Update on Hyperon/ Vertex Studies

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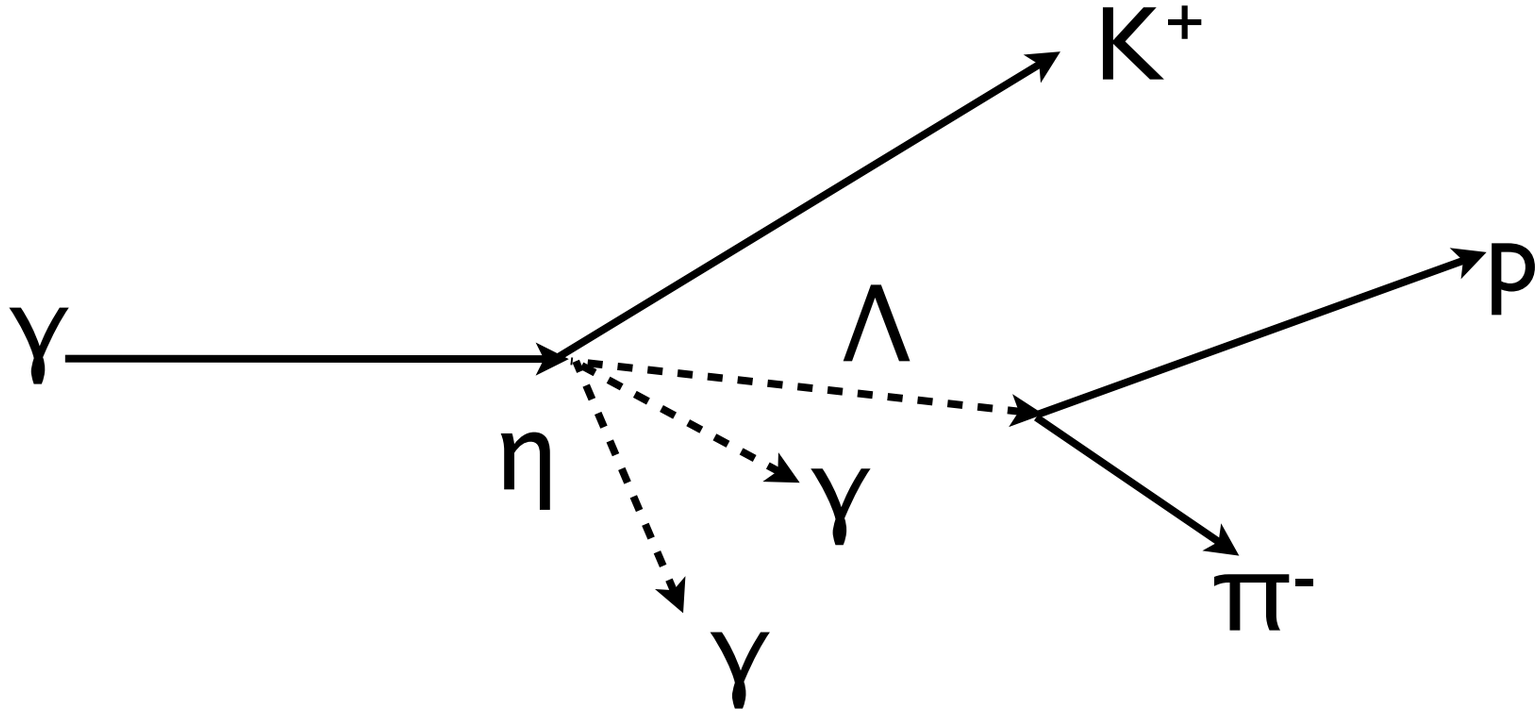
Motivation

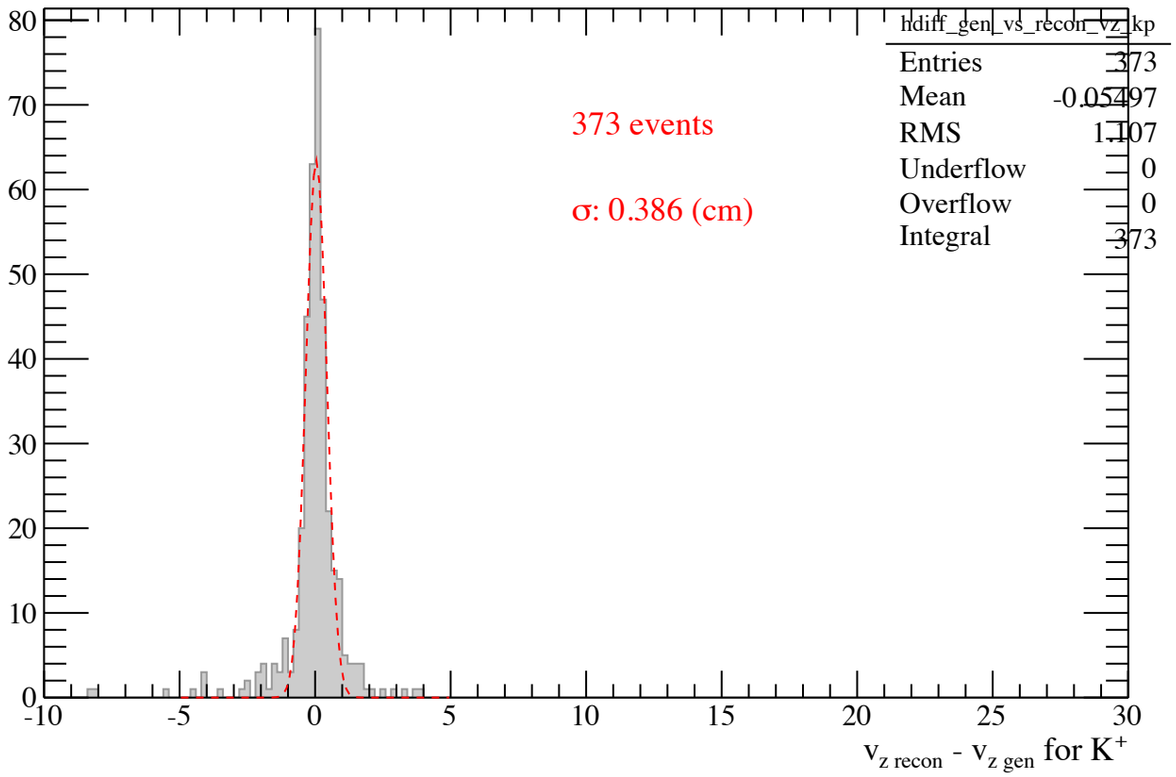
- Test GlueX's ability (hardware/software) to reconstruct secondary, tertiary vertices
- Helps with strangeness physics (Λ, Σ, Ξ)
- Previous studies using $\Lambda \rightarrow p\pi^-$ showed that vertices could be reconstructed with ~0.5 cm resolution
- Now using Paul's TTrees for analysis; before only using ANALYSIS classes

Recap of Λ vertex

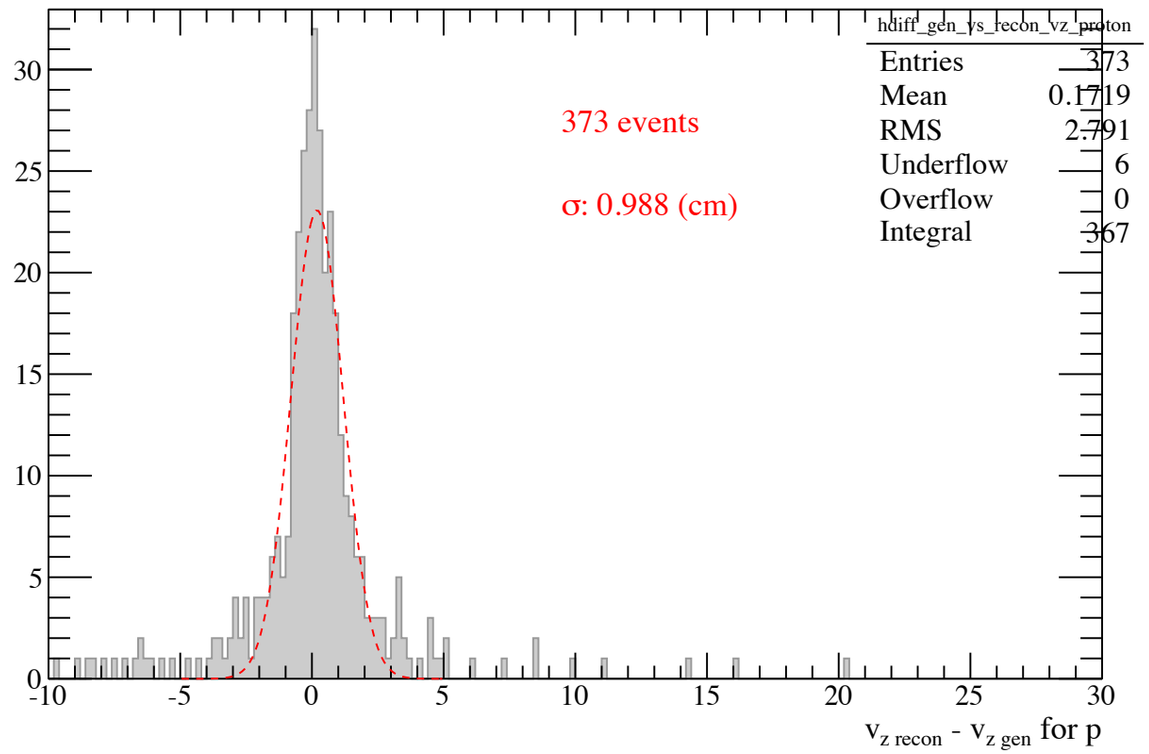
- Reaction is $\gamma + p \rightarrow K^+ \Lambda(1670), \Lambda(1670) \rightarrow \Lambda\eta, \Lambda \rightarrow p\pi^-, \eta \rightarrow \gamma\gamma$
- Kinematic fit constrains vertices of all charged particles, mass of Λ, η
- Kinematic fit first finds p, π^-, constrains secondary vertex. Then finds intersection of Λ and K^+ to set primary vertex



Plots of Λ vertex (cτ=7.89 cm)



$v_{z\ recon} - v_{z\ gen}$ for K^+

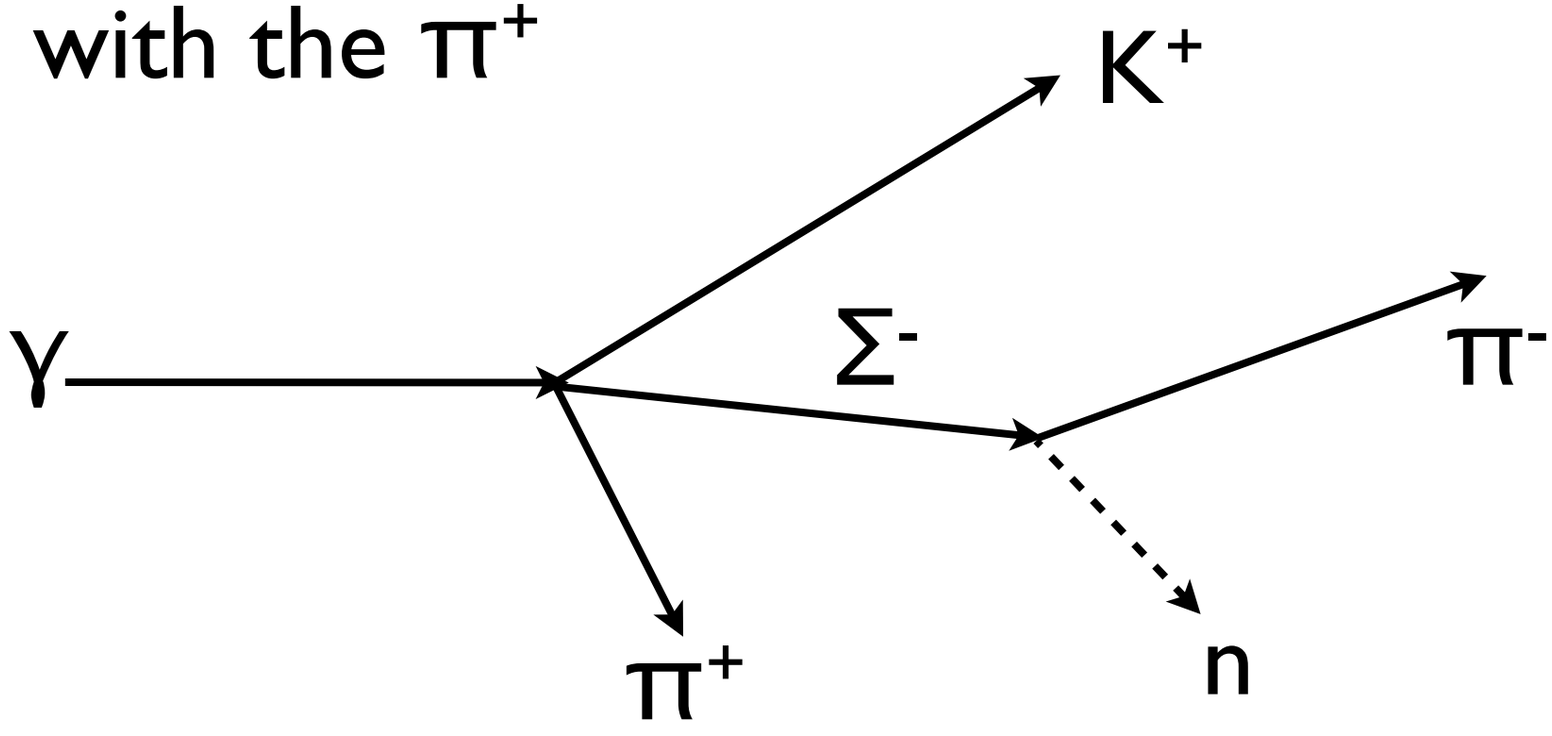


$v_{z\ recon} - v_{z\ gen}$ for p

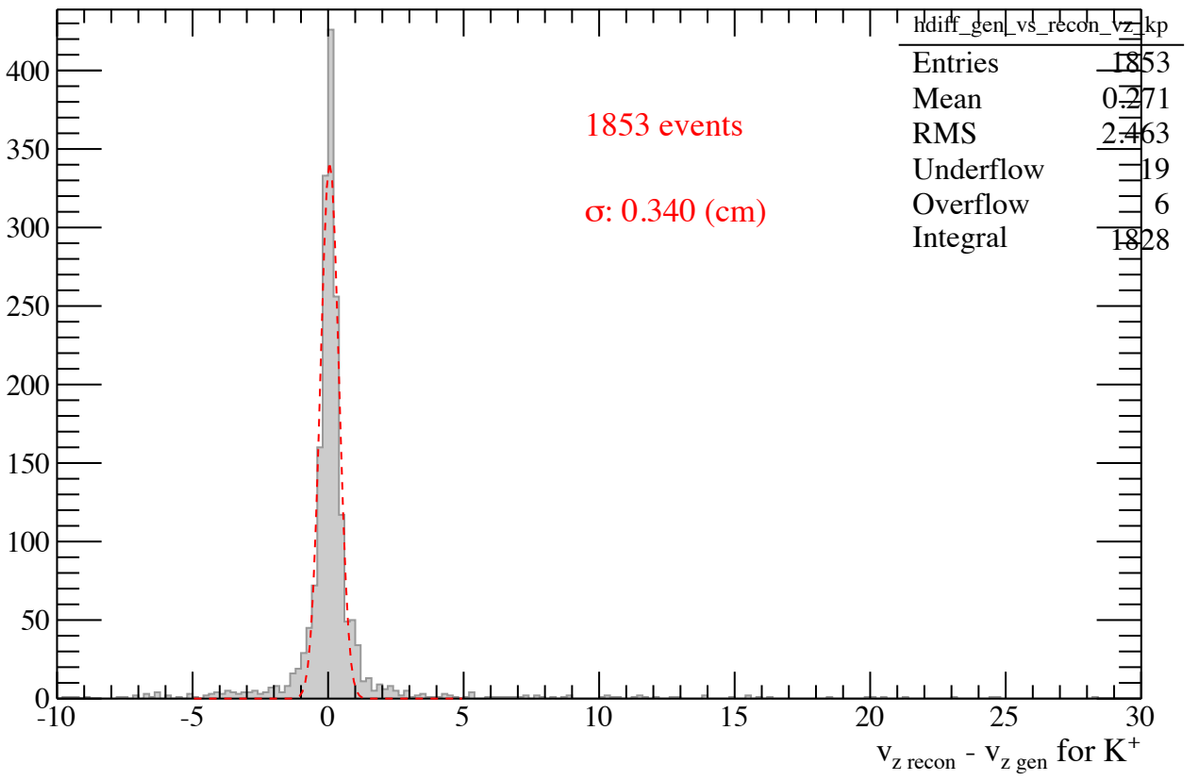
Kinematic fit constraint on vertices working

Vertex for Σ^-

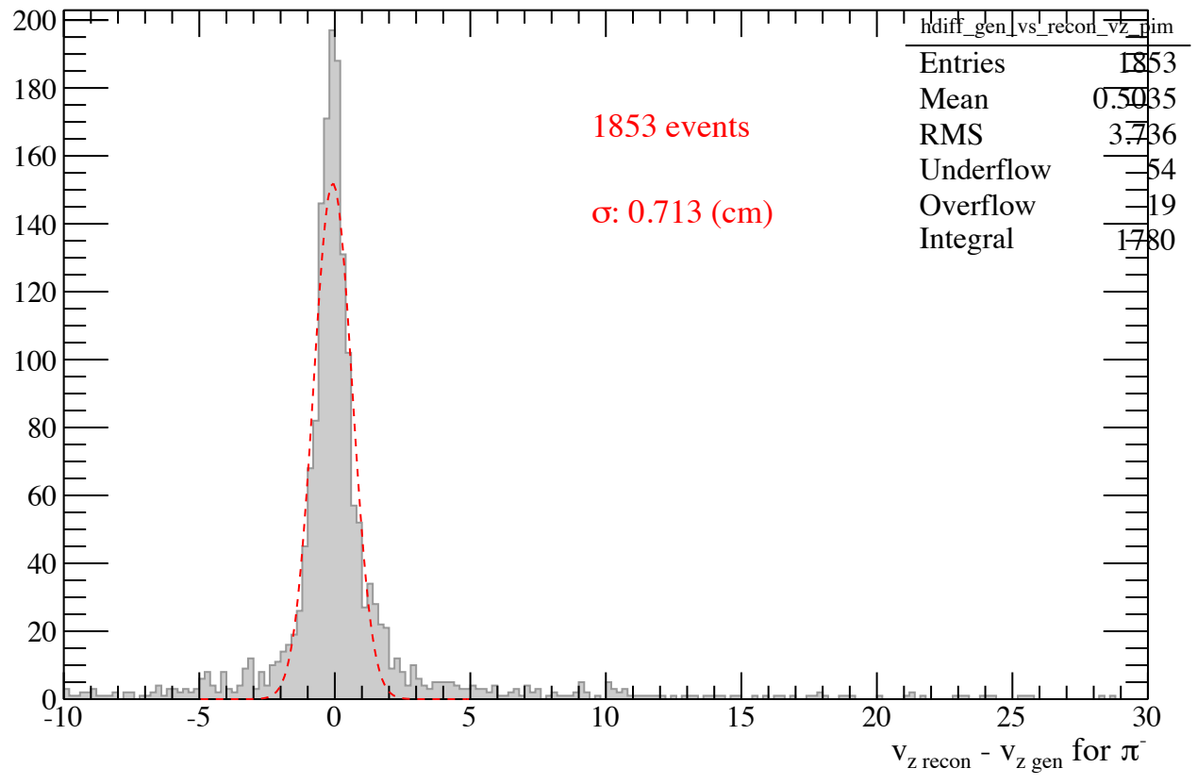
- Use reaction $\gamma + p \rightarrow K^+ \Lambda(1405)$, $\Lambda(1405) \rightarrow \Sigma^-\pi^+$, $\Sigma^- \rightarrow n\pi^-$
- The kinematic fit constrains the Σ^- mass, as well as the secondary vertex
- The kinematic fit will first find the K^+ and π^+ primary vertex, then swim the Σ^- to find the secondary vertex as the intersection with the π^+



Plots of Σ^- vertex ($c\tau$=4.34 cm)



$v_{z\ recon} - v_{z\ gen}$ for K^+



$v_{z\ recon} - v_{z\ gen}$ for π^-

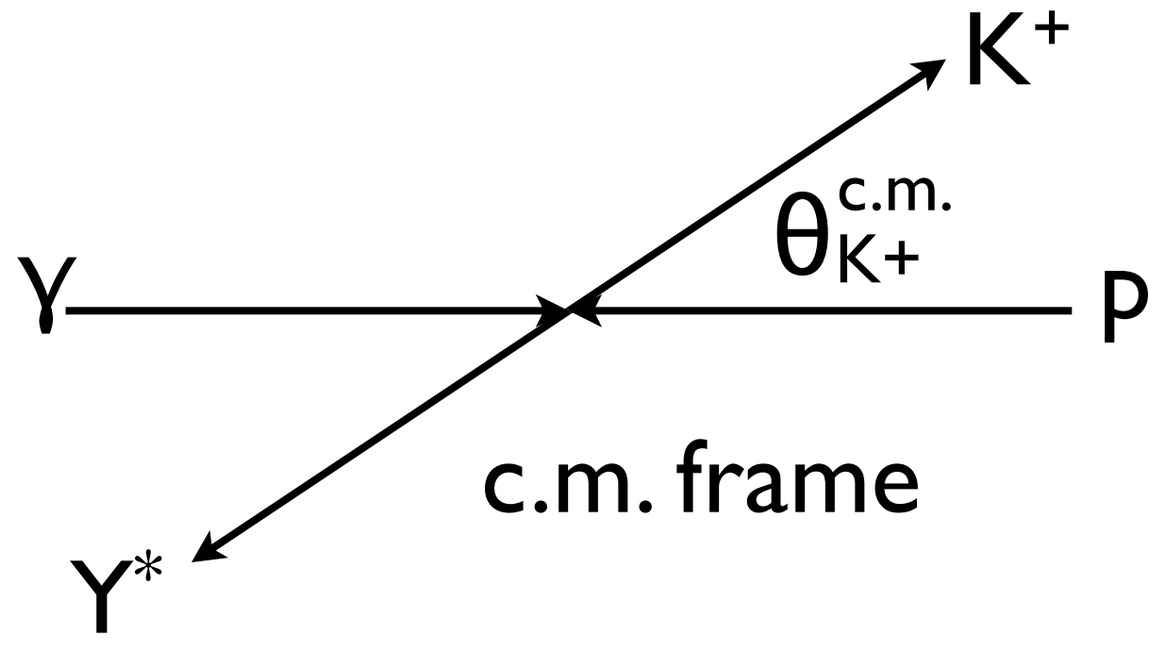
Kinematic fit constraint on vertices working

Acceptance Studies

- For hyperon physics (S=-1), if we want to do a coupled-channel analysis of various hyperon decay final states ($\Sigma\pi$, NK, $\Lambda\pi$,$\Lambda\eta$, ...) we want to know how finely we can bin the data

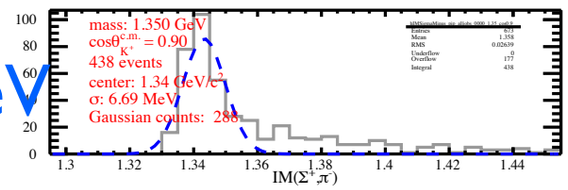
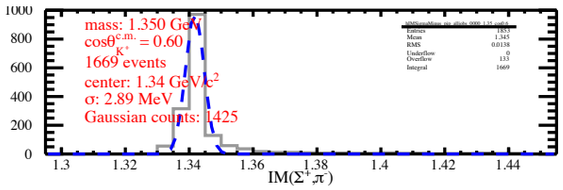
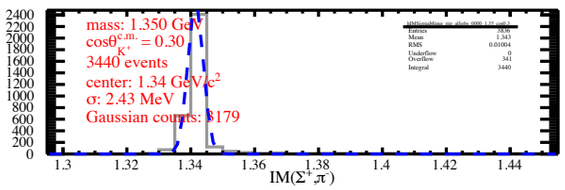
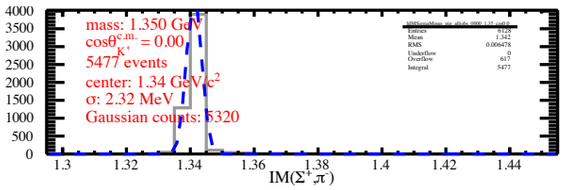
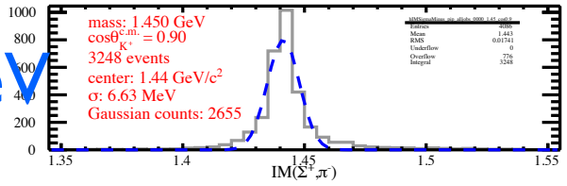
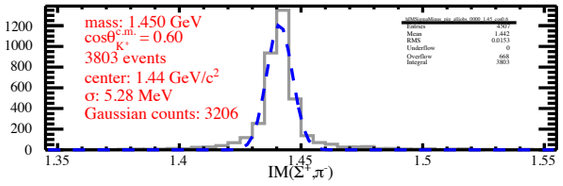
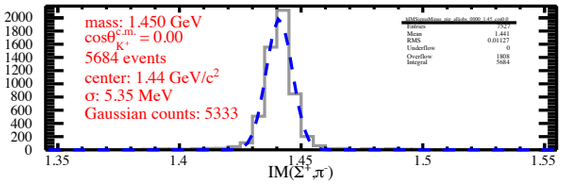
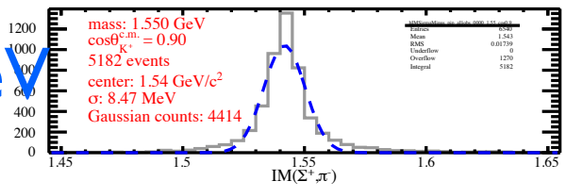
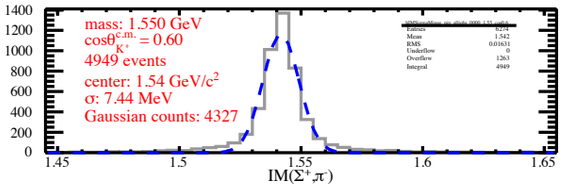
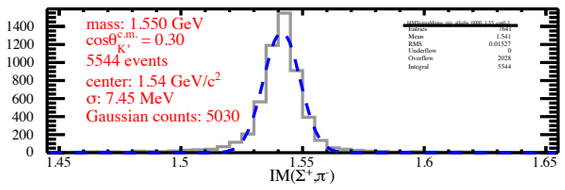
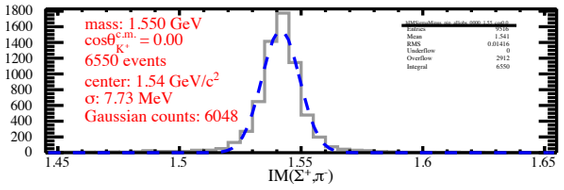
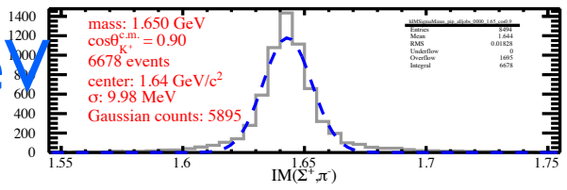
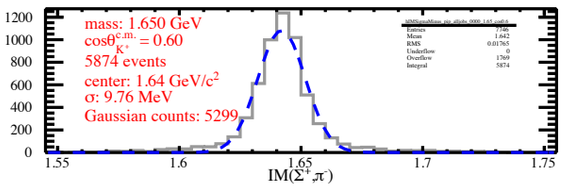
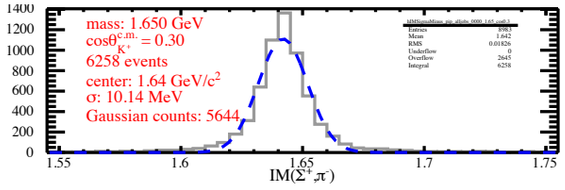
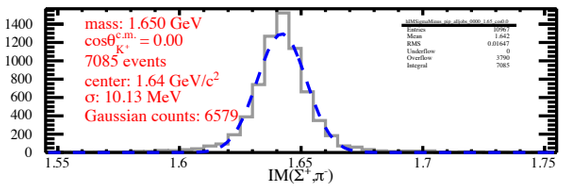
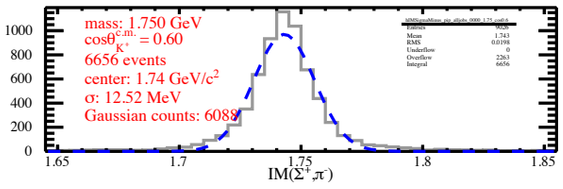
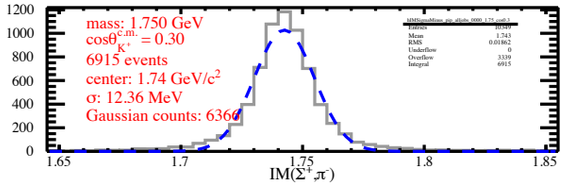
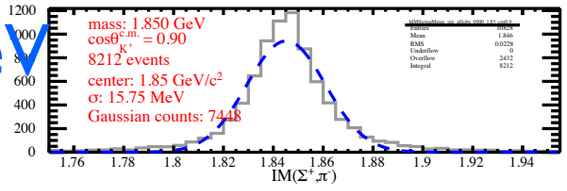
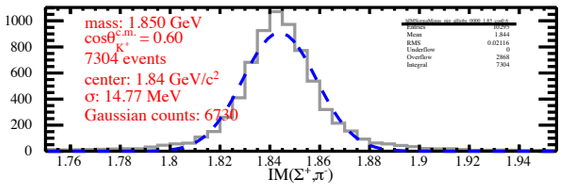
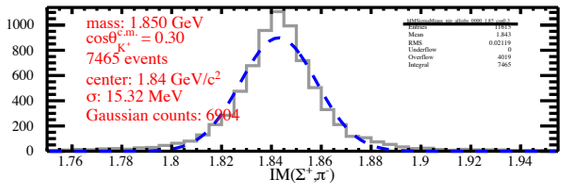
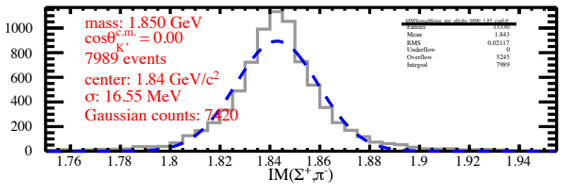
- Generated $\Sigma^-\pi^+$ events with 0.1 MeV width and $\cos\theta^{c.m.}_{K^+}$ within ±0.05 of specific values

- Look at mass resolution of excited hyperon, acceptance

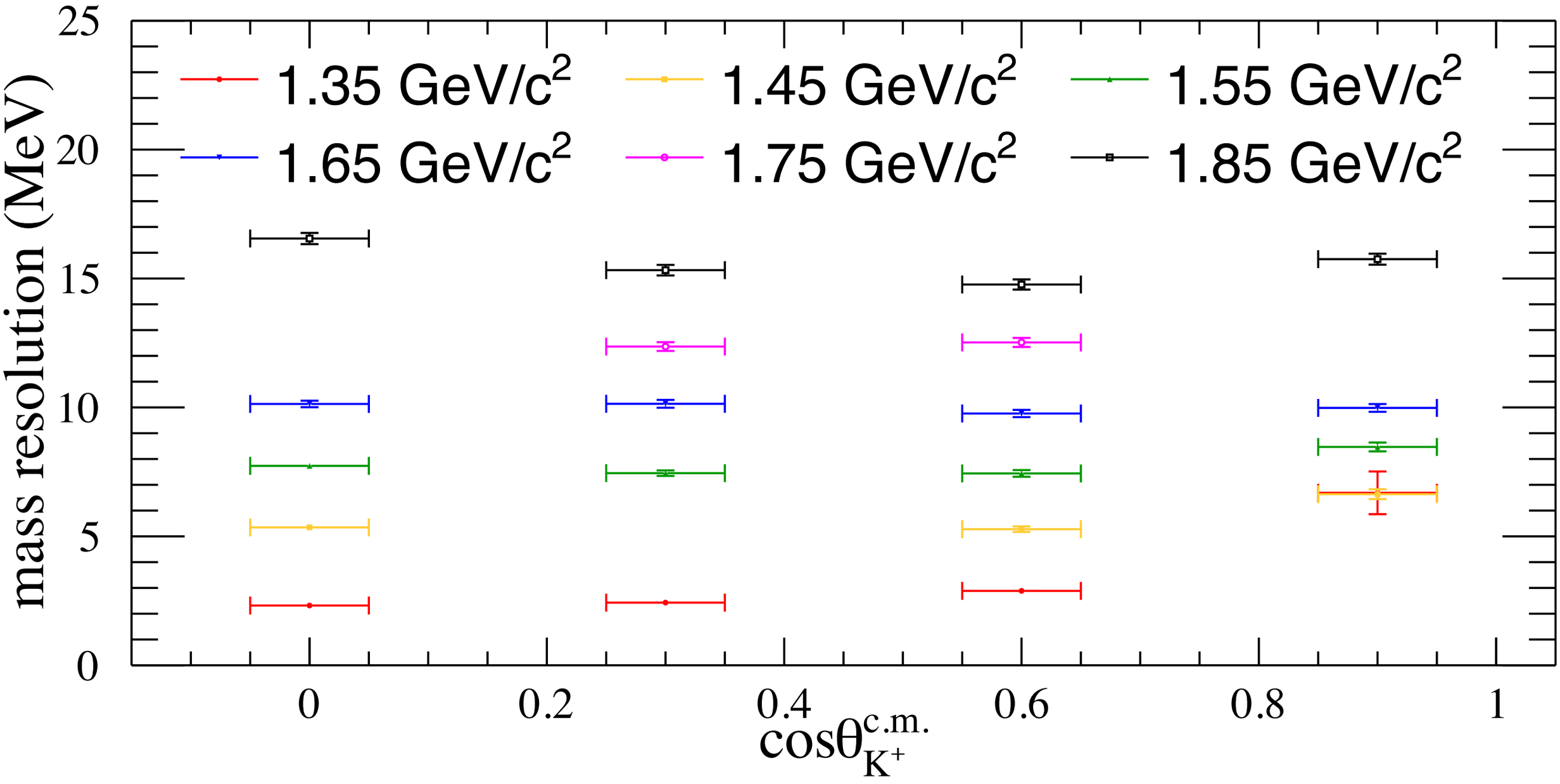


Fit IM($\Sigma^-\pi^+$) with Gaussian

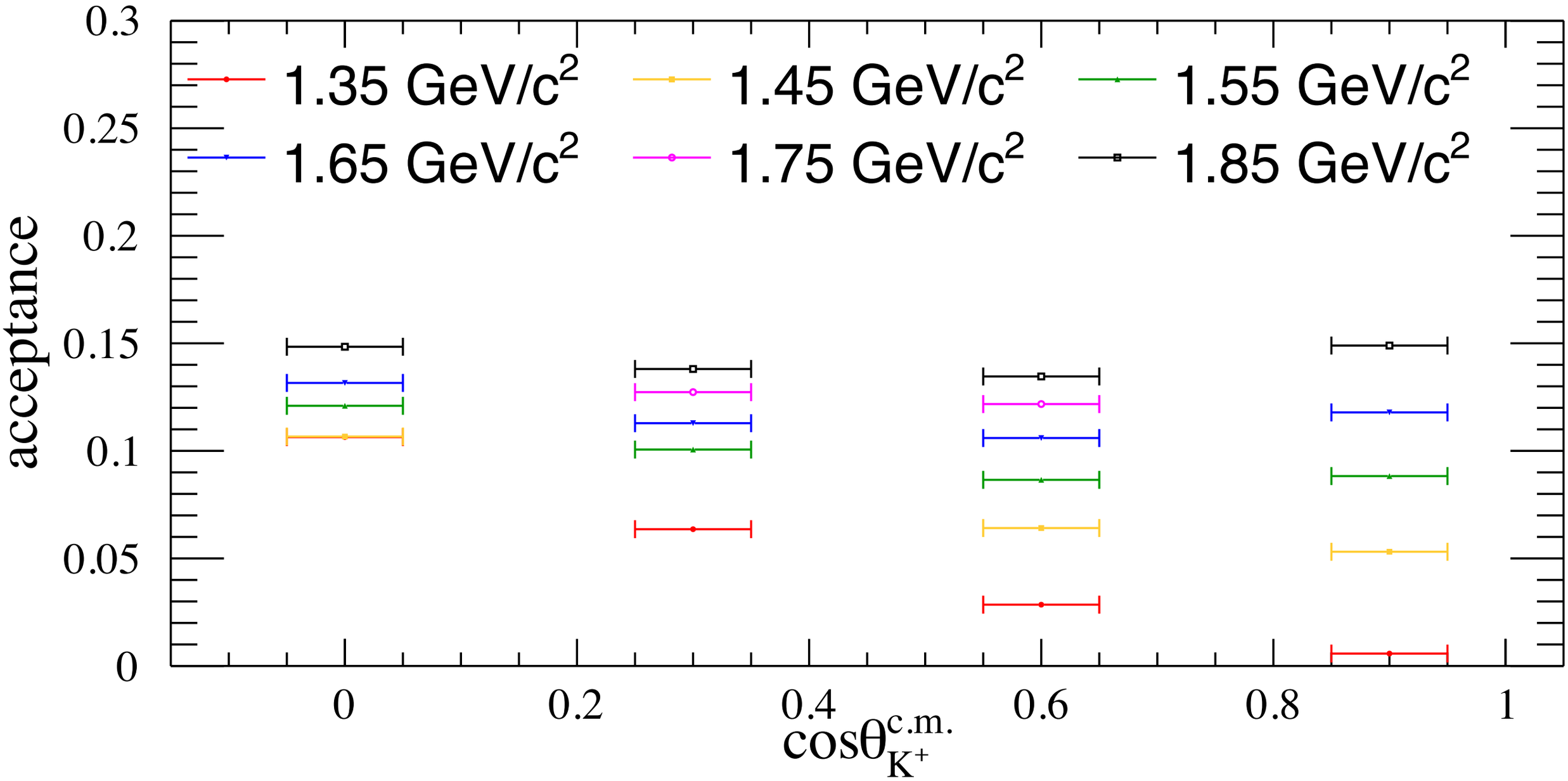
Missing blocks are due to jobs failing...

	$\cos\theta^{c.m.}_{K^+}=0.9$	$\cos\theta^{c.m.}_{K^+}=0.6$	$\cos\theta^{c.m.}_{K^+}=0.3$	$\cos\theta^{c.m.}_{K^+}=0.0$
1.35 GeV				
1.45 GeV				
1.55 GeV				
1.65 GeV				
1.75 GeV				
1.85 GeV				

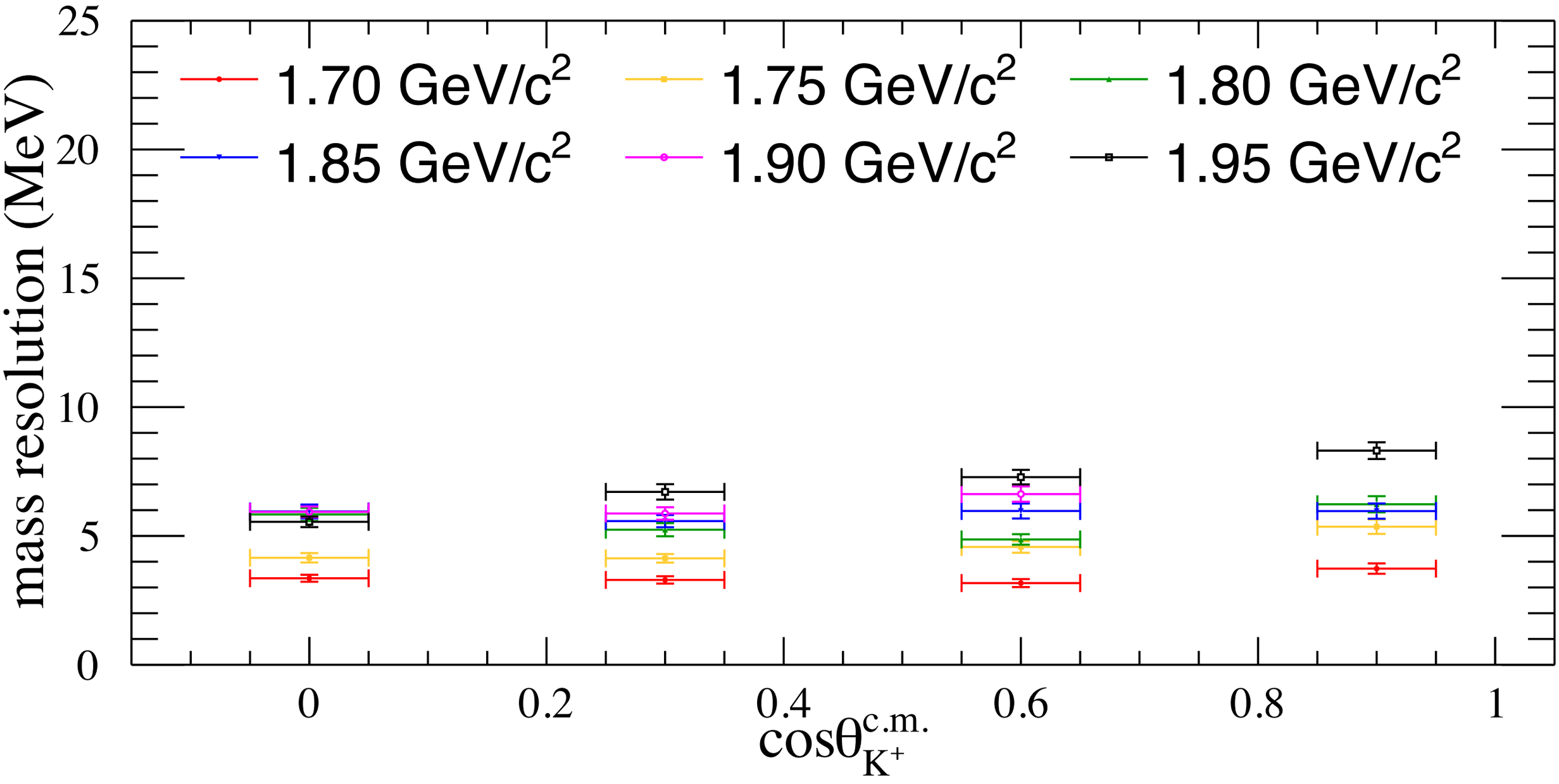
$\Sigma^{-}\pi^{+}$ Mass Resolutions



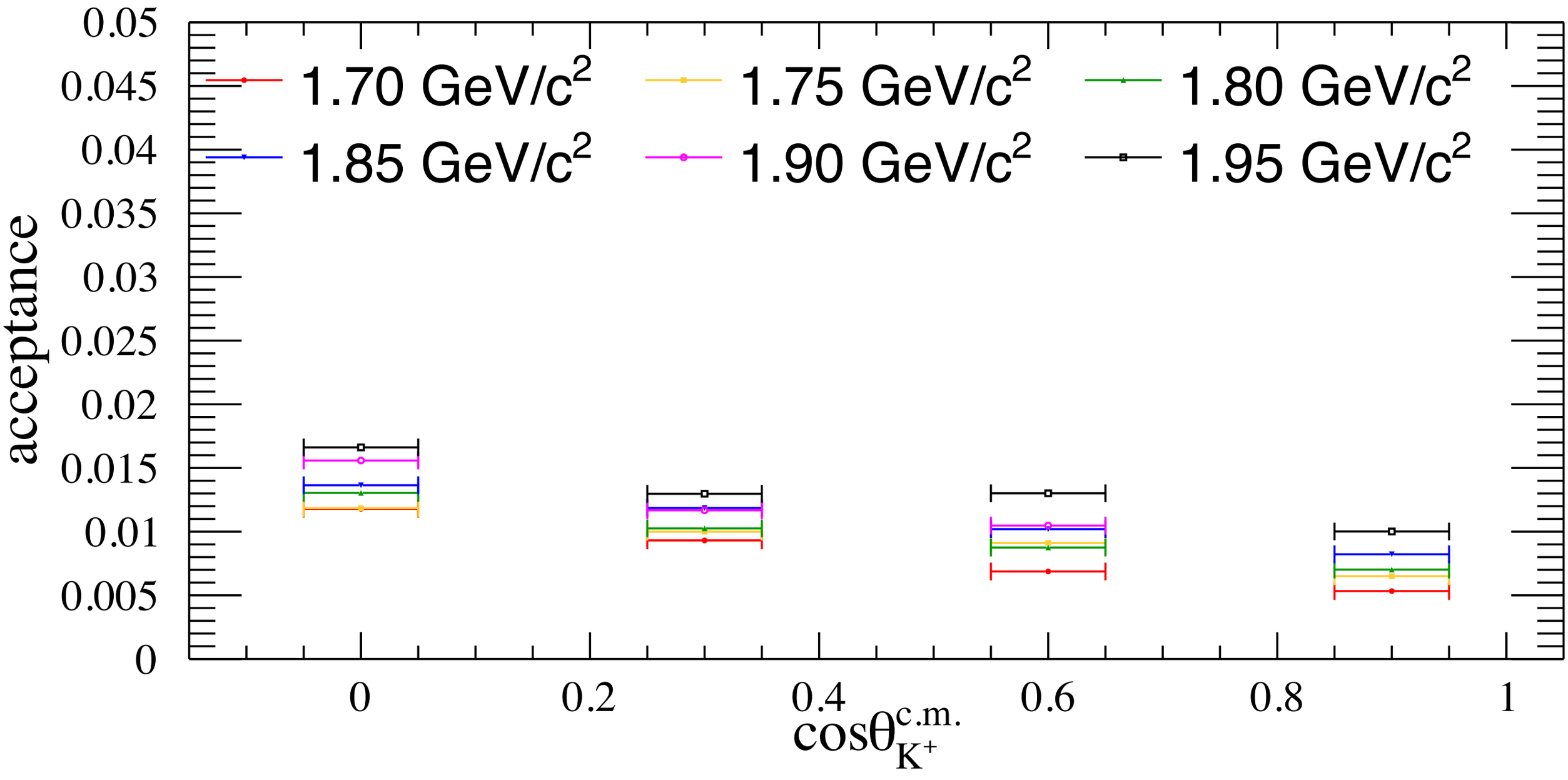
$\Sigma^-\pi^+$ Acceptances



Λη Mass Resolutions



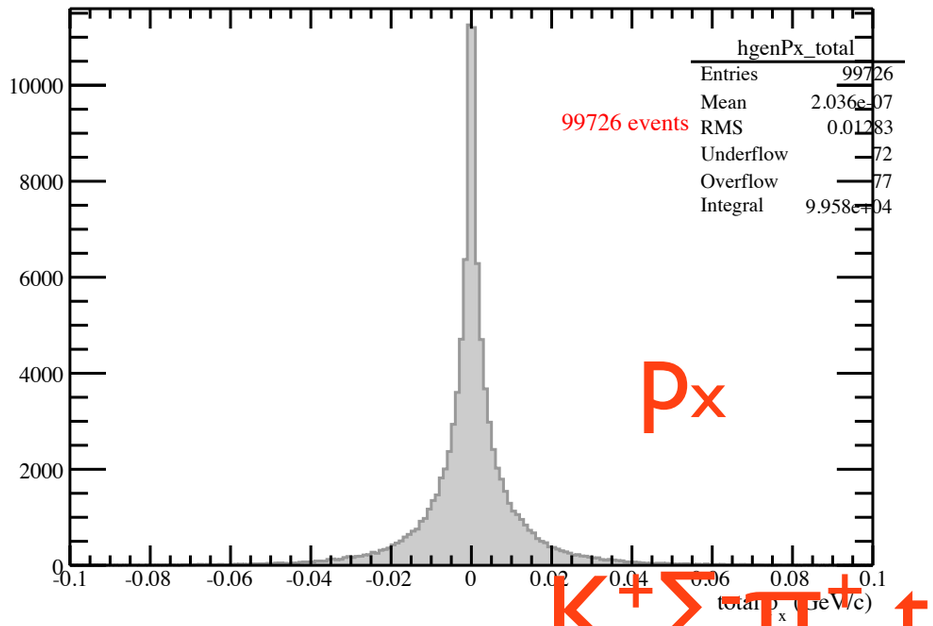
Λη Acceptances

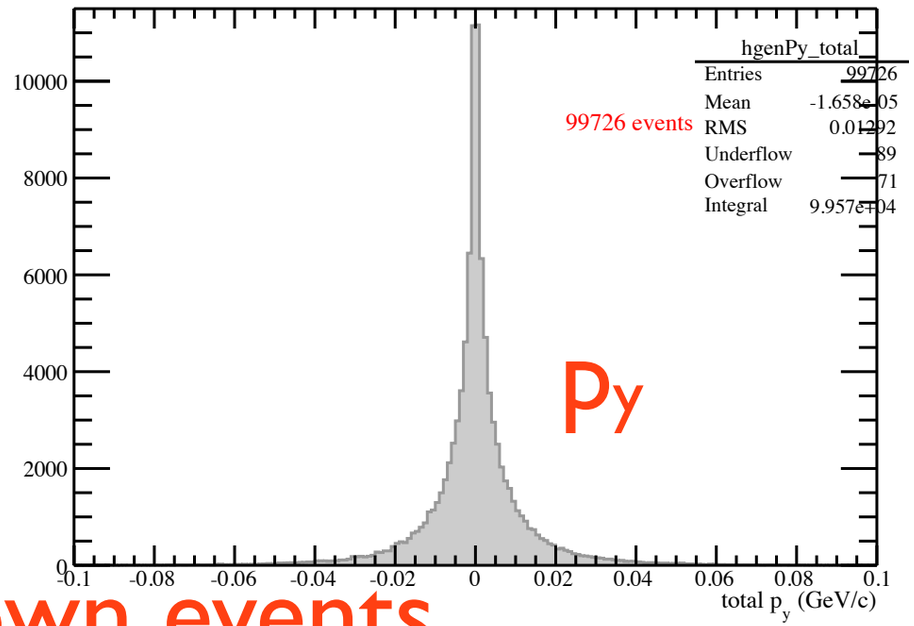


why so low?

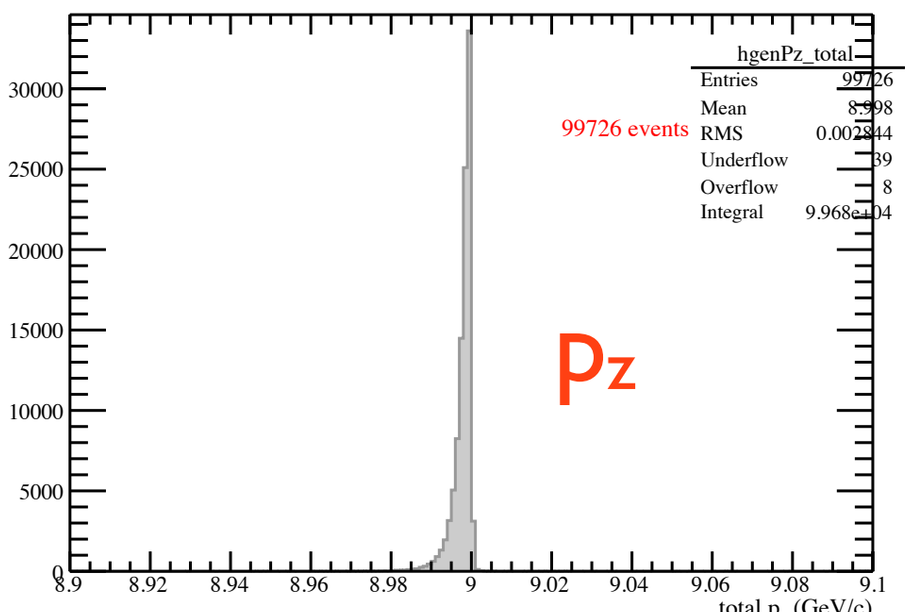
Slightly off topic...

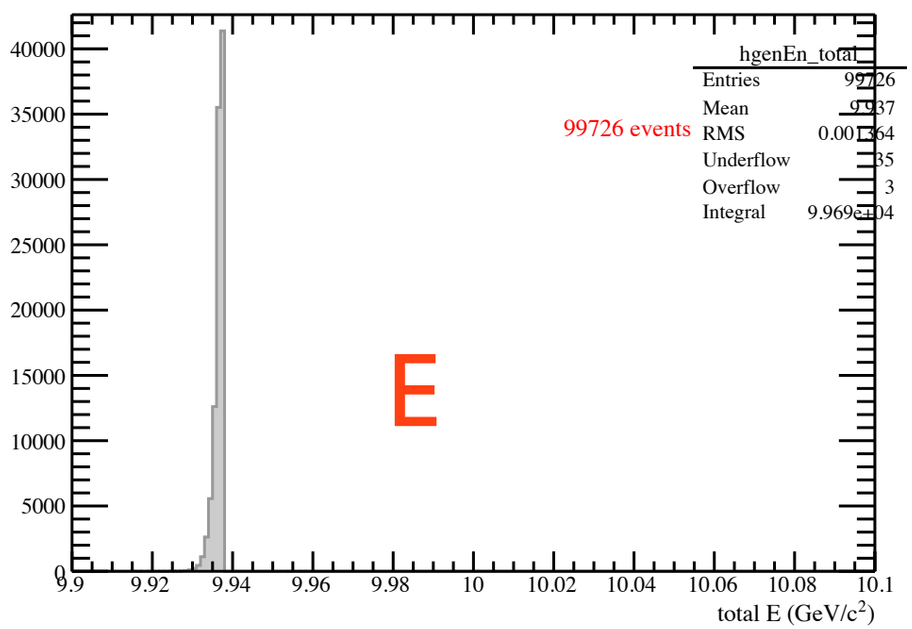
- Why do the total generated momenta look like this?
- Do we want to fix hd_dump output of DMCThrown?





$K^+\Sigma^-\pi^+$ thrown events





Conclusions

- Kinematic fit to secondary vertex works for Σ^+ and Σ^-, as well as for Λ
- Acceptances for each channel vary, mass resolutions are 5-20 MeV
- Other possible channels:
  - $p\ K^+\ K^-$ (no secondary vertex)
  - $K_S\ \Lambda\ \pi^+$ (secondary vertex for K_S, Λ)
  - $K^+\ K^+\ \Xi^-$ (secondary, tertiary vertices)
  - $K^+\ K_S\ \Xi^0$ (secondary, tertiary vertices)