

Amplitude analysis of GlueX ($p\eta'\pi^0$) data

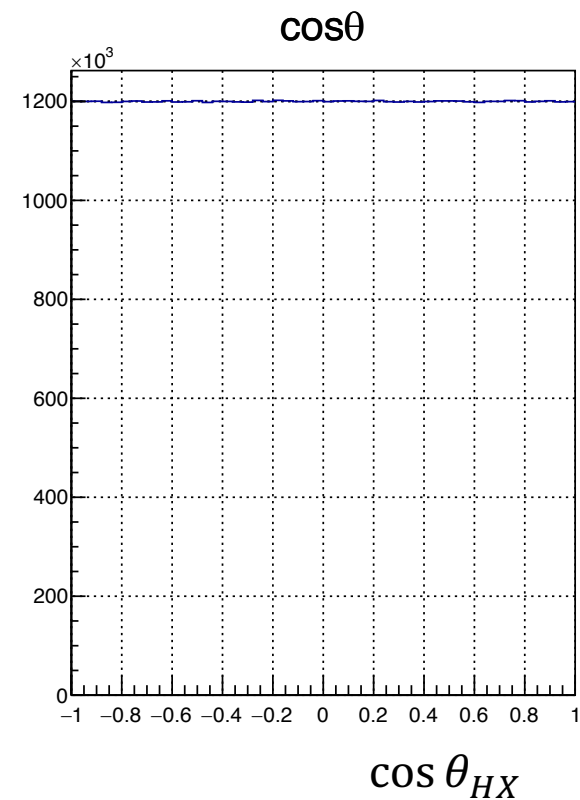
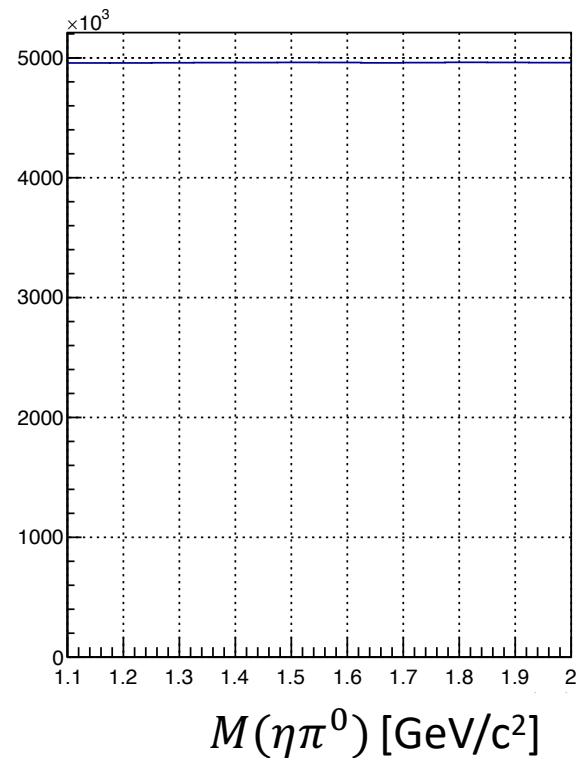
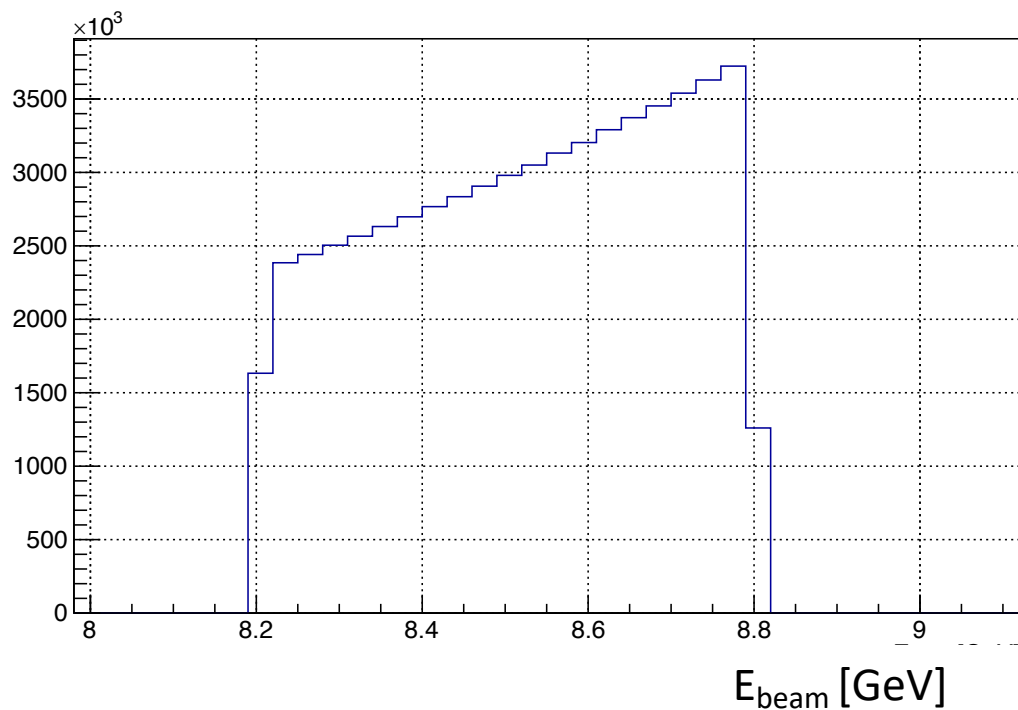
Florida International University 2020

Mariana Khachatryan

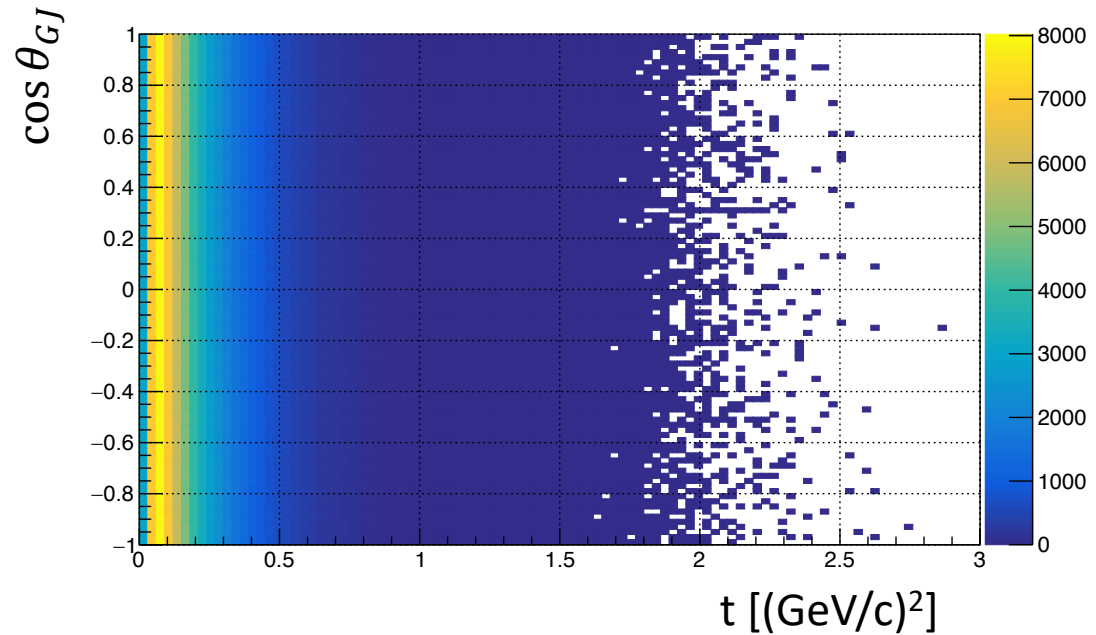
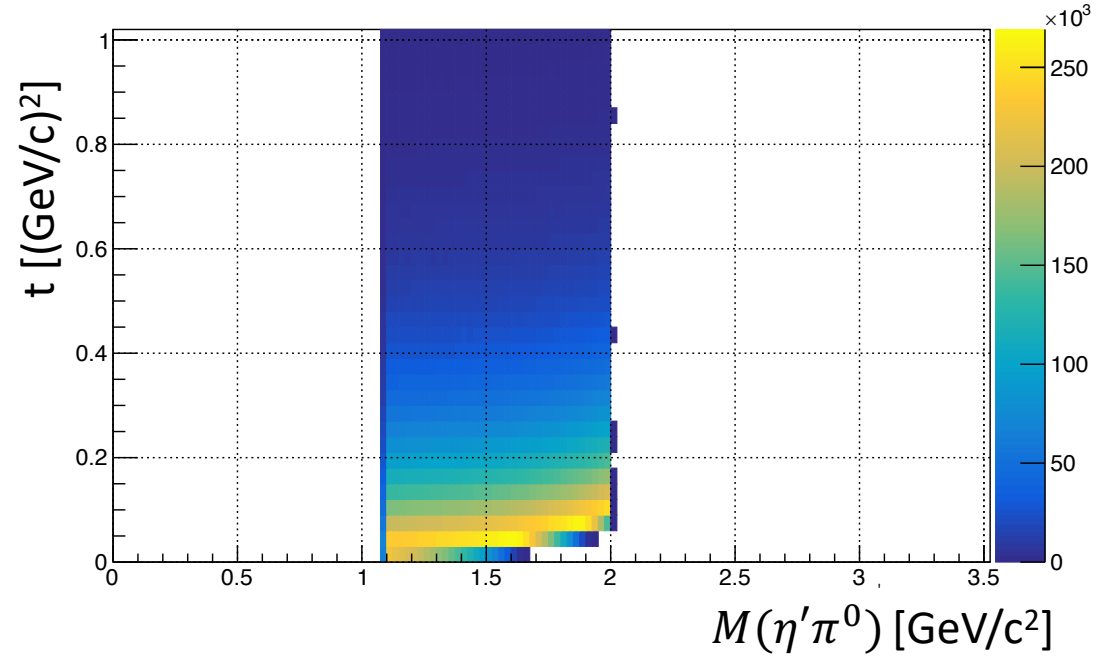
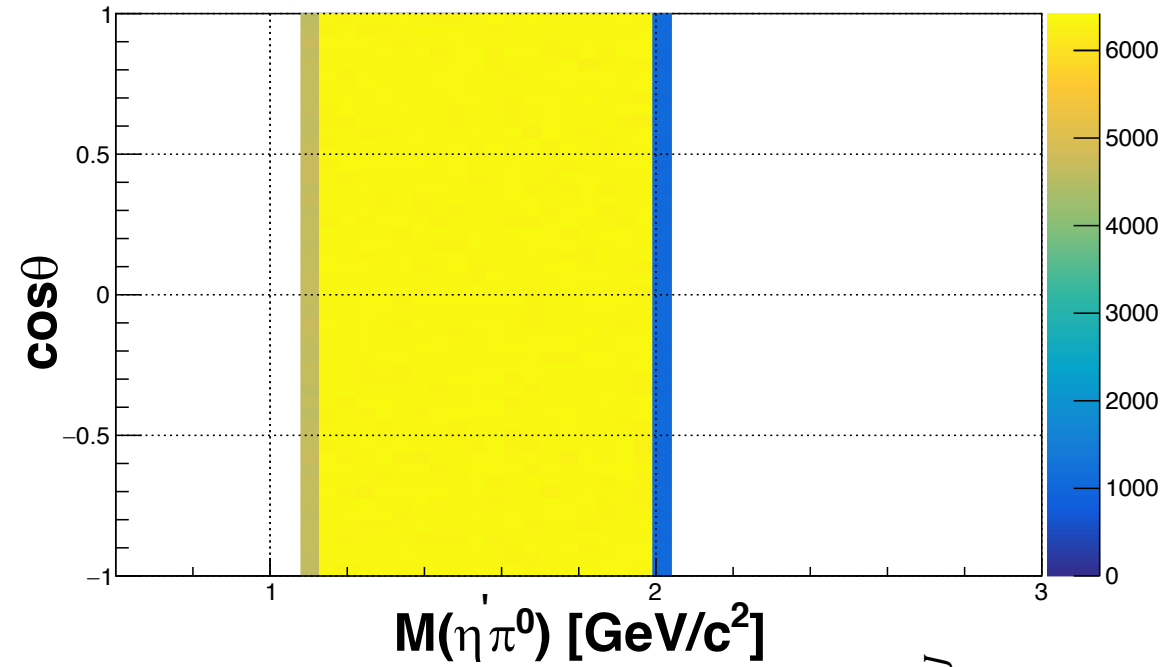
Generated $60 \cdot 10^6$ ($p\eta'\pi^0$) **flat** events with AmpTools

$$p\gamma \rightarrow p\eta'\pi^0,$$
$$\eta' \rightarrow \pi^+\pi^-\eta,$$
$$\eta \rightarrow \gamma\gamma$$

- Flat in $\cos\theta_{GJ}$
- Flat in $M(\eta\pi^0)$



Generated $30 \cdot 10^6$ ($p\eta'\pi^0$) flat events with AmpTools



1. Fitting entire GlueX phase 1 data for four γ polarization plane angles relative to horizontal (0, 45, 90, 135^o) using loop statement in AmpTools (not using amorphous data)
 2. Fitting using new feature in Amptools that does multiple fits with randomized initial parameters (100 fits), to choose good starting parameters
 3. Fit intensity with different wave sets:
 - $S_0, P_{0,1}, D_{0,1,2} \ \epsilon=+1$
 - $S_0, P_{0,1}, D_{0,1,2} \ \epsilon=\pm 1$
 - $S_0, P_{0,\pm 1}, D_{0,\pm 1,\pm 2} \ \epsilon=\pm 1$
1. Invariant mass bin size of 75 MeV/c², momentum transfer bin size of 0.6 (GeV/c)²

Plot acceptance uncorrected results

19259 GlueX ($p\eta'\pi^0$) events for 4 γ polarization plane angles relative to horizontal (0, 45, 90, 135 $^\circ$)

0 Deg. $P_\gamma = 0.3519$

45 Deg. $P_\gamma = 0.3374$

90 Deg. $P_\gamma = 0.3303$

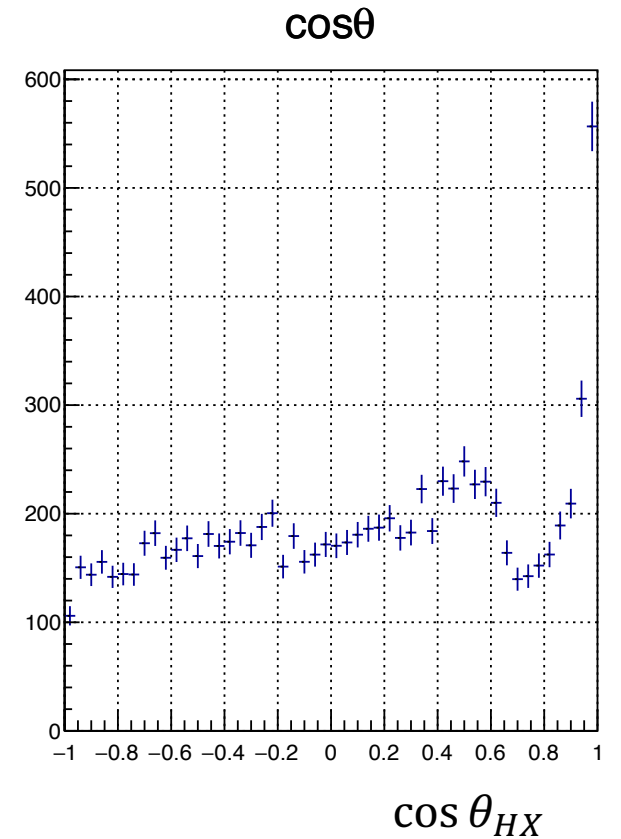
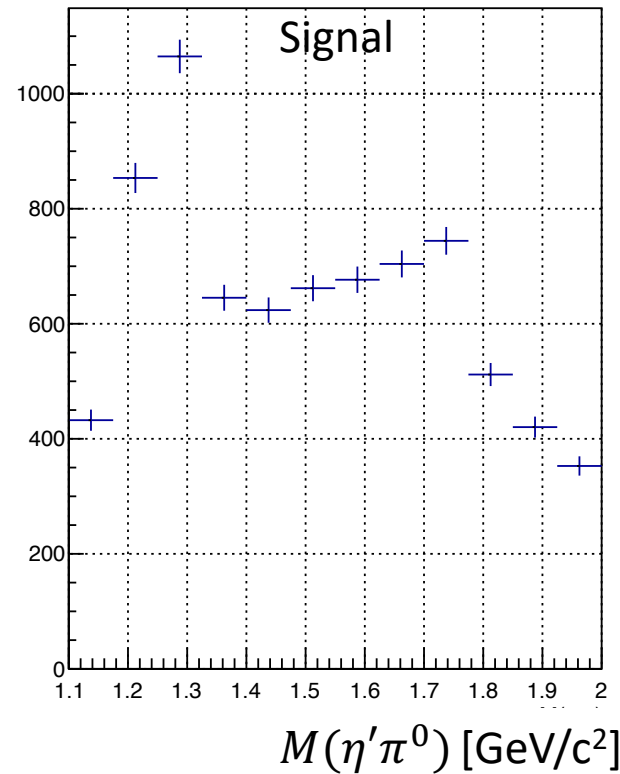
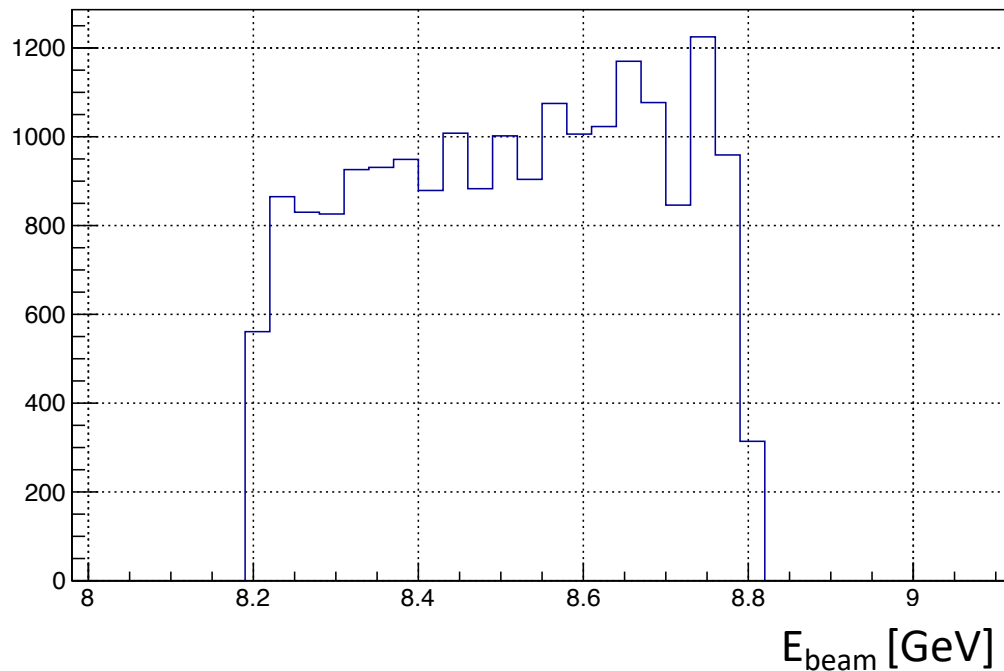
135 Deg. $P_\gamma = 0.3375$

Number of signal events 7691

Signal-Background separation using Probabilistic Weighing Method

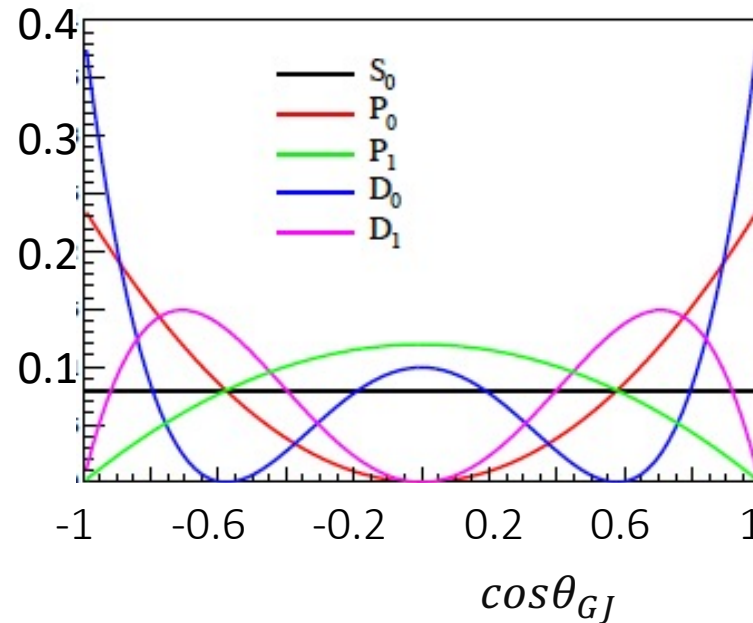
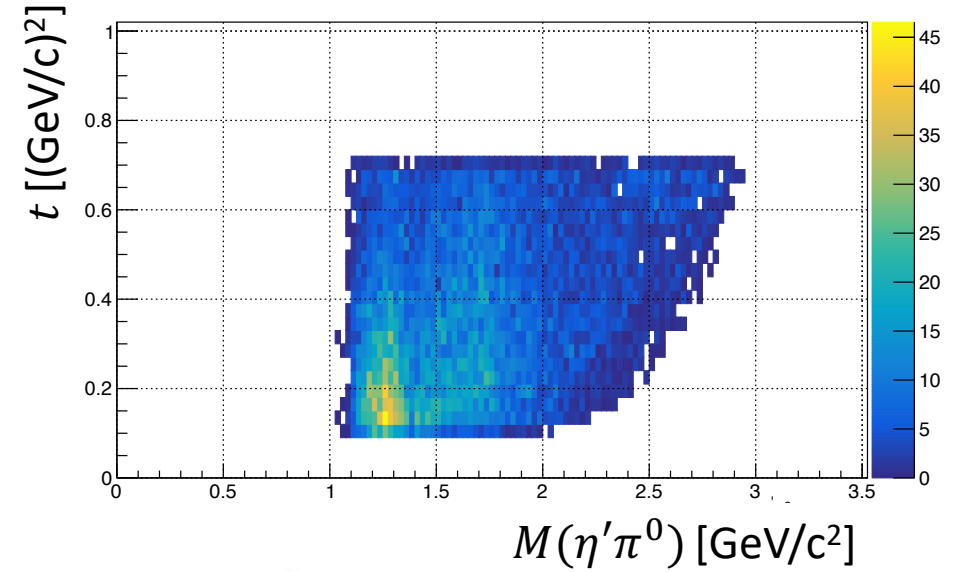
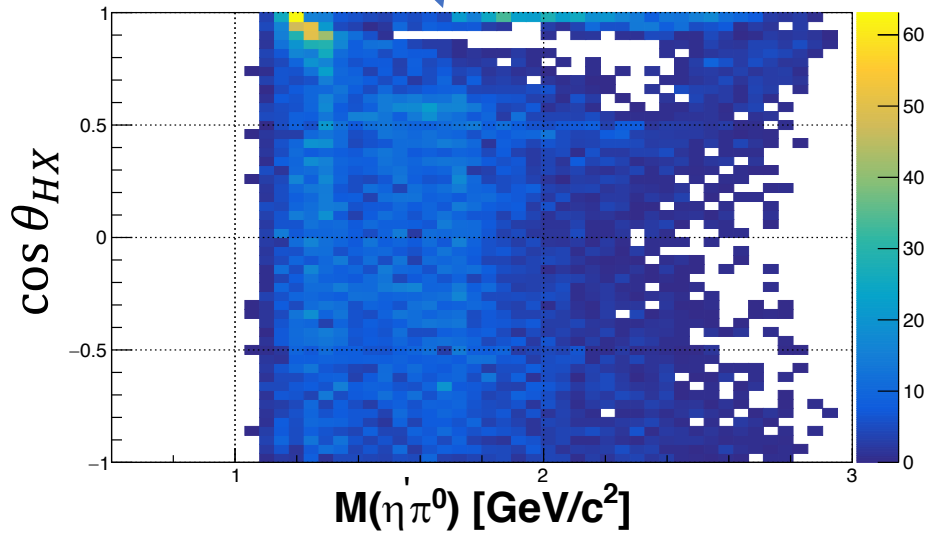
Reaction $\gamma p \rightarrow p\eta'\pi^0$

$\eta' \rightarrow \pi^+\pi^-\eta$, $\eta \rightarrow \gamma\gamma$



18482 GlueX ($p\eta'\pi^0$) events for 4 γ polarization plane angles relative to horizontal (0, 45, 90, 135 $^\circ$) + amorphous data

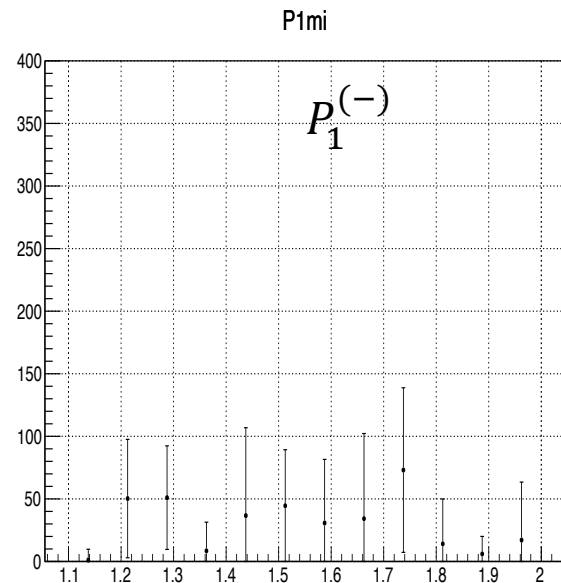
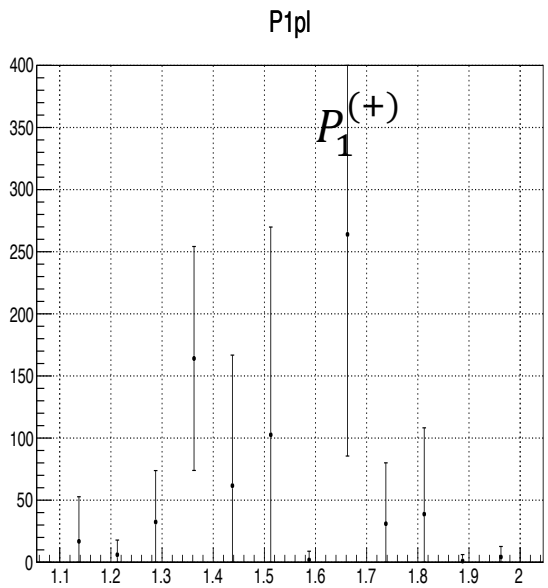
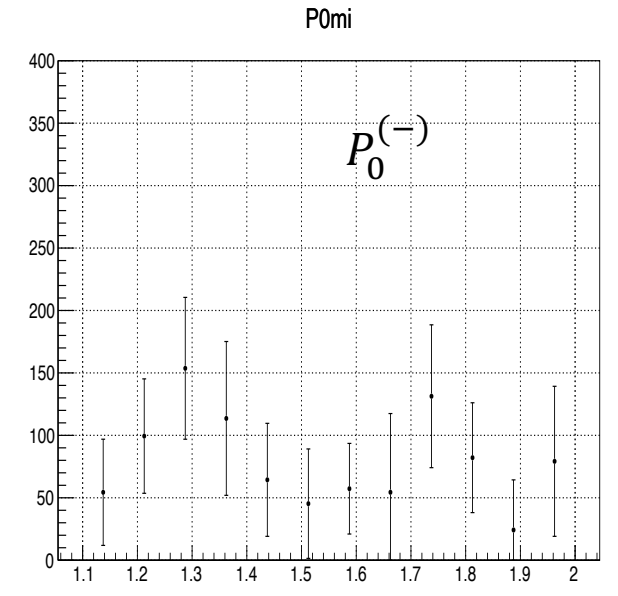
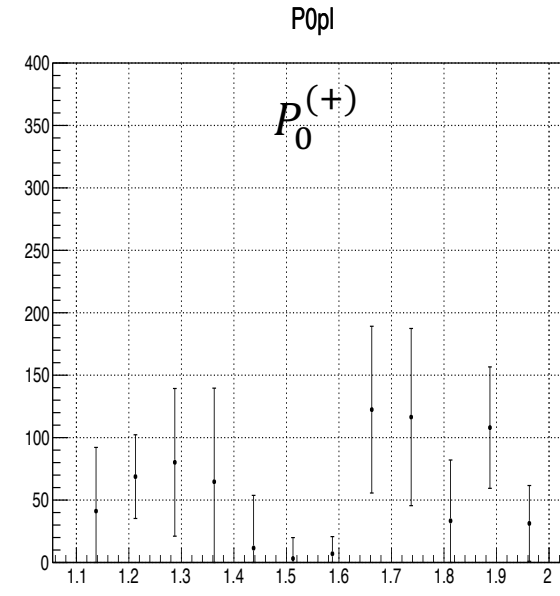
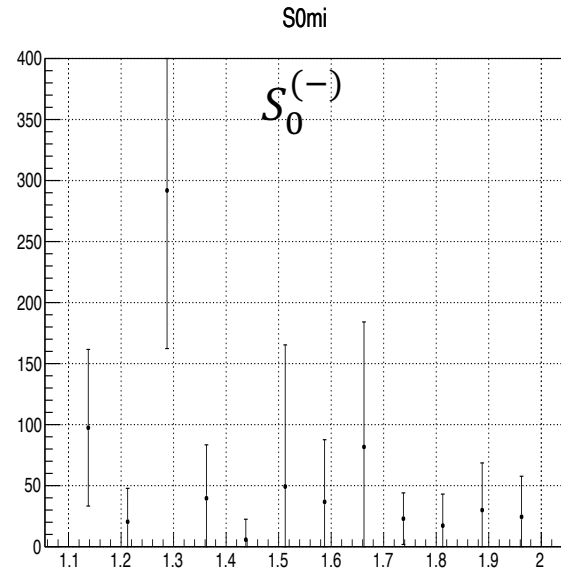
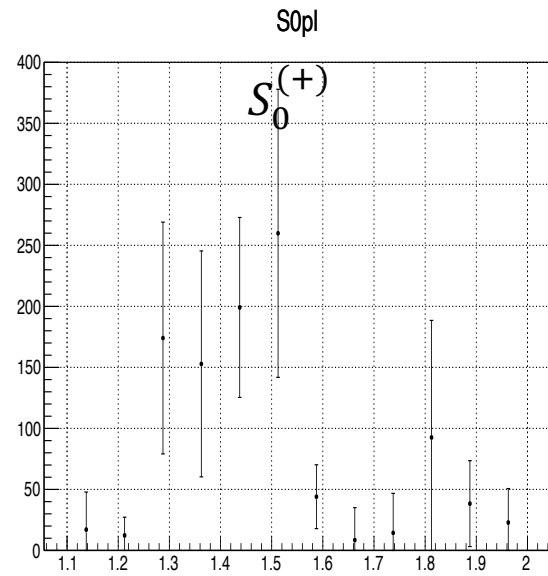
Δ^+ rejection ($0.0 \text{ GeV}/c^2 < M_{\pi^0 p} < 1.4 \text{ GeV}/c^2$)



Fit in M and t bins
 1.1-2 GeV/c² 12 bins
 0.1-0.7 (GeV/c)² 1 bin

Fit with $S_0, P_{0,1}, D_{0,1,2}$ $\epsilon = \pm 1$

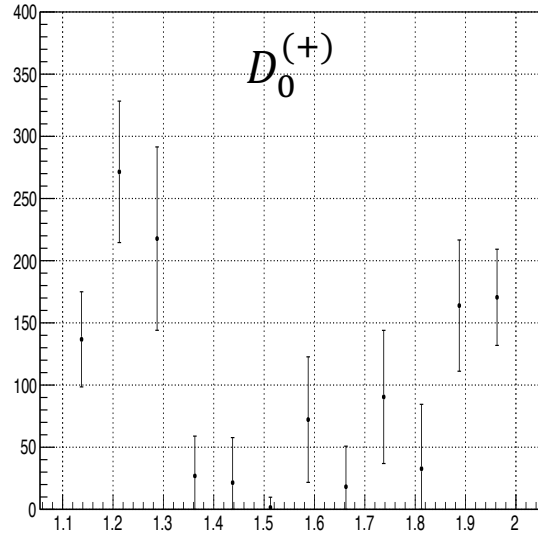
Acceptance uncorrected



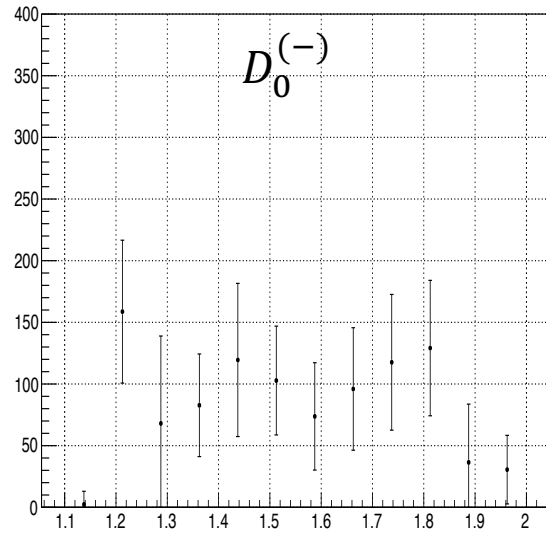
Fit with $S_0, P_{0,1}, D_{0,1,2} \epsilon = \pm 1$

Acceptance uncorrected

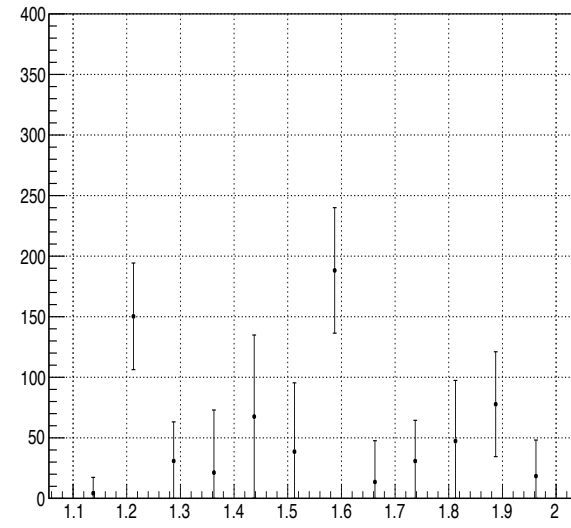
D0pl



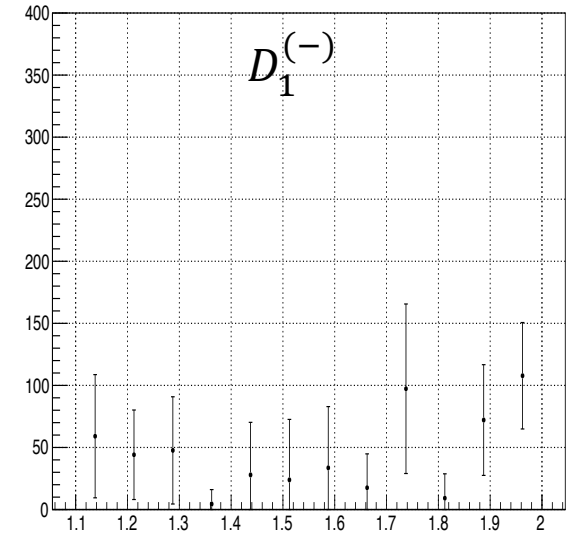
D0mi



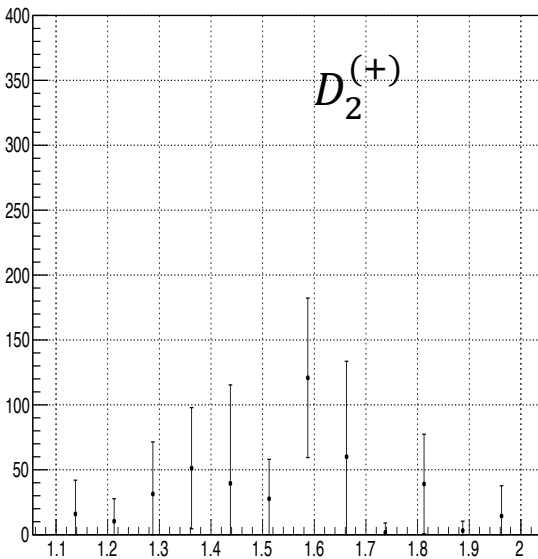
D1pl



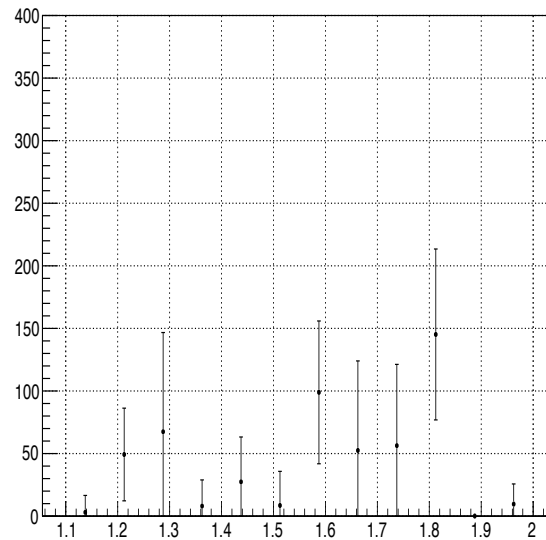
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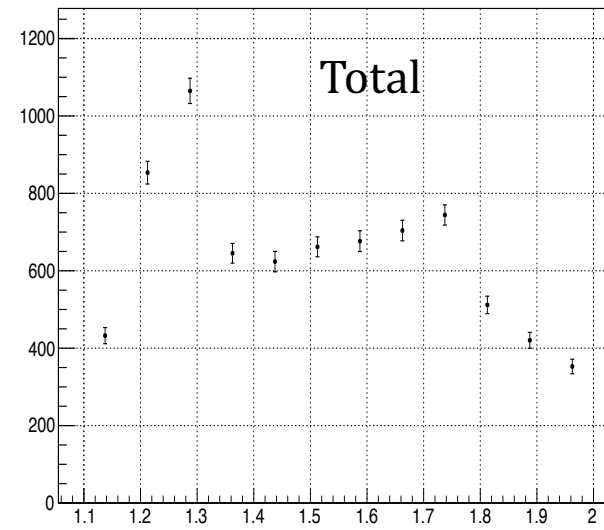
D2pl



D2mi



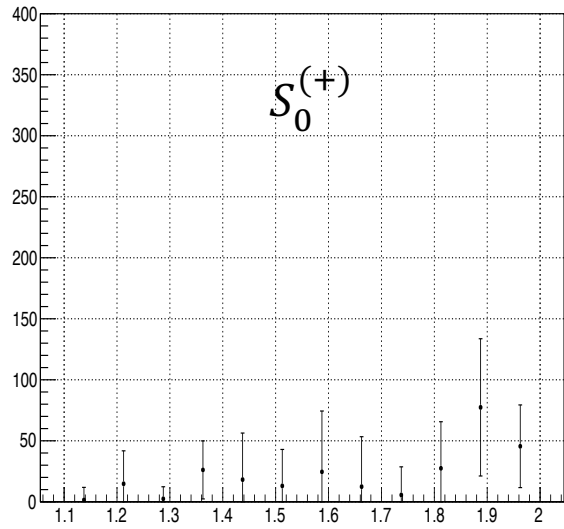
All waves



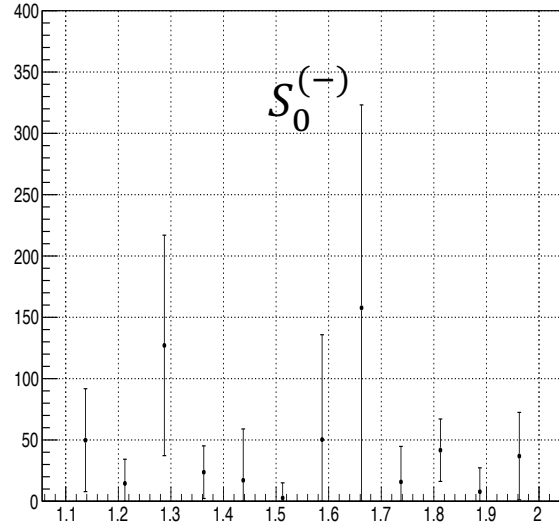
Fit with $S_0, P_{0,\pm 1}, D_{0,\pm 1,\pm 2}$ $\varepsilon = \pm 1$

Acceptance uncorrected

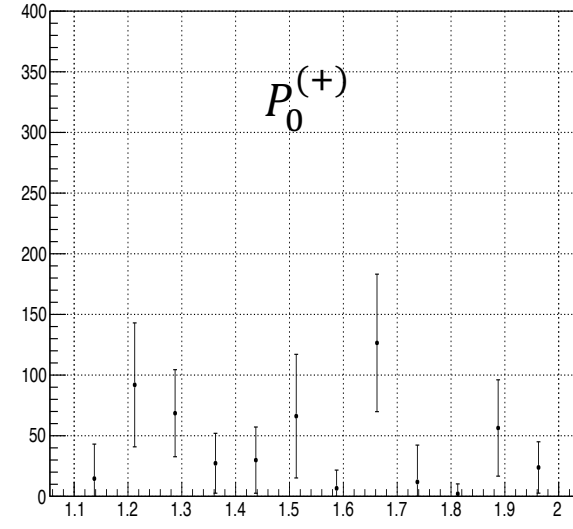
S0pl



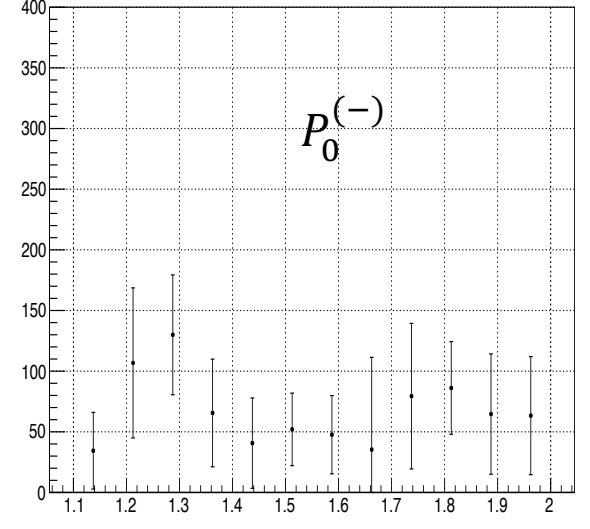
S0mi



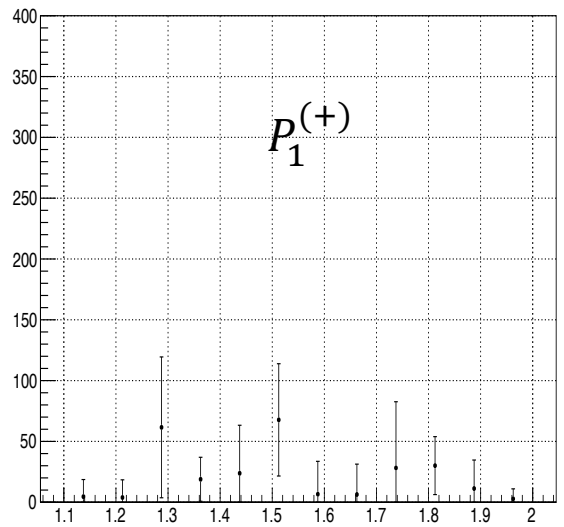
P0pl



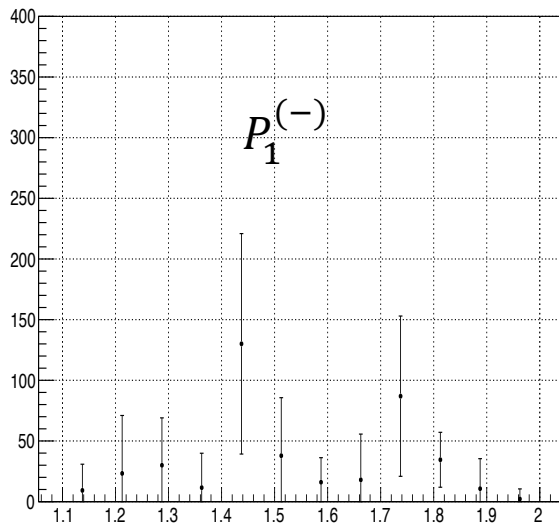
P0mi



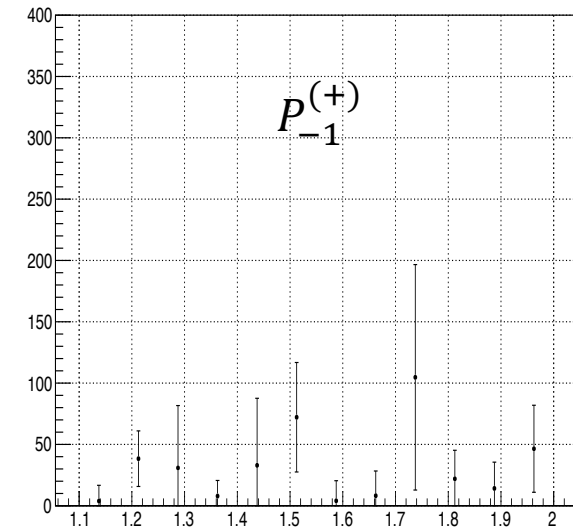
P1pl



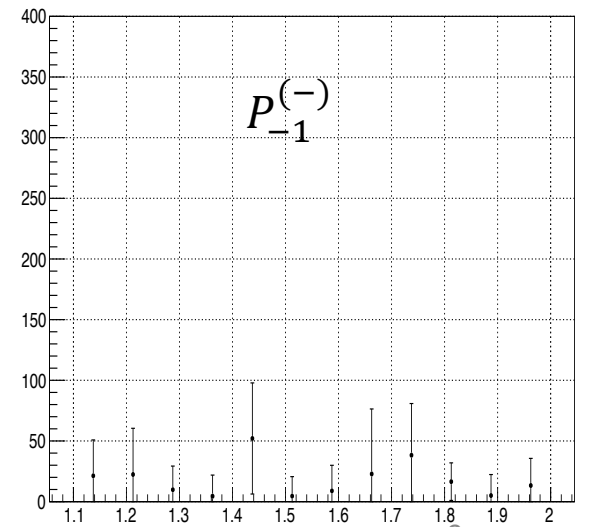
P1mi



Pmi1pl

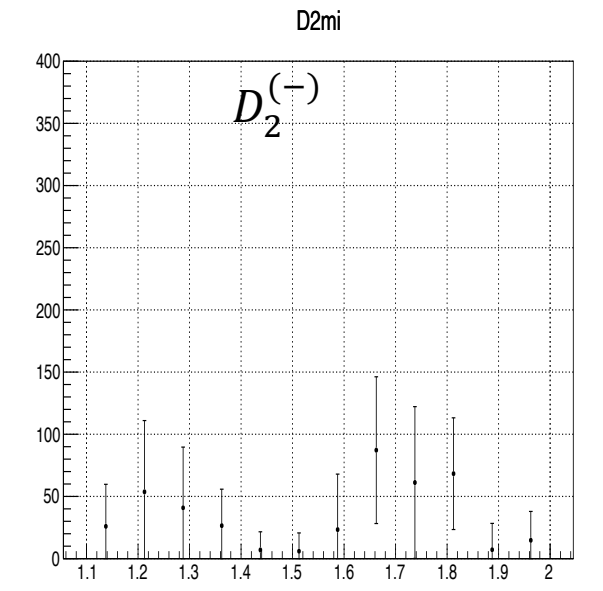
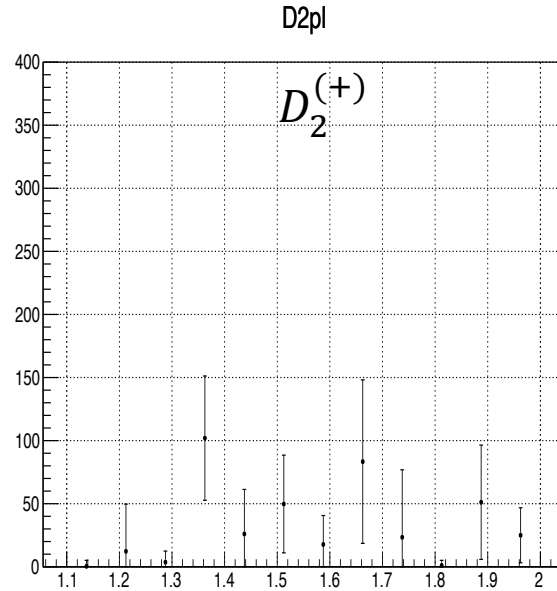
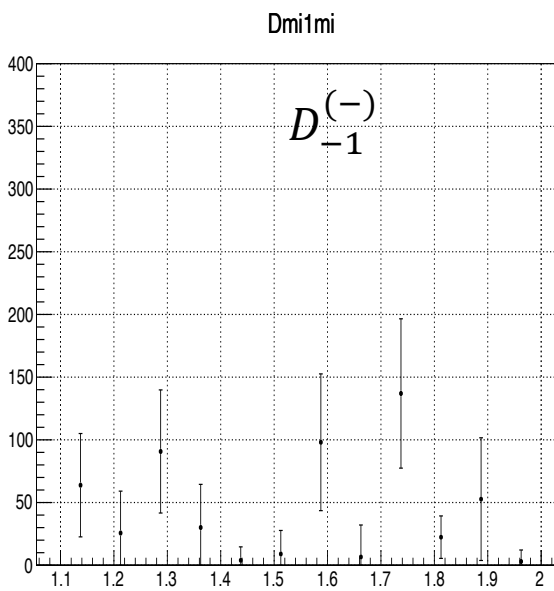
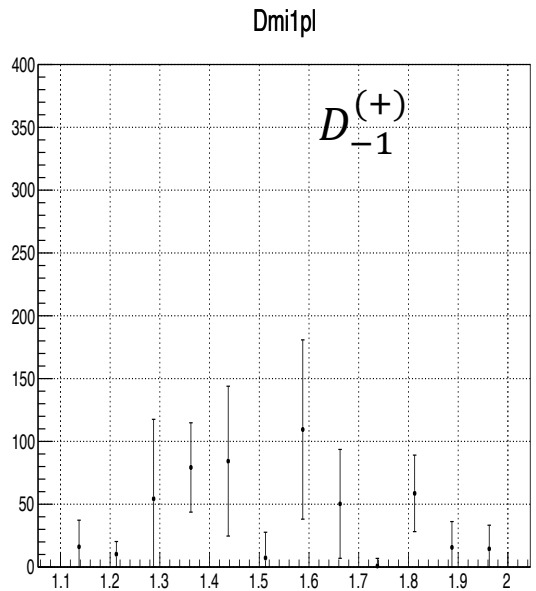
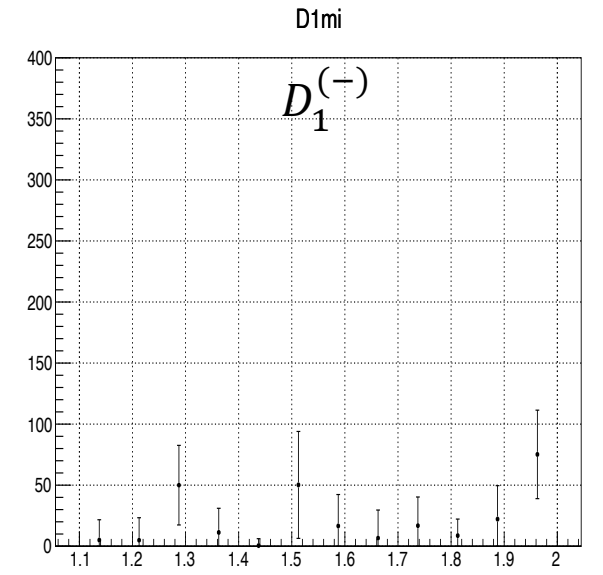
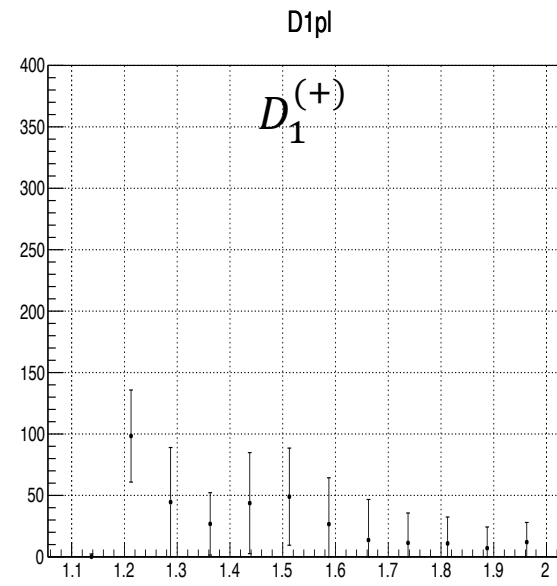
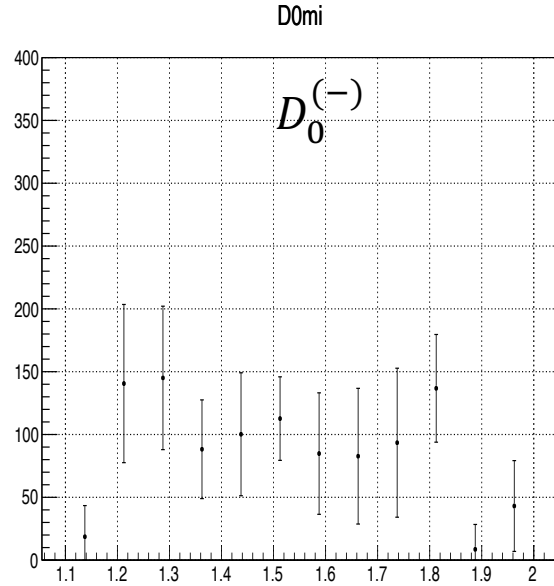
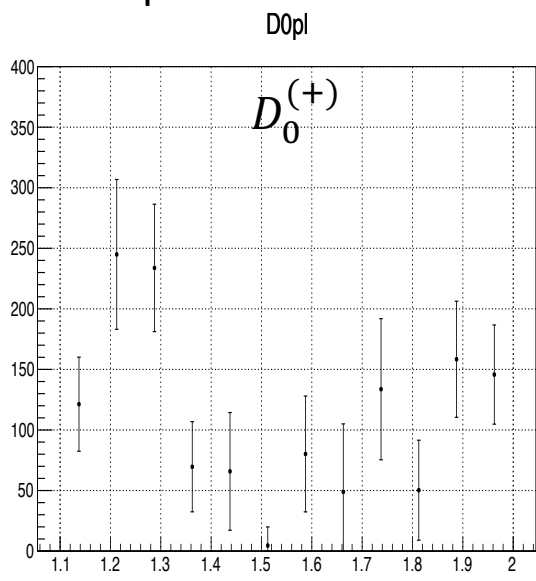


Pmi1mi

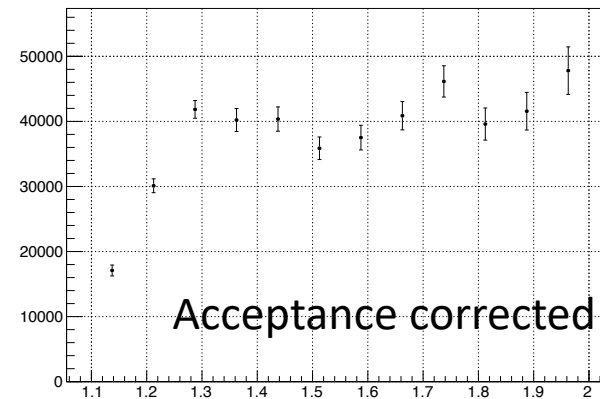
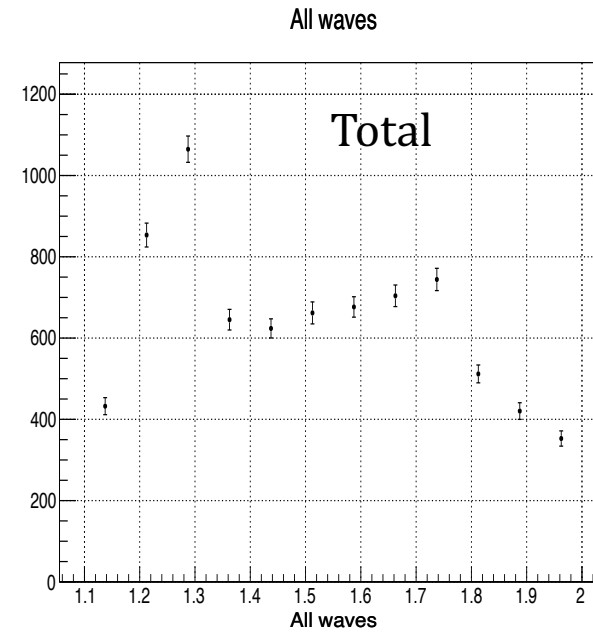
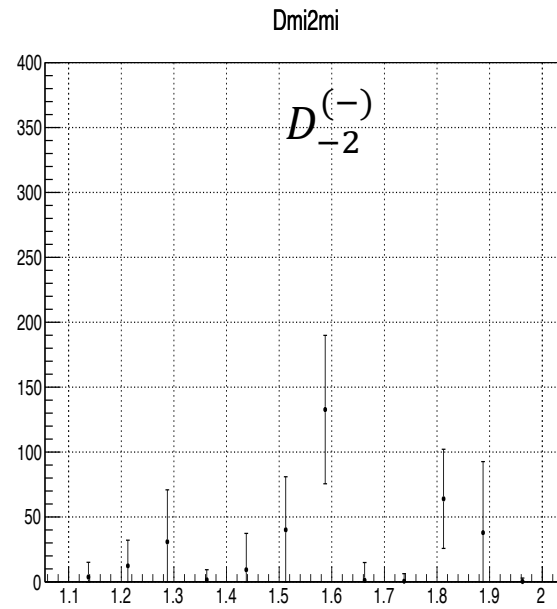
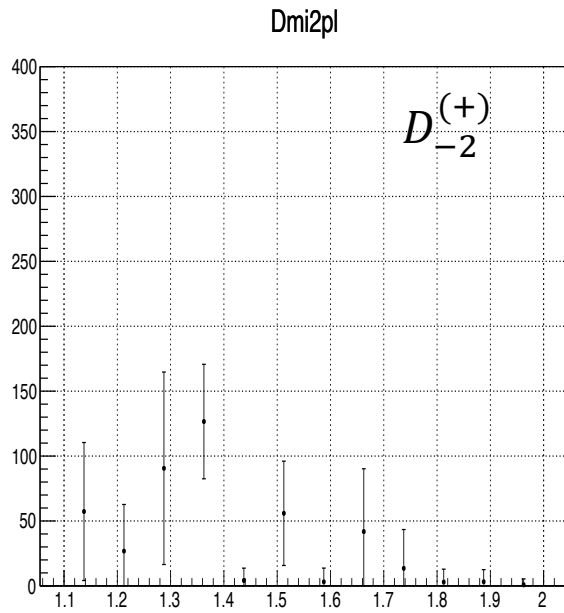


Fit with $S_0, P_{0,\pm 1}, D_{0,\pm 1,\pm 2} \ \varepsilon = \pm 1$

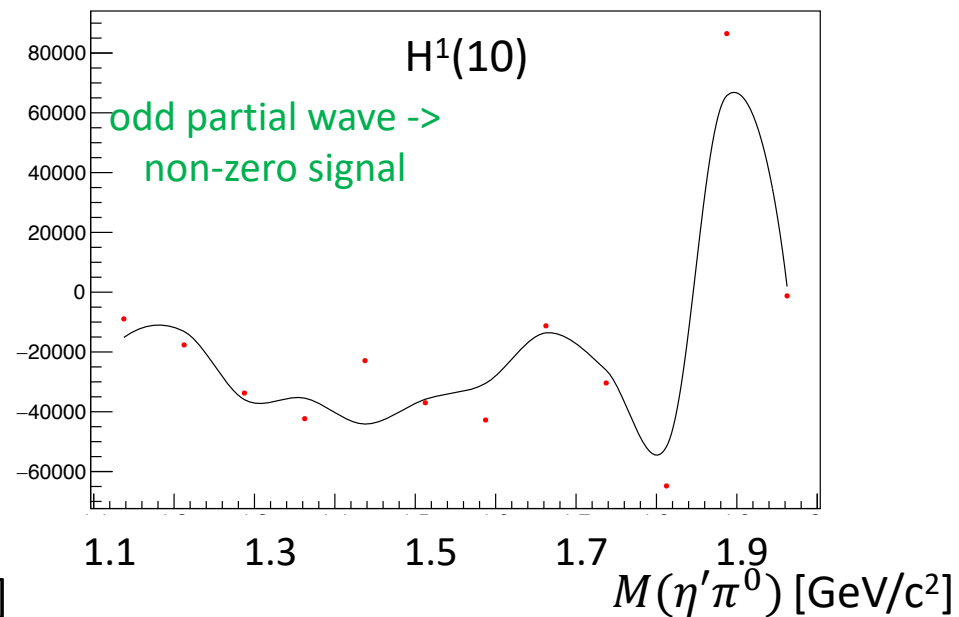
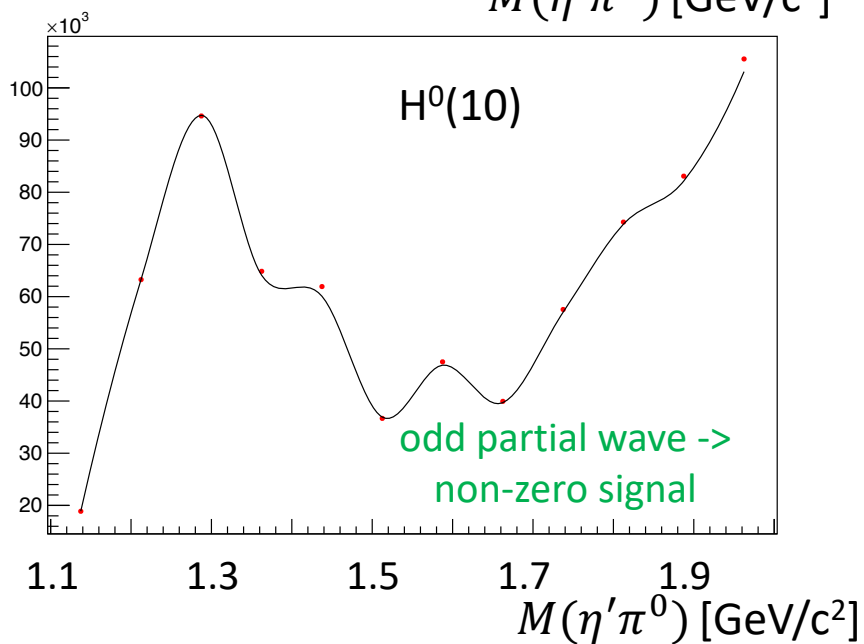
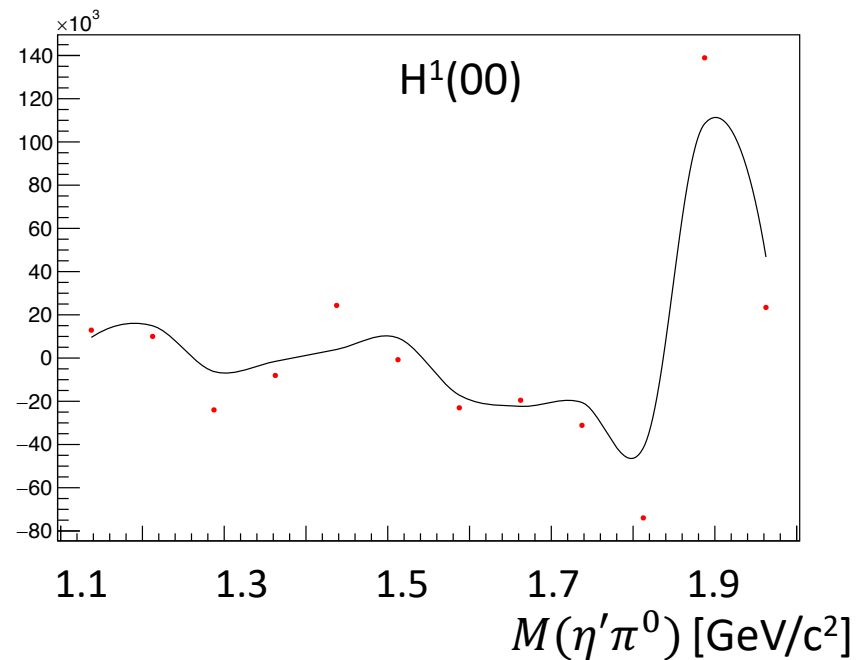
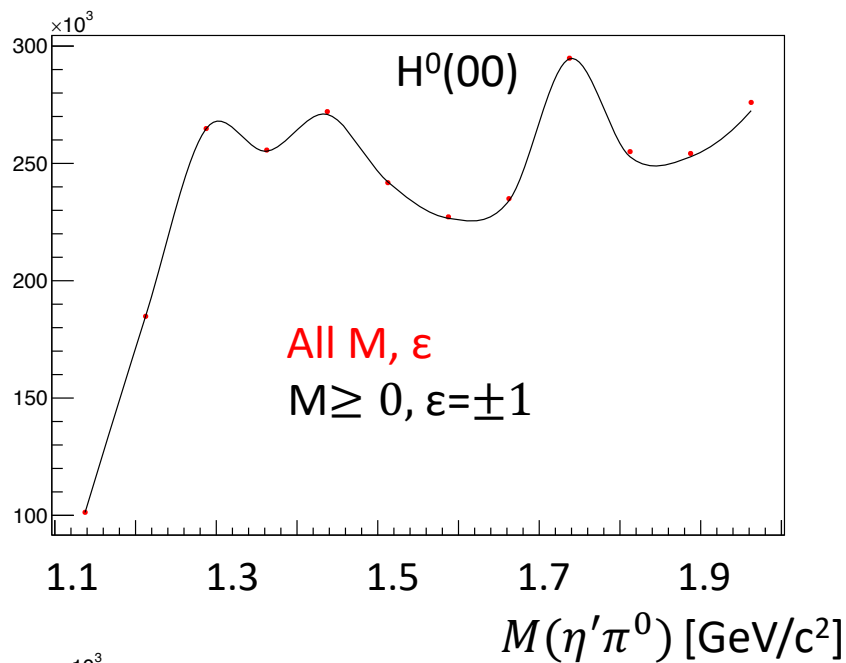
Acceptance uncorrected



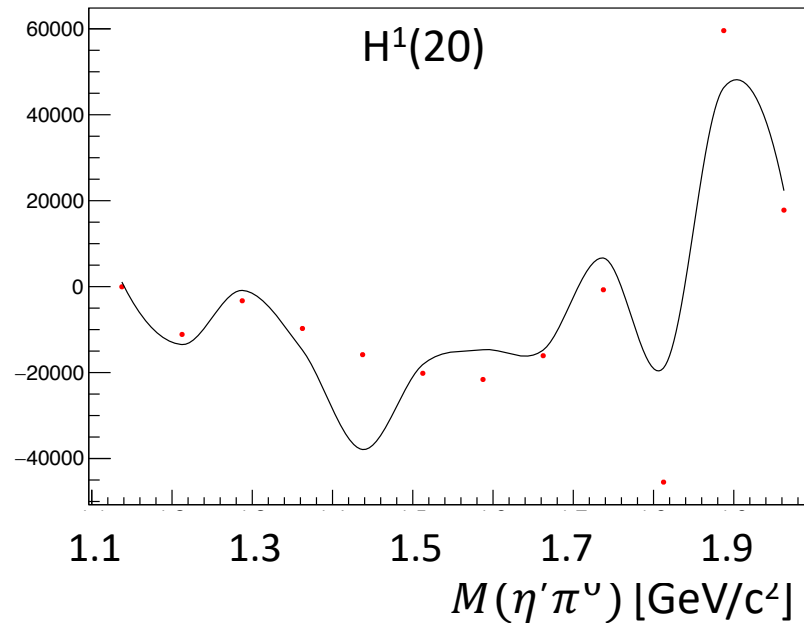
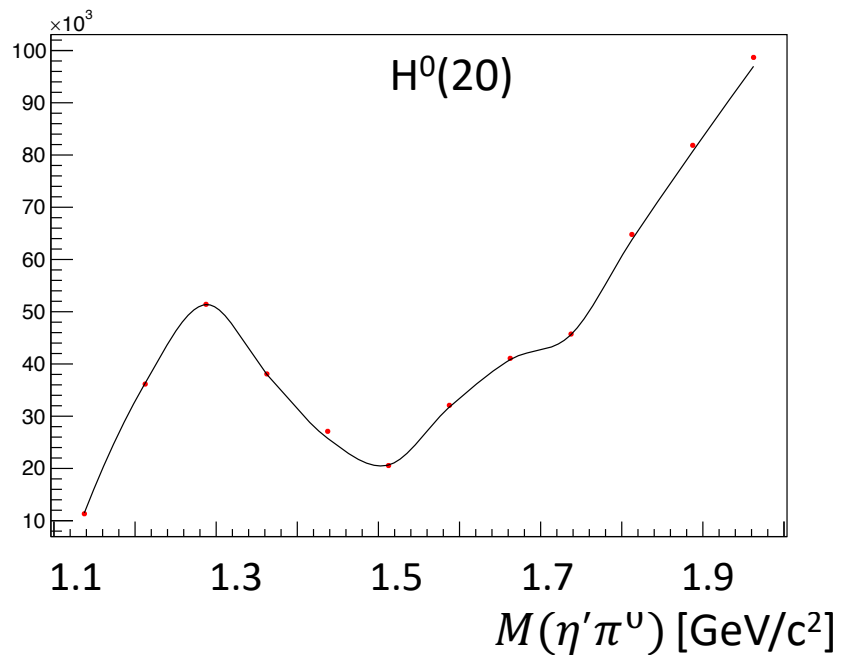
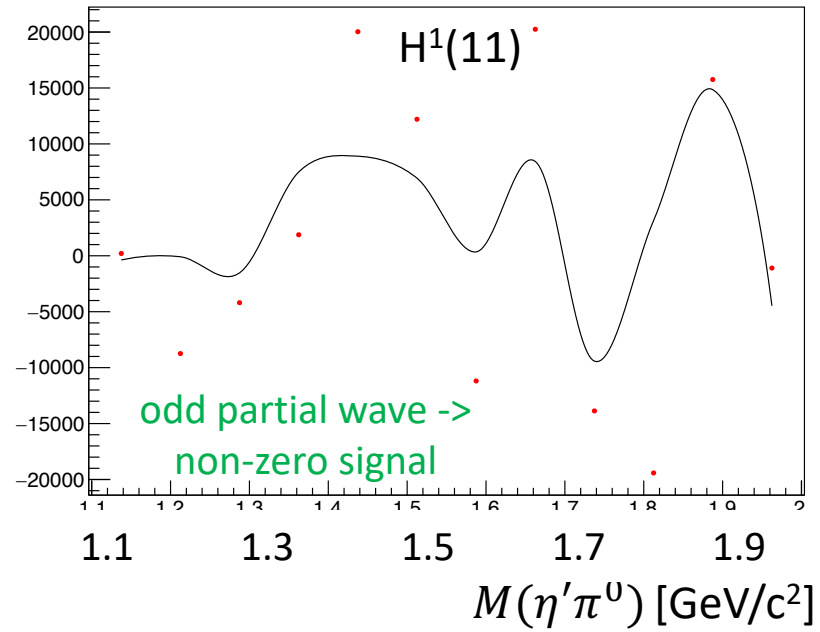
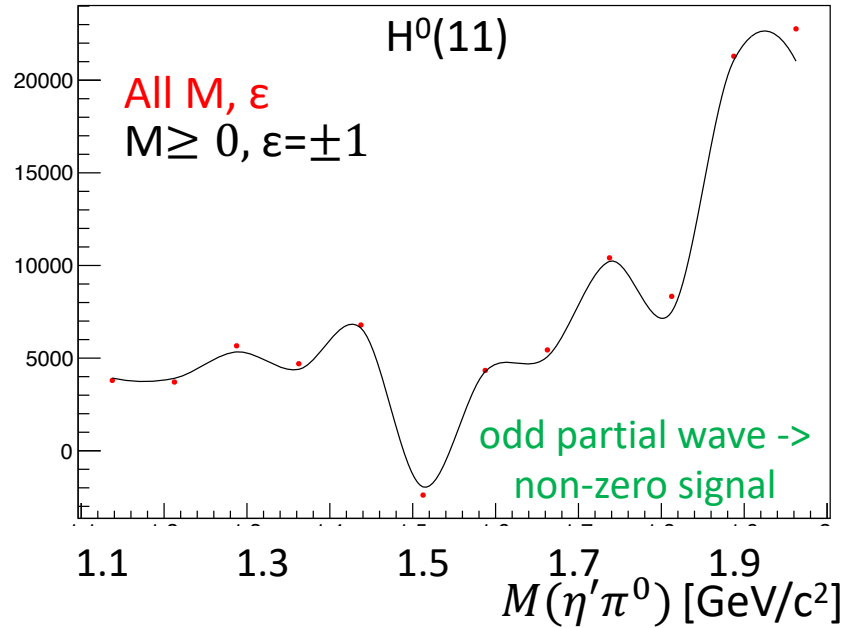
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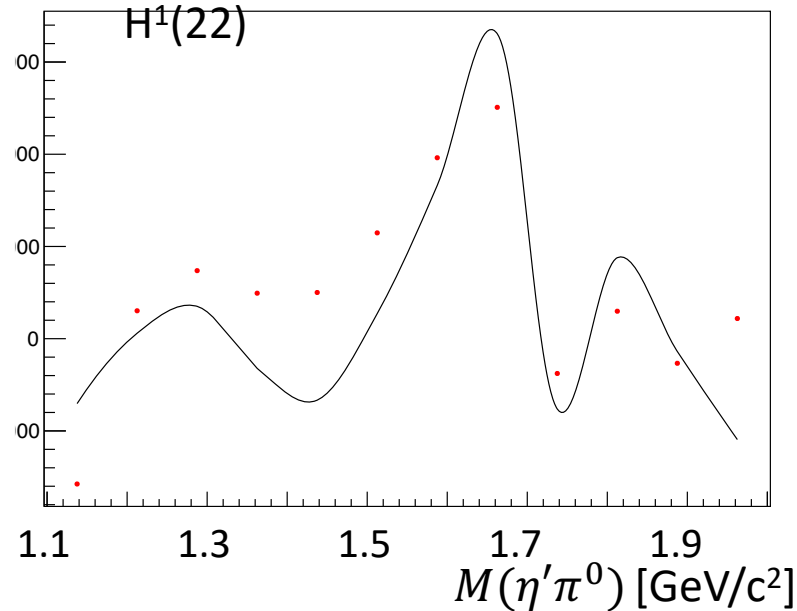
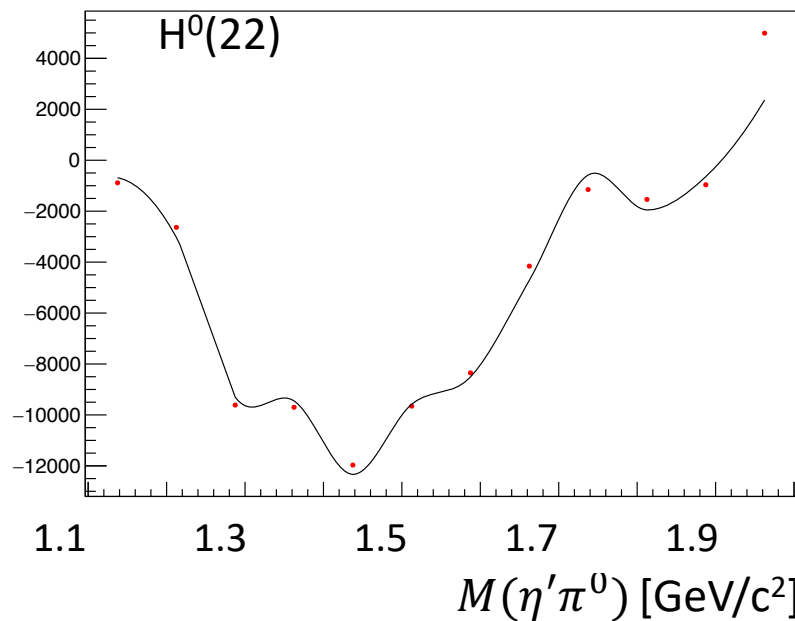
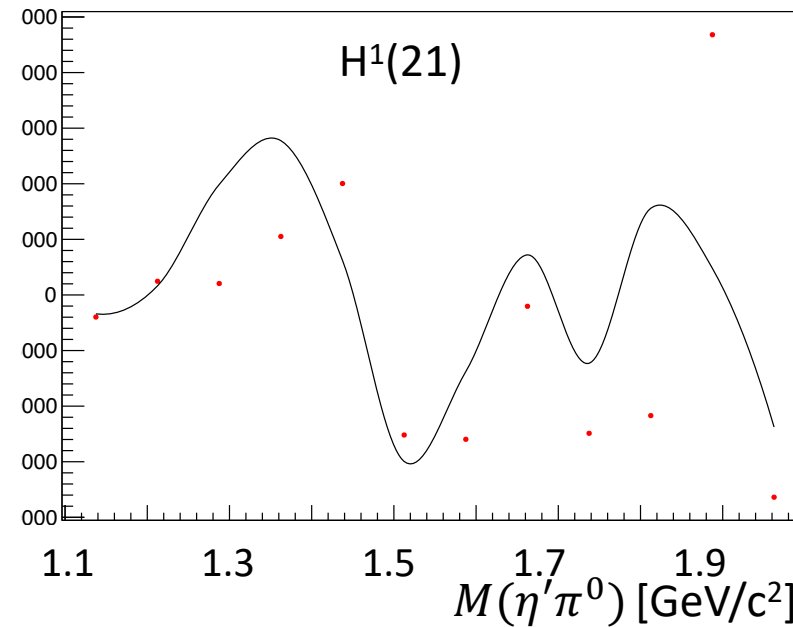
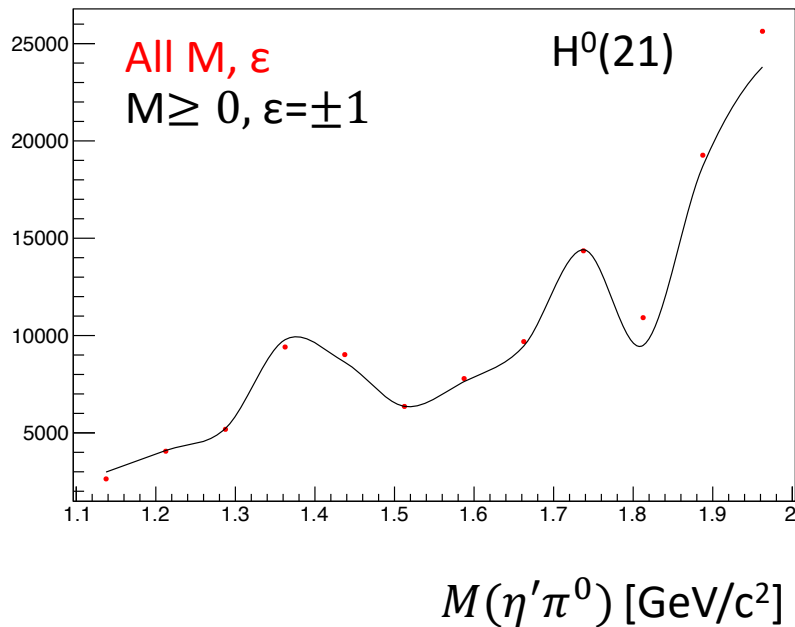
$0.1 < t < 0.7 \text{ (GeV/c)}^2$



$0.1 < t < 0.7 \text{ (GeV/c)}^2$



$0.1 < t < 0.7 \text{ (GeV/c)}^2$



Moments from fit results with **all M, ϵ** agree with moments from fit with $M \geq 0, \epsilon = \pm 1$