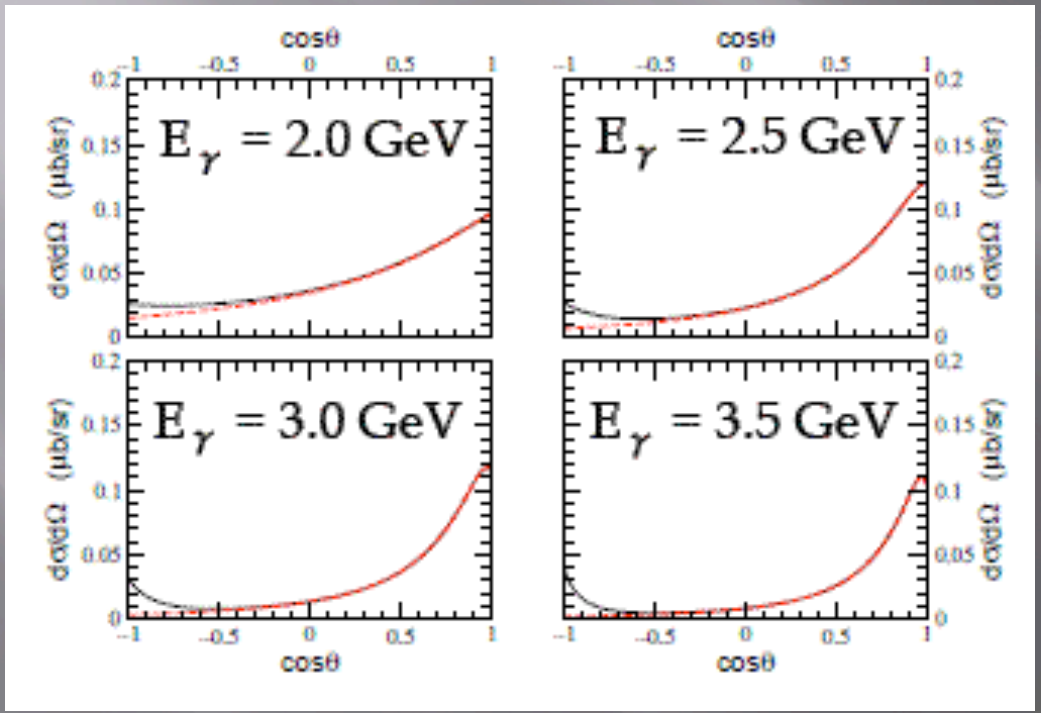
N* States

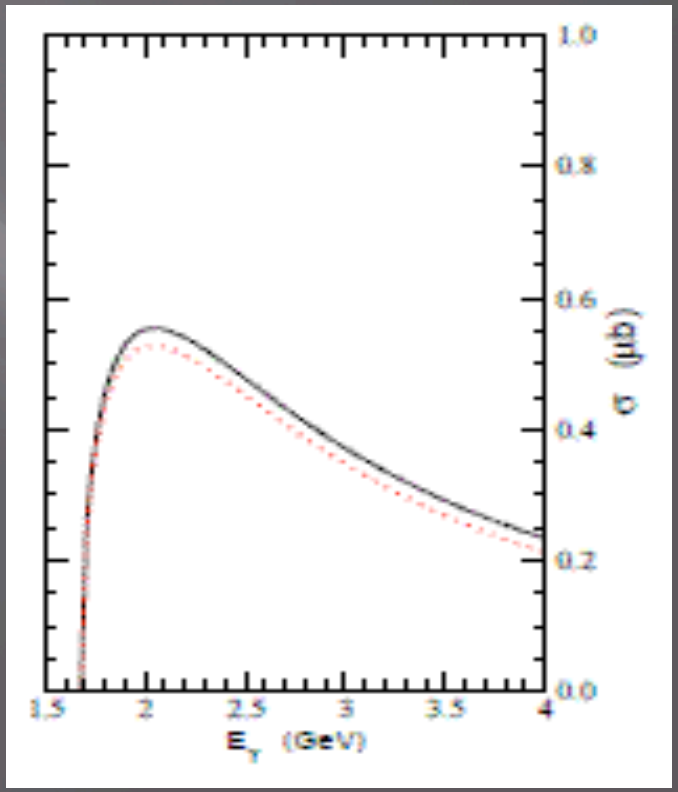
- Missing N* resonances
  - predicted by quark models
  - hard to find (wide, overlapping resonances)
- Most N* data comes from π N analyses (π beams or decays into final state π's)
- Coupled-channels analysis of N* decays
  - Can be used to isolate the different N* signals
  - Y and Y* decay channels are new
- Several N* predicted to decay non-negligibly to Y* channels:
  - $K^{*0}\Lambda$
    - $[N7/2-]_1(2090) = N(2190)G_{17}$****
    - $[N1/2-]_3(1945) = N(2090)S_{11}$*
    - $[N1/2-]_5(2070)$
  - $\Sigma^{*}K^{+}$
    - $[N5/2+]_2(1980)$
    - $[N3/2-]_5(2095)$

* Capstick, Roberts; Phys Rev D, 58 074011 (1998)

$K^{*0}\Lambda$ Predictions

- Cross-sections predominantly t-channel process (red lines)
- However, in the s-channel calculations only the Born term is included
  - No resonant s-channel terms included because not enough information yet on couplings

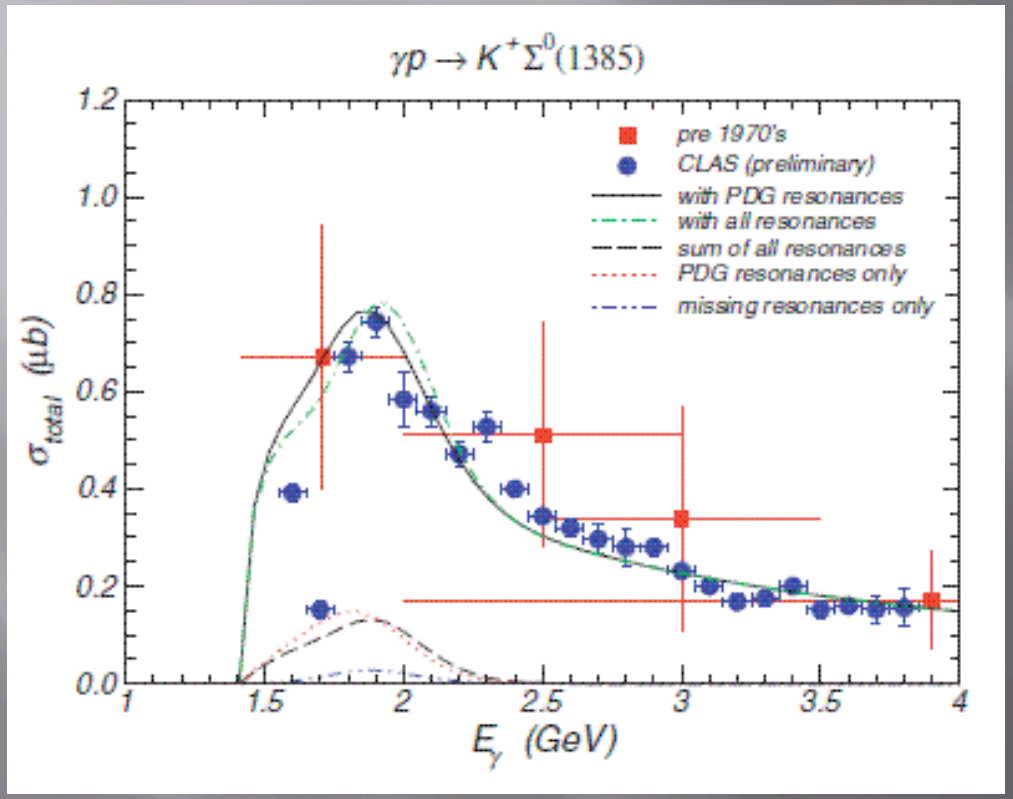


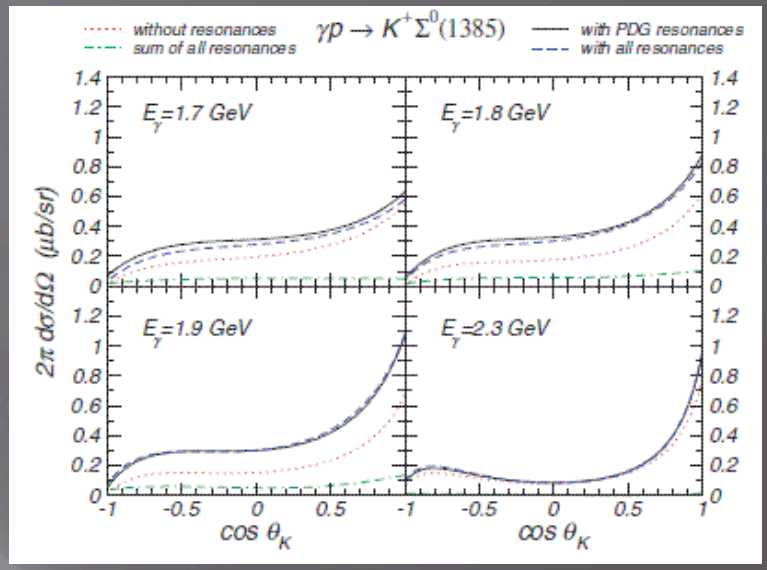


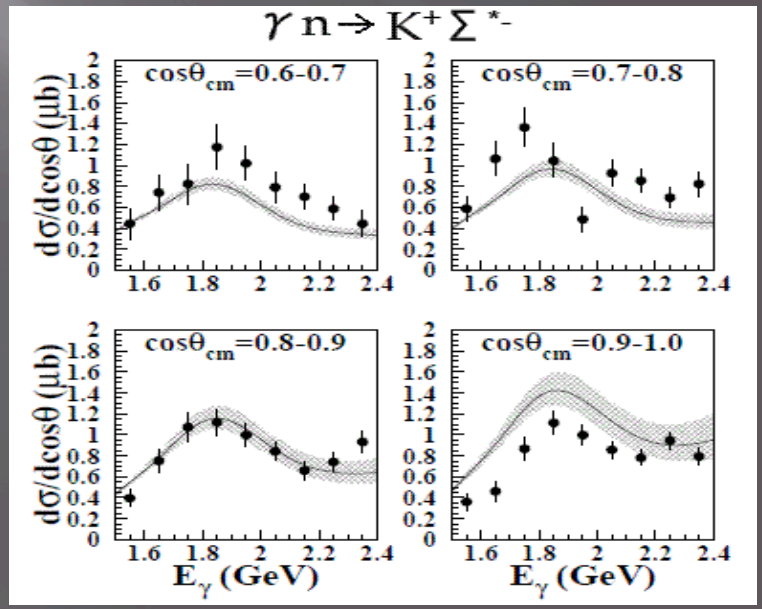
* Oh, Kim; arxiv:0602112v4 (2006)

K+ Σ^{*-} Predictions and LEPS Data

- γ P Prediction shown, γ N on the way
- γ N LEPS/CLAS data forward/large angles
- Haiyun Lu: eg3, High Energy







* Hicks, et al. (LEPS); arxiv:0812.0771v1 (2008)

* Oh, Ko, Nakayama; Phys Rev C, 77 045204 (2008)

g13 Experiment Overview

- Ran between October 2006 and June 2007

g13a – Circularly Polarized Photons

- E_e 2.0 GeV, 84% γ polarization
- E_e 2.65 GeV, 78% γ polarization
- Trigger = 2 Sectors, Up to 10 kHz
- Statistics
  - $2*10^{10}$ Triggers
  - $> 2*10^5$ Exclusive $K^0 \Lambda$ Events

g13b – Linearly Polarized Photons

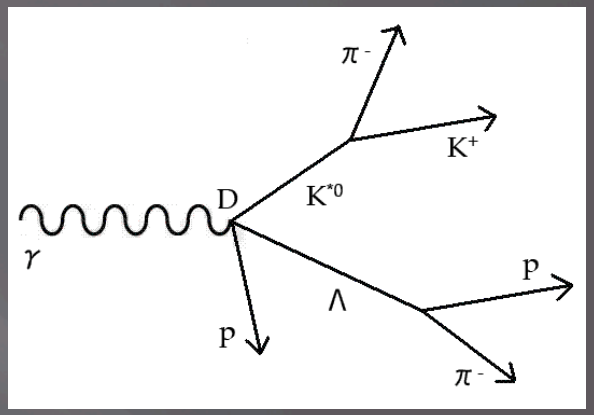
- E_e 3.3 – 5.2 GeV
- E_γ 1.1 – 2.3 GeV
  - Six Settings
  - Polarization 70 – 90%
- Trigger = 1 Sector, 7 – 8 kHz
- Statistics
  - $3*10^{10}$ Triggers
  - $> 10^5$ Exclusive $K^0 \Lambda$ Events

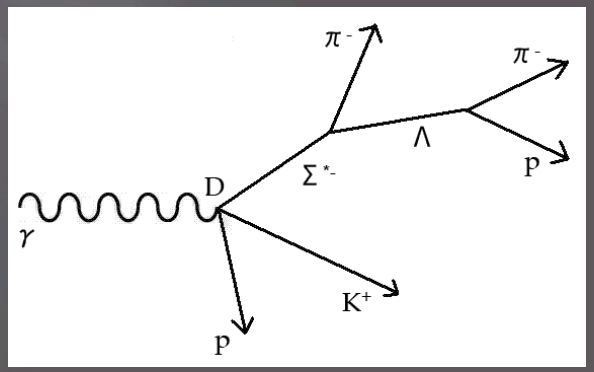
g13 Experiment Status

- Pass 1 of g13b cooking completed
  - Problem found with dc-alignment
  - No trip files
- Pass 1 of g13a cooking underway (7.5%)

Analysis Outline

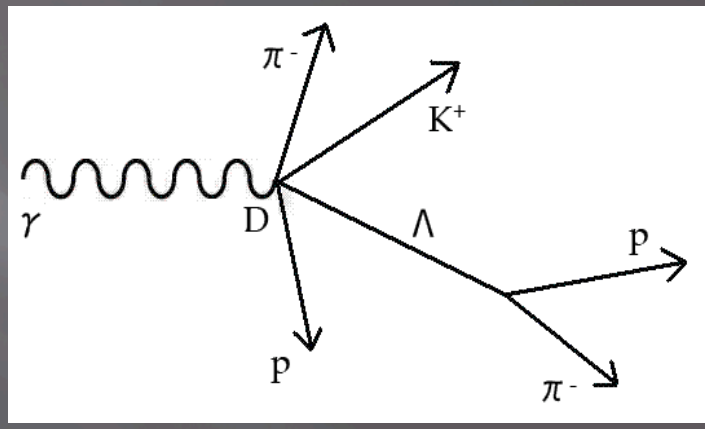
- Pass0 g13a Data, ~2% of g13a Total
- Reaction-Specific Particle Identification
- Wide-cut Event Candidate Skim
- p & π^- Identification
- Λ Event Selection
- K^+ Identification
- Missing Proton Event Selection
- K^{*0}, Σ^{*-} Interference Cut



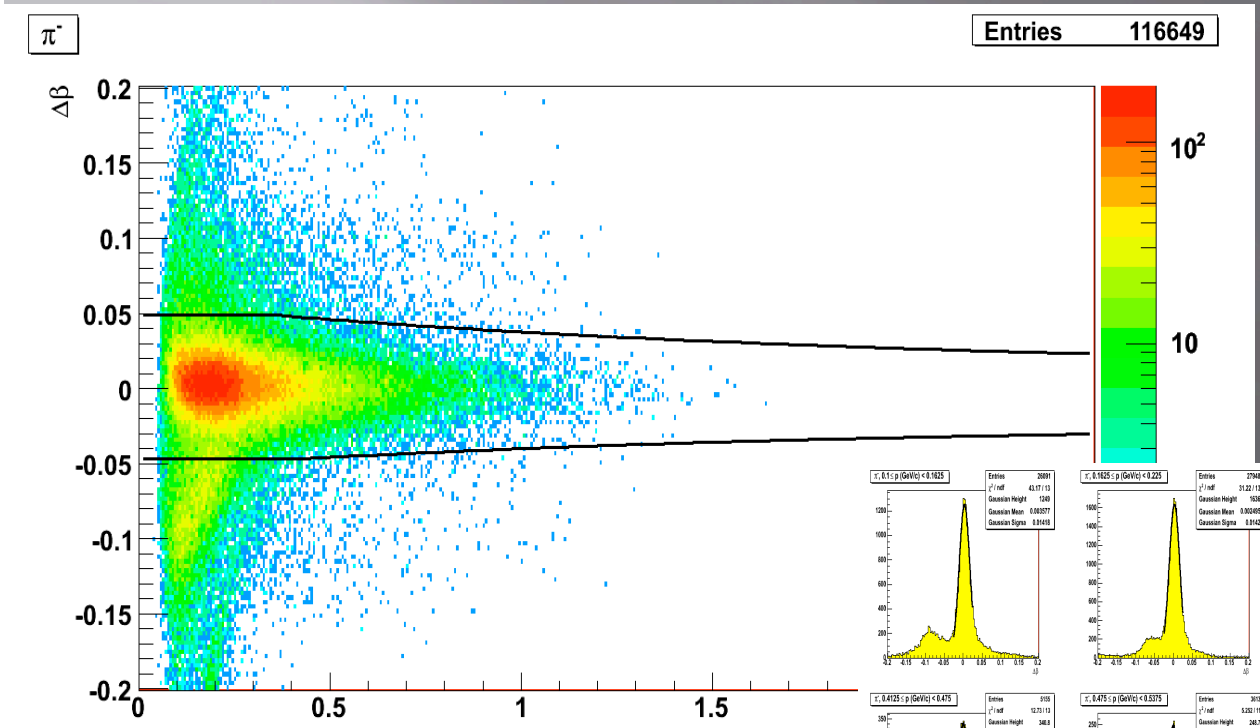


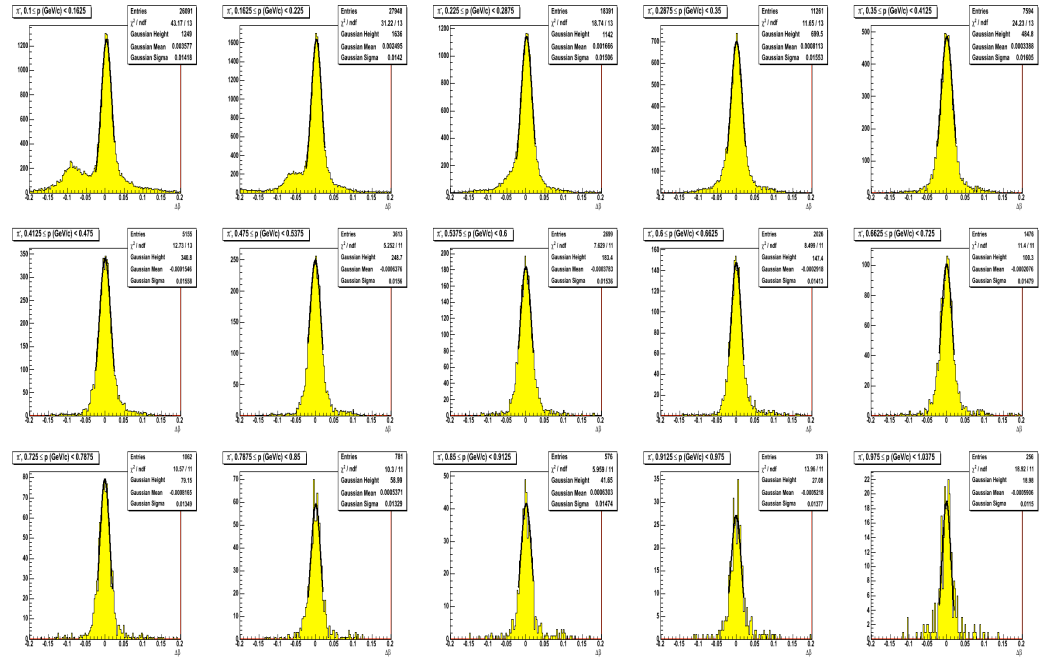
Event Candidate Skim

- Require at least 2 q^+ and 2 q^- tracks
- Test every possible track combination: all q^- tracks as π^-, all q^+ tracks as p and K^+
- The γ with time closest to the π^- at reaction vertex is selected
- Wide Timing Cuts
  - p, π^- within 8 ns at Λ decay vertex
  - K^+, π^- within 5 ns at reaction vertex
  - γ, π^- within 4 ns at reaction vertex
  - γ, K^+ within 6 ns at reaction vertex
- Wide Mass Cuts
  - 1.09 GeV < Λ Invariant Mass < 1.14 GeV
  - 0.7 GeV < p Missing Mass < 1.2 GeV
- 0.025% Data Remaining, Negligible Signal Loss



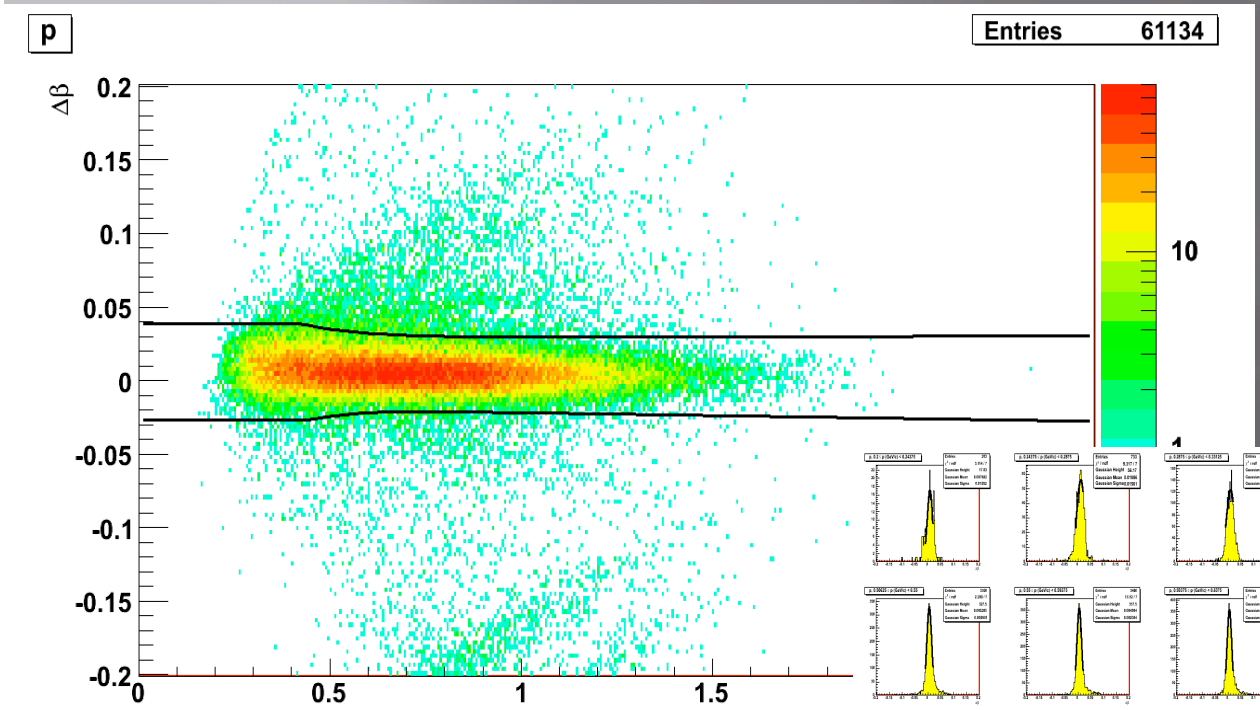
π^- Identification

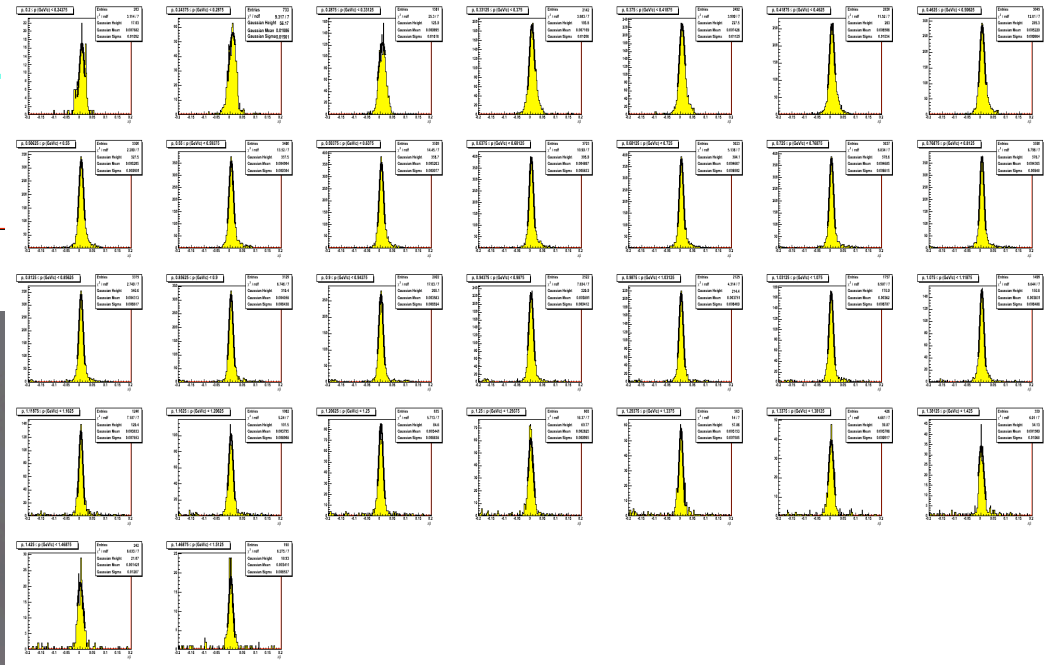




- $\Delta\beta$ Vs Momentum
  - Fit to Gaussians, 3σ Cut

Proton Identification

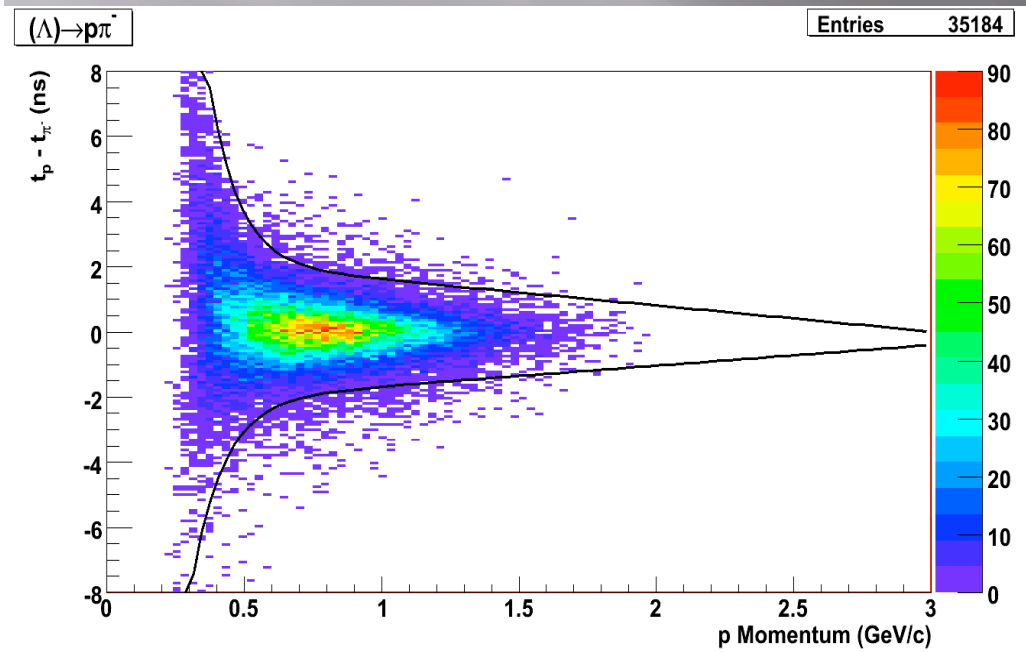


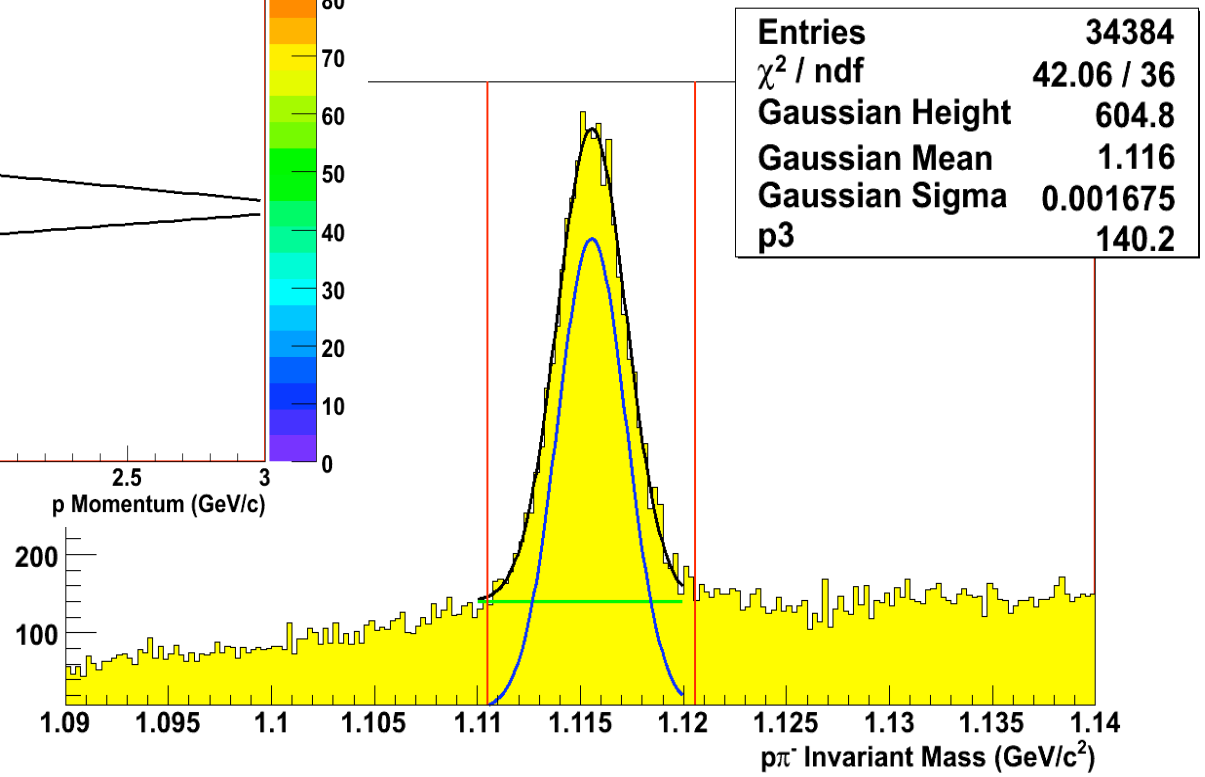


- $\Delta\beta$ Vs Momentum
  - Fit to Gaussians, 3σ Cut

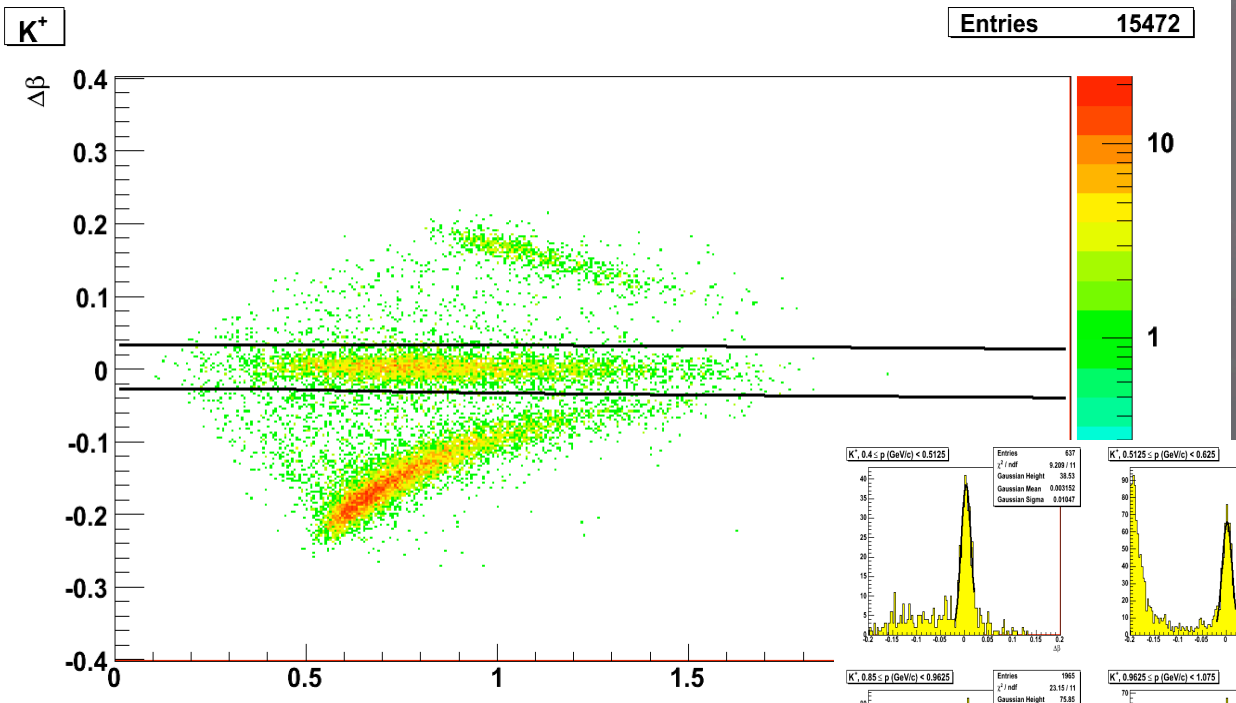
Λ Selection

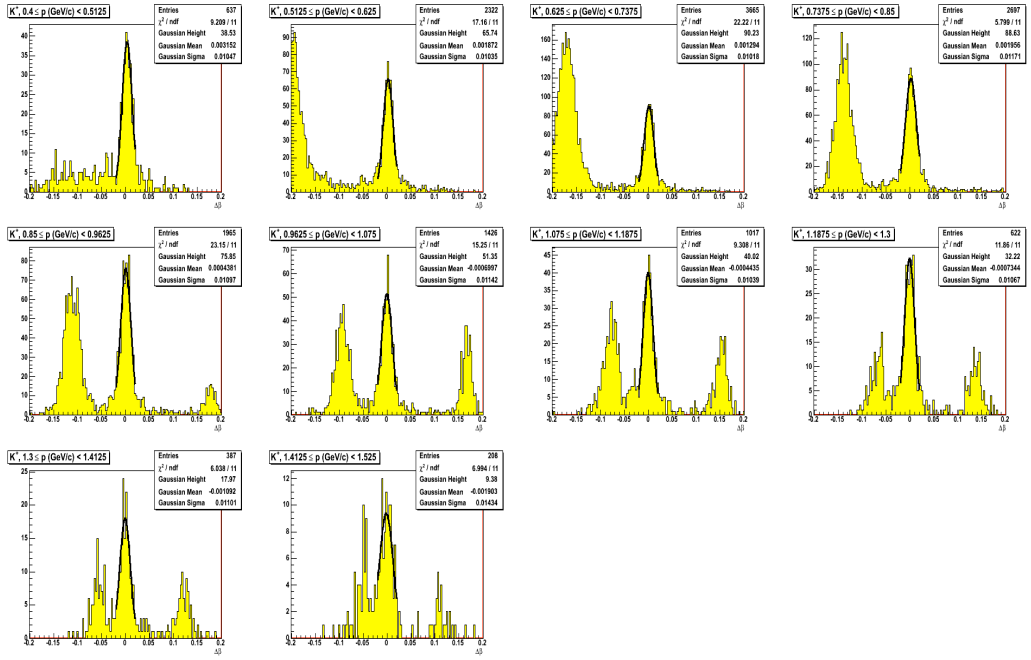
- Fit $t_p - t_{\pi^-}$ vs Proton momentum to Gaussians, Cut at 3 σ
- Fit $p\pi^-$ Invariant Mass to Gaussian + Flat Background, Cut at 3 σ





K^+ Identification

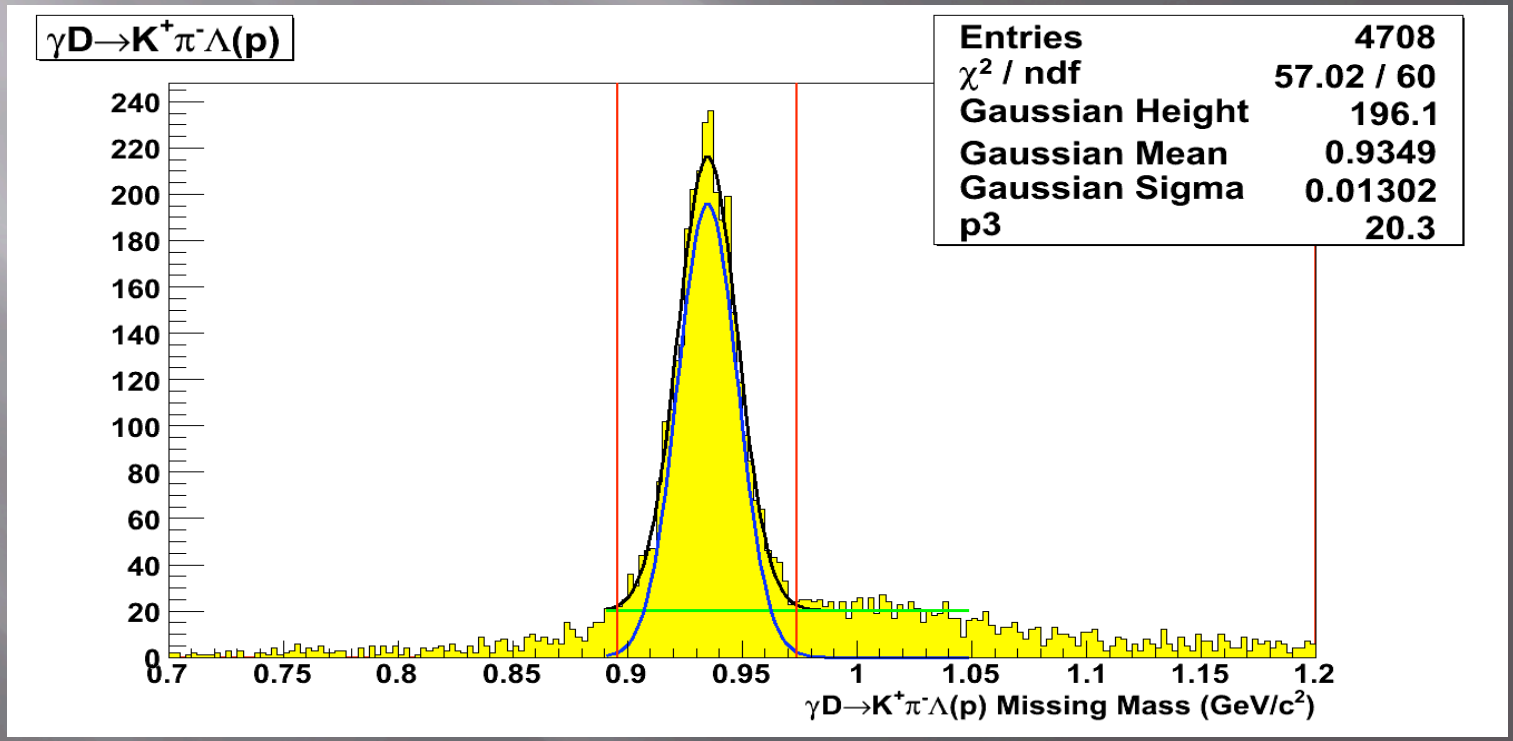




- $\Delta\beta$ Vs Momentum
  - Fit to Gaussians, 3σ Cut

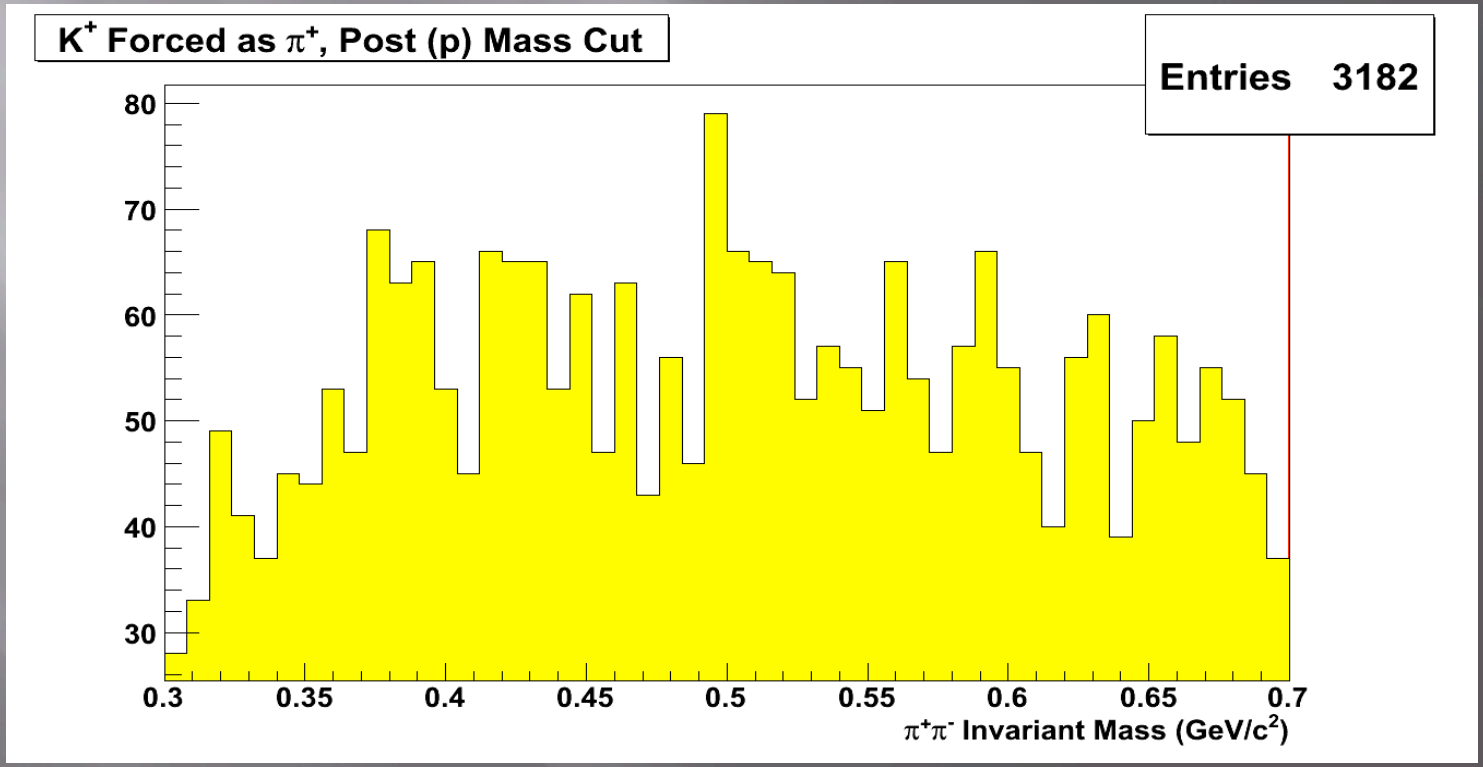
Missing Proton Selection

- Fit Proton Missing Mass to Gaussian + Flat Background, Cut at 3 σ
- 1.4% of events have > 1 successful track combination: the one with the smallest p, π^- Δ t is chosen



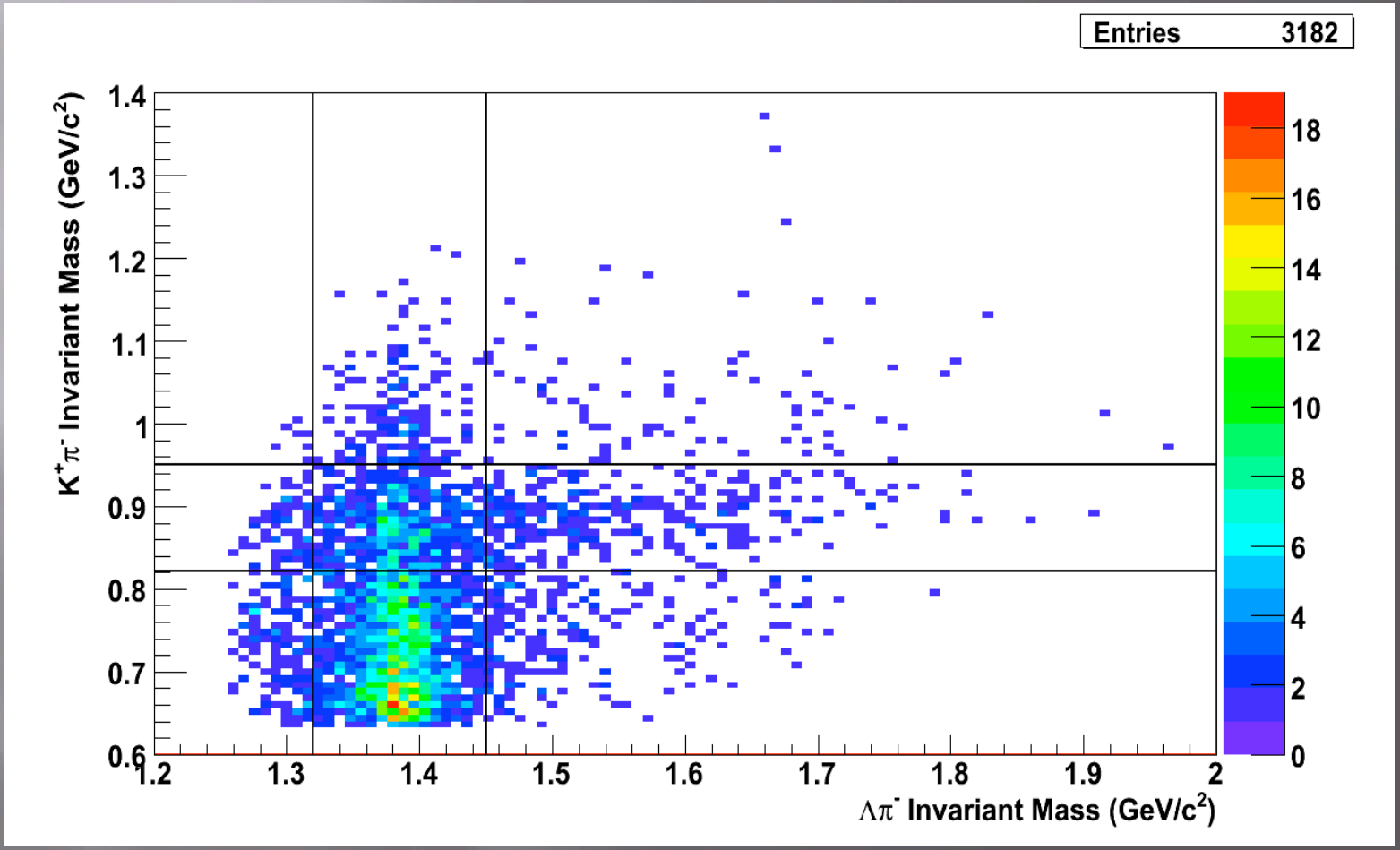
K^+ Misidentification

- A π^+ misidentified as a K^+ will most likely manifest in K^0
- π^+, π^- invariant mass by forcing all K^+ as π^+

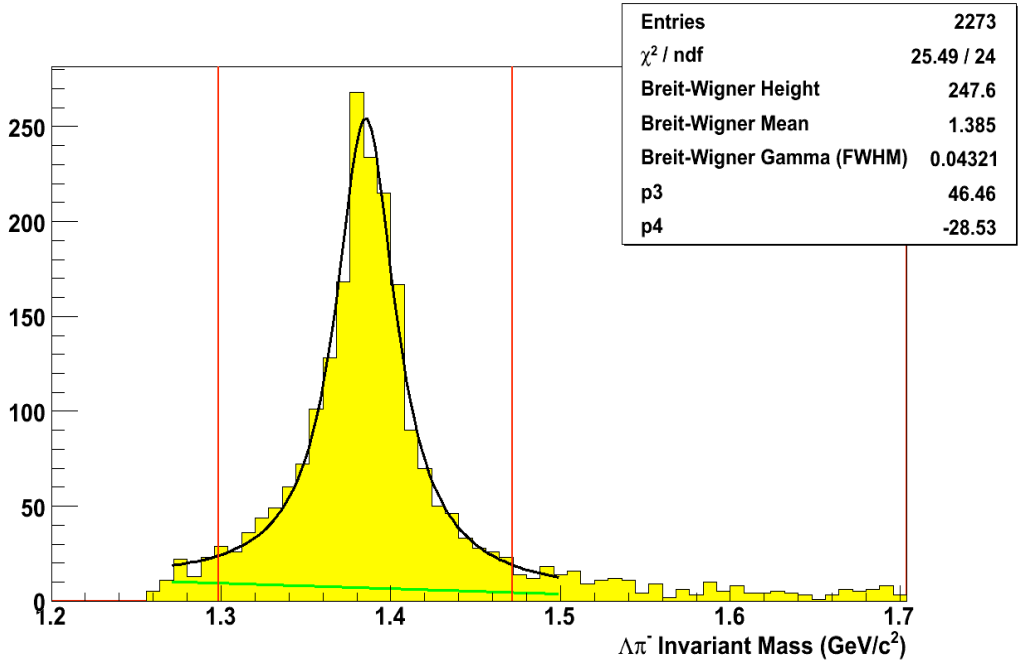


Interference

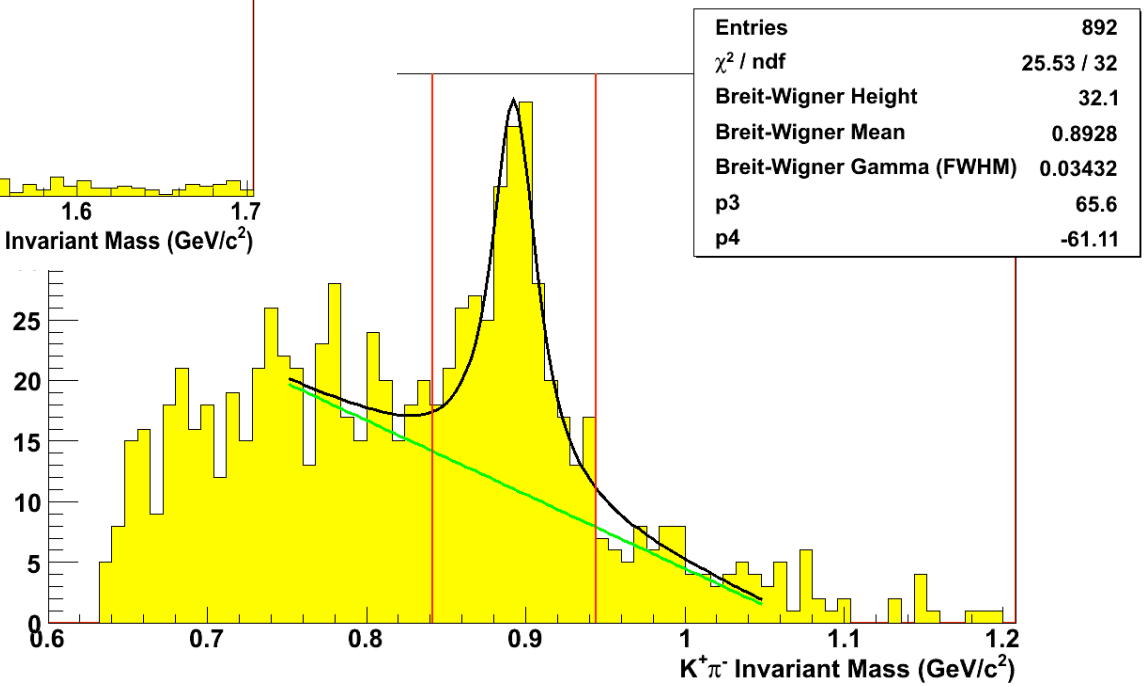
- Interference Cut



Signals, 2% g13a Data



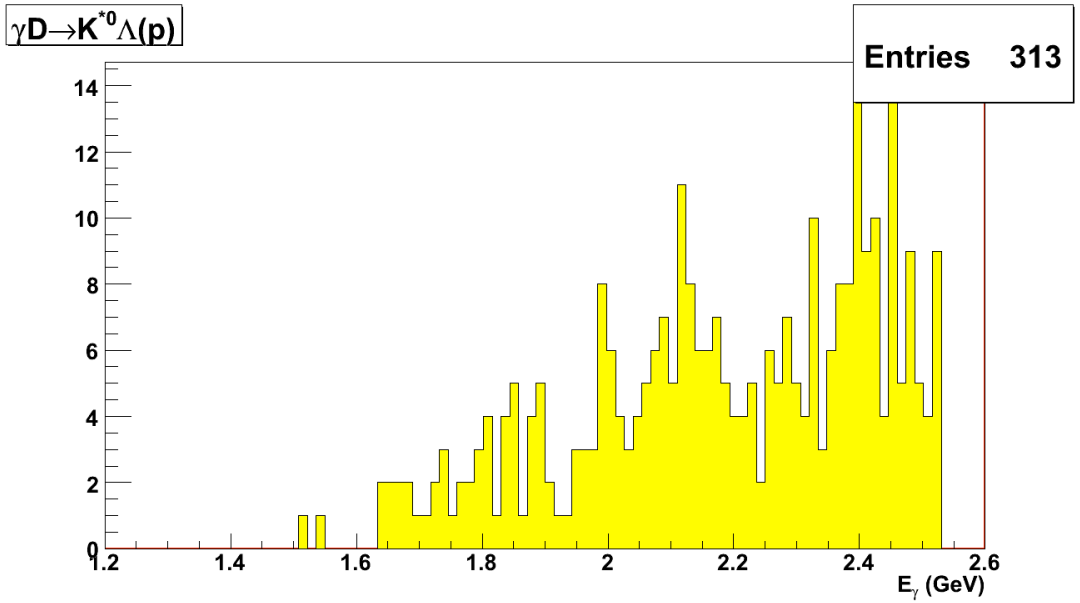
- Σ^{*-}
  - 1798 Events
  - 10.9 Sig/Back Ratio

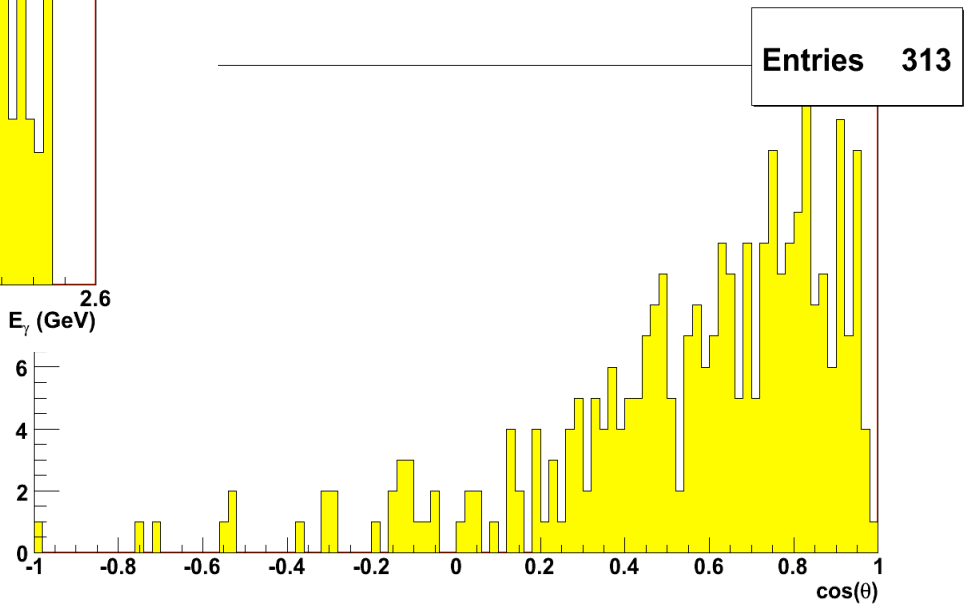


- K^{*0}
  - 179 Events
  - 1.1 Sig/Back Ratio

$K^{*0}\Lambda$ Signal Binning

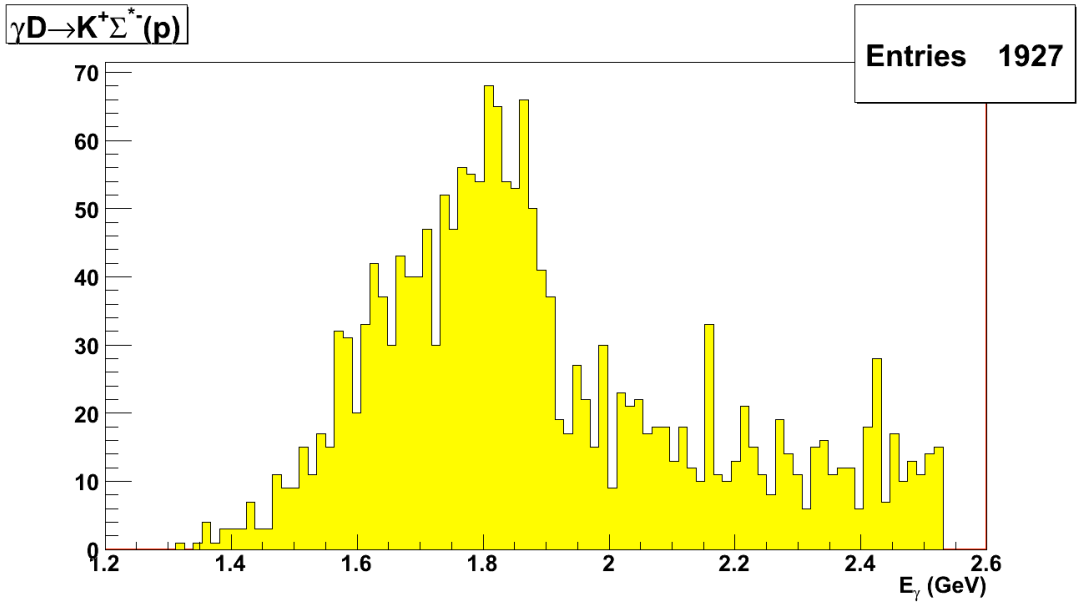
- 2% of g13a Data
- 25 Bins In Either Variable (1D), ~350 Counts/Bin

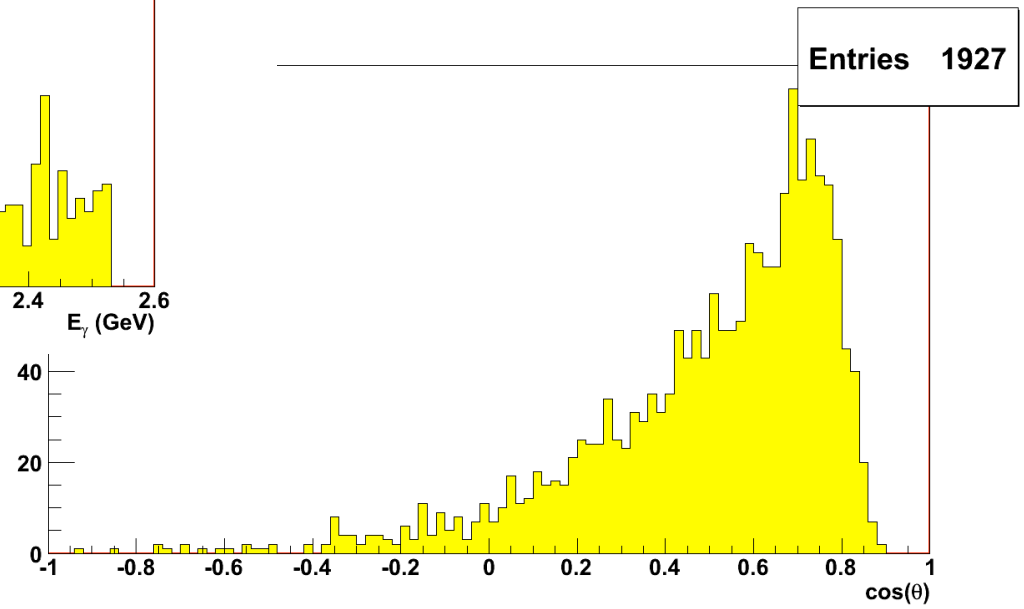




$K^+\Sigma^{*-}$ Signal Binning

- 2% of g13a Data
- 25 Bins in Either Variable (1D), ~3600 Counts/Bin





Major Ongoing/Future Work

- Acceptance Corrections
  - Using fsgen with t-channel model from Oh, Kim
  - Working on Matching Monte Carlo & Data
- Beam Energy & Momentum Corrections
  - γ D->pp π^- Kinematic Fit, Track Momentum Treated As Unknown (eg3)
- Photon Flux Determination (gflux)
- Reproduce a Known Cross-Section
- Systematic Error Studies
- Calculate $K^{*0}\Lambda$ and $K^+\Sigma^{*-}$ Cross Sections & Asymmetries