PWA Challenge

Florida International University 2020

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Generated 200000 $(p\eta\pi^0)$ events with AmpTools

Generated amplitudes are
- S0/a0 (980 MeV)
- D1/a2 (1318 MeV)
- P1/π_1(1400 MeV) (exotic)
- G1/a_2' (1700)

J-Spin
M-absolute value of spin projection along z axis
ϵ-reflectivity
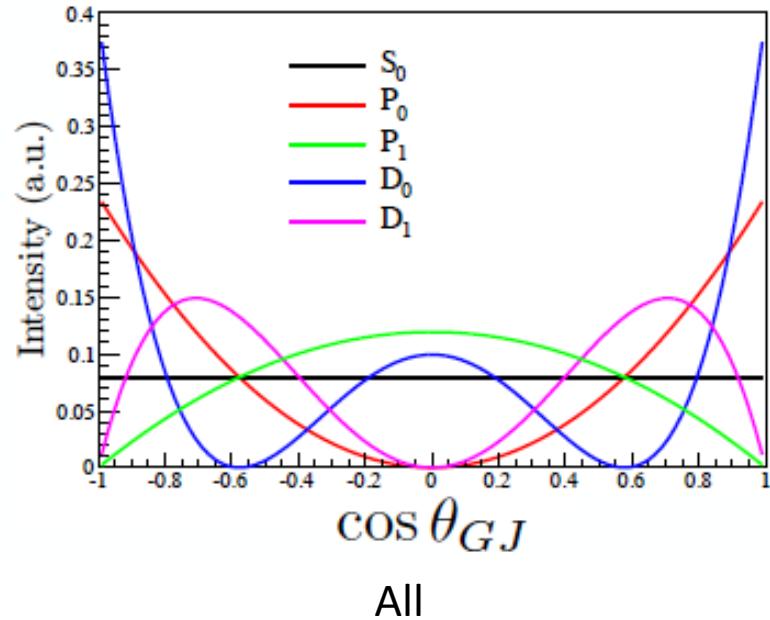
| J	M	ε	Real	Imaginary	BW Mass	BW Width
0	0	-1	2000	0	0.98	0.075
1	1	+1	60	140	1.354	0.330
2	1	+1	1000	0	1.318	0.111
4	1	+1	0	20	1.995	0.257
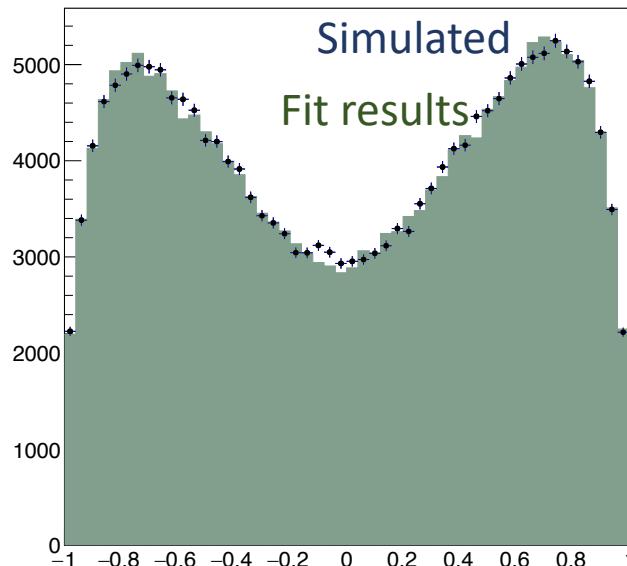
Because of the mass dependence of the fit, we need to fix some of the parameters for it converges

| J	M	ε	Real	Imaginary	BW Mass	BW Width
0	0	-1	2096	0	0.98	0.074
1	1	+1	64	130	1.363	0.327
2	1	+1	968	0	1.316	0.108
4	1	+1	0	22	2.04	0.36

Results with $cos\theta_{GJ}$

Fit results

All

Simulated

Fit results

S0

P1

D1
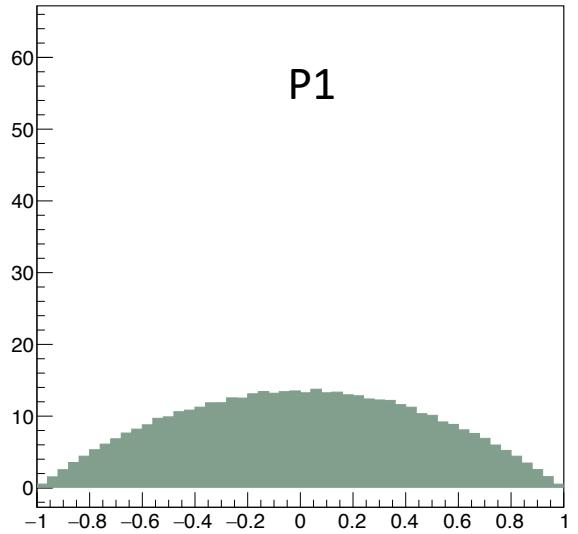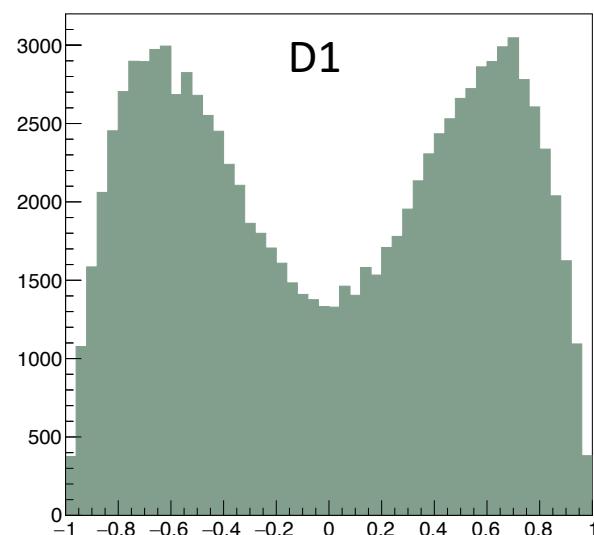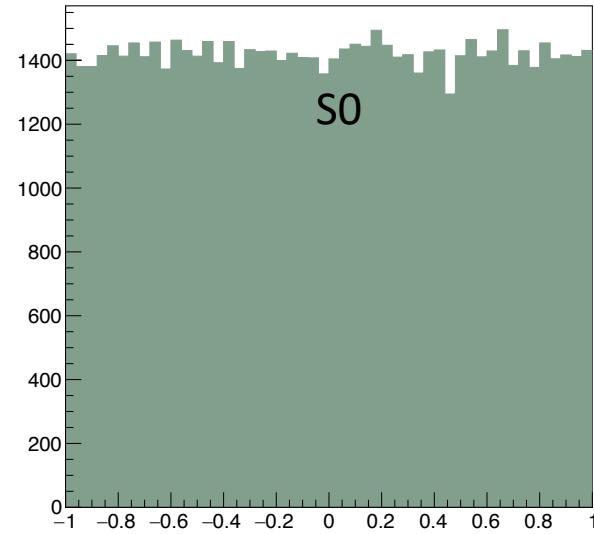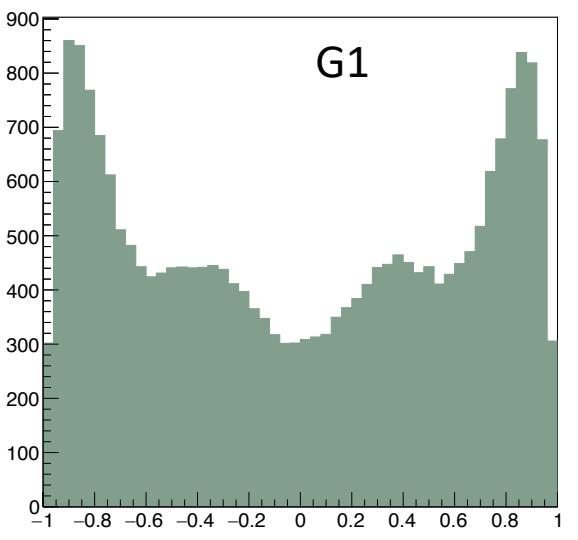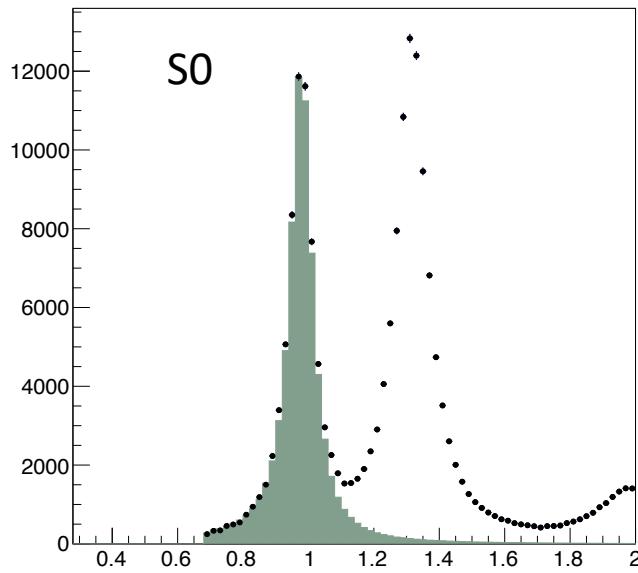
G1
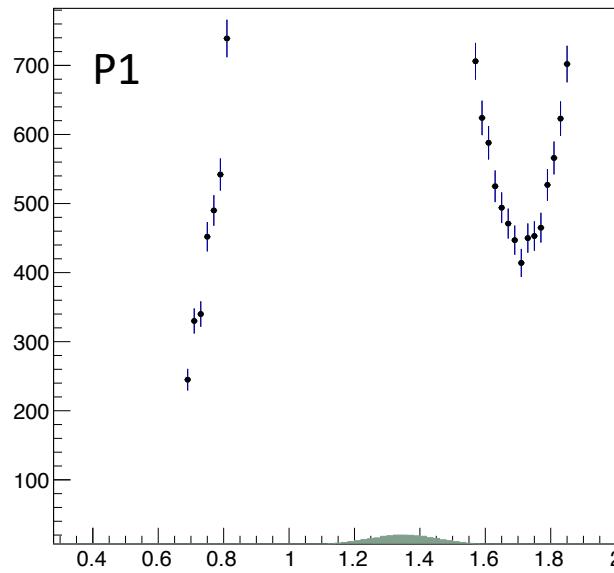
Results with invariant mass of $\eta\pi^0$
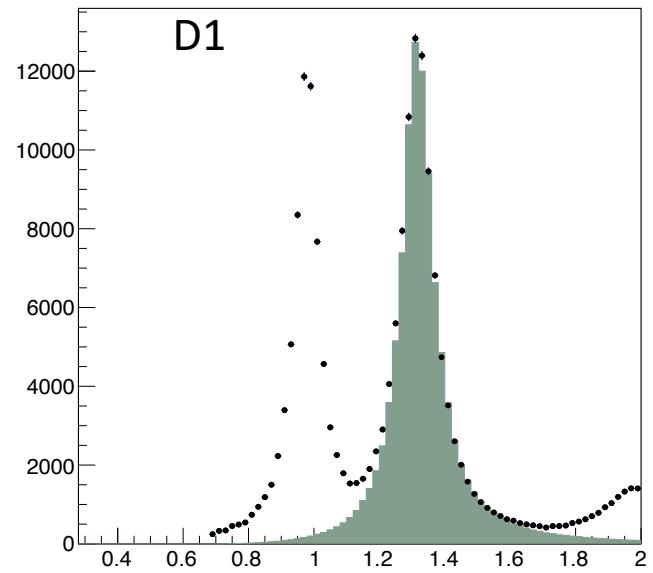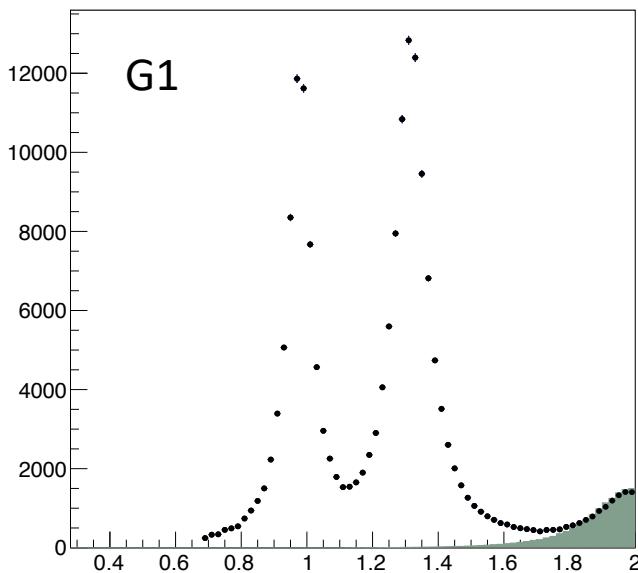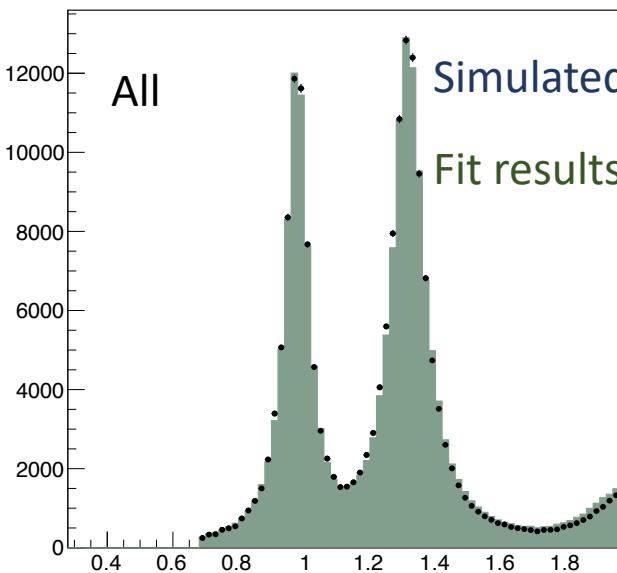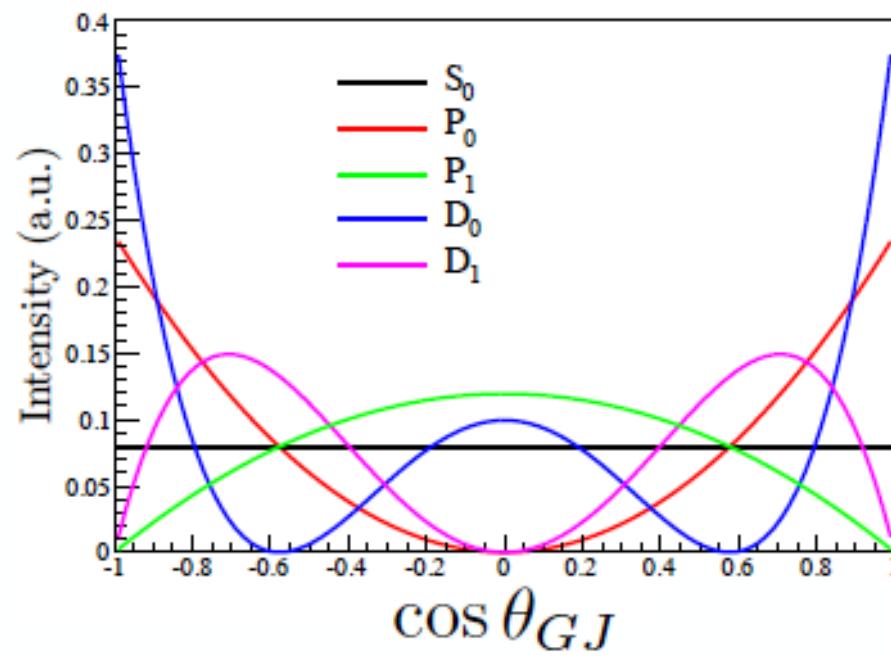
Generated amplitudes are
- S0/a0 (980 MeV)
- D1/a2 (1318 MeV)
- P1/π_1(1400 MeV)
- G1/a_2' (1700)
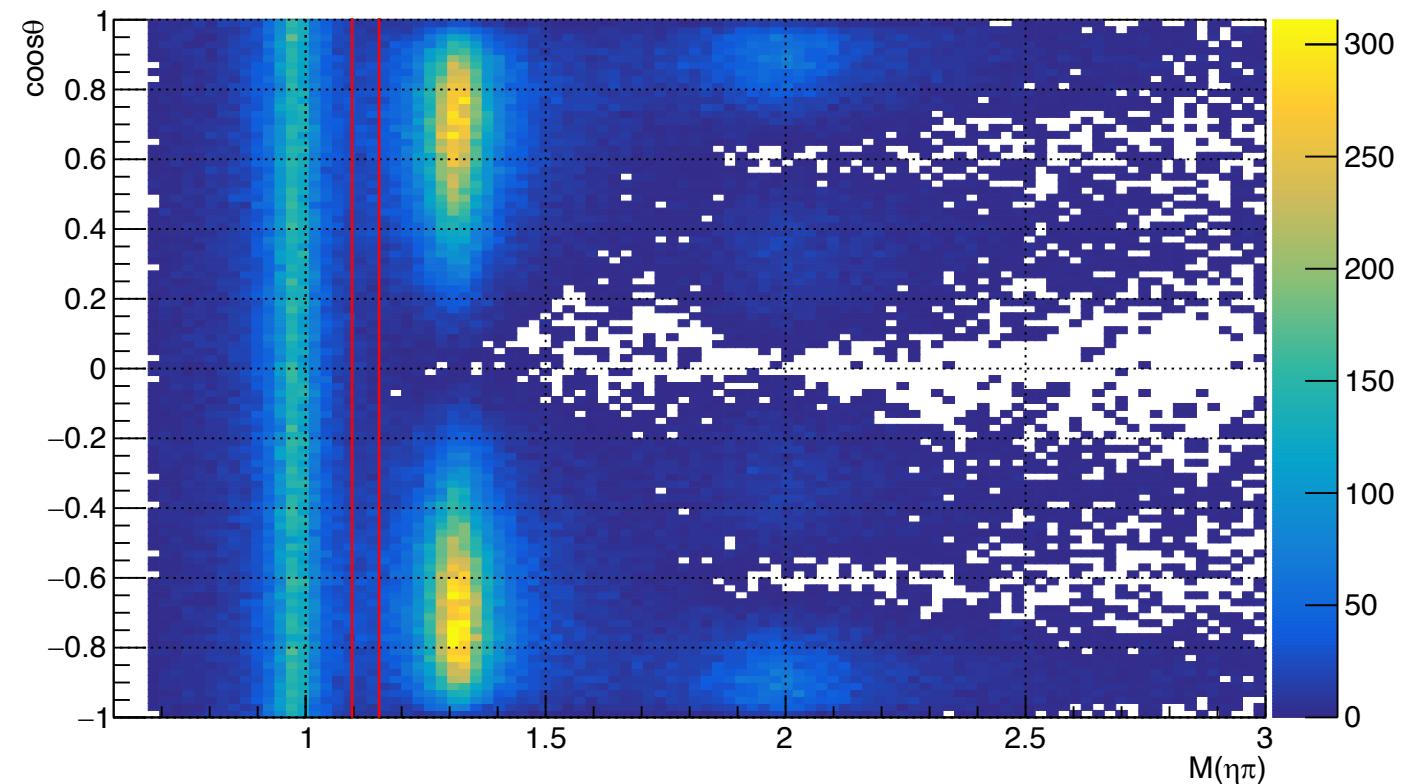
Fited amplitudes are
- S0-
- D1+
- P1+
- P0-
- P1-
- D0-
- D1-
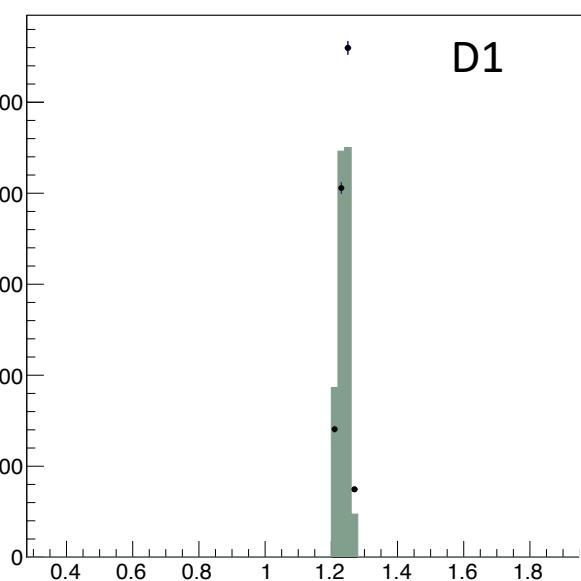
M($\eta\pi^0$) range from 0.7 to 3
N bins=45
Bin width$\approx$ 0.051
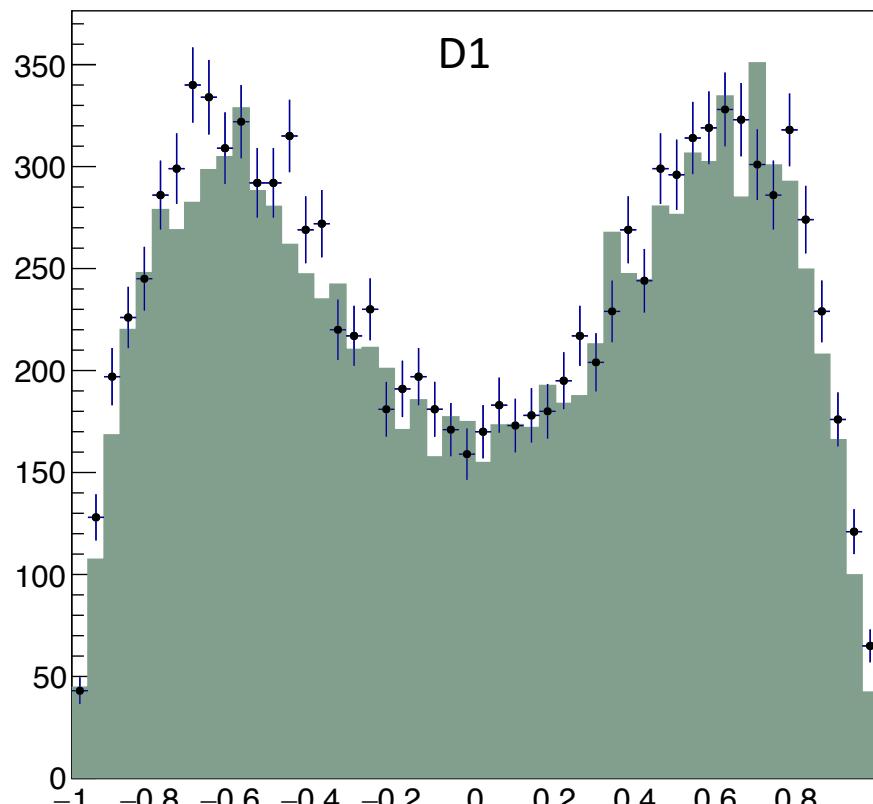
Results with fitting in different bins of invariant mass of $\eta\pi^0$

Bin 10

Invariant Mass of $\pi^+ \pi^-$
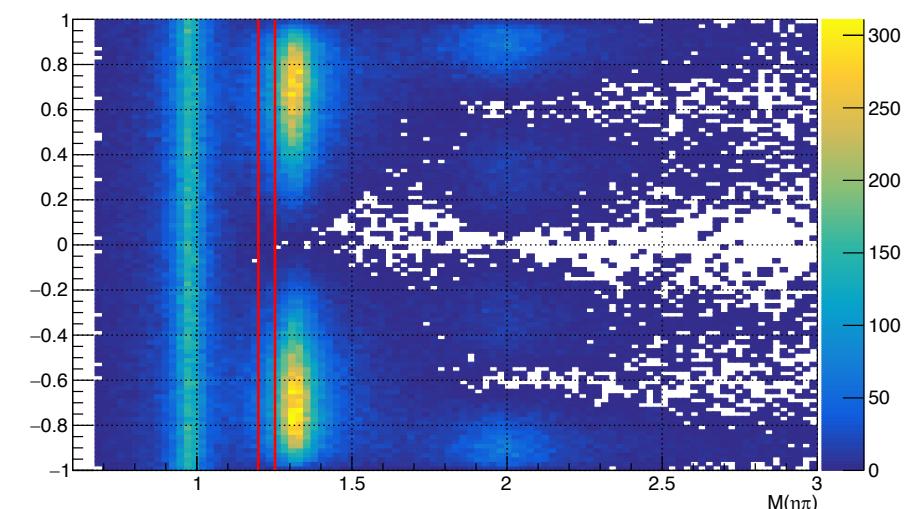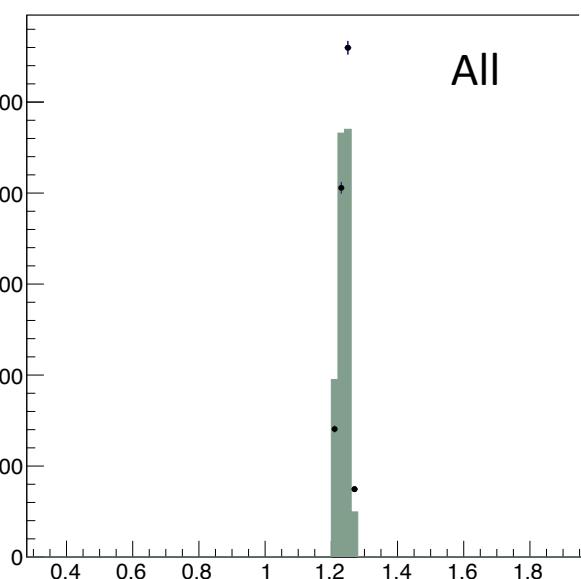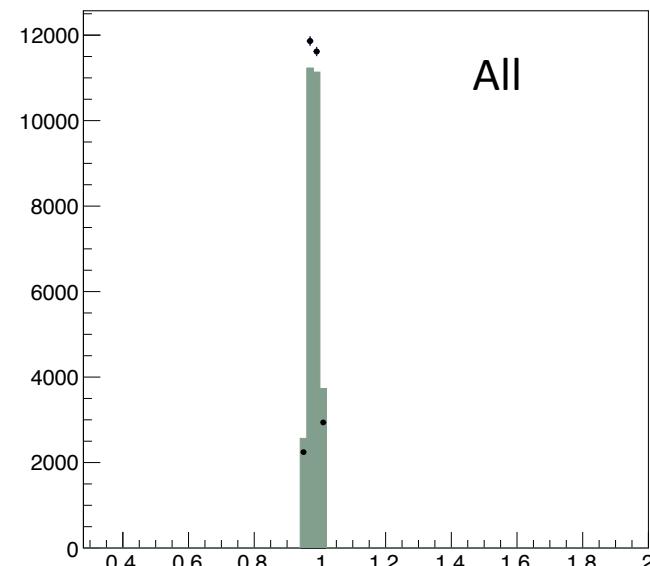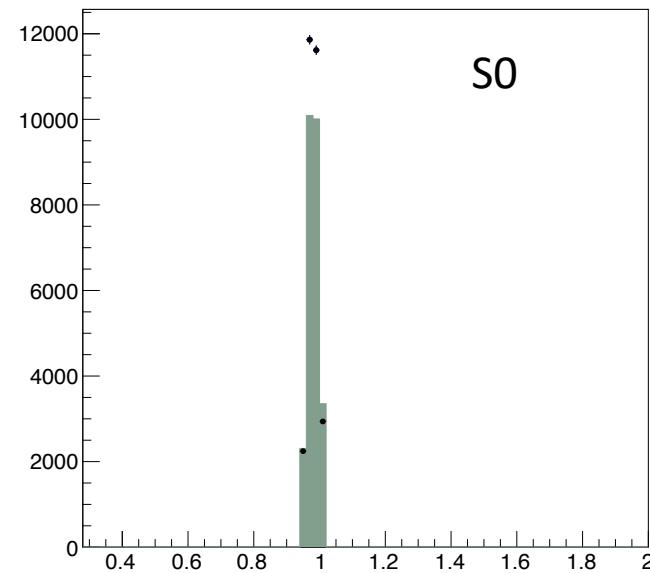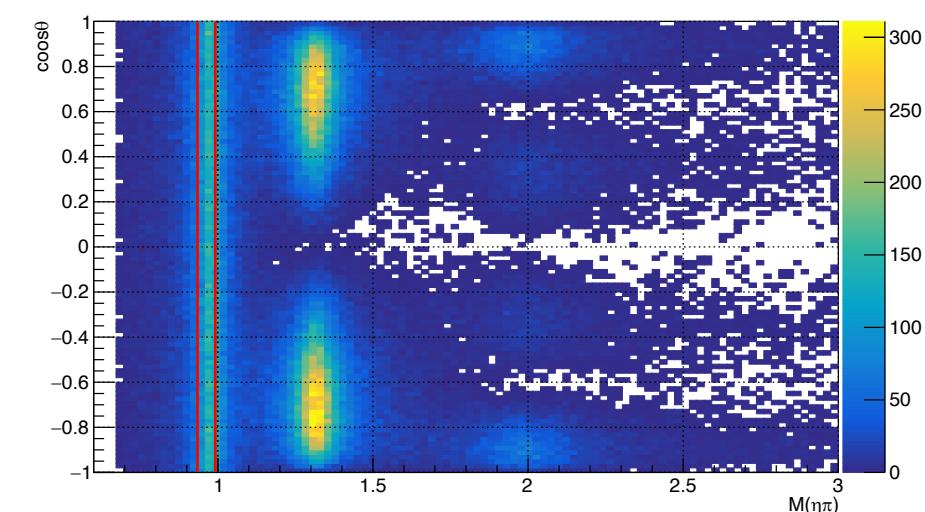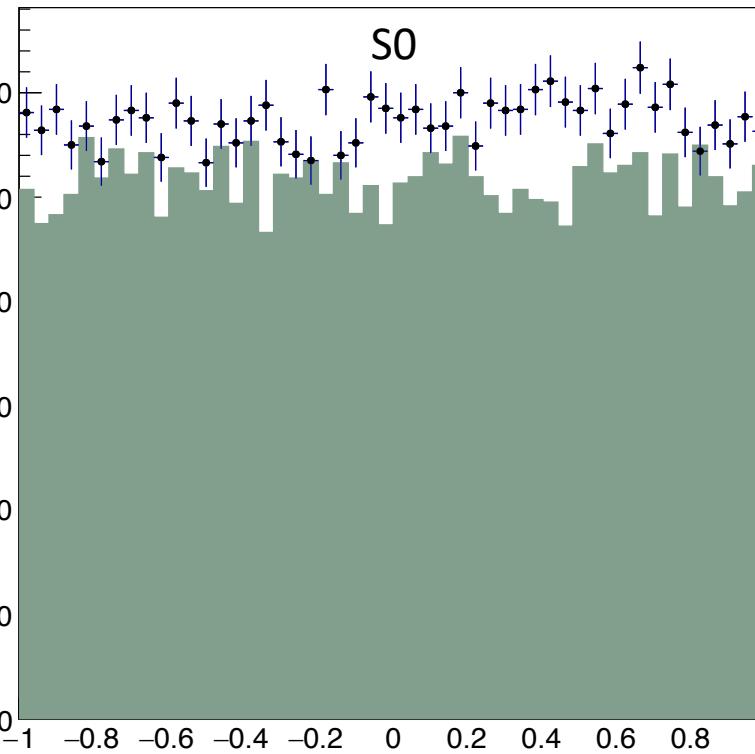
D1

cos(θ) of Resonance Production

D1

Invariant Mass of $\pi^+ \pi^-$

All

$M(\eta\pi)$

Results with fitting in different bins of invariant mass of $\eta\pi^0$

Bin 5

Invariant Mass of $\pi^+ \pi^-$


S0

cos(θ) of Resonance Production

S0

All

All
bins

$\eta\pi$ S

S0-

$\eta\pi$ P0

$\eta\pi$ P1-

$\eta\pi$ P1+

P1+

$\eta\pi$ D0-

$\eta\pi$ D1-

$\eta\pi$ D1+

D1+

$\eta\pi$ All Waves

All

D1+
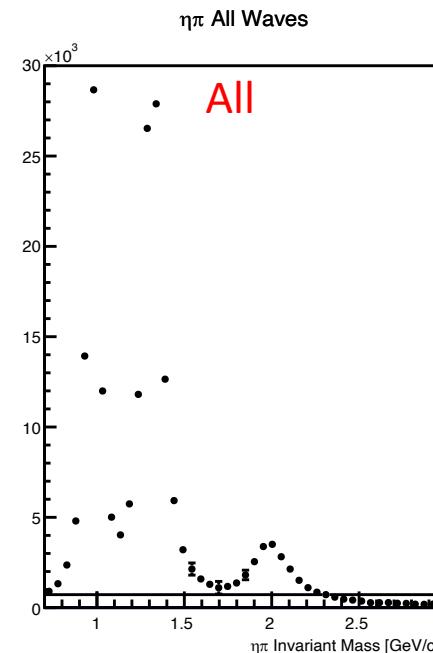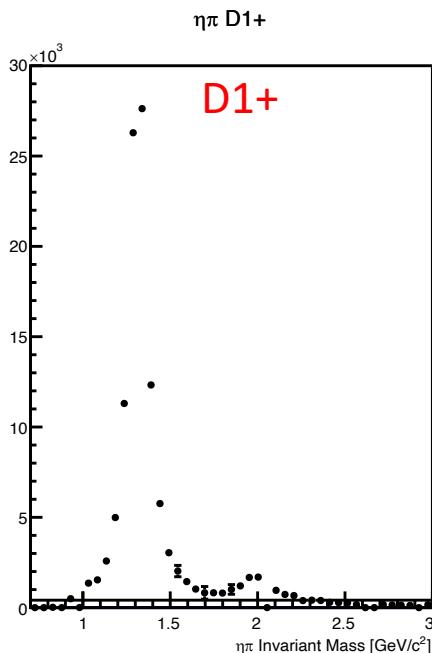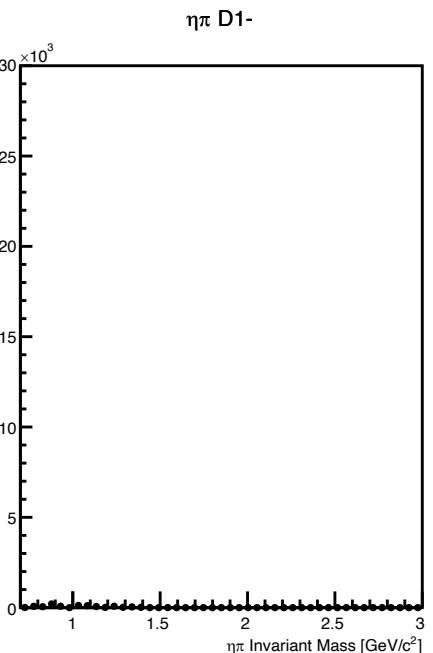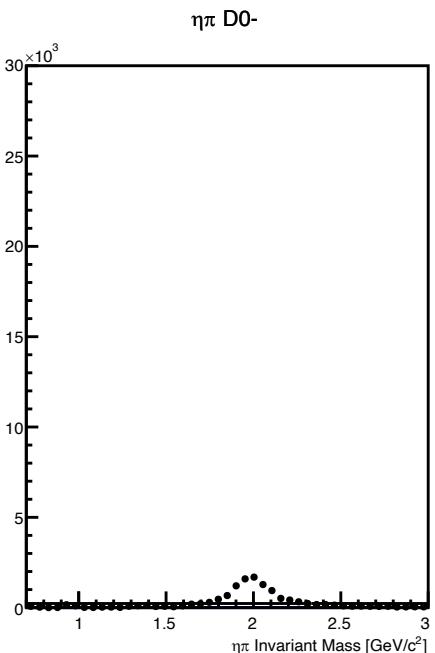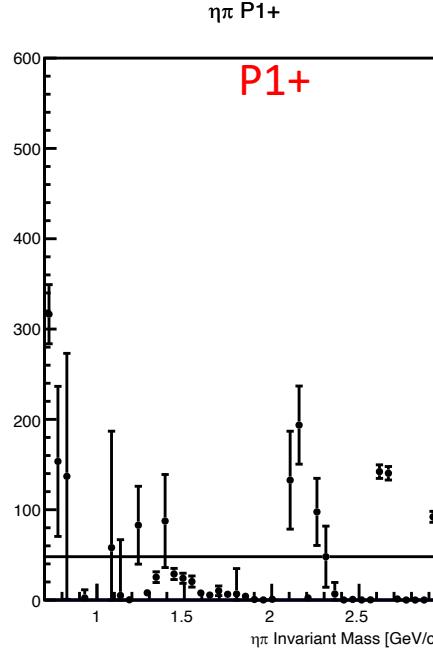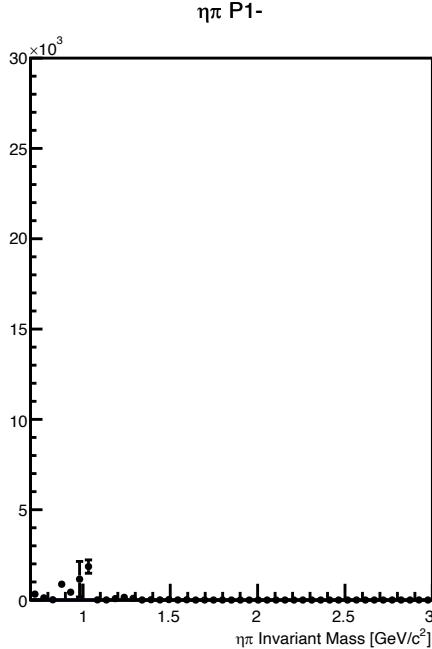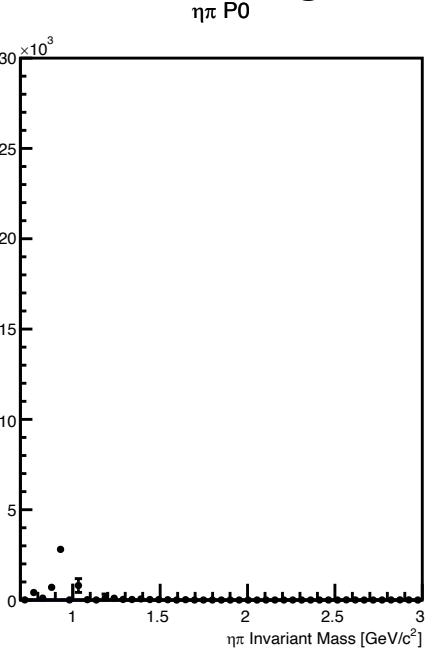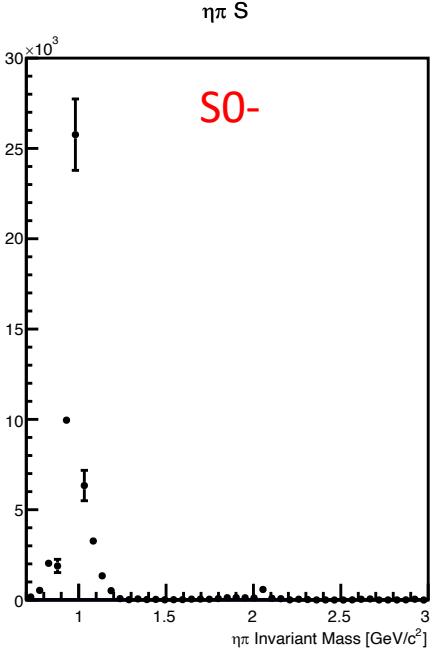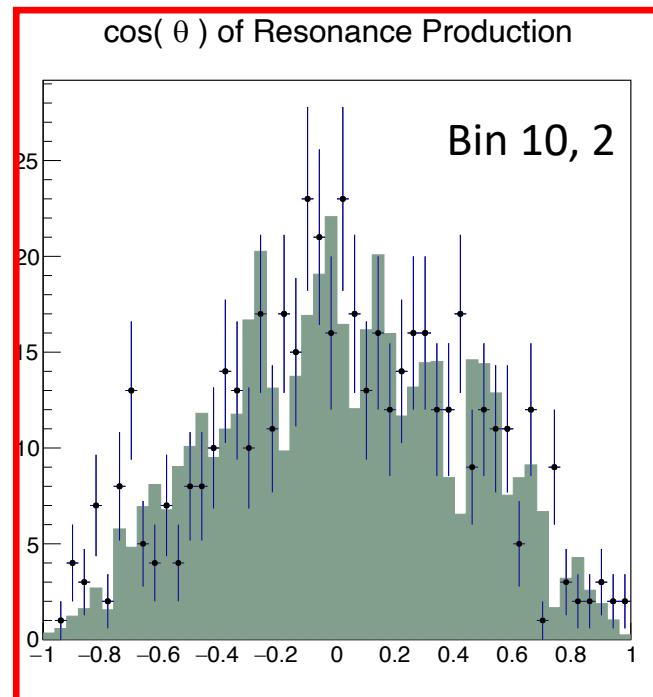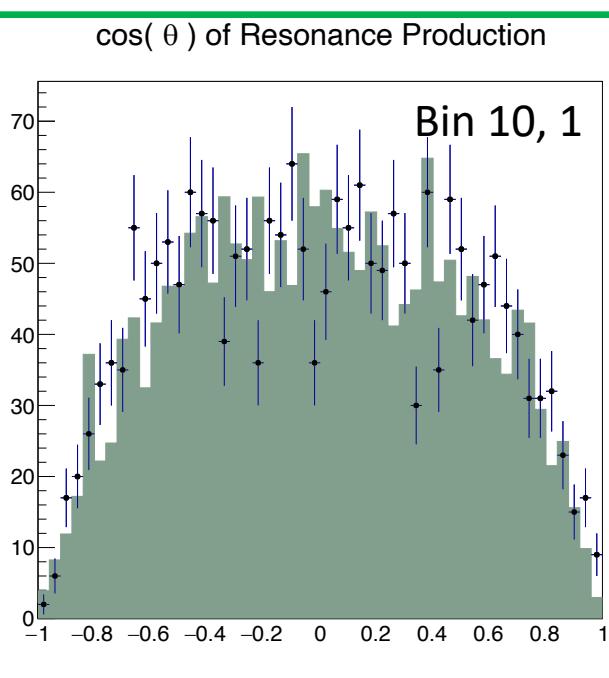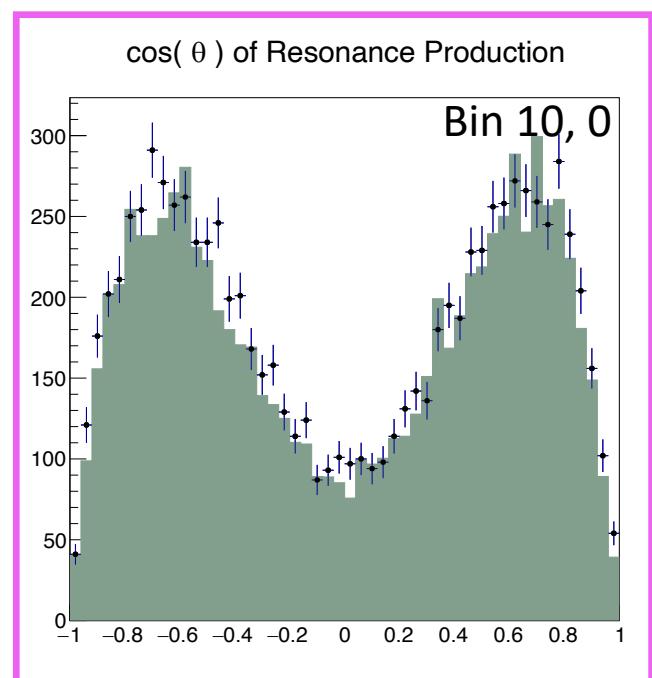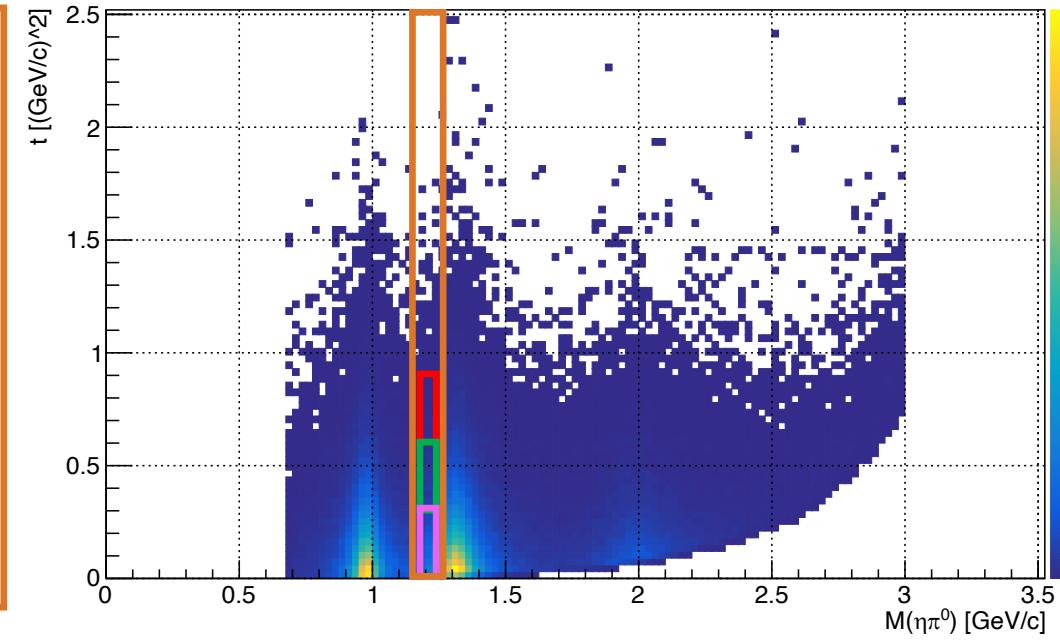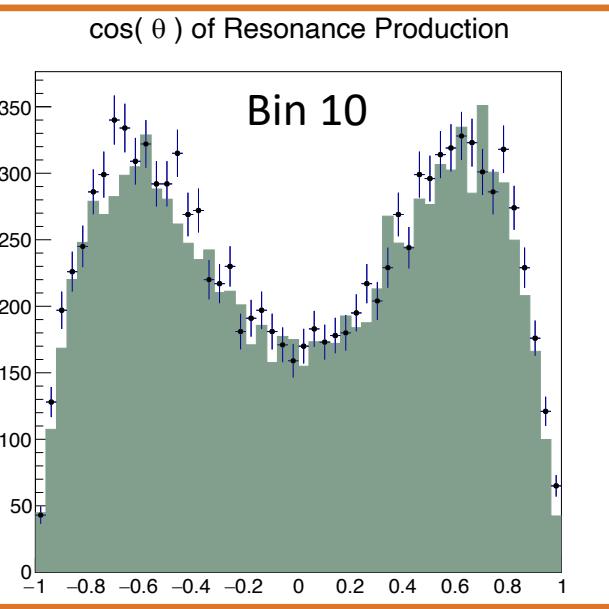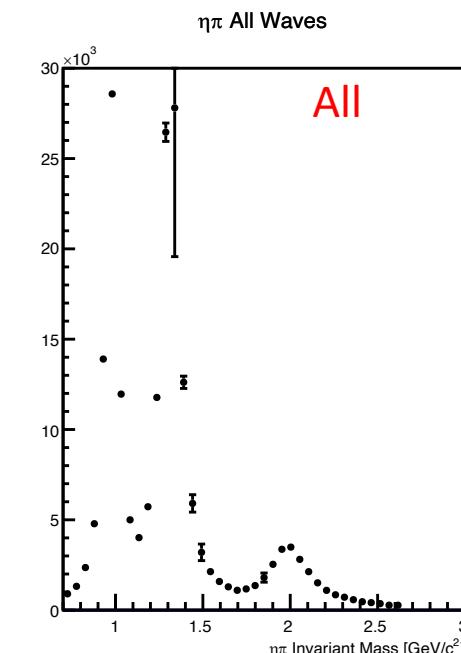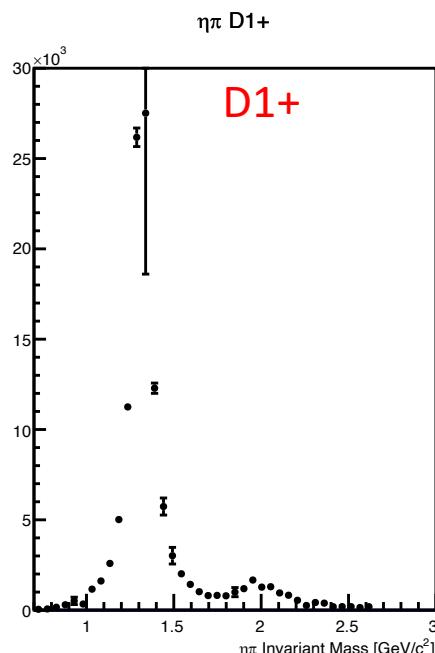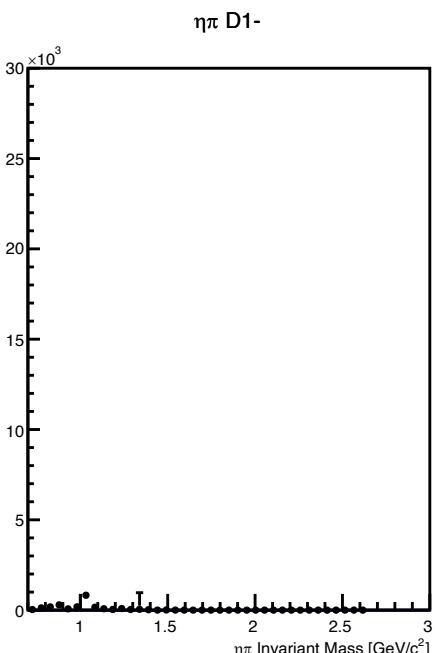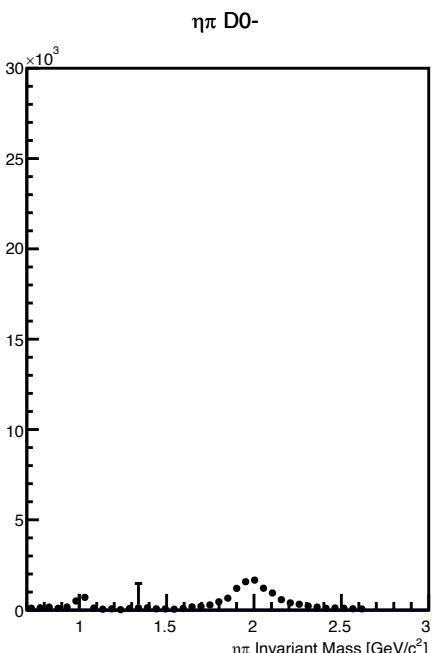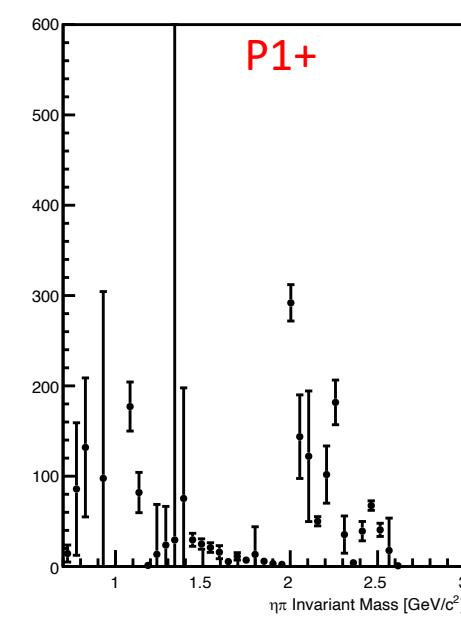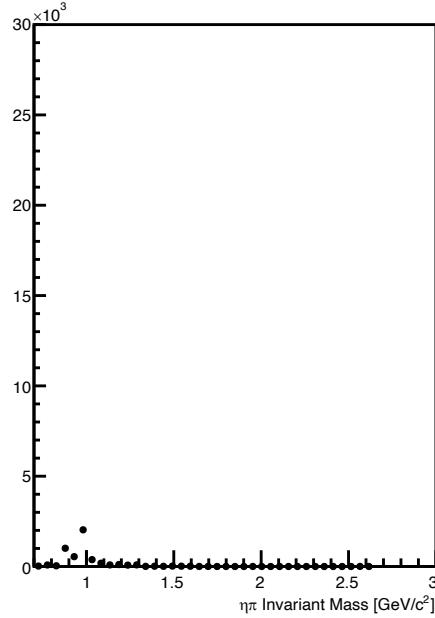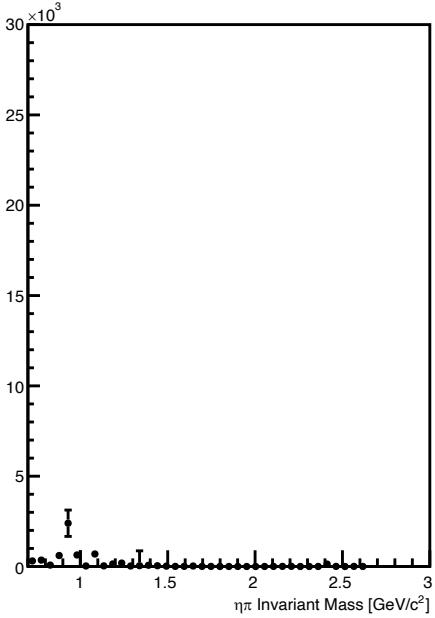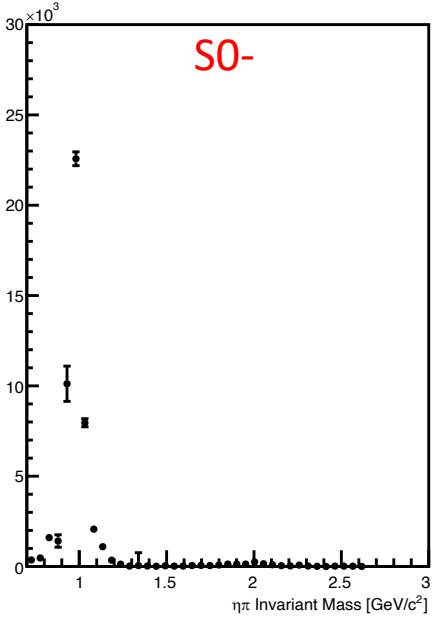
M($\eta\pi^0$) range from 0.7 to 3
N bins=45
Bin width≈ 0.051
t range from 0 to 1.2
N bins=4
Bin width≈ 0.3

All
bins

Backup slides

```
# resonance parameters
parameter azeromass 0.980 fixed
parameter azerowidth 0.075 fixed
parameter atwomass 1.318 fixed
parameter atwowidth 0.111 fixed
parameter afourmass 1.995 fixed
parameter afourwidth 0.257 fixed
parameter pionemass 1.354 fixed
parameter pionewidth 0.330 fixed

fit etapi0

reaction EtaPi0 Beam Proton Eta Pi0

genmc   EtaPi0 ROOTDataReader /group/halld/Software/workshops/pwa_challenge_2019/amptools_1/flat.root
accmc   EtaPi0 ROOTDataReader /group/halld/Software/workshops/pwa_challenge_2019/amptools_1/flat.root
data EtaPi0 ROOTDataReader /group/halld/Software/workshops/pwa_challenge_2019/amptools_1/sample1.root

normintfile EtaPi0 etapi0_ni.txt

# sum for helicity of N'=+1/2. Amplitudes should be duplicated for N'=-1/2.
sum EtaPi0 Negative
sum EtaPi0 Positive

# negative reflectivity
amplitude EtaPi0::Negative::S0- TwoPSAngles 0 0 -1
amplitude EtaPi0::Negative::S0- BreitWigner [azeromass] [azerowidth] 0 2 3

# positive reflectivity
amplitude EtaPi0::Positive::P1+ TwoPSAngles 1 1 1
amplitude EtaPi0::Positive::P1+ BreitWigner [pionemass] [pionewidth] 1 2 3

amplitude EtaPi0::Positive::D1+ TwoPSAngles 2 1 1
amplitude EtaPi0::Positive::D1+ BreitWigner [atwomass] [atwowidth] 2 2 3

amplitude EtaPi0::Positive::G1+ TwoPSAngles 4 1 1
amplitude EtaPi0::Positive::G1+ BreitWigner [afourmass] [afourwidth] 4 2 3

# initialize
initialize EtaPi0::Negative::S0- cartesian 10.0 0.0 real
initialize EtaPi0::Positive::P1+ cartesian 10.0 10.0
initialize EtaPi0::Positive::D1+ cartesian 10.0 0.0 real
initialize EtaPi0::Positive::G1+ cartesian 10.0 10.0
```

Initial value of production coefficient

```
fit FITNAME

reaction EtaPi Beam Proton Eta Pi0


sum EtaPi Negative
sum EtaPi Positive


genmc EtaPi ROOTDataReader GENMCFILE
accmc EtaPi ROOTDataReader ACCMCFILE
data EtaPi ROOTDataReader DATAFILE

#sum EtaPi Negative

amplitude EtaPi::Negative::S0- TwoPSAngles 0 0 -1
amplitude EtaPi::Negative::P0- TwoPSAngles 1 0 -1
amplitude EtaPi::Negative::P1- TwoPSAngles 1 1 -1
amplitude EtaPi::Negative::D0- TwoPSAngles 2 0 -1
amplitude EtaPi::Negative::D1- TwoPSAngles 2 1 -1

amplitude EtaPi::Positive::P1+ TwoPSAngles 1 1 1
amplitude EtaPi::Positive::D1+ TwoPSAngles 2 1 1

initialize EtaPi::Negative::S0- cartesian 1000.0 1.0 real
initialize EtaPi::Negative::P0- cartesian 1.0 0.0
initialize EtaPi::Negative::P1- cartesian 1.0 0.0
initialize EtaPi::Negative::D0- cartesian 1.0 0.0
initialize EtaPi::Negative::D1- cartesian 1000.0 1.0

initialize EtaPi::Positive::P1+ cartesian 1.0 0.0
initialize EtaPi::Positive::D1+ cartesian 1.0 0.0
```
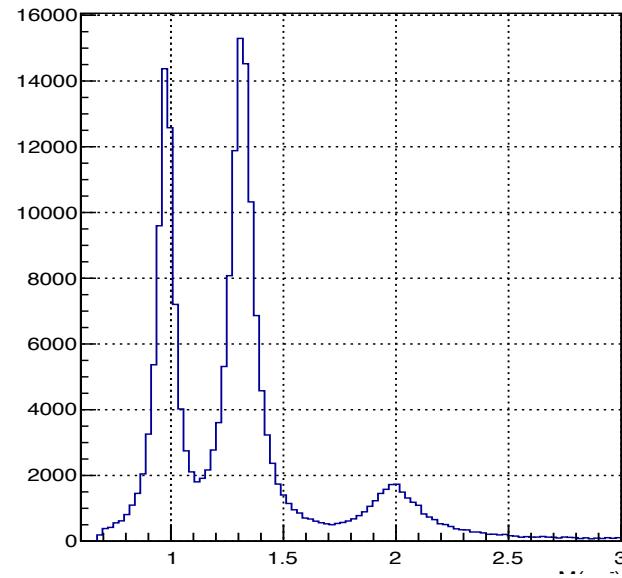
All

M($\eta\pi^0$)

cosθ
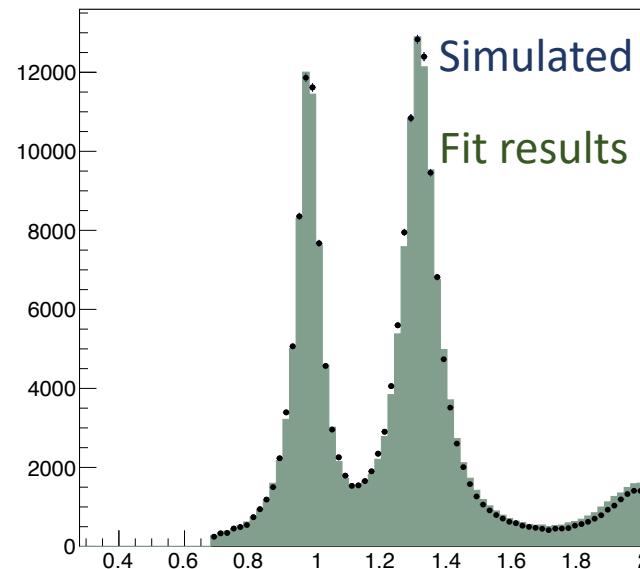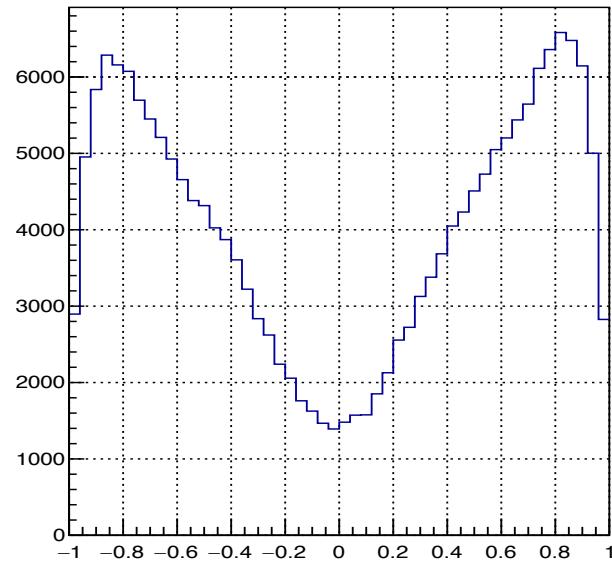
Plotted using the data file

plotted with twopi_plotter_mom