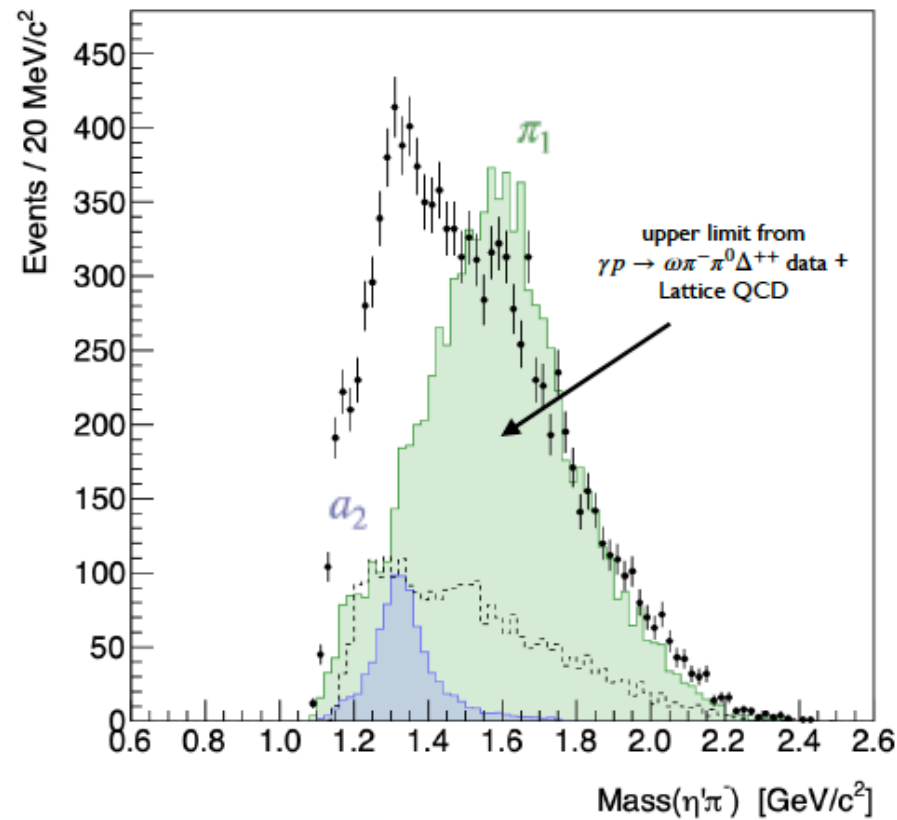
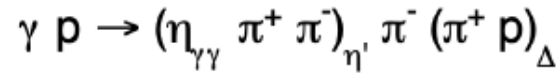
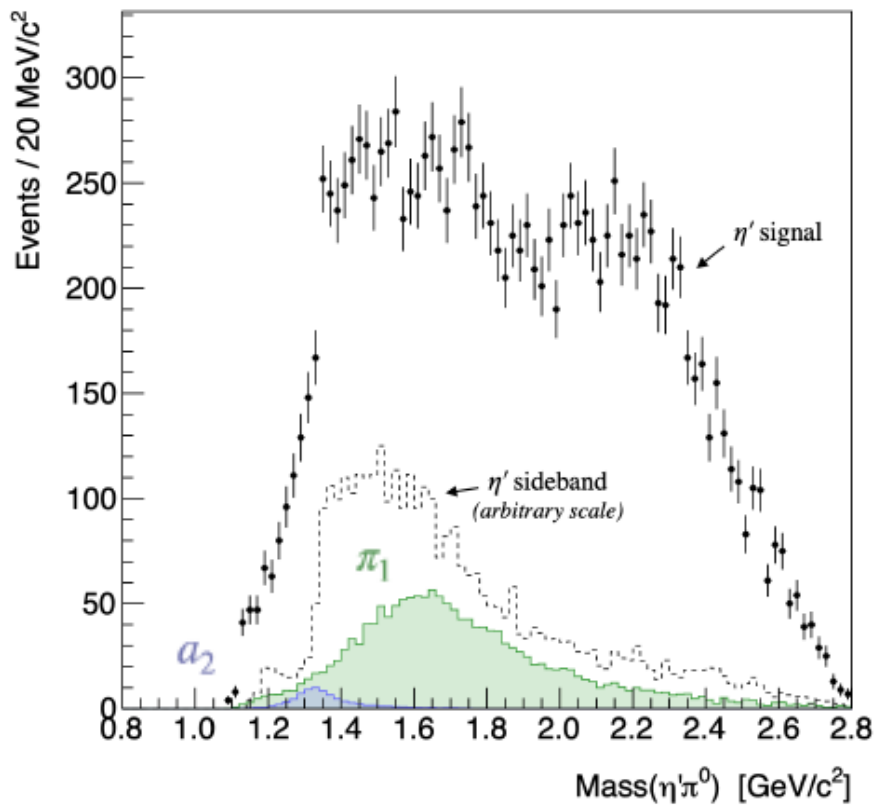
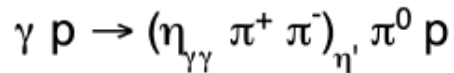


Analysis of $\gamma p \rightarrow \eta' \pi^- \Delta^{++}$, $\eta' \rightarrow \pi^+ \pi^- \eta$,
 $\eta \rightarrow \gamma \gamma$

Florida International University 2022

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$\eta' \pi$ channel for π_1 searches



For the $\pi_1(1600)$: $\sigma B = \sigma(\gamma p \rightarrow \pi_1 p) \times B(\pi_1 \rightarrow \eta' \pi^0) \times B(\eta' \rightarrow \pi^+ \pi^- \eta) \times B(\eta \rightarrow \gamma\gamma) \times B(\pi^0 \rightarrow \gamma\gamma)$
 $= (20\text{nb}) \times (10\%)_{\text{LQCD}} \times \dots = 2\text{nb} \times \dots$

Against a Δ^{++} , use:

$$\sigma(\gamma p \rightarrow \pi_1^- \Delta^{++}) = 250\text{nb}$$

$$\sigma(\gamma p \rightarrow a_2^- \Delta^{++}) = 400\text{nb}$$

(remember this is for $0.0 < -t < 0.5$ (GeV/c^2)²)

Against a proton, use:

$$\sigma(\gamma p \rightarrow \pi_1^0 p) = 20\text{nb}$$

$$\sigma(\gamma p \rightarrow a_2^0 p) = 20\text{nb}$$

(remember this is for $0.2 < -t < 0.5$ (GeV/c^2)²)

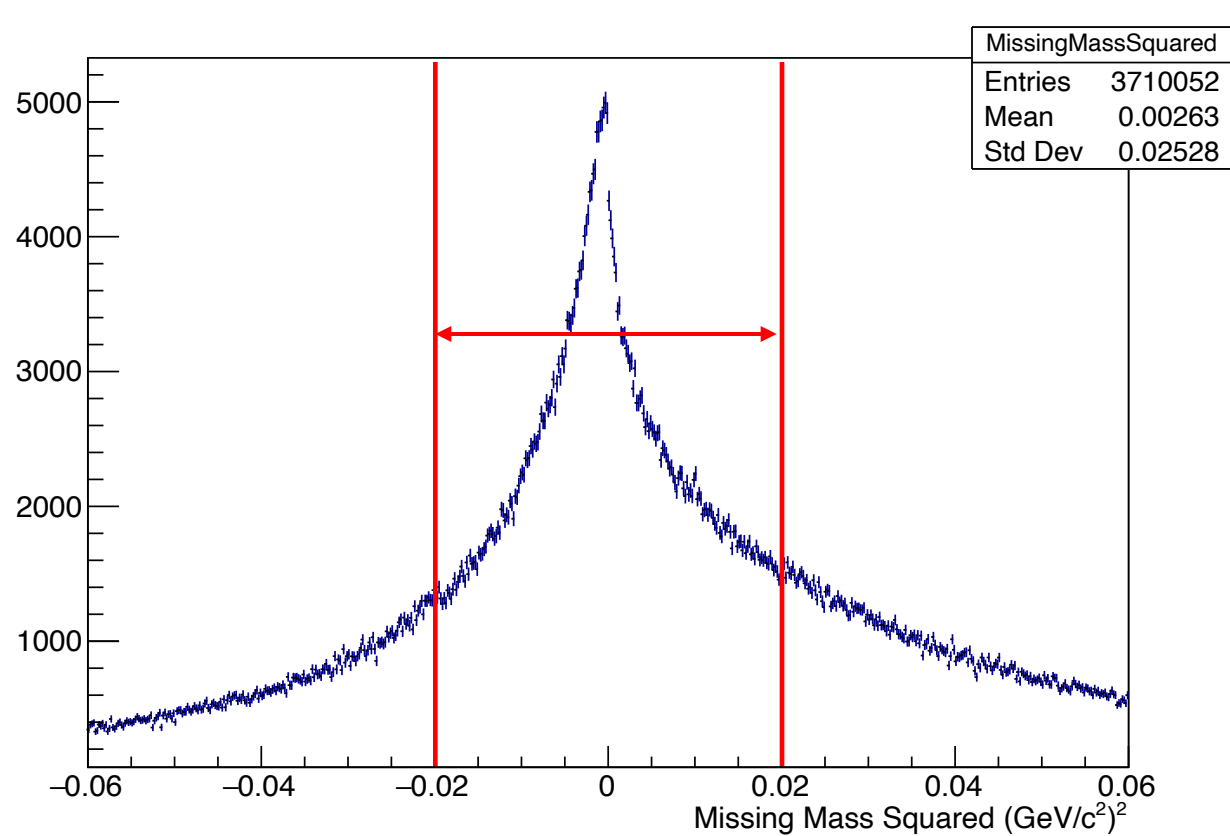
$\sigma(\pi_1)$ obtained assuming *all* of the $l=1$ $\omega \pi^+ \pi^-$ comes via: $\pi_1 \rightarrow b_1 \pi \rightarrow \omega \pi \pi$. This puts an upper limit on the cross section for the production of π_1 times the branching fraction for $\pi_1 \rightarrow b_1 \pi$

Reaction selection cuts

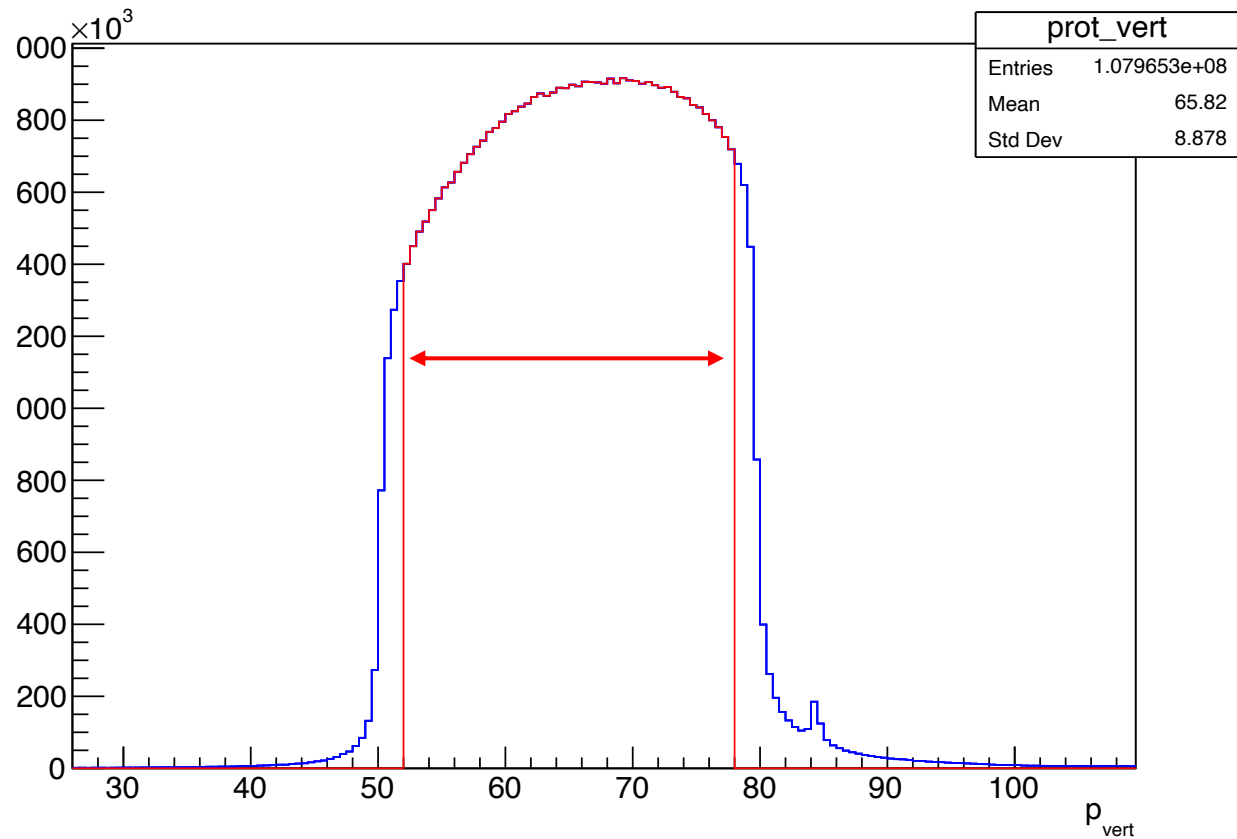
1. FCAL shower quality >0.5
2. E_{beam} 8.2-8.8 GeV
3. $11.3^\circ < \theta_\gamma < 11.9^\circ$ Avoid gap region between calorimeters
4. $p_{\text{vert}}^\perp < 1 \text{ cm}$ $52 \text{ cm} < p_{\text{vert}}^z < 78 \text{ cm}$
5. Kin. Fit χ^2 Per NDF <15
6. Use combo only if combo has not been used with particles in it
7. $|MM^2| < 0.02 \text{ (GeV/c}^2)^2$
8. $0.1 \text{ (GeV/c)}^2 < t < 1.5 \text{ (GeV/c)}^2$
9. Accidental subtraction
10. $M(\Delta^{++}) < 1.3 \text{ GeV}$
11. $\mu - 2\sigma < M(\eta') < \mu + 2\sigma$ or sideband subtractions

Analysis cuts

$|MM^2| < 0.02 \text{ (GeV/c}^2\text{)}^2$

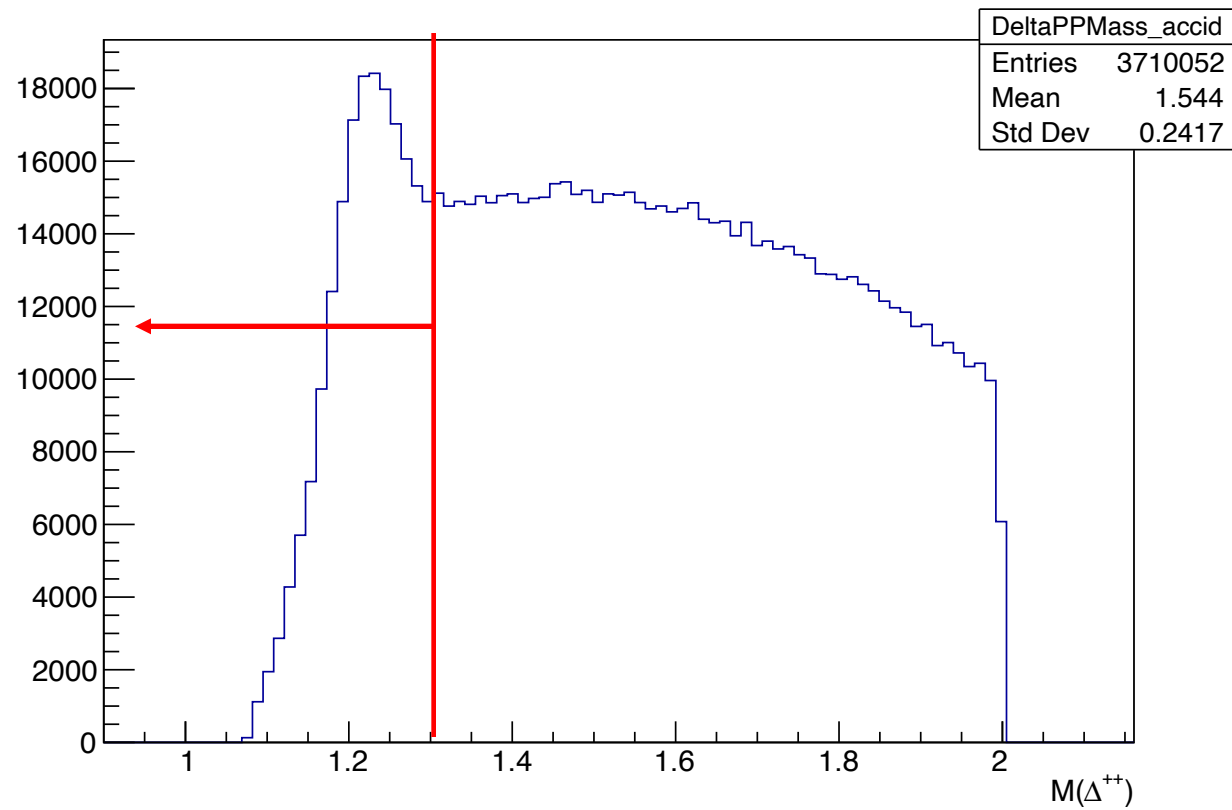


$52 \text{ cm} < p_{\text{vert}}^z < 78 \text{ cm}$

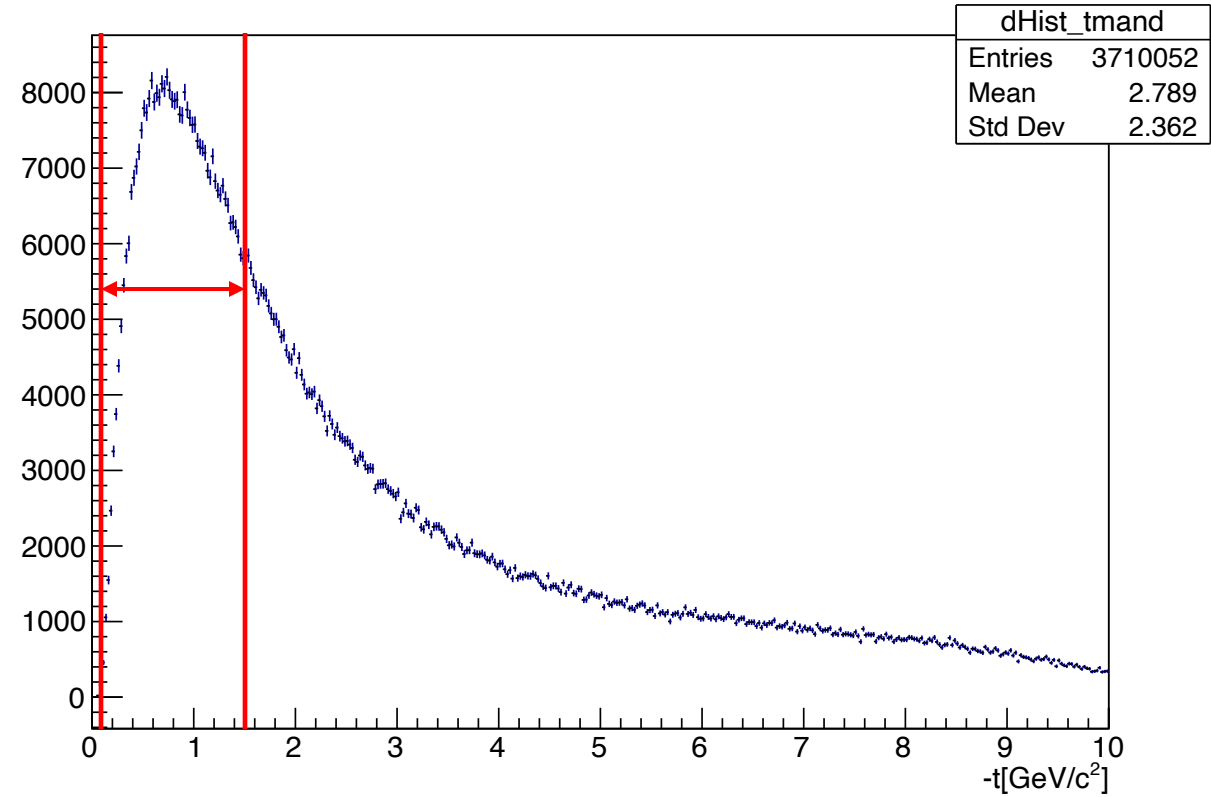


Analysis cuts

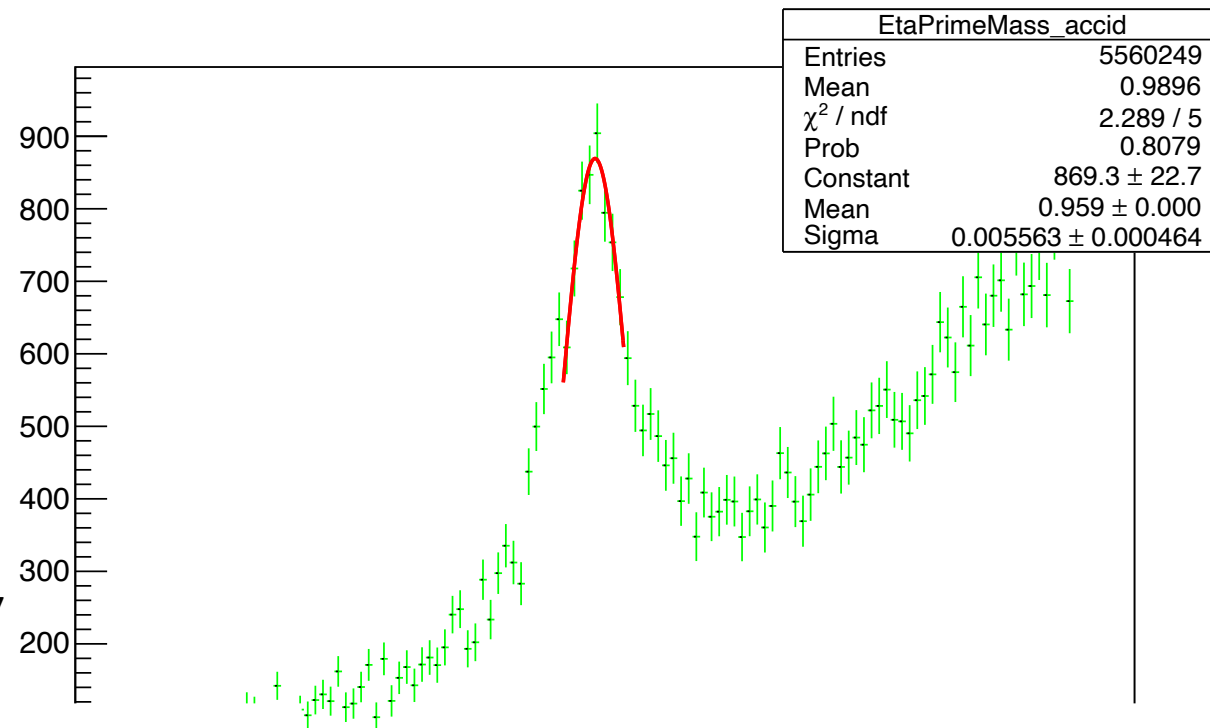
$$M(\Delta^{++}) < 1.3 \text{ GeV}$$



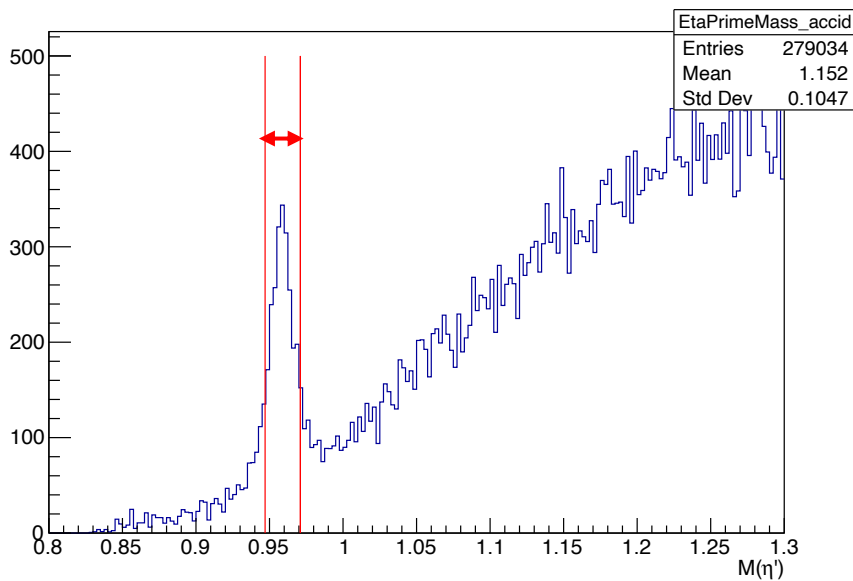
$$0.1 (\text{GeV}/c)^2 < t < 1.5 (\text{GeV}/c)^2$$



Selecting $M(\eta')$ signal region two different ways

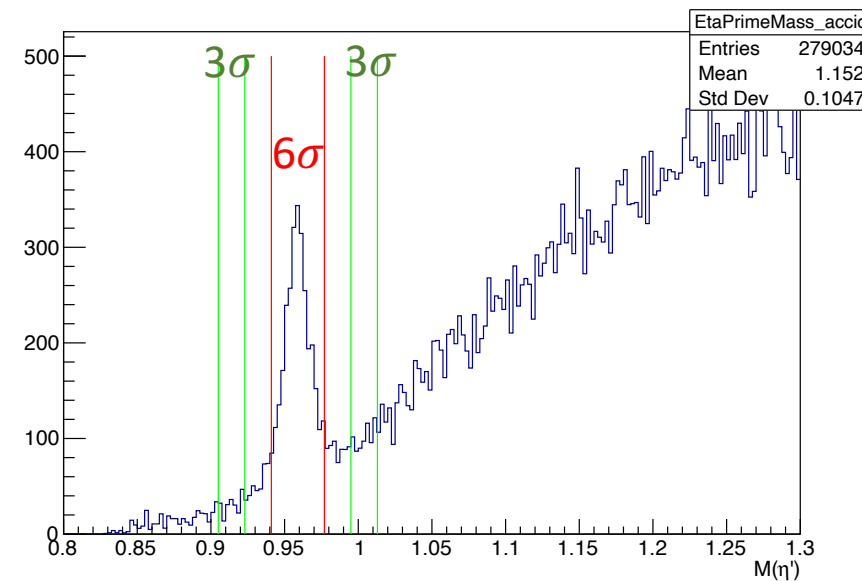


Selecting 2σ region within η' peak



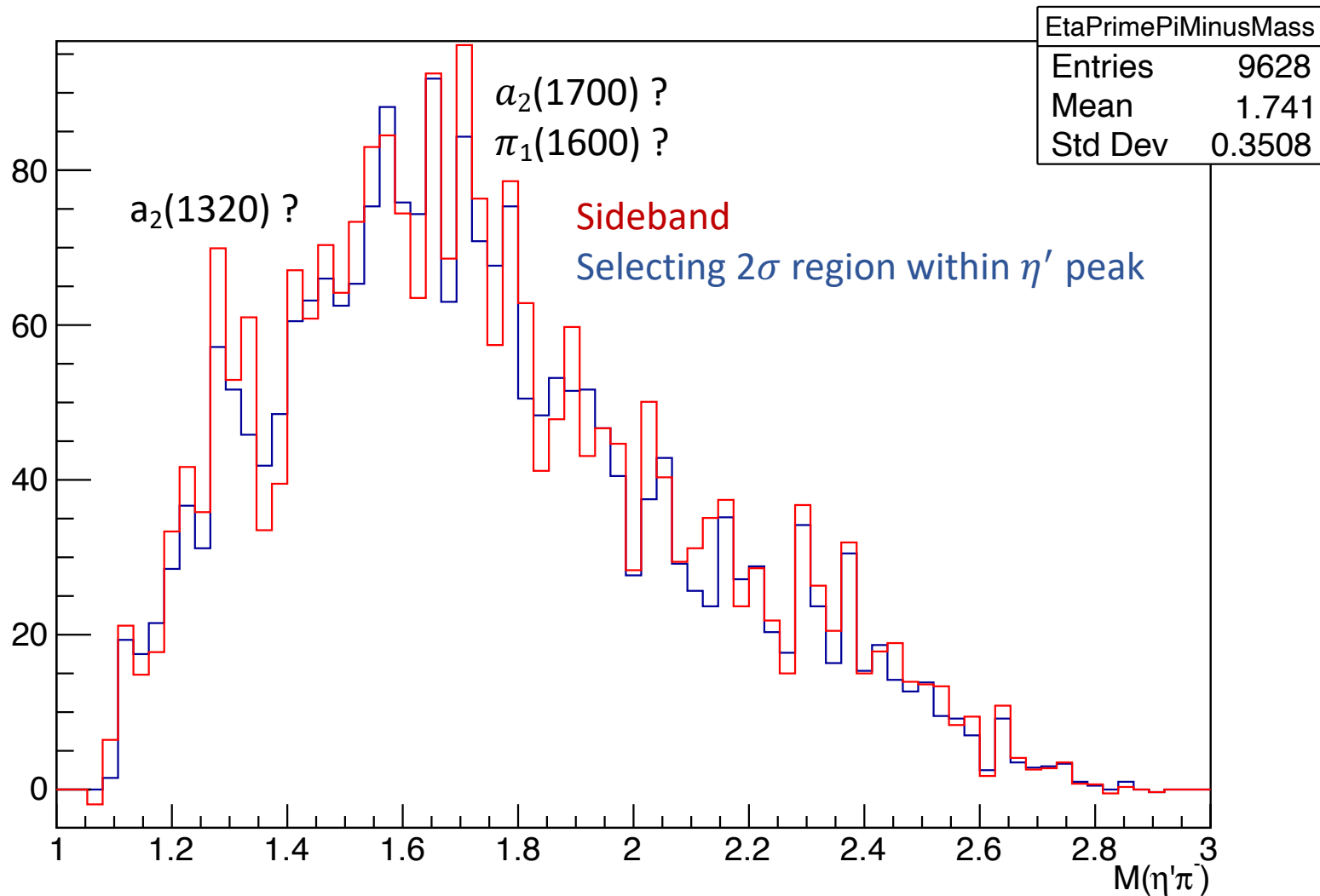
0.92 0.94 0.96 0.98 1 1.02

Sidband subtraction



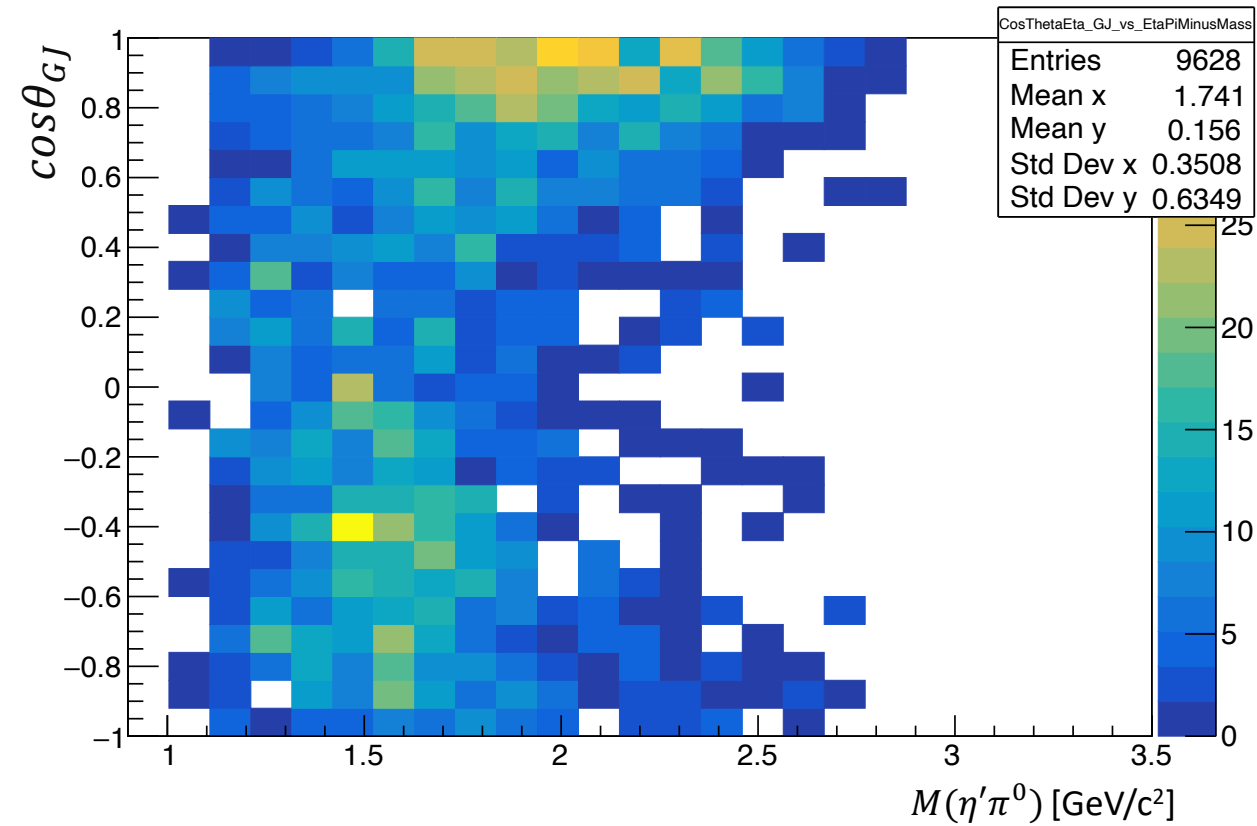
Invariant mass distributions after all the cuts

$M(\eta'\pi^-)$

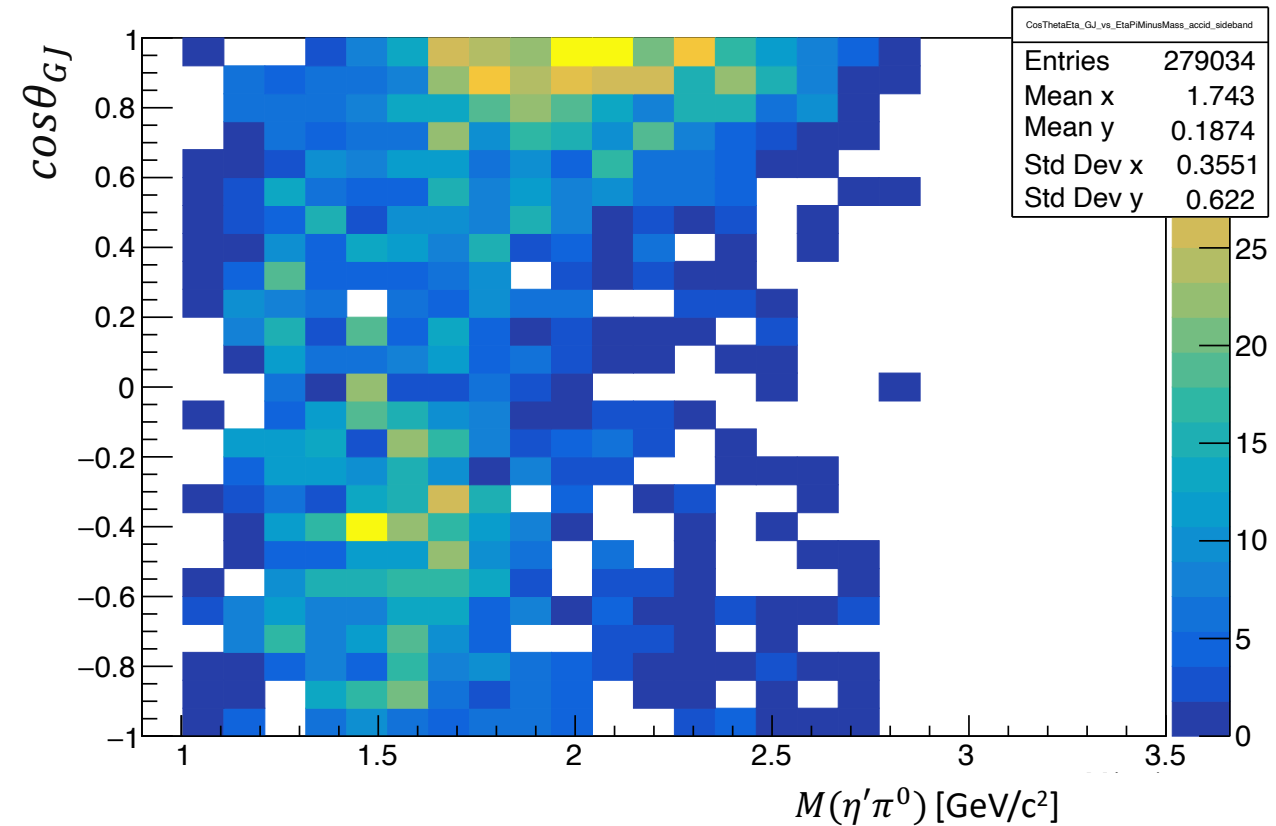


$M(\eta'\pi^-)$ vs $\cos\theta_{GJ}$ after all cuts

Selecting 2σ region within η' peak



Sideband



- Number of unused showers
- Energy of unused showers
- Missing energy
- Photon energy
- Look for rho
- Look for baryonic contributions