



$\Lambda(1405)$ Photoproduction

Trevor Reed

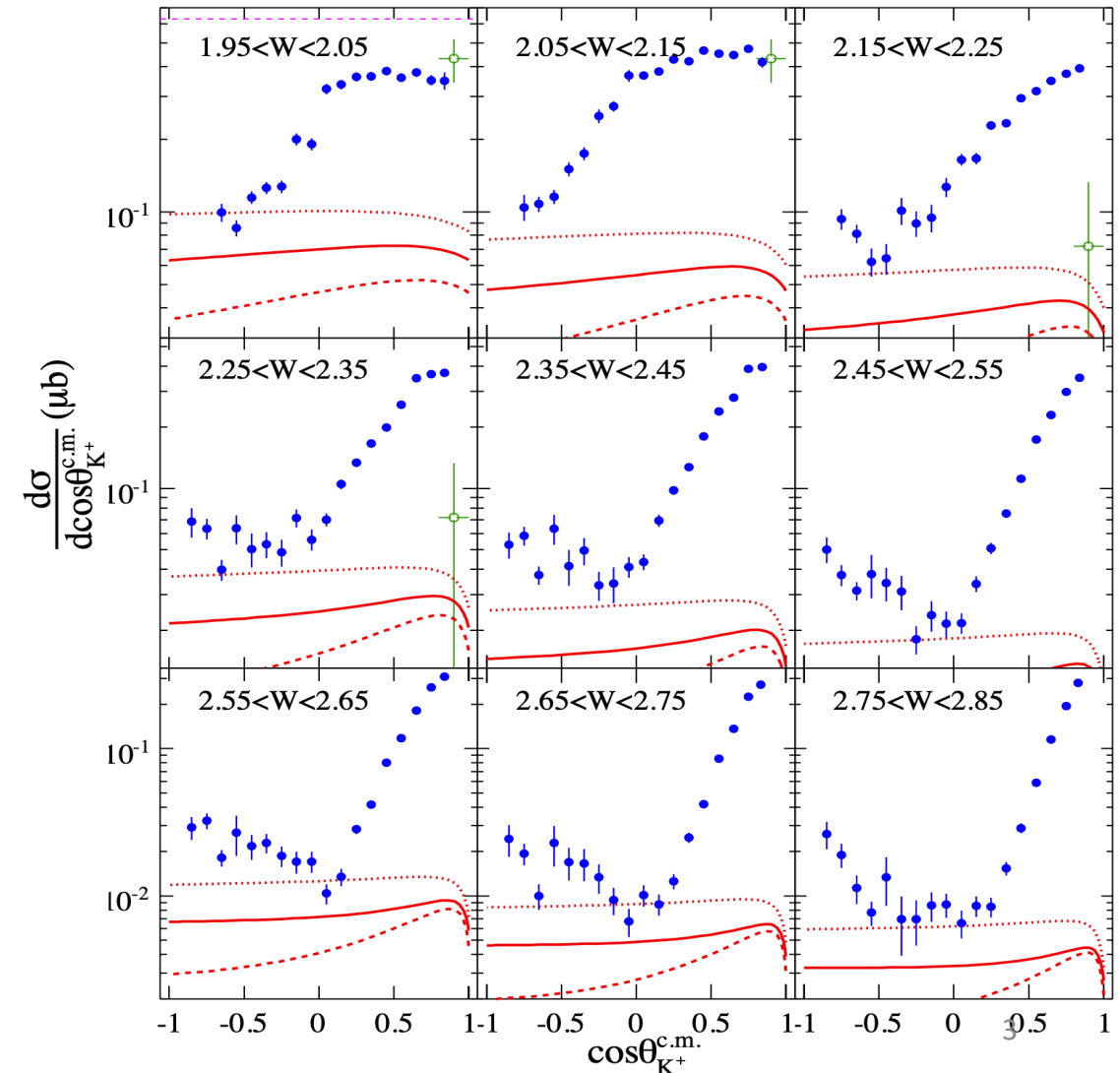
Florida International University

Motivation: Cross Sections

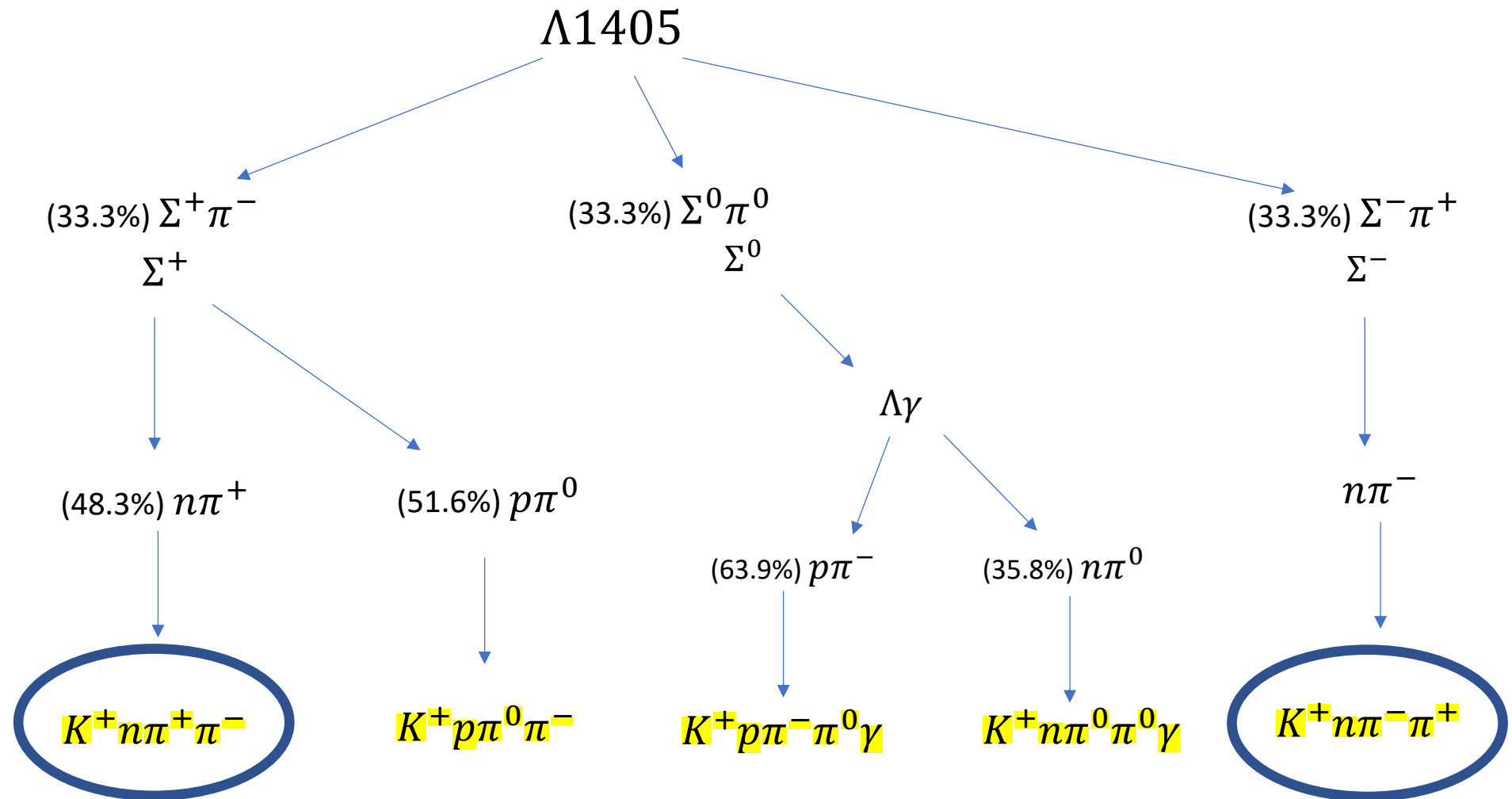
- Structure of Λ_{1405} still not well understood
 - Atypical line shape
 - Deviates from usual Breit-Wigner Resonance
 - Three-quark baryon, hybrid baryon, baryon-meson molecule
- Photoproduction cross sections can provide insight to underlying mechanisms involved
- A need for higher energy, higher $|t|$ cross section data for Λ_{1405}

Current Λ_{1405} Photoproduction Data

- From <https://doi.org/10.1103/PhysRevC.88.045201>, K. Moriya, 2013, CLAS g11a
- Center-of mass energy, s , maxes out around 8.1 GeV^2
- Limited as well for high $|t|$ values



$$\gamma + p \rightarrow K^+ + \Lambda_{1405}$$

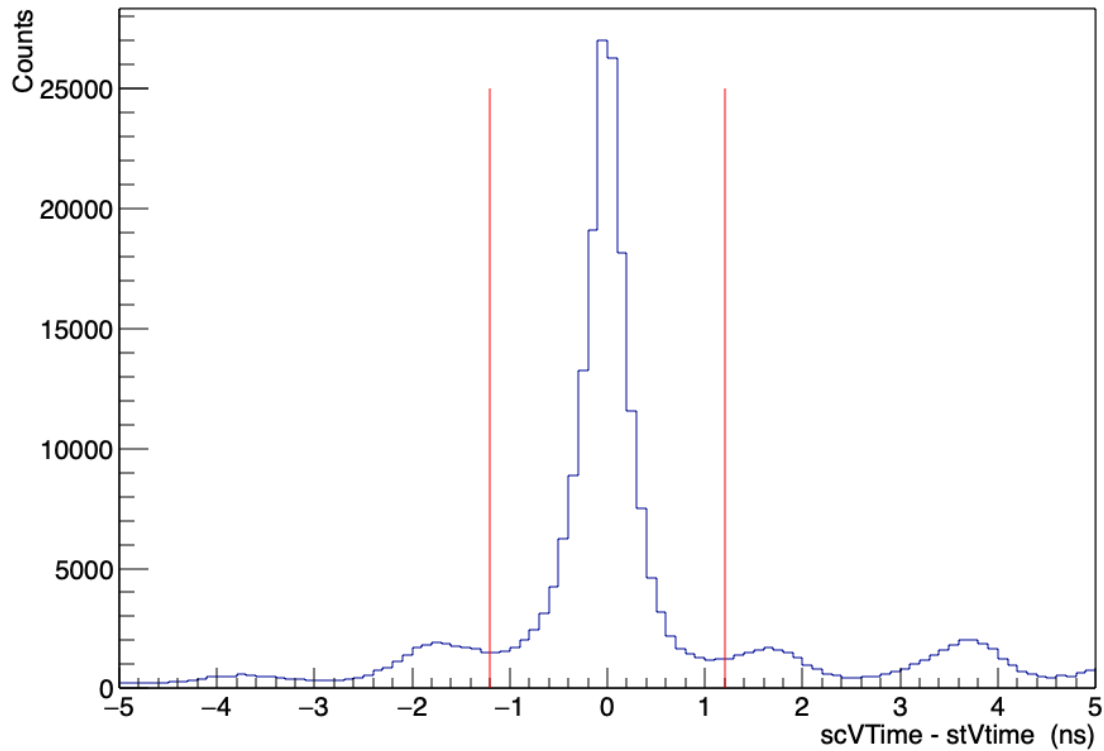


Final state particles:

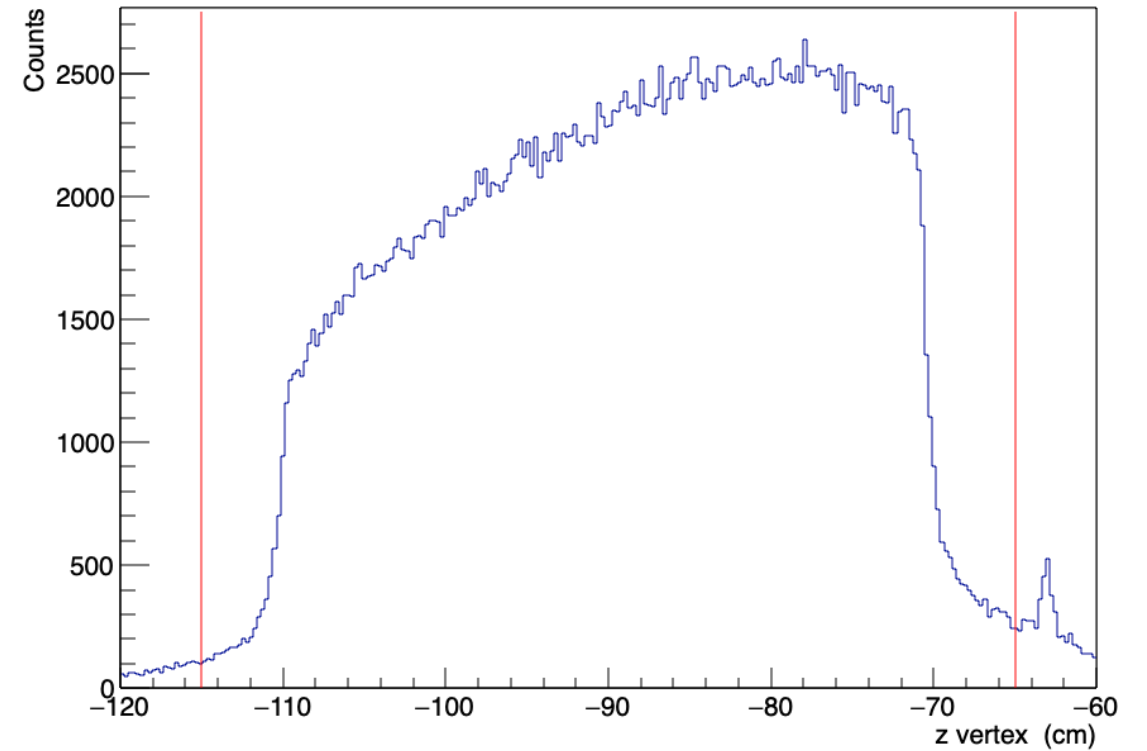
Data

g12 Data

Timing Cut: $|scv - stv| \leq 1.2$

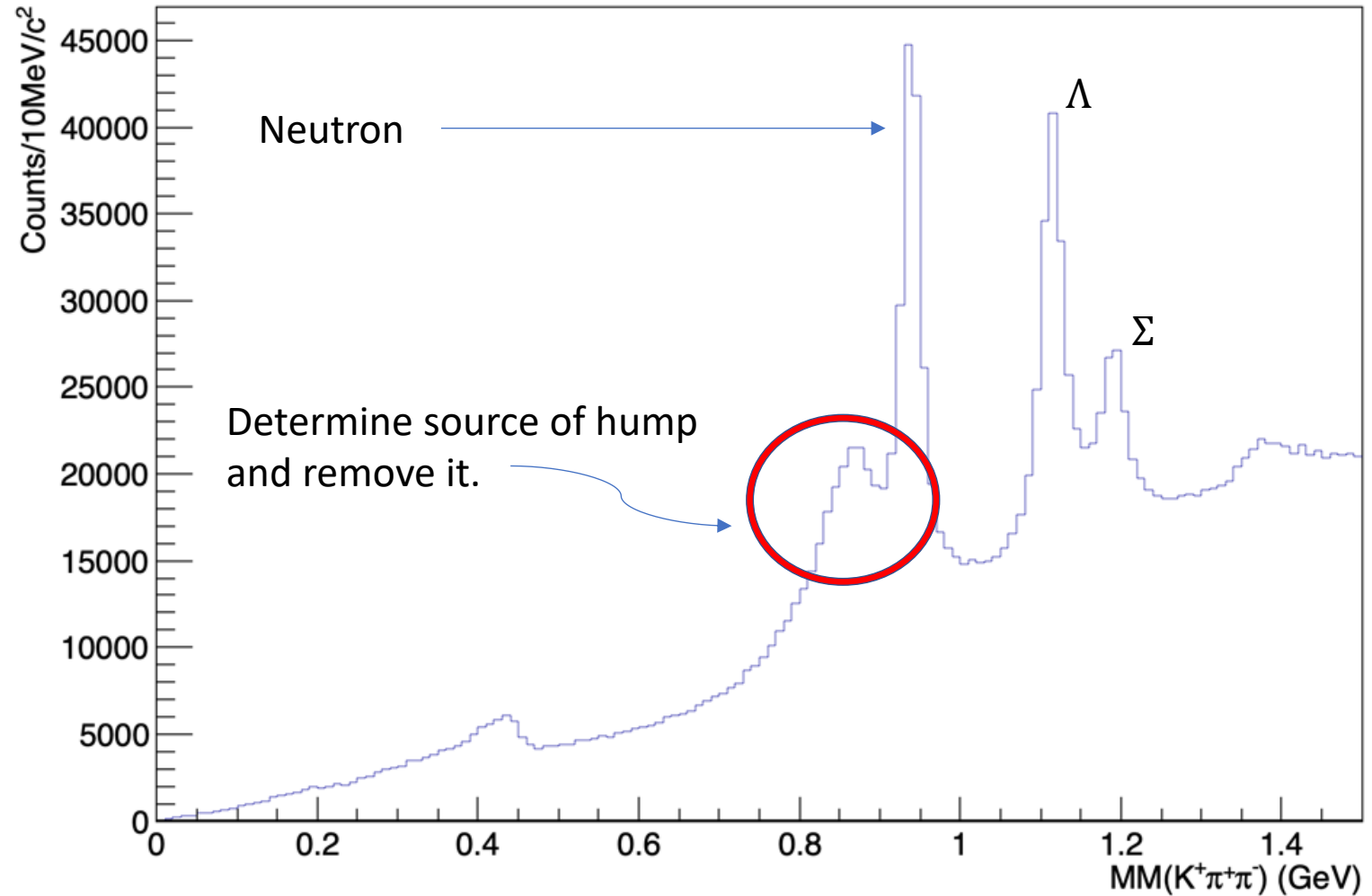


Z Vertex Cut: $|z_{vert} + 90| \leq 25$



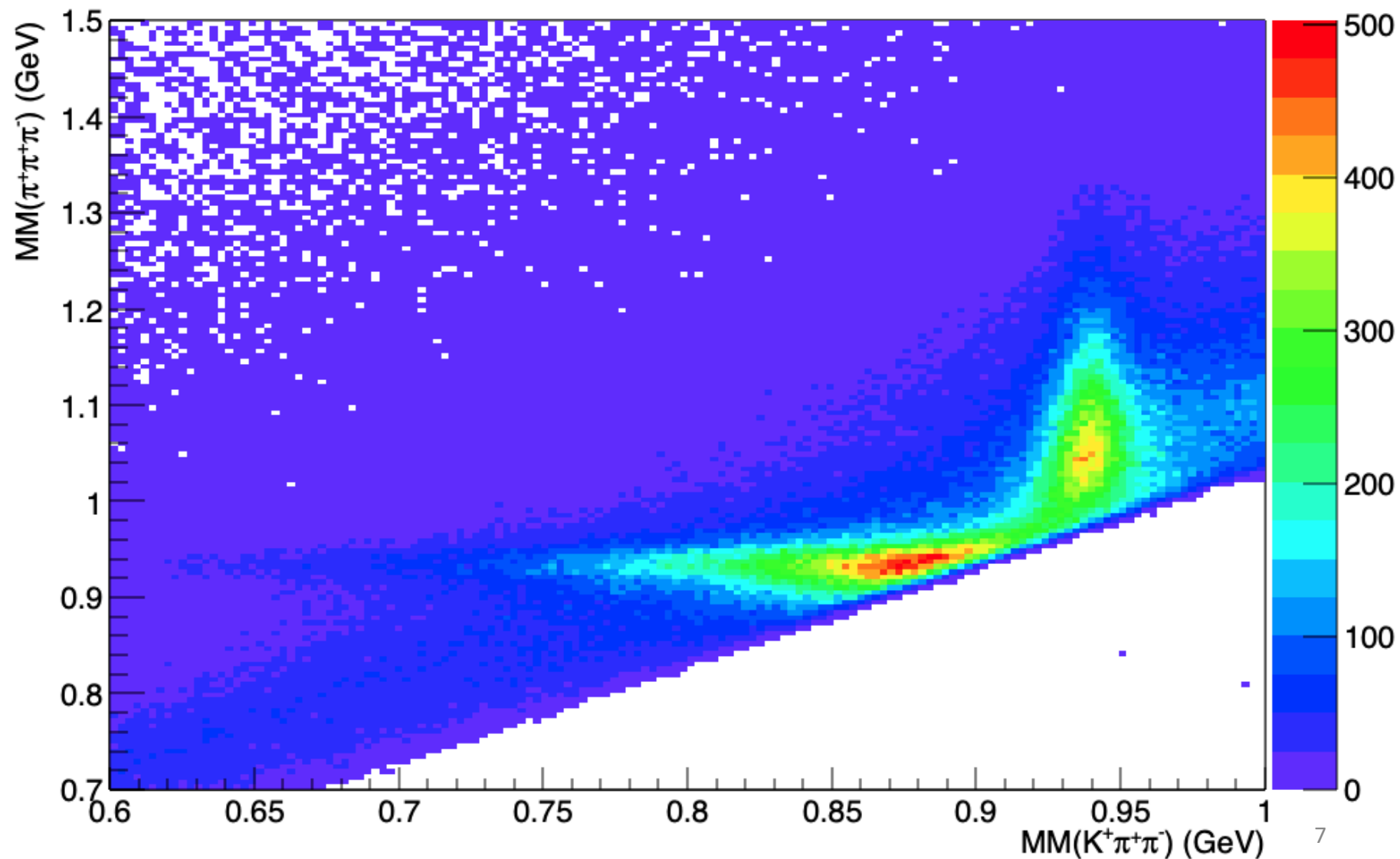
Requiring $1 K^+, 1 \pi^+, 1 \pi^-$

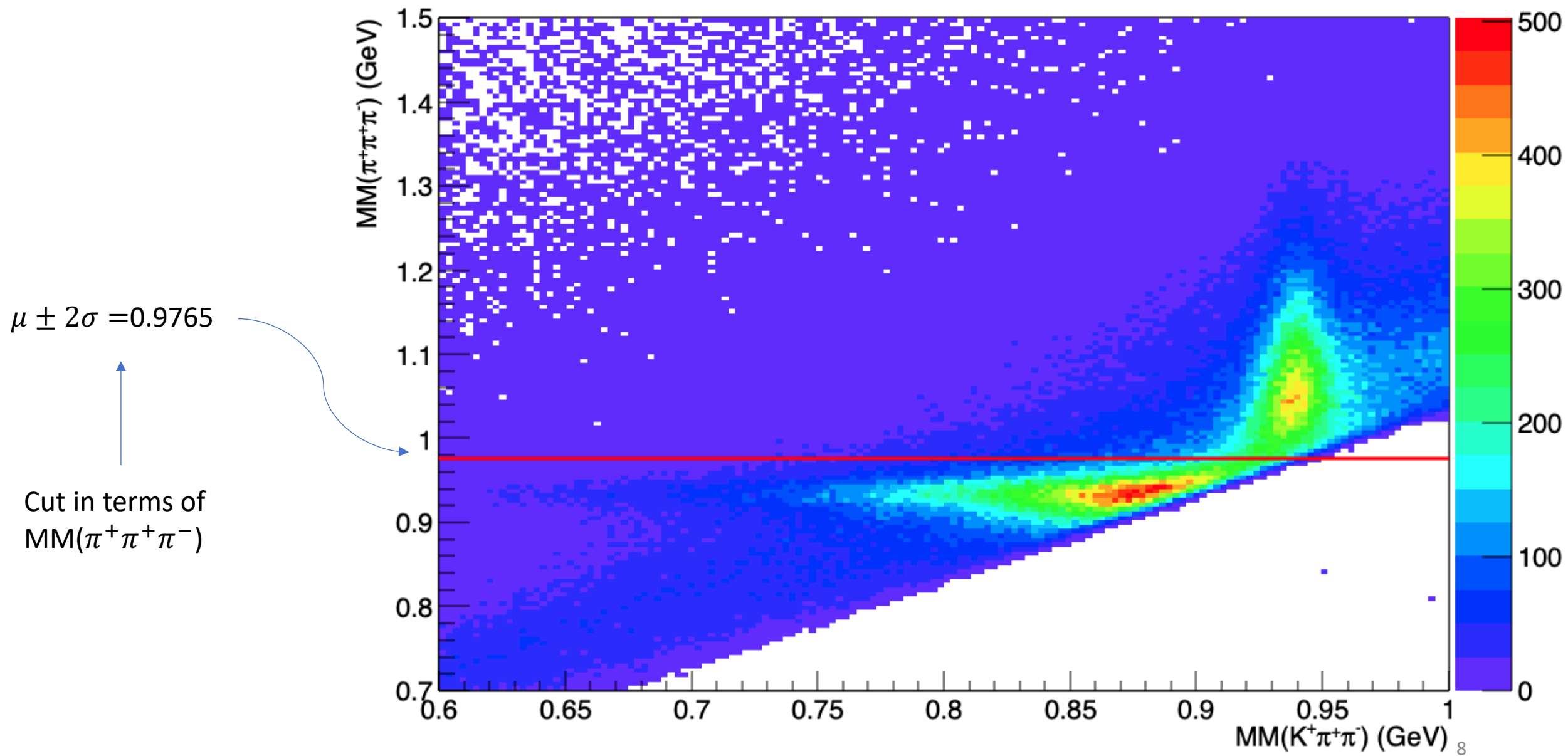
- g12 Data
- Timing and z-vertex cuts applied
- 2,903,628 Entries



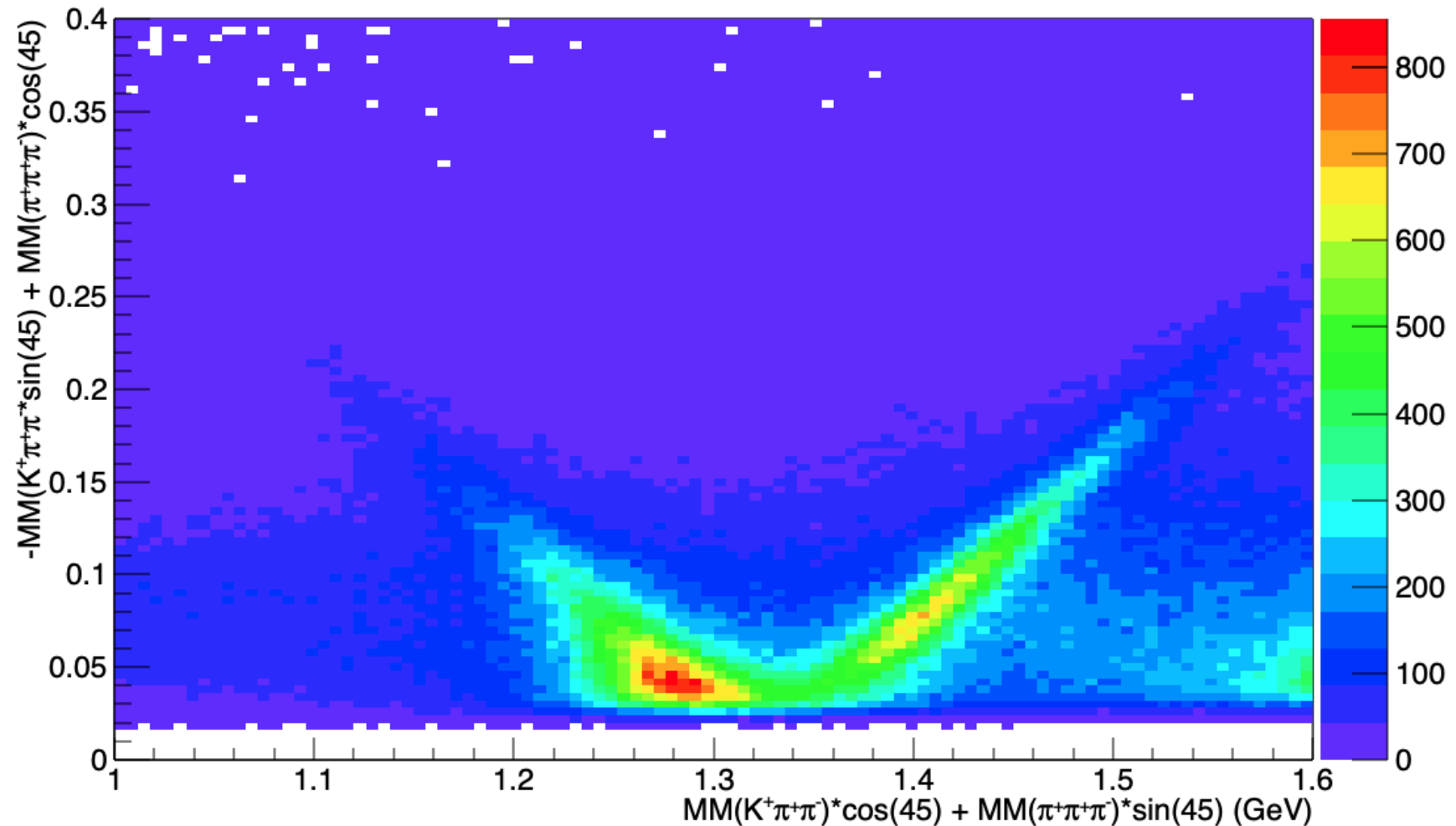
MM($\pi^+ \pi^+ \pi^-$) vs. MM($K^+ \pi^+ \pi^-$)

- Misidentification of π^+ as K^+
- Redefine the K^+ as π^+ using π^+ mass
$$K^+ \rightarrow \pi^+$$
- Then construct new variable,
MM($\pi^+ \pi^+ \pi^-$)

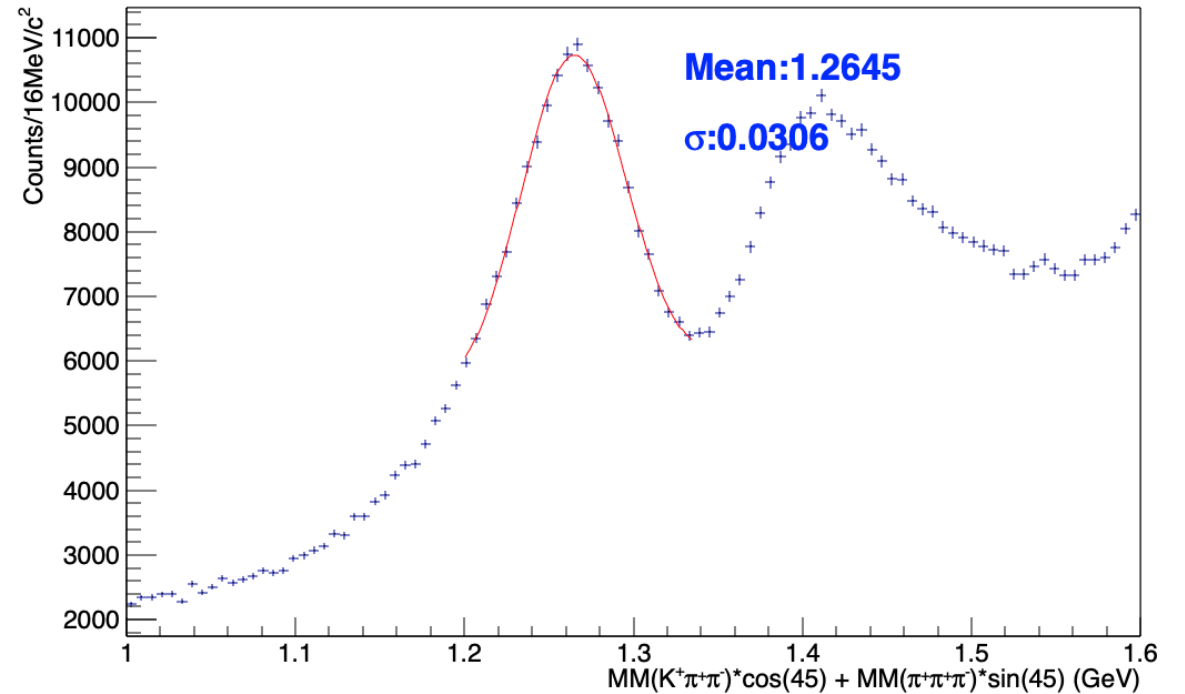
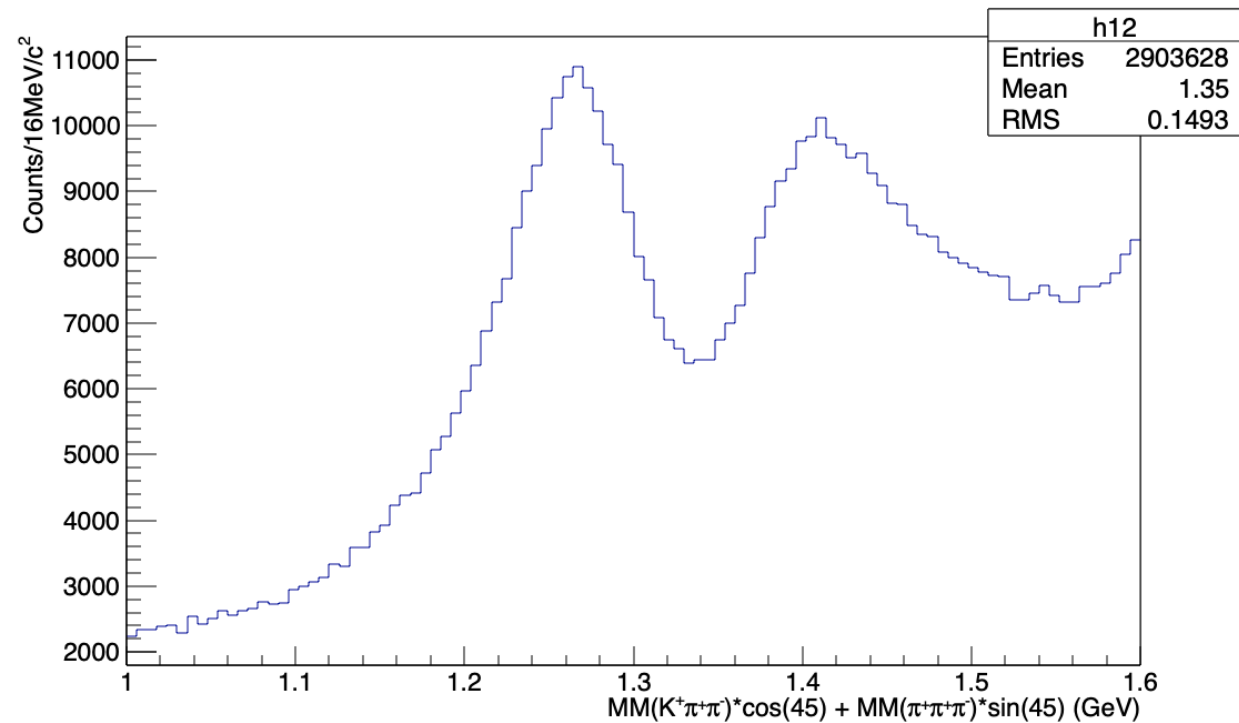




MM($\pi^+\pi^+\pi^-$) vs. MM($K^+\pi^+\pi^-$) Rotated
by 45°

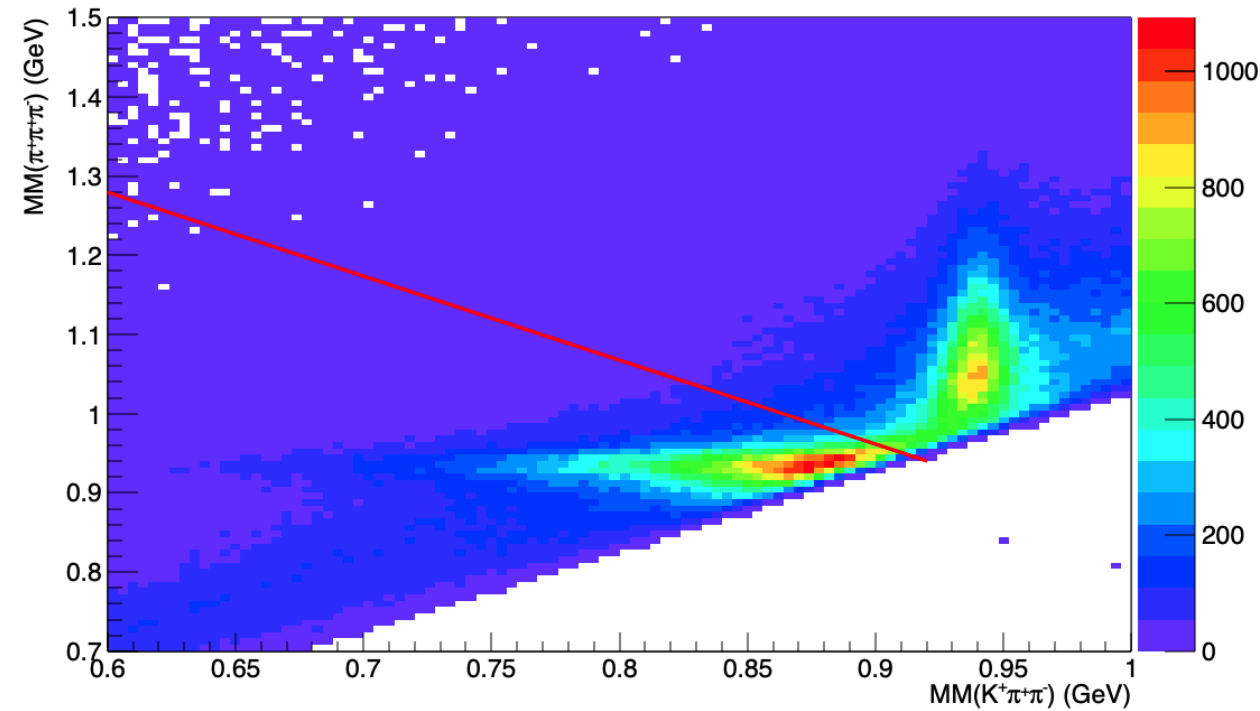
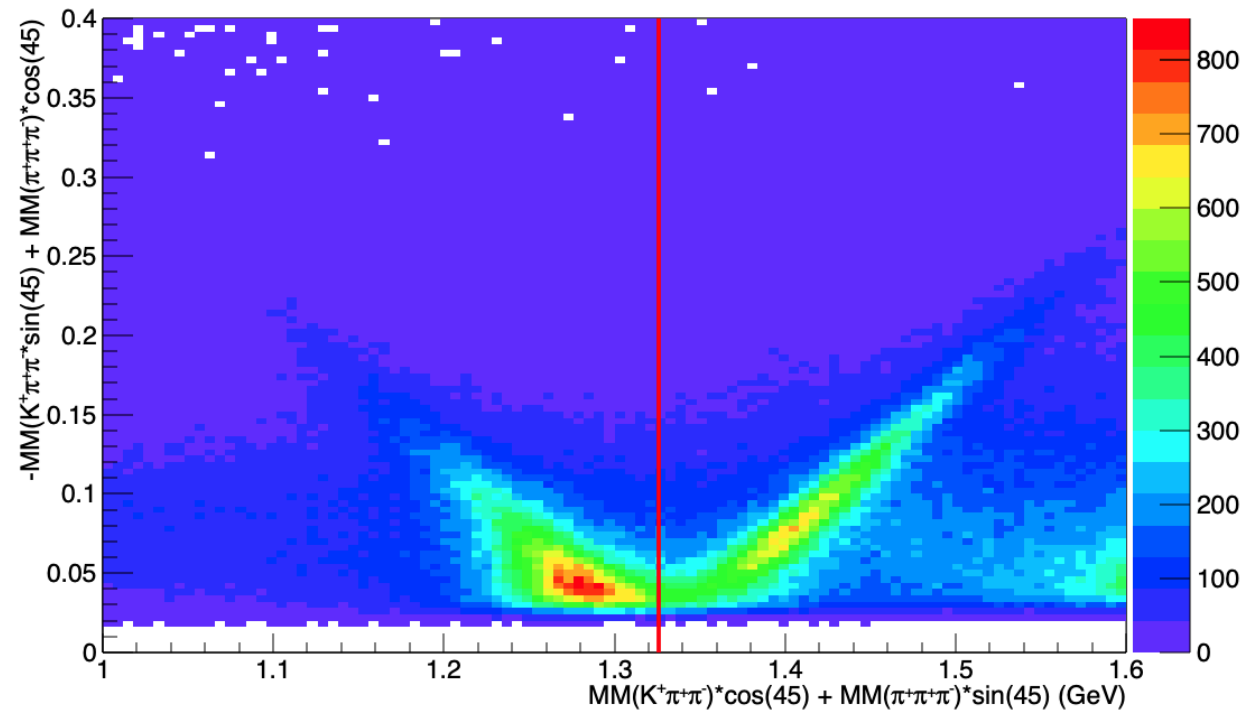


Projecting onto Rotated Axis



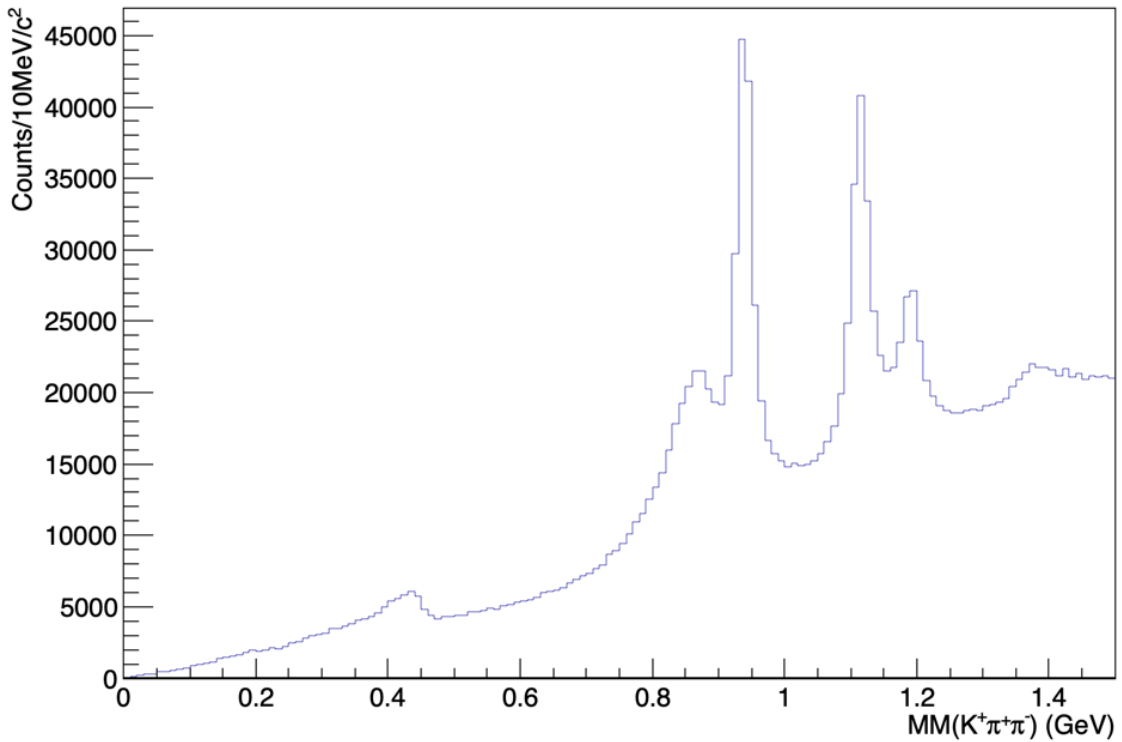
Cut everything below $\mu + 2\sigma = 1.3257$

Cut on Rotated Axis

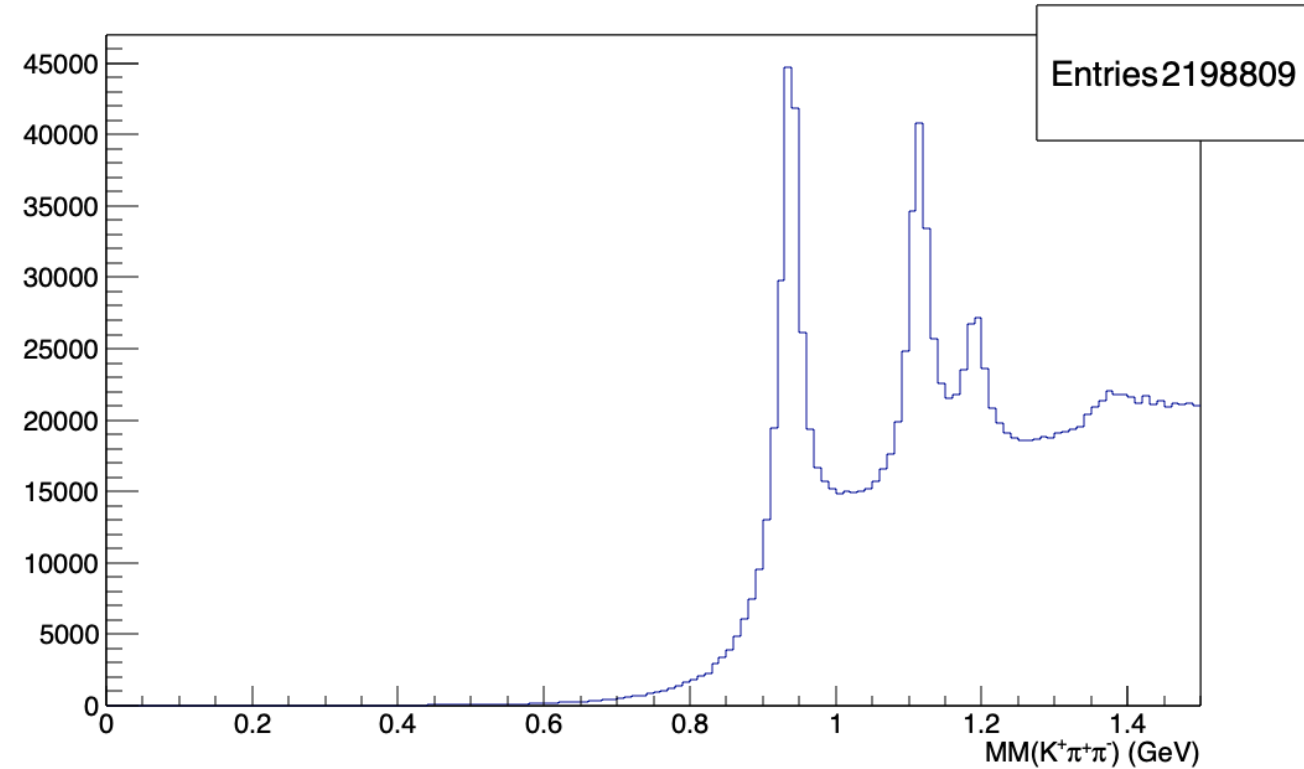


Applying $MM(\pi^+\pi^+\pi^-)$ Cut

No Cuts

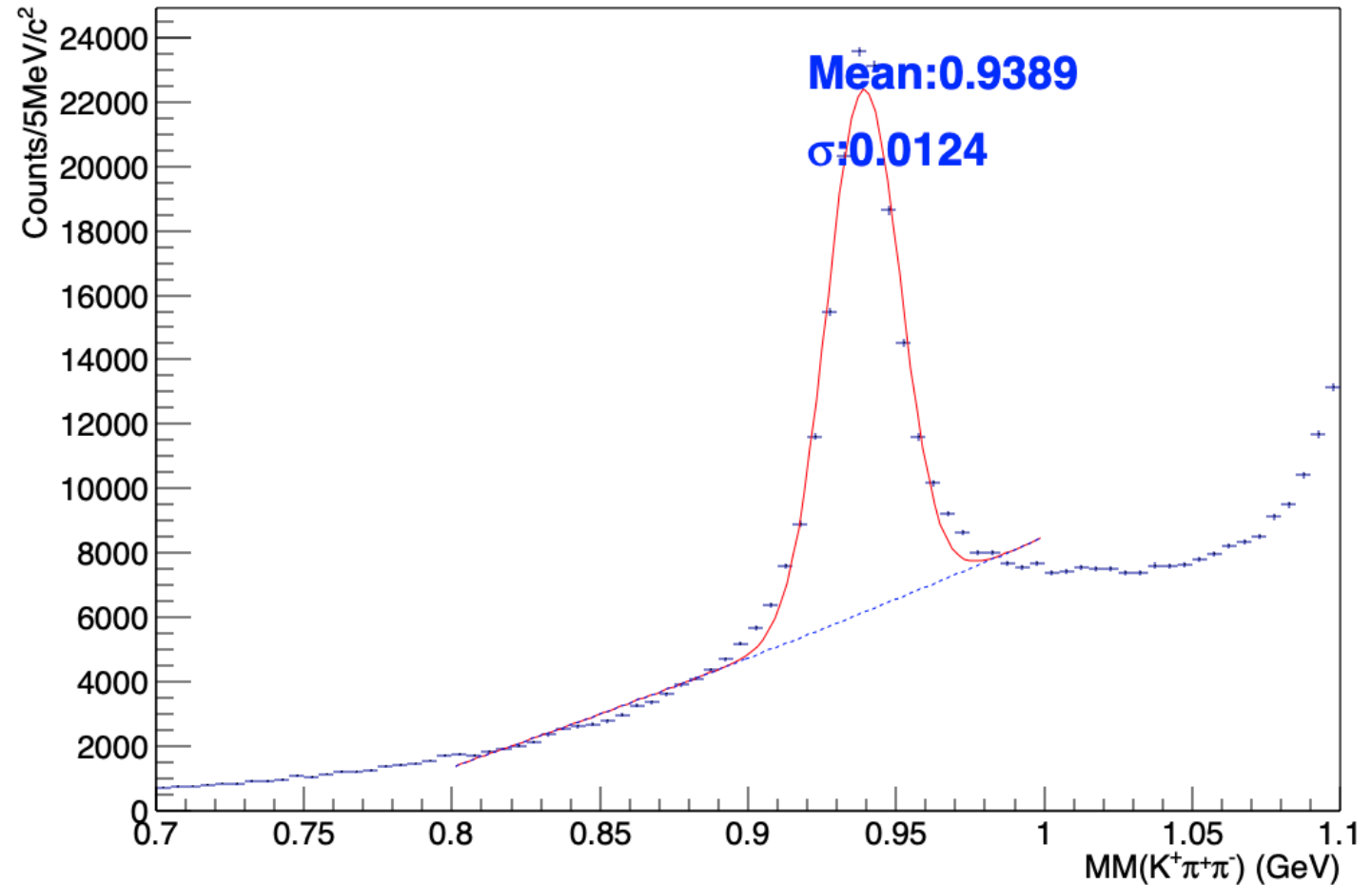


With $MM(\pi^+\pi^+\pi^-)$, $MM(K^+\pi^+\pi^-)$ Cut

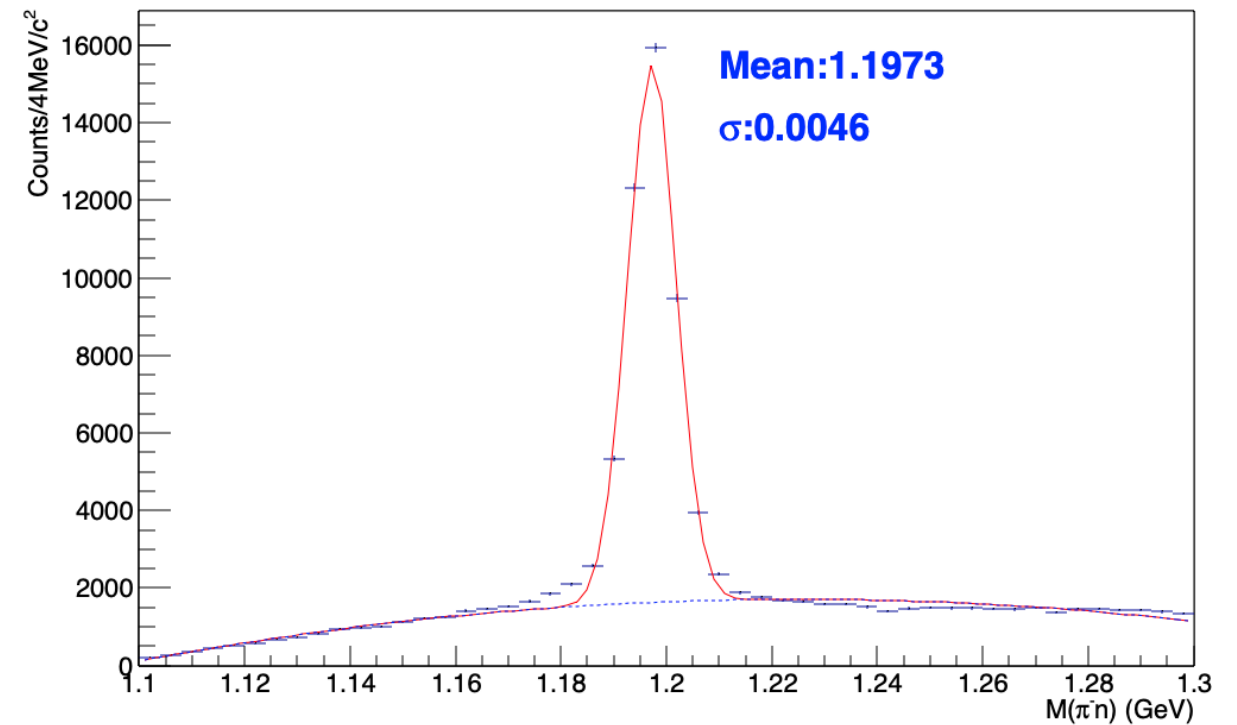
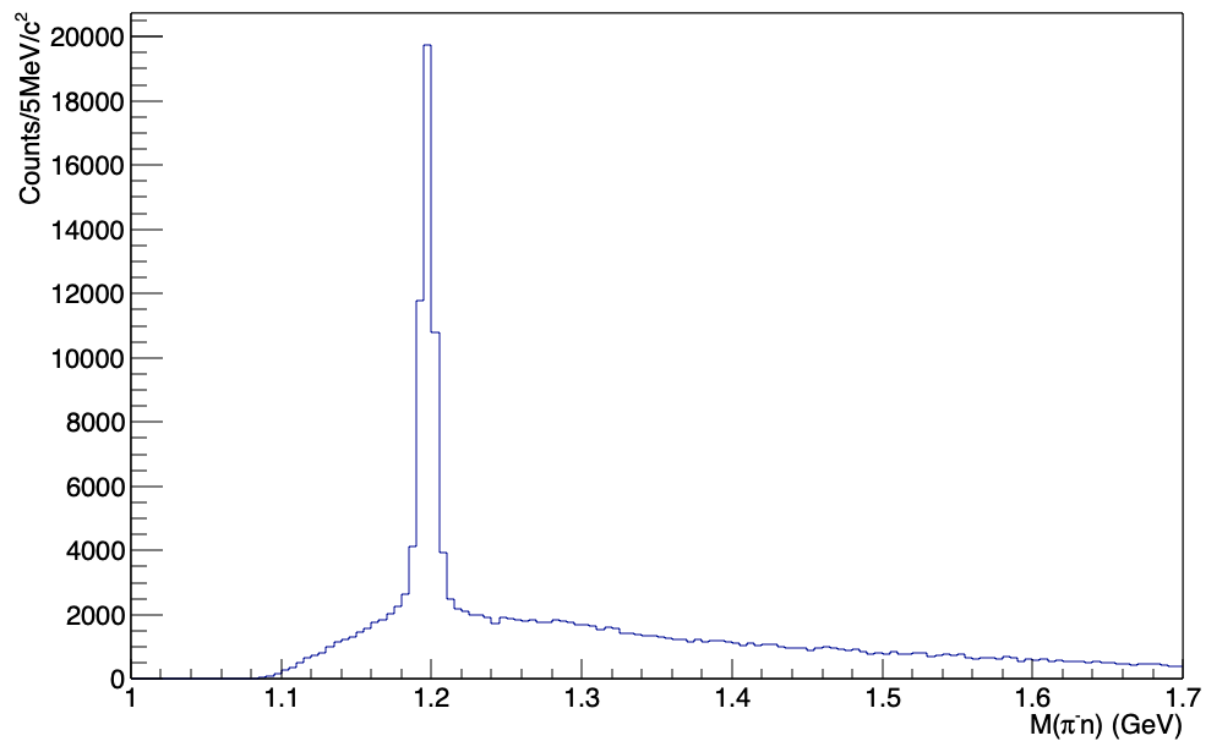


Defining Neutron Cuts

- Cut $\mu \pm 3\sigma$
- Gaussian with quadratic background function



$\Sigma^- \pi^+$ Channel; Defining Σ^- Cut

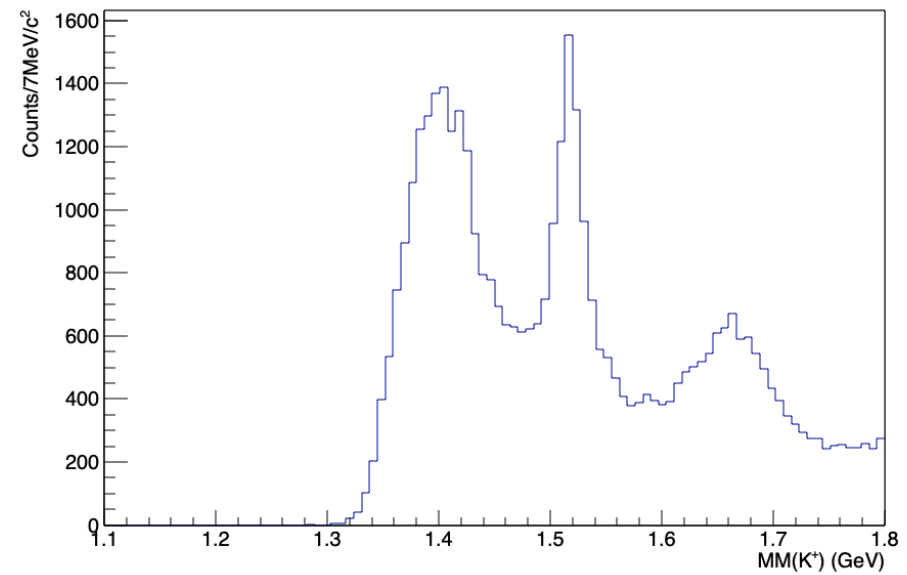
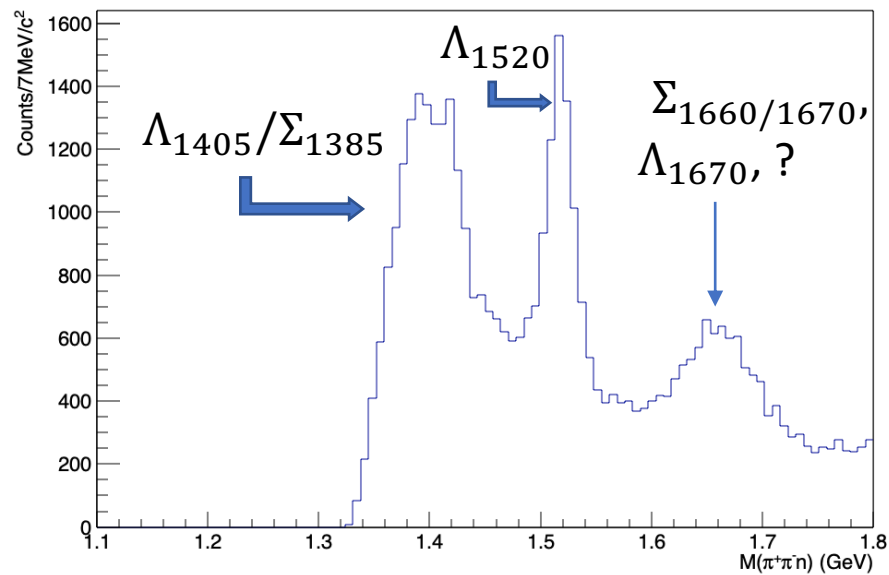


Only keep events with $M(\pi^- n)$ value between $\mu \pm 3\sigma$

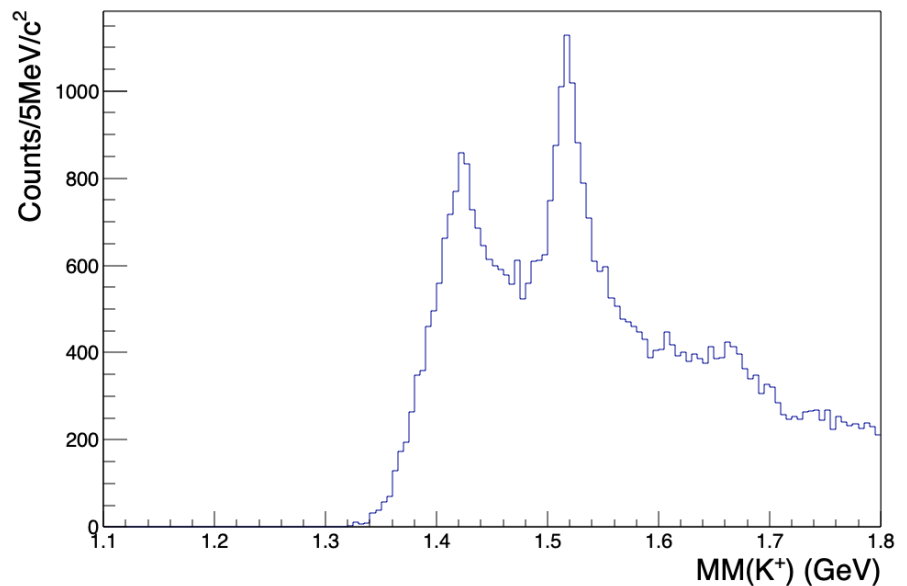
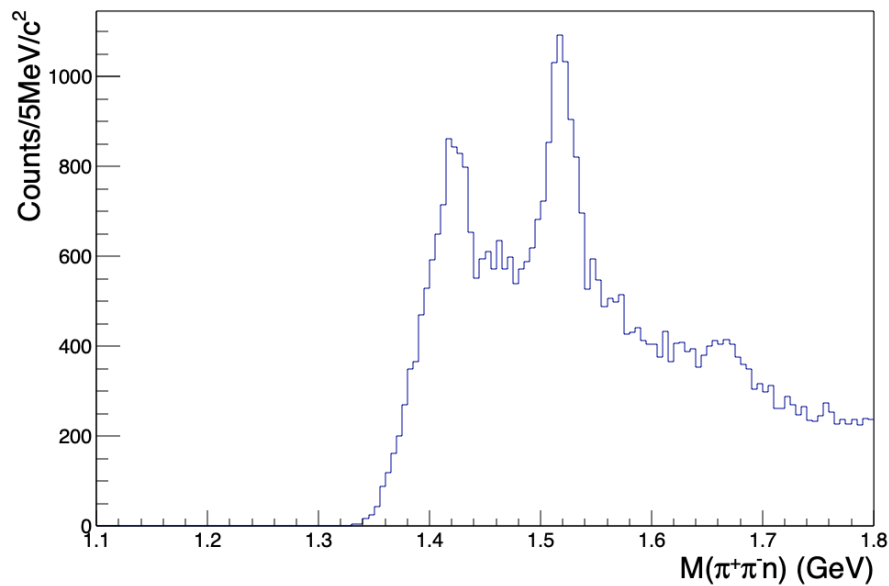
$$M(\pi^+\pi^-n)$$

$$MM(K^+)$$

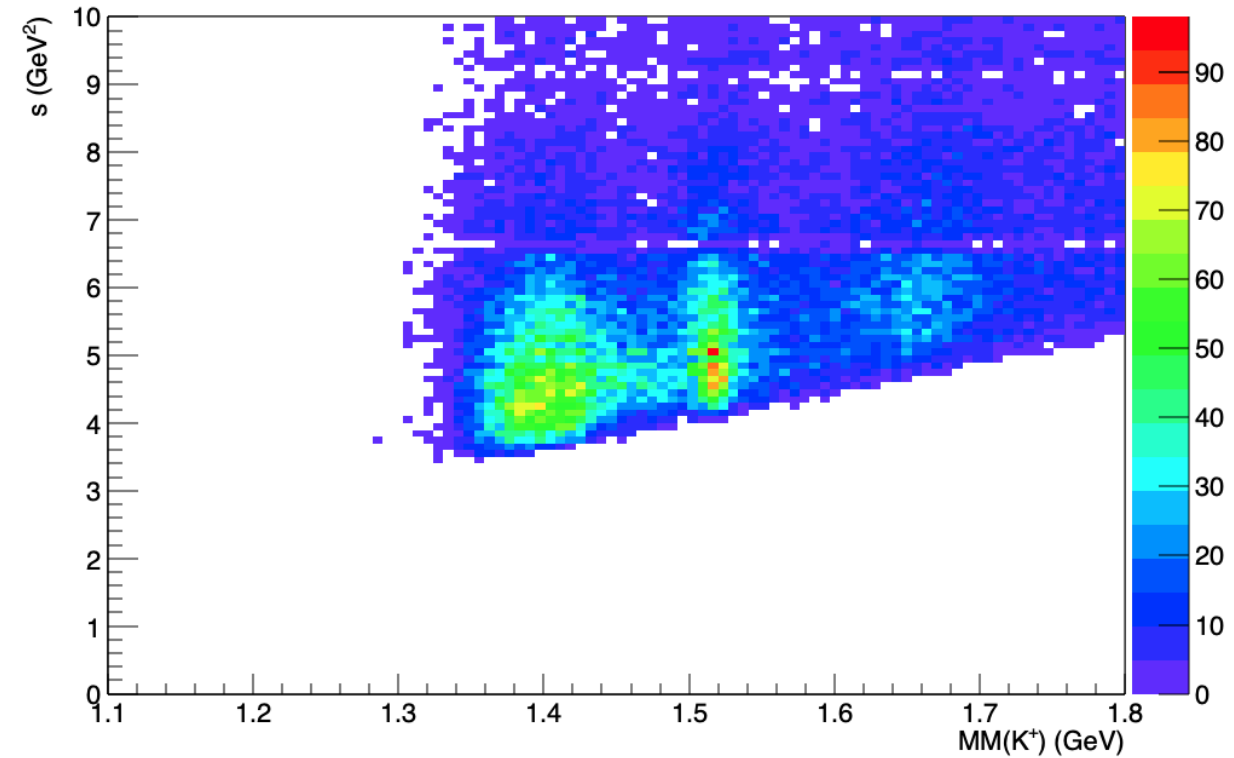
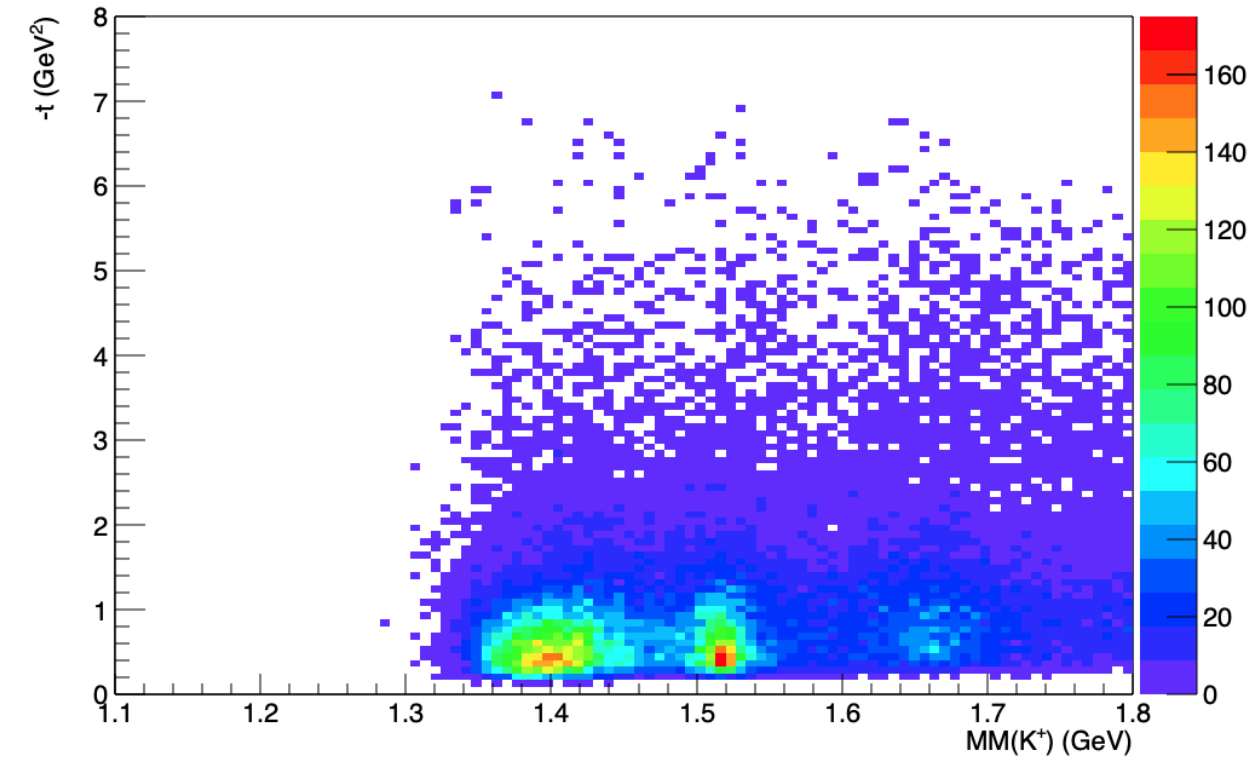
$$\Sigma^-\pi^+$$



$$\Sigma^+\pi^-$$



Mandelstam Variables



Conclusion

- This is a first look; a lot can change and be improved upon
- High s and $|t|$ statistics appear to be limited

Next Steps

- Begin looking at CLAS12 data: Run Group A/K

Thank you!