3-Pion Photo-Production at Jlab Hall B

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For the CLAS collaboration

Gluonic Excitations
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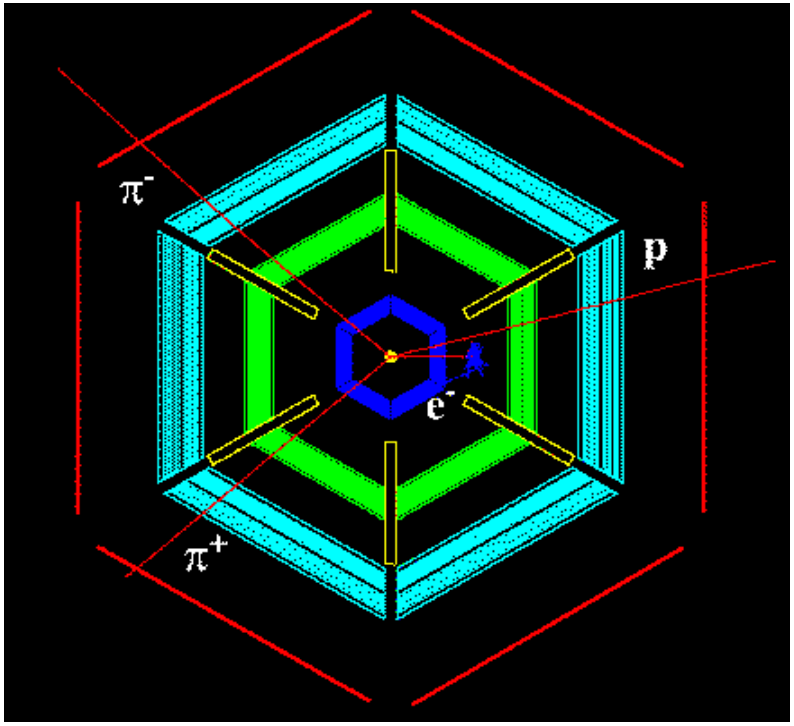
Objectives

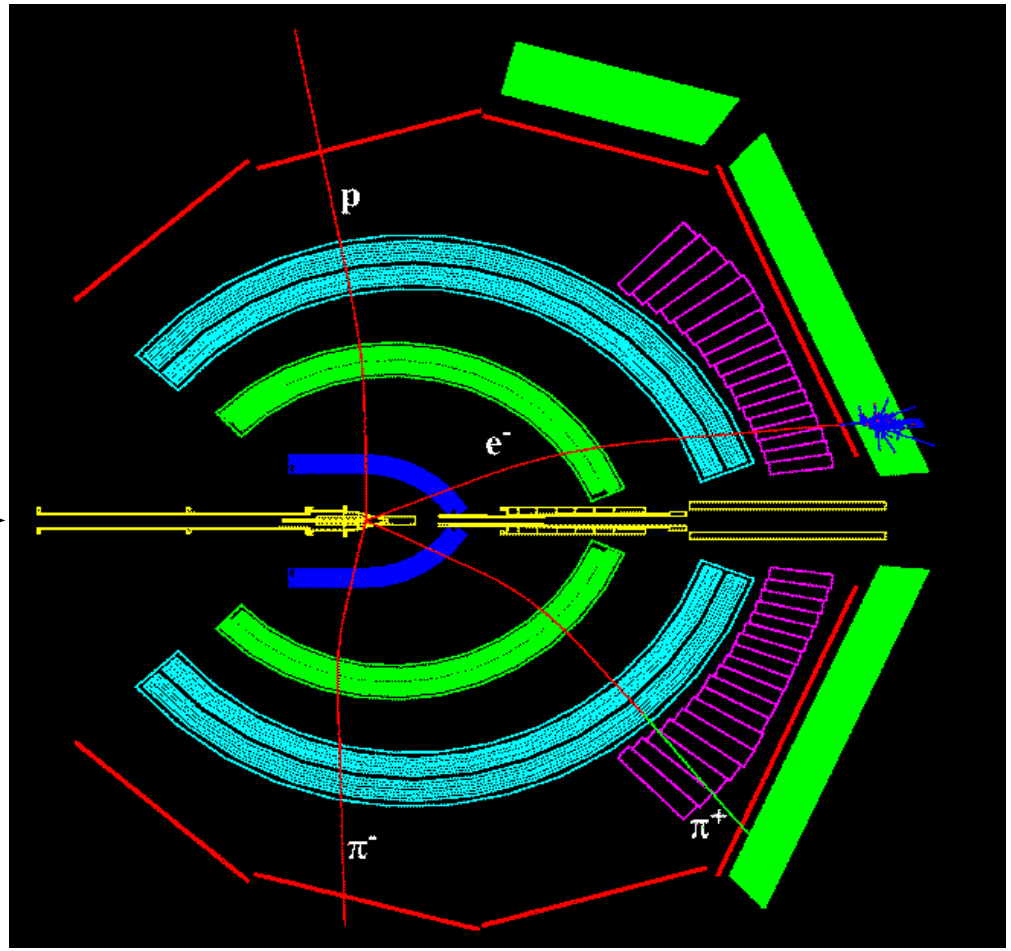
- State motivations behind the experiment
- Give a brief description of CLAS
- Point out complications of the analysis
- Demonstrate meson photo-production at clas
- Show “very” preliminary PWA results

CLAS: CEBAF Large Acceptance Spectrometer

Beam's eye view: x-y plane



Side view: y-z plane



G6c-E01-017
Meson Spectroscopy in Few-body decays

Running Period : 8/17/2001-9/11/2001

Electron beam energy: 5.74 GeV

Photon beam energy: [4.8-5.4] GeV

Photon beam flux: 5×10^{6} sec^{-1}

Target: 18 cm LH_2

Torus B-field: 50% of the max field

Complications ... limitations

- **CLAS hole in the forward direction:**
  - π^- lab theta acceptance down to 10 deg.
  - π^+ lab theta acceptance down to 5 deg.
- **Photon beam energy low:**
  - t-channel recoil excited baryon production.
- **Unpolarized photon beam:**
  - Rank of the density matrix is 4.
    Summing over final states...
    4 sets of non-interfering terms!!!

CLAS g6c-(E01-017)

Reactions currently under study:

$$\gamma\, p \rightarrow \pi^+ \pi^+ \pi^- (n)$$

$$\gamma\, p \rightarrow \pi^+ \pi^- p (\pi^0)$$

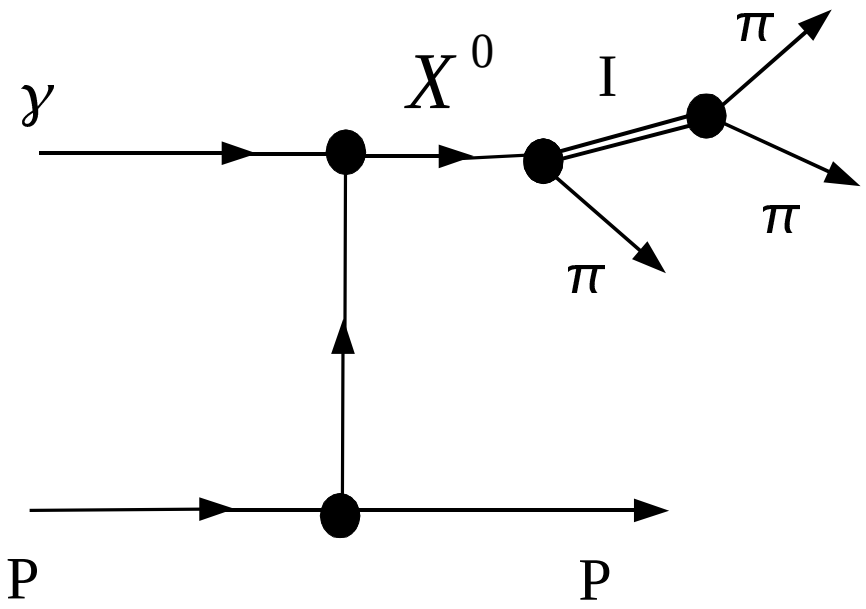
$$\gamma\, p \rightarrow \pi^+ \pi^- (p)$$

$$\gamma\, p \rightarrow K^+ K^+ K^- (n)$$

$$\gamma\, p \rightarrow K^+ K^- (p)$$

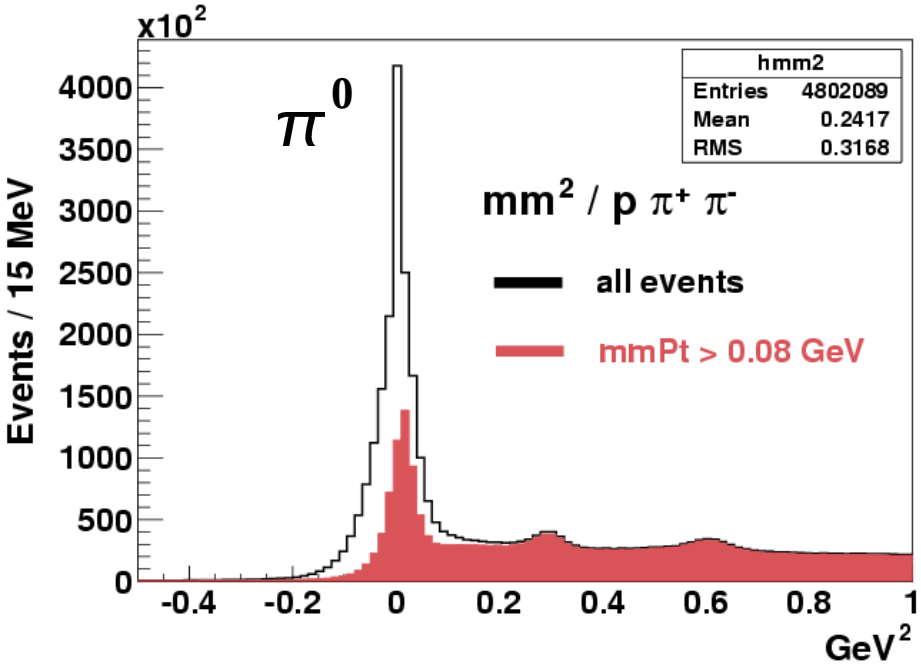
Total triggers: 1.1 Billion

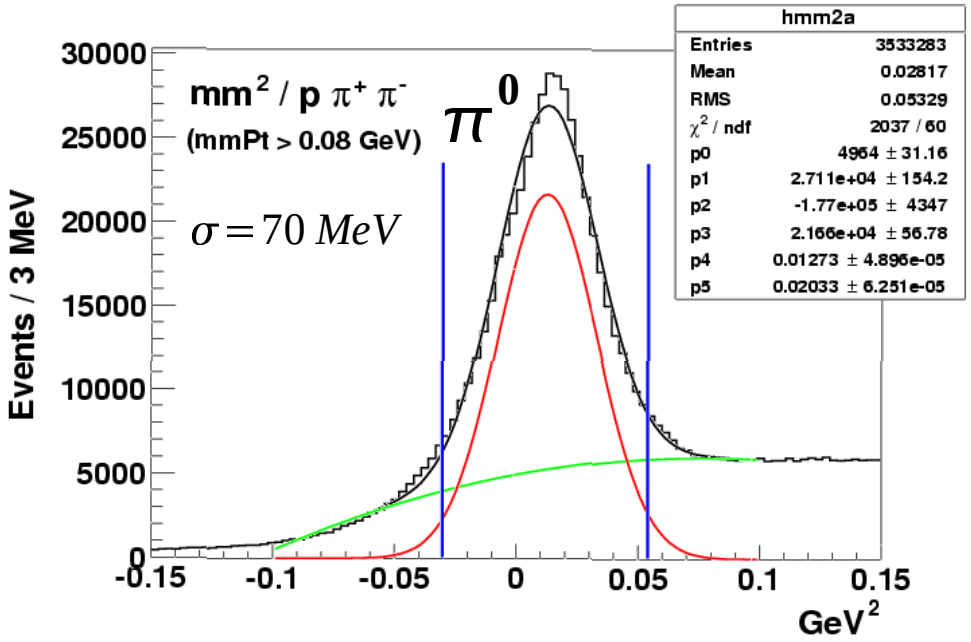
CLAS g6c: $\pi^+ \pi^- p(\pi^0)$

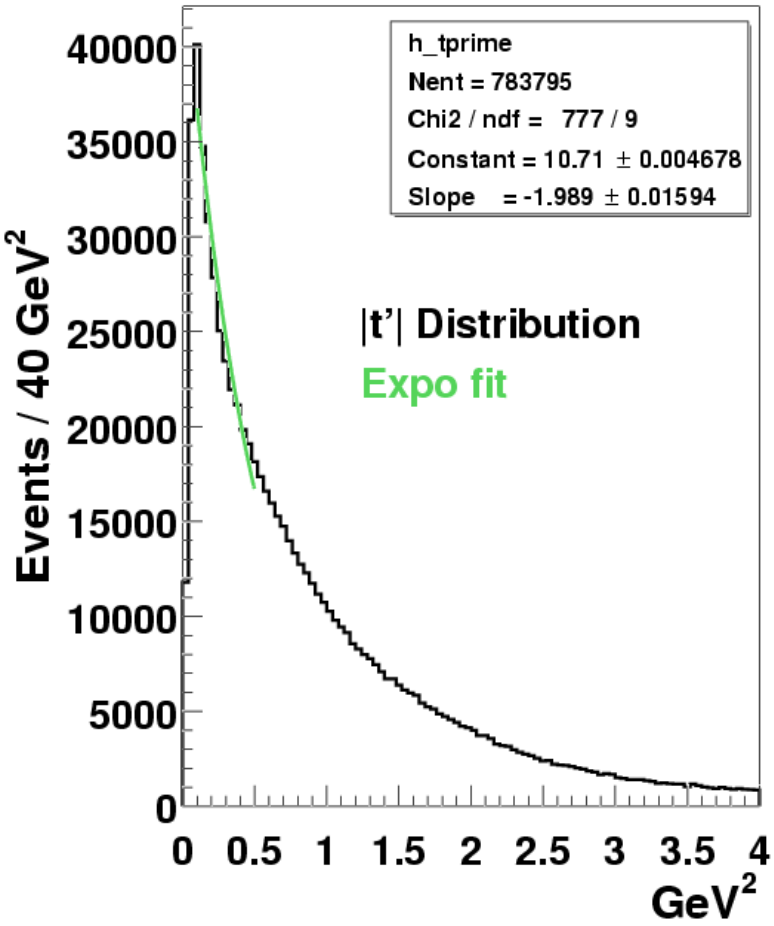


- Neutral exchange reaction
- Both Isovector/Isoscalar X states possible

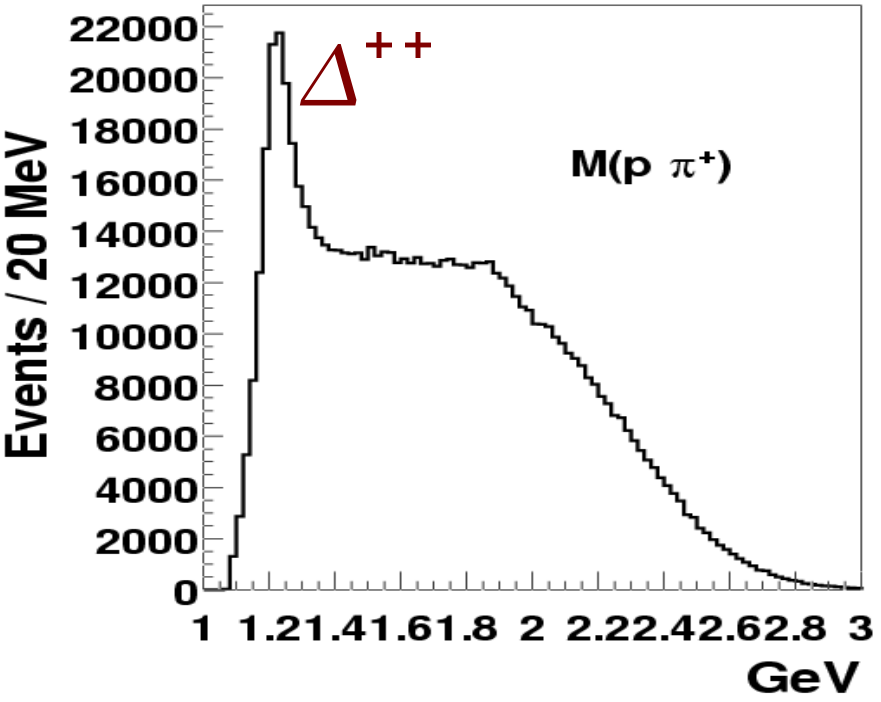
CLAS g6c: $\gamma\, p \rightarrow p\, \pi^+ \pi^- (\pi^0)$

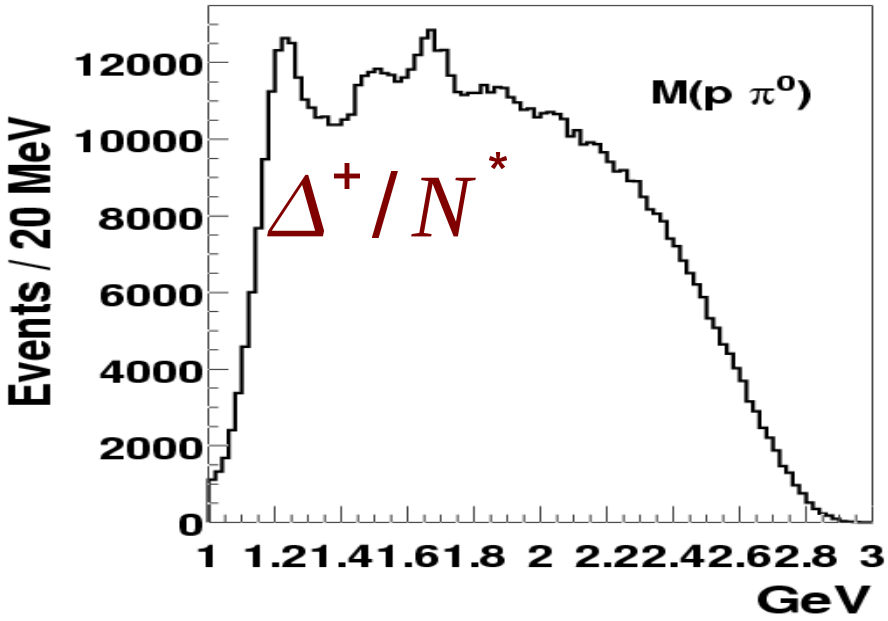


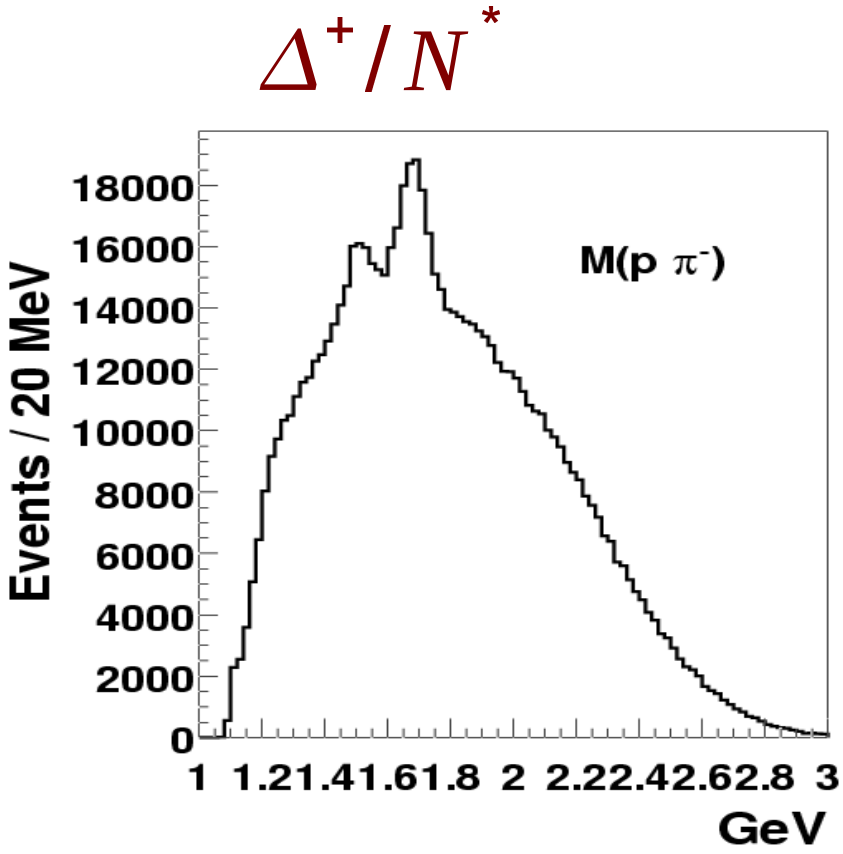




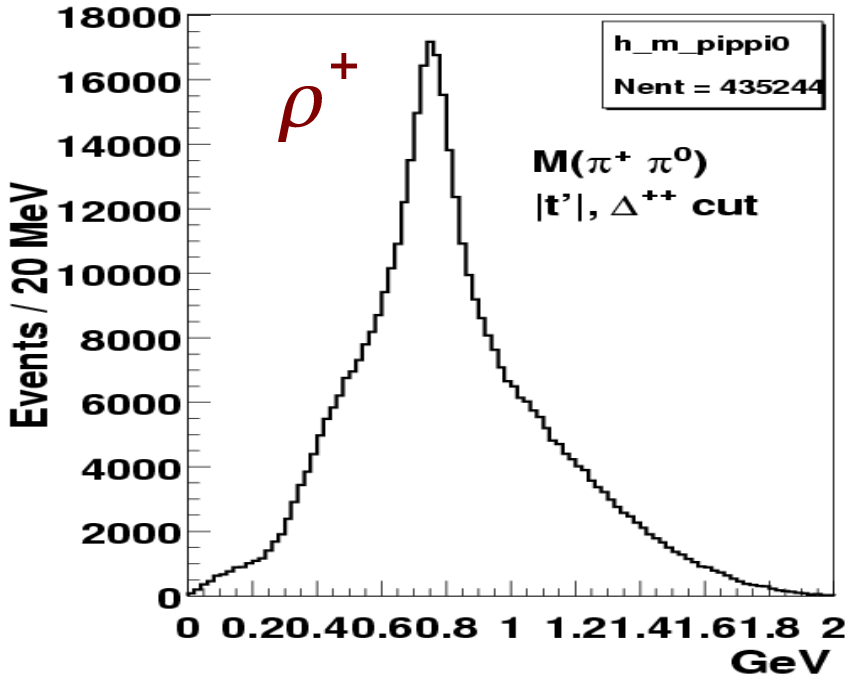
CLAS g6c: $\gamma p \to p \pi^+ \pi^- (\pi^0)$

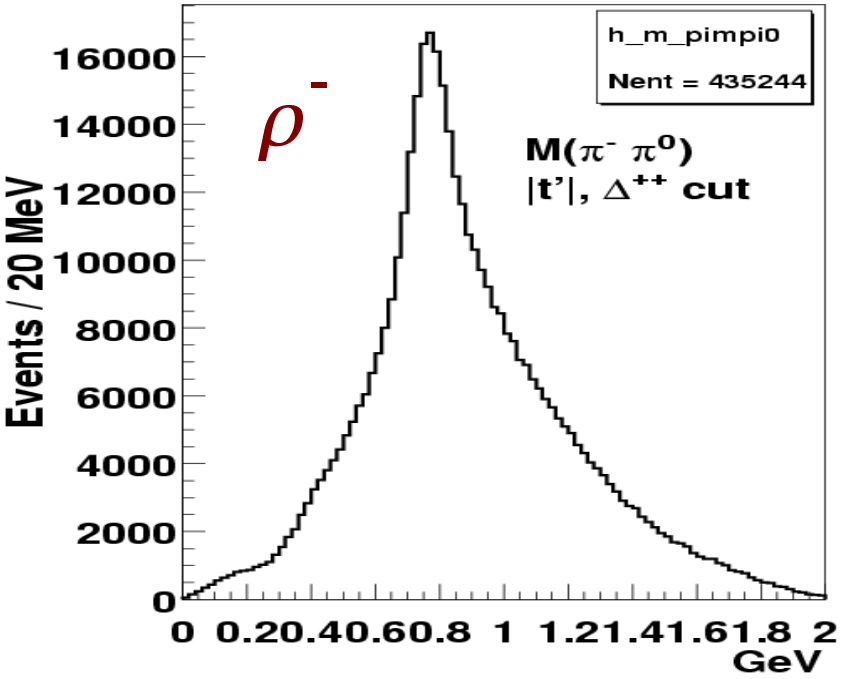


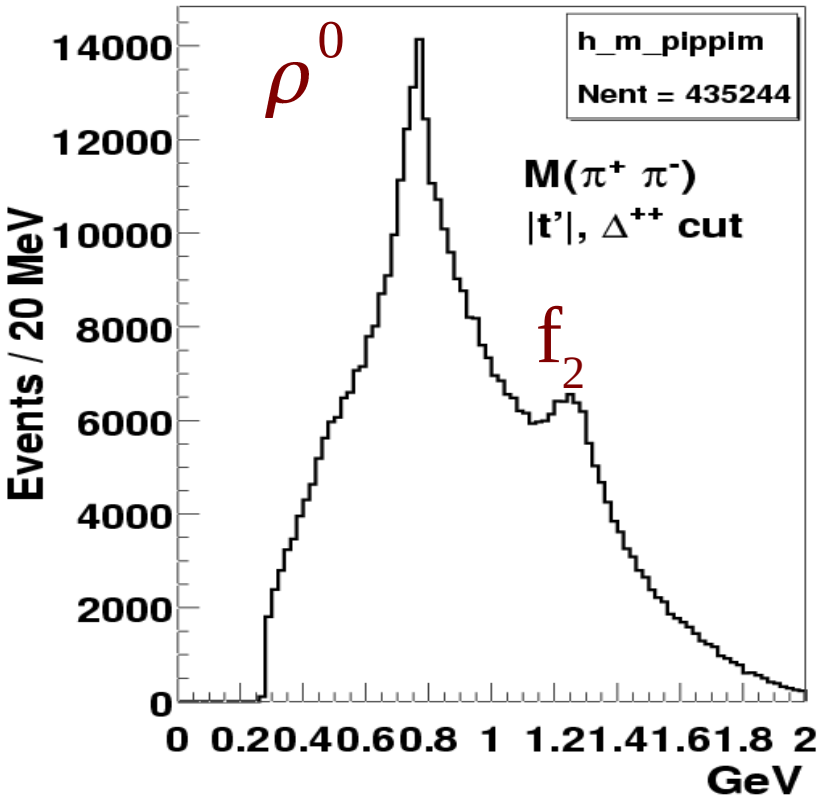




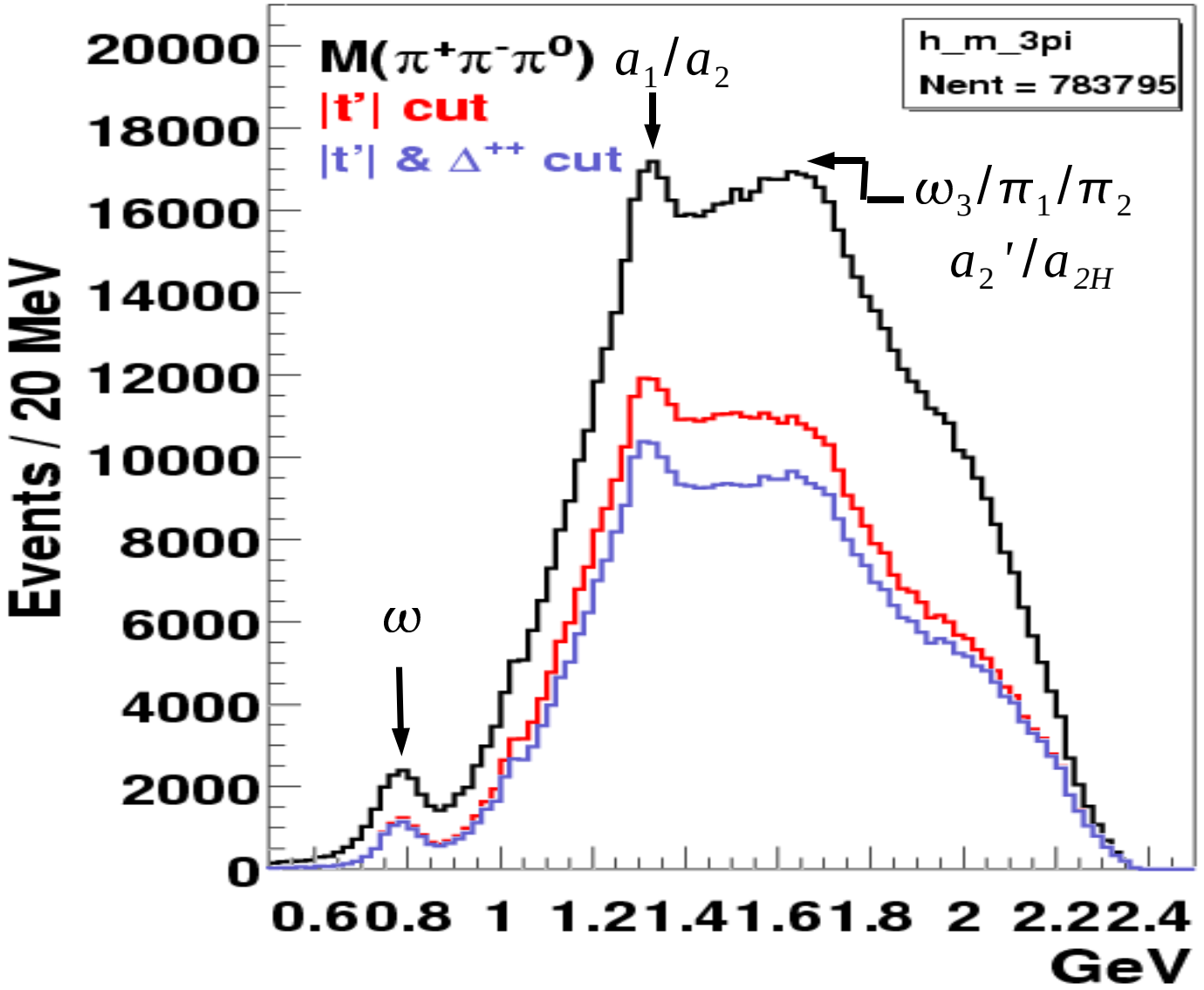
CLAS g6c: $\gamma p \to p \pi^+ \pi^- (\pi^0)$



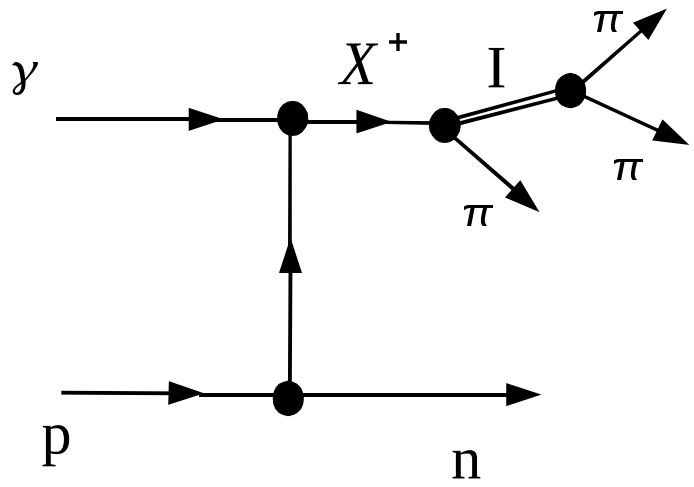




CLAS g6c: $\gamma p \to p \pi^+ \pi^- (\pi^0)$

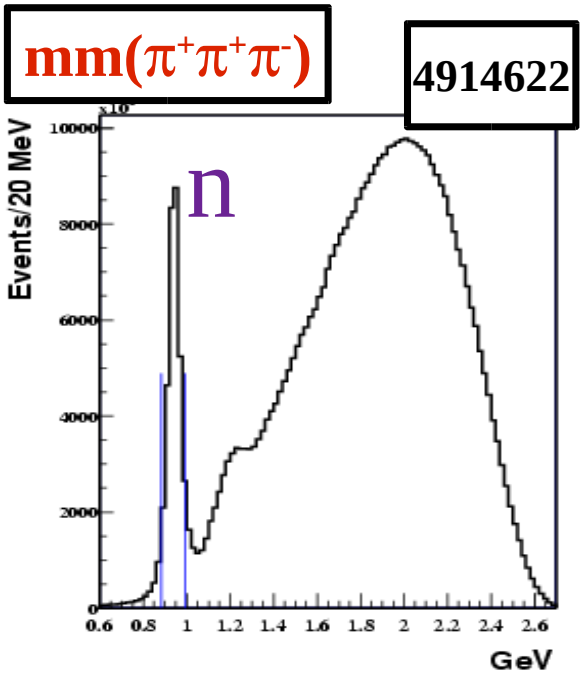


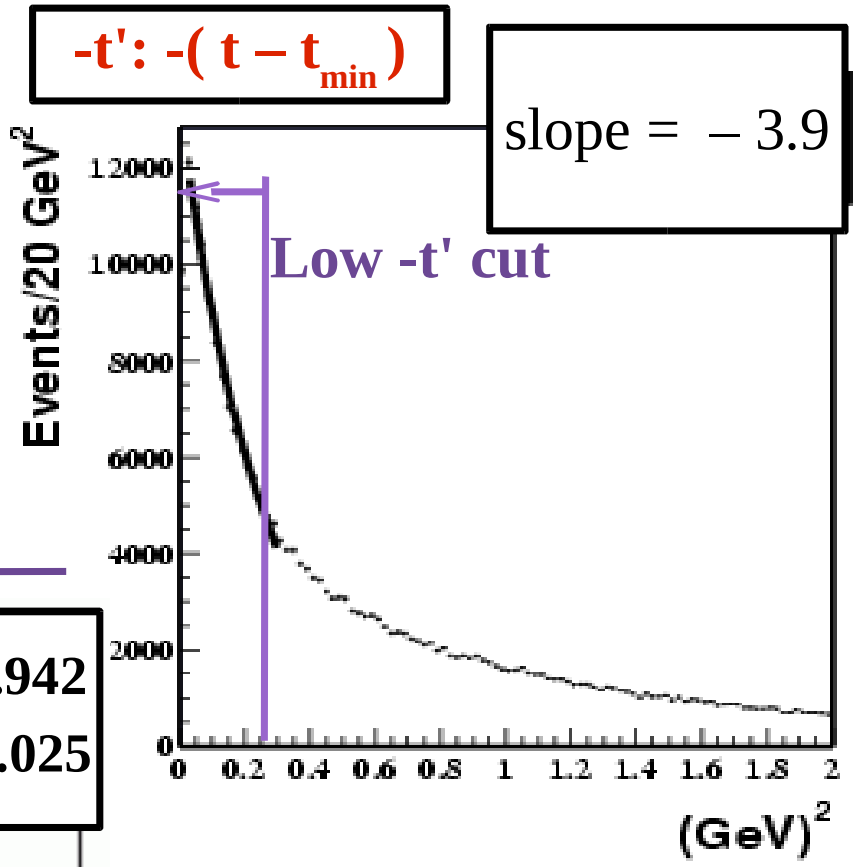
CLAS g6c: $\pi^+\pi^+\pi^-(n)$



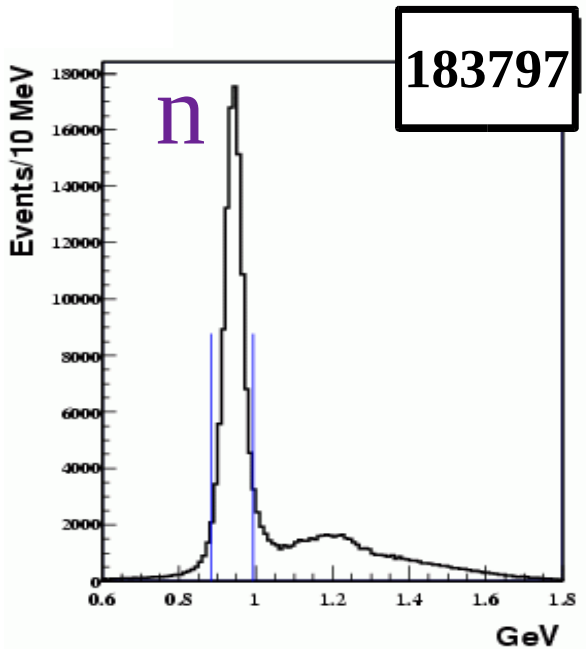
- Charge exchange reaction
- Only Isovector X possible

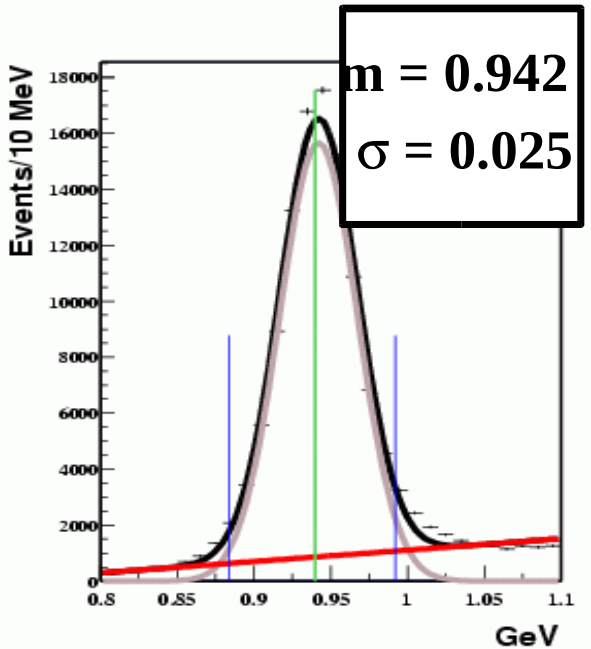
CLAS g6c: $\gamma p \rightarrow \pi^+ \pi^+ \pi^- (n)$





Choosing low -t' events



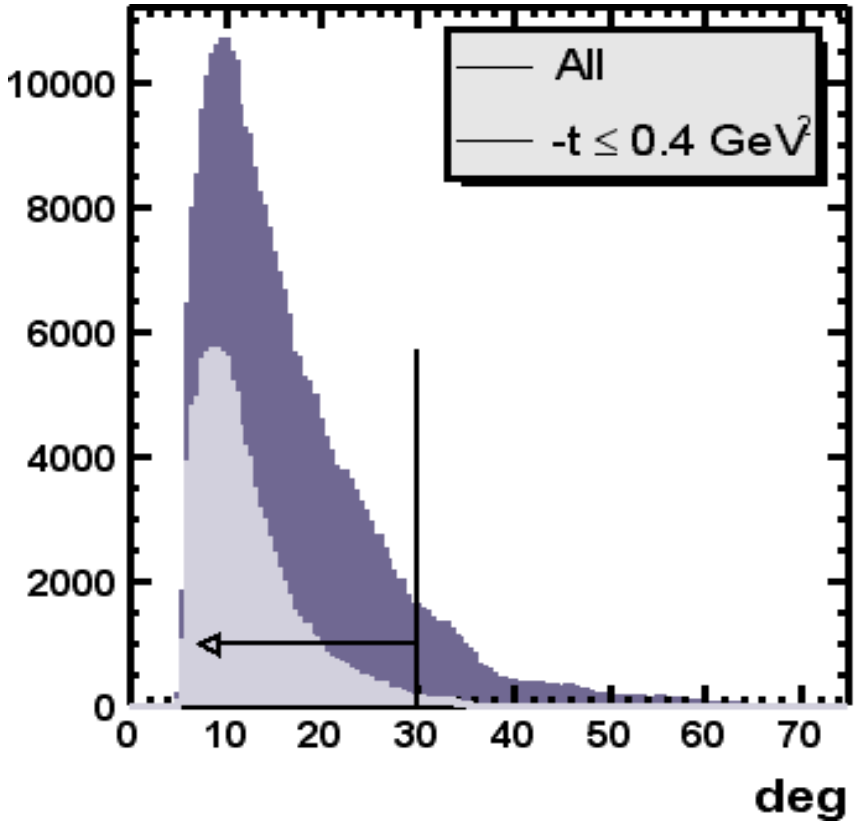


θ – lab angles:

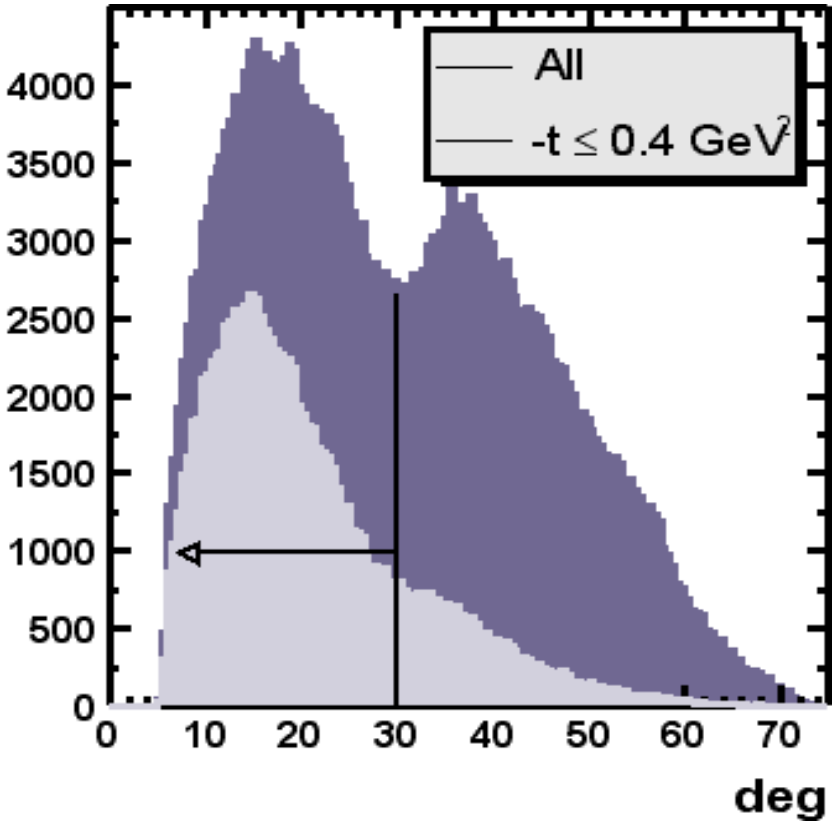
CLAS g6c: $\gamma\, p \rightarrow \pi^+ \pi^+ \pi^- (n)$

Another handle at cutting out excited baryon recoils

$\pi_1^+ (\mathit{fast})$

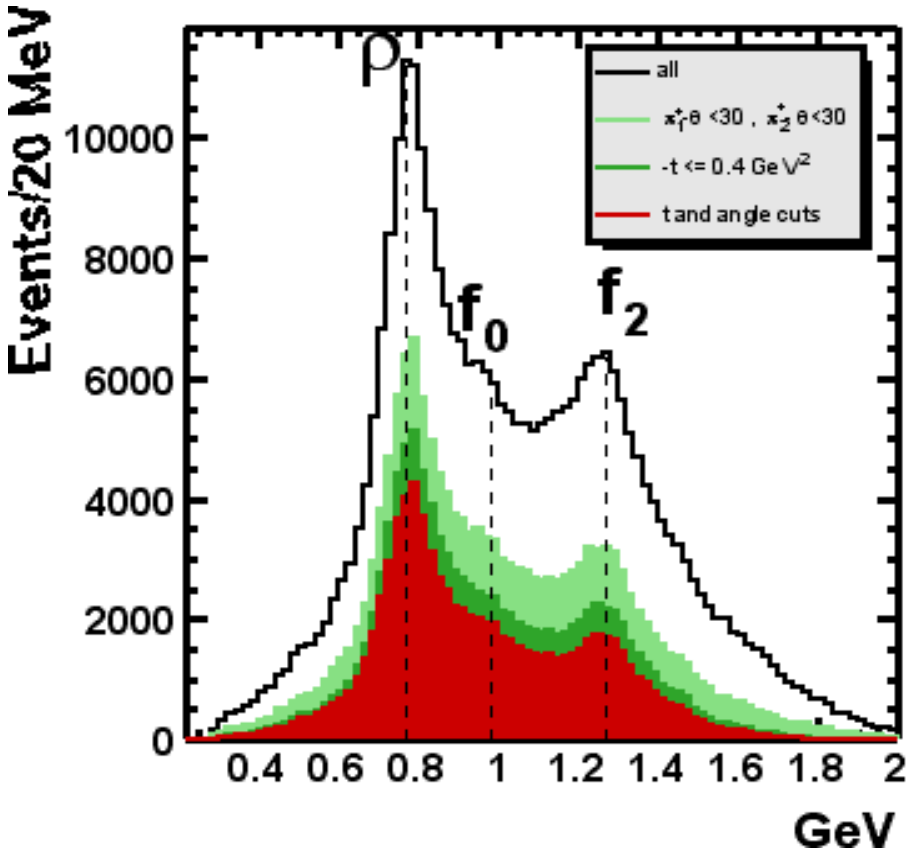


$\pi_2^+ (\mathit{slow})$

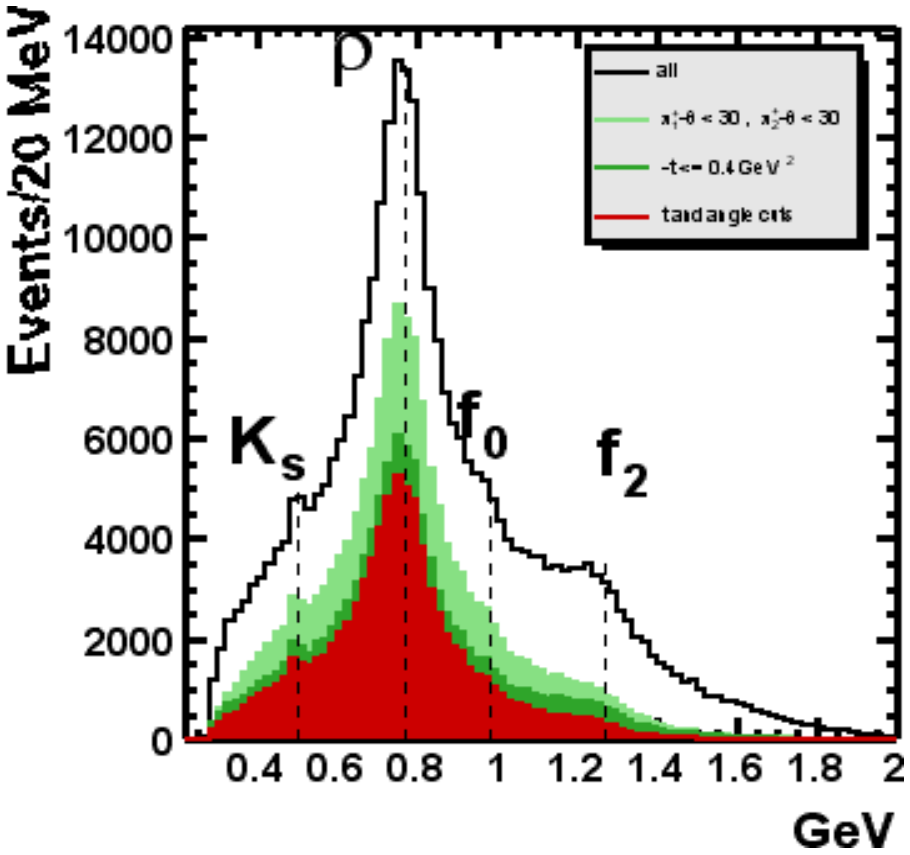


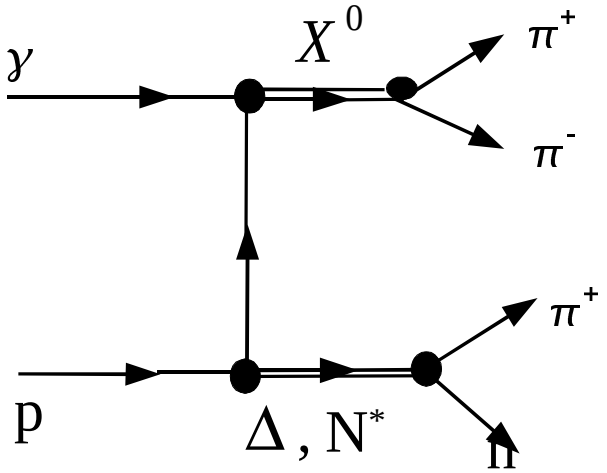
CLAS g6c: $\gamma p \to \pi^+ \pi^+ \pi^- (n)$

$m(\pi_1^+ \pi^-)$



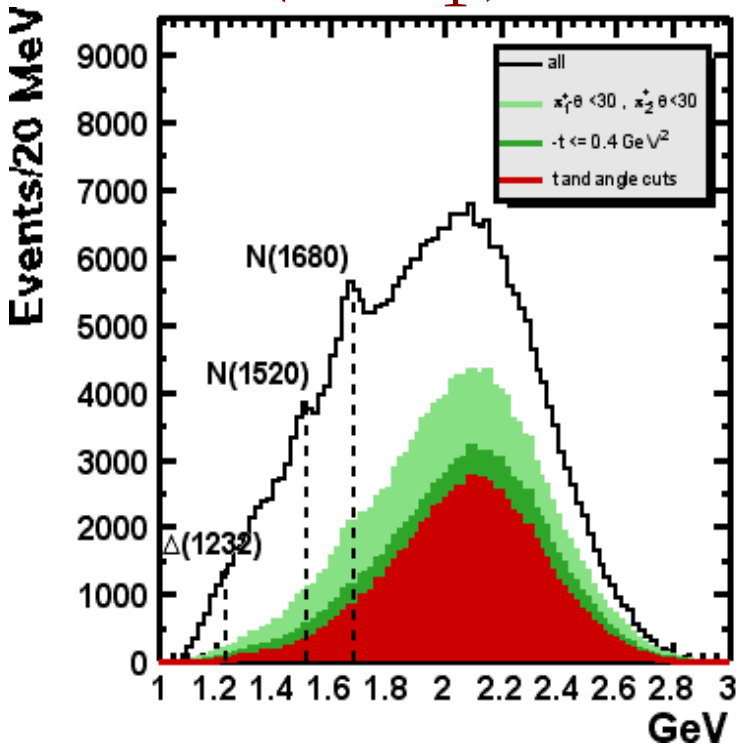
$m(\pi_2^+ \pi^-)$



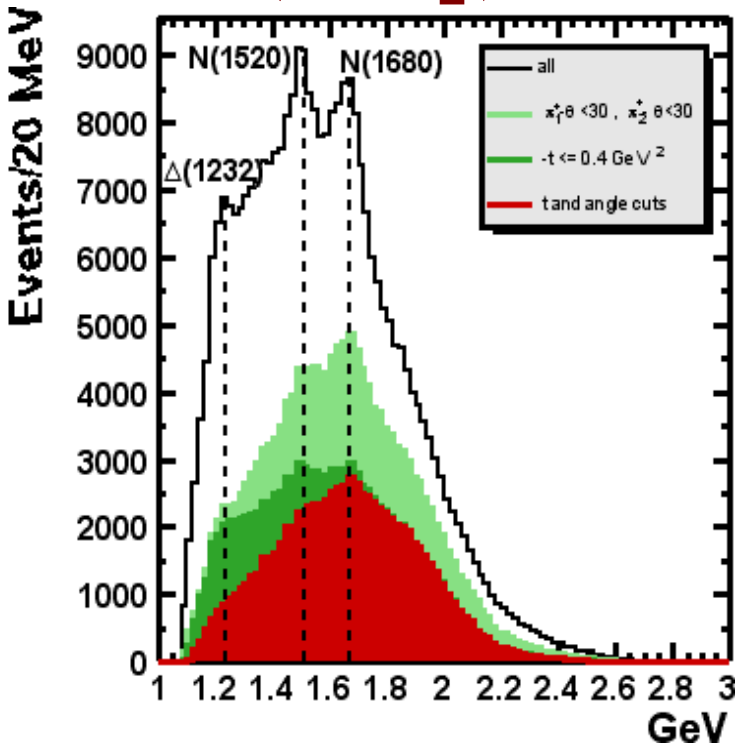


CLAS g6c: $\gamma p \to \pi^+ \pi^+ \pi^- (n)$

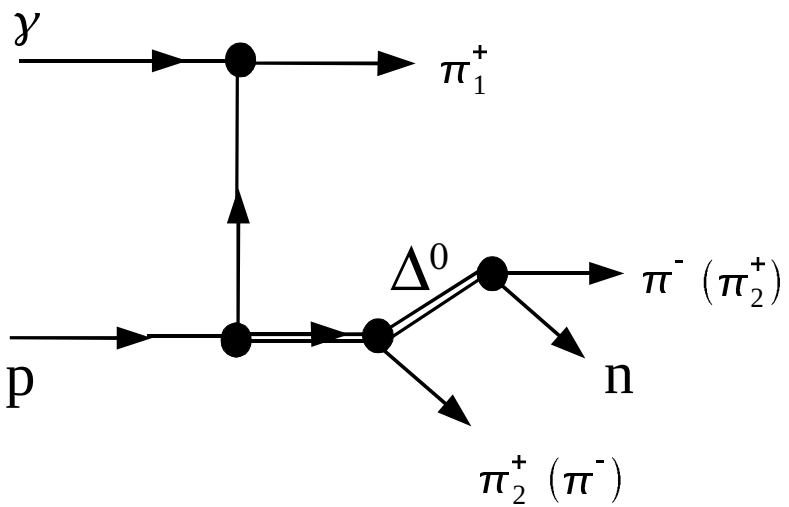
$m(n\pi_1^+)$



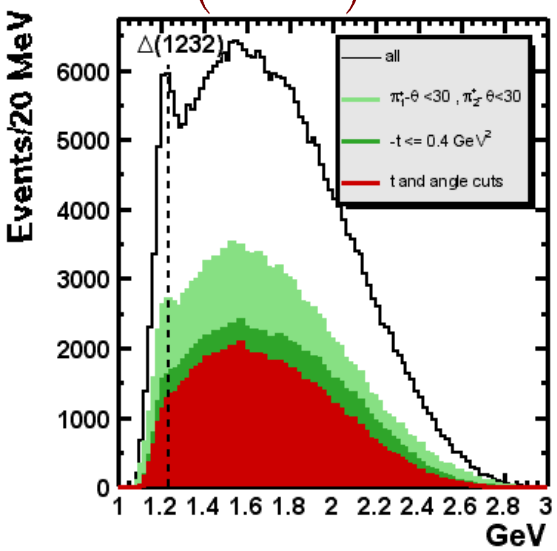
$m(n\pi_2^+)$



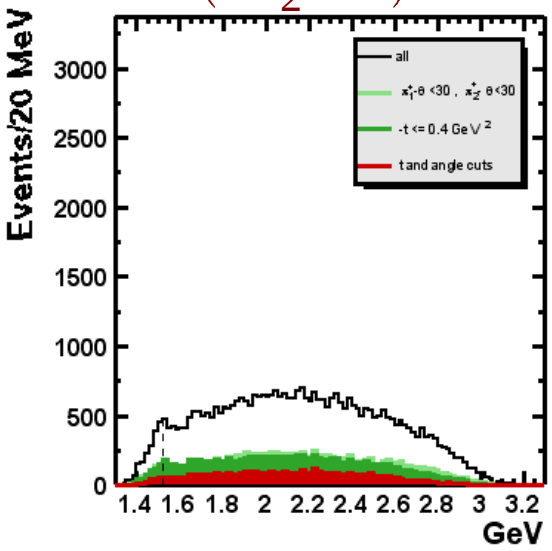
CLAS g6c: $\gamma\, p \to \pi^+ \pi^+ \pi^- (n)$



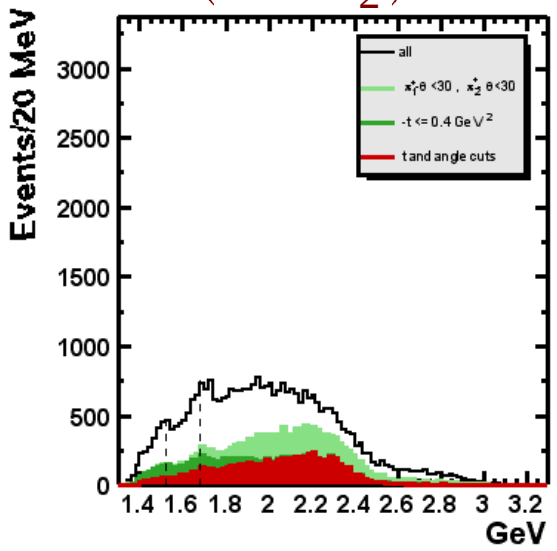
$m(n\pi^-)$



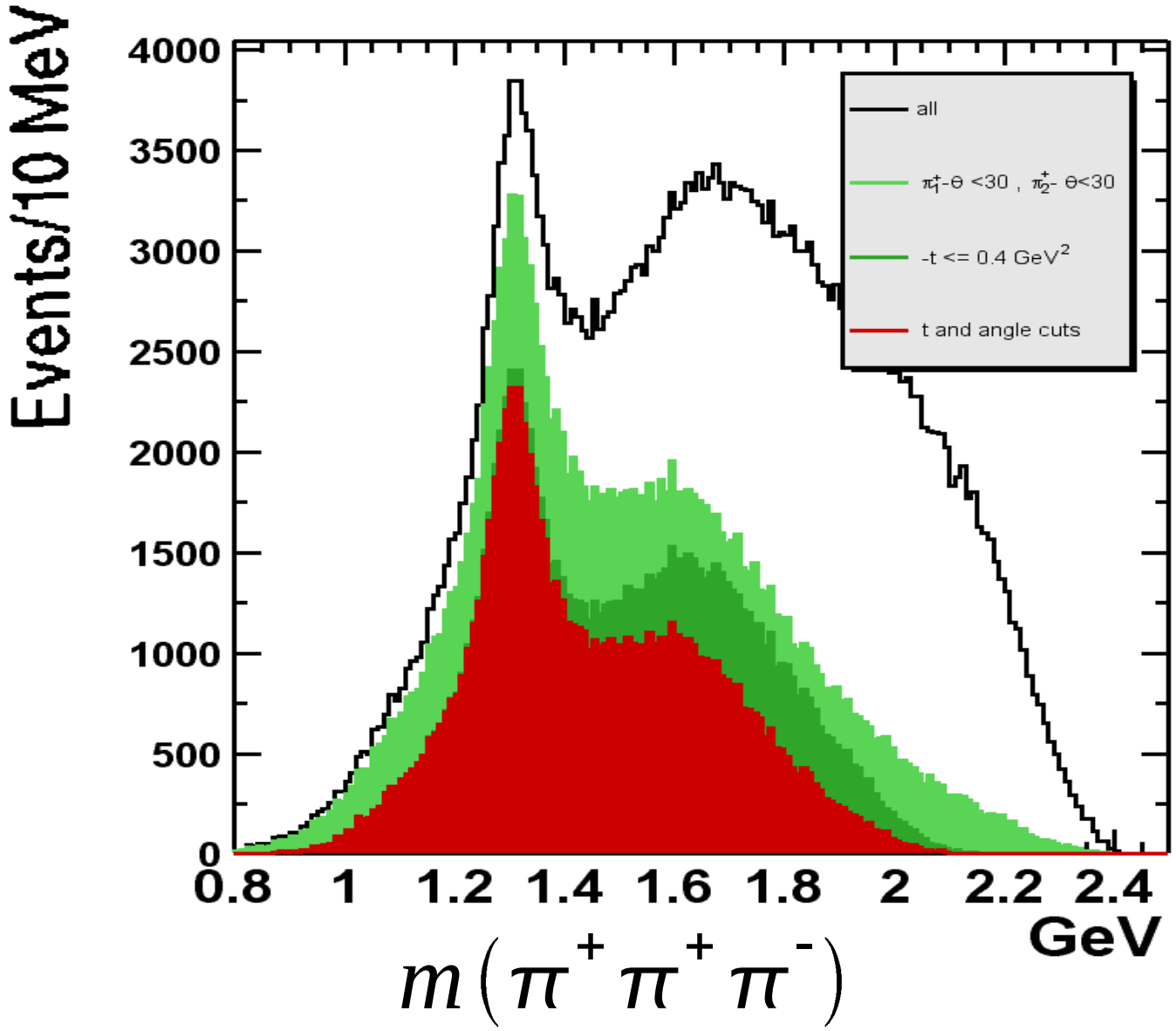
$m(\Delta_2^+\pi^-)$



$m(\Delta^-\pi_2^+)$

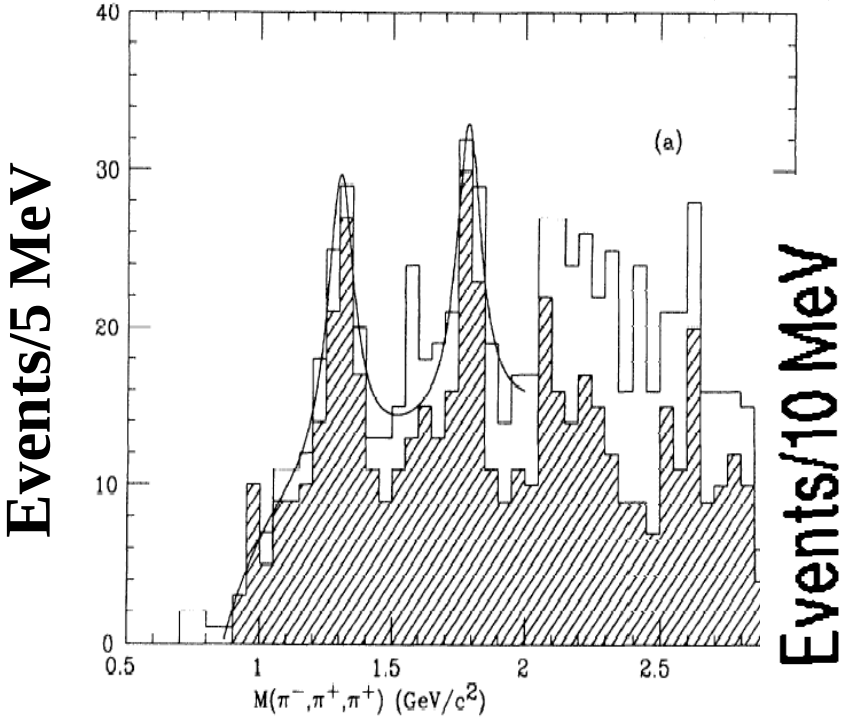


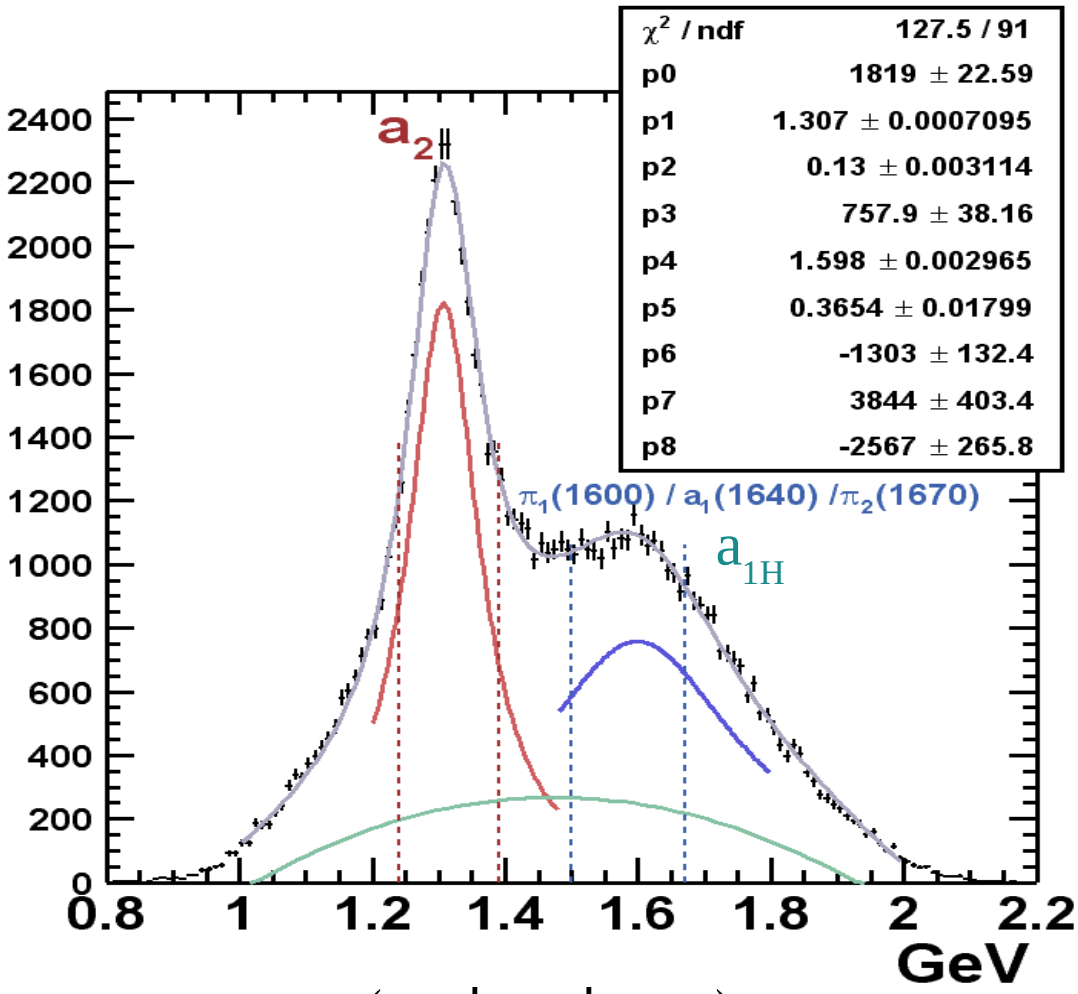
CLAS g6c: $\gamma\, p \to \pi^+ \pi^+ \pi^- (n)$



CLAS g6c: $\gamma\, p \to \pi^+ \pi^+ \pi^- (n)$

Condo et al, PRD. 43, 2787 (1991)





$$m_{a_2(1320)} = 1307 \pm 0.7\ MeV/c^2$$

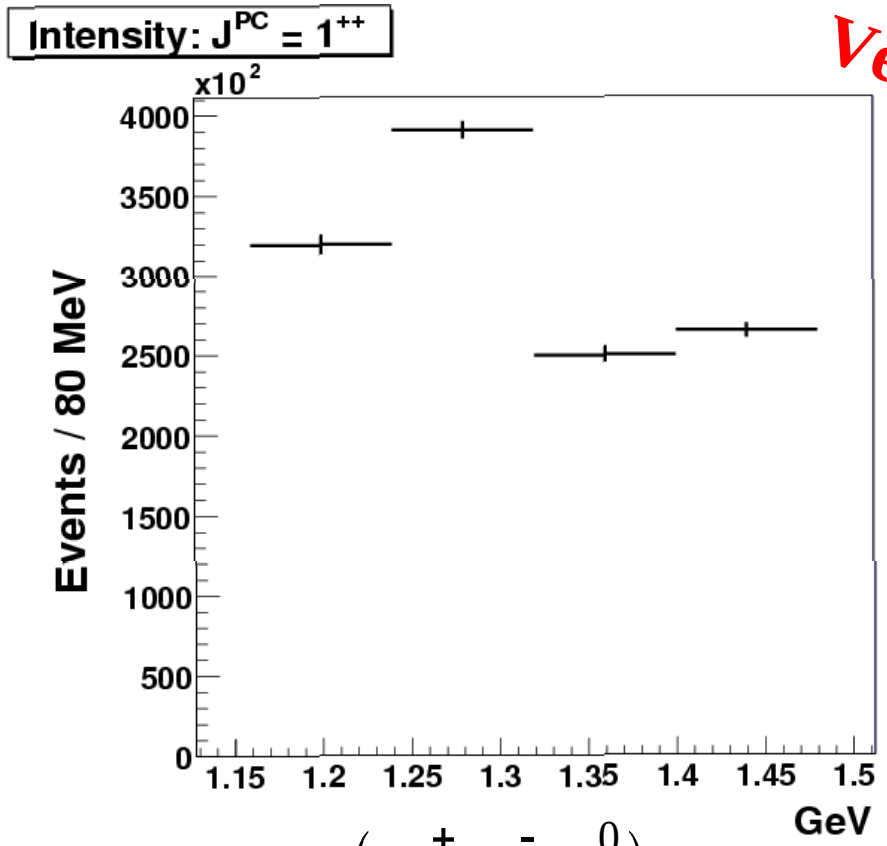
$$\Gamma_{a_2(1320)} = 130 \pm 3\ MeV/c^2$$

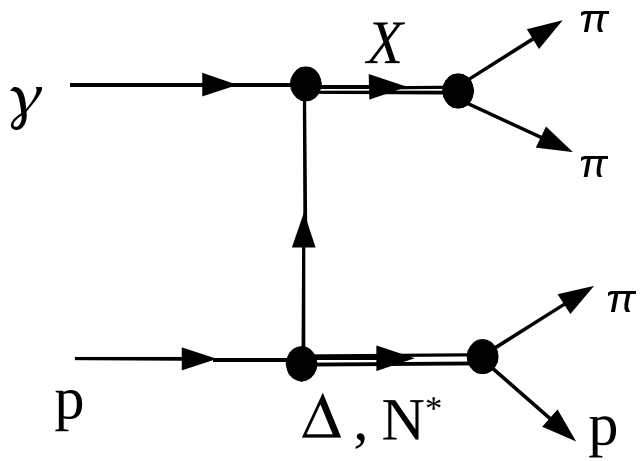
$$m_X = 1598 \pm 3\ MeV/c^2$$

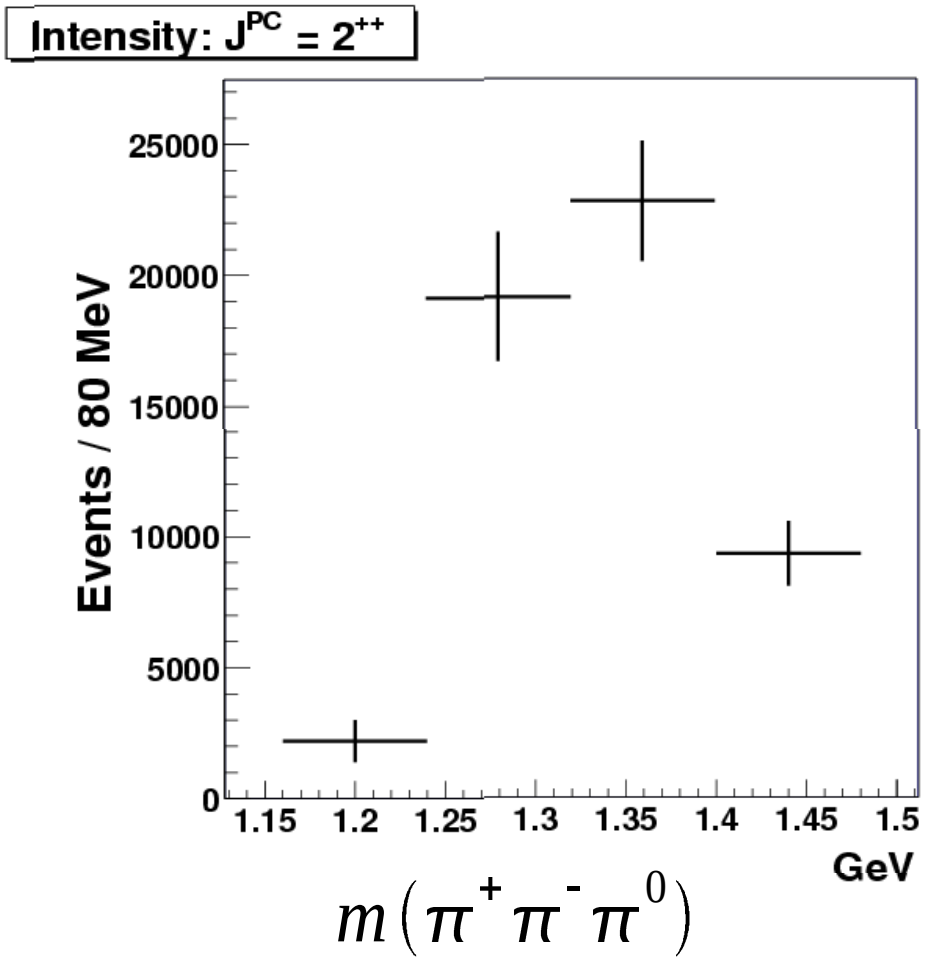
$$\Gamma_X = 365 \pm 18\ MeV/c^2$$

CLAS g6c: $\gamma p \to p \pi^+ \pi^- (\pi^0)$

Very preliminary







Summary and Outlook

- High statistics sample of peripheral 3π photo-production.

- Preliminary results indicate Isobar model PWA is working!

- We are in “new grounds” with inclusion of the excited baryon recoil states in the PWA.