

# Analysis of $\eta'\pi^+n$

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# The Channel

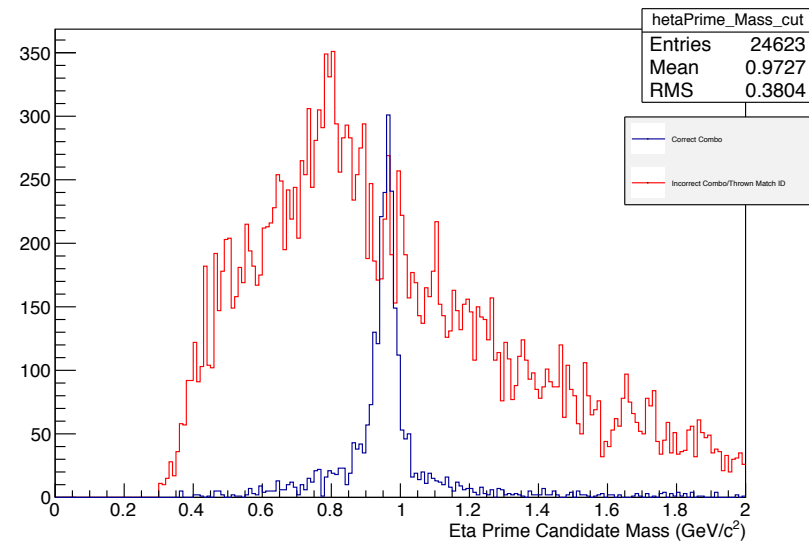
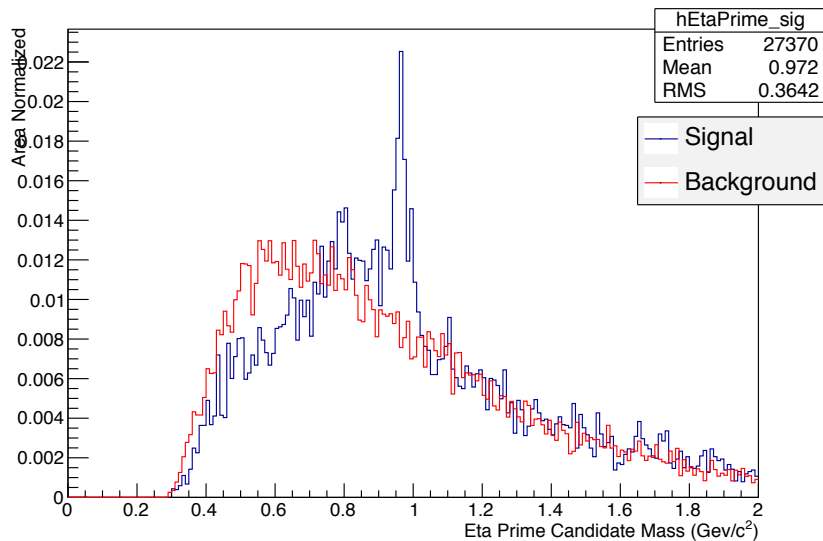
- $\gamma p \rightarrow \eta' \pi^+ n$  ;  $\eta' \rightarrow \gamma \pi^+ \pi^-$  (Branching fraction 29.3%)
  - Final state particles:  $\gamma \pi^+ \pi^- \pi^+ n$
- Goal: To see how clean of a signal we can get for GlueX
- Important channel for  $\pi_1(1600) \rightarrow \eta' \pi^+$  searches
- Similar to many other common channels and therefore difficult to discriminate

# Major Steps

- Find strong discriminating variables
- Run signal and background through multivariate BDT analysis using discriminating variables (but not a variable with a clear peak)
- Find BDT cut with highest purity\*signal efficiency

# $\eta'$ Mass

- Should be clear peak at  $\eta'$  mass, but  $2 \pi^+$  in final state makes this more difficult
- Left histogram filled on average twice, once with the pion from the eta' and once with the pion not from the eta'
- Imposed a cut on the thrown  $\eta'$  mass and match IDs to take out these wrong combinations
- Blue peak on right histogram is my signal that I'll be feeding into the TMVA analysis (everything else will be background)

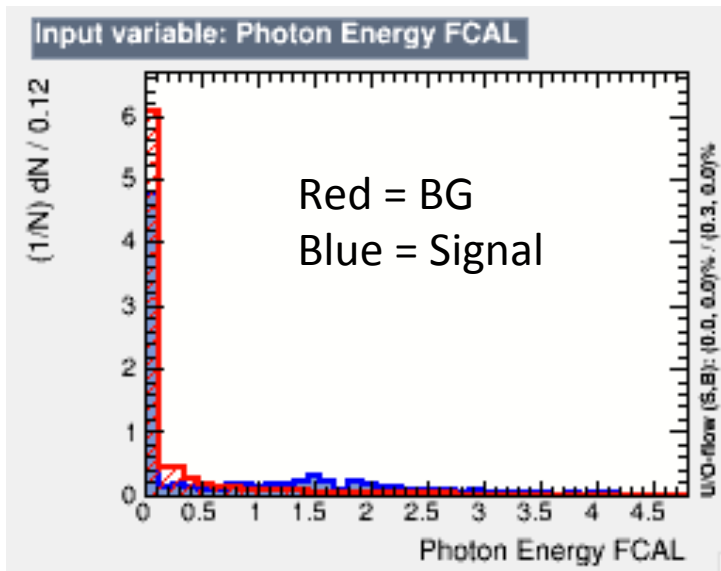
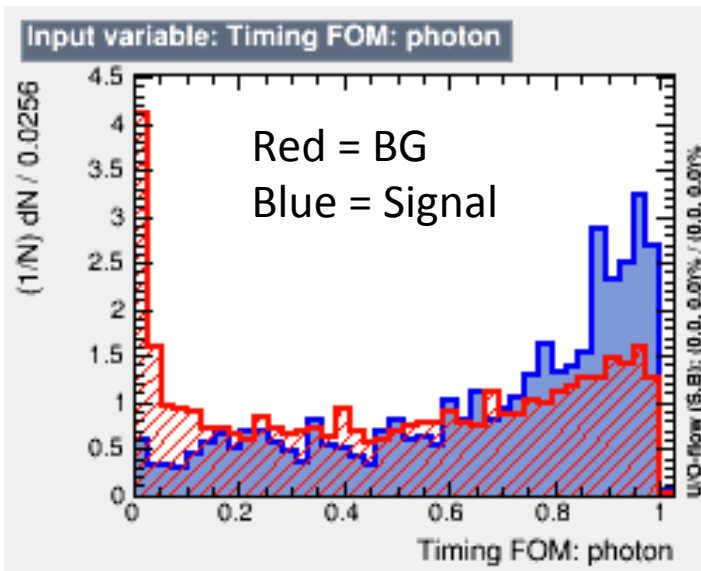
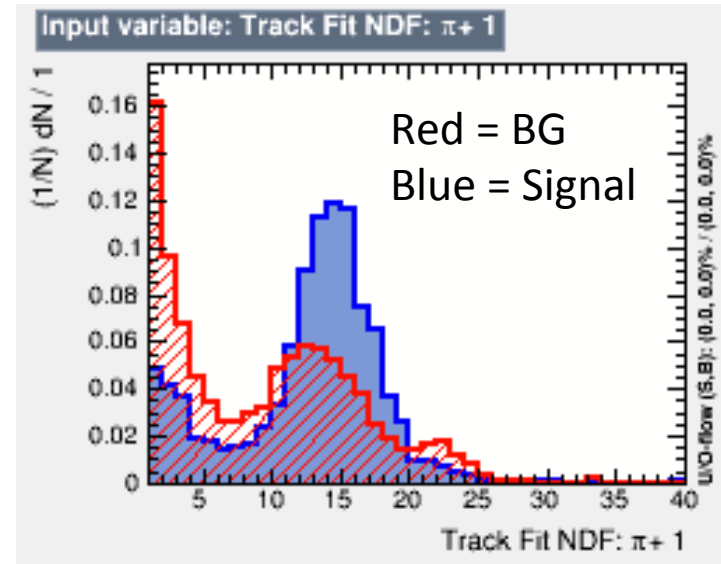
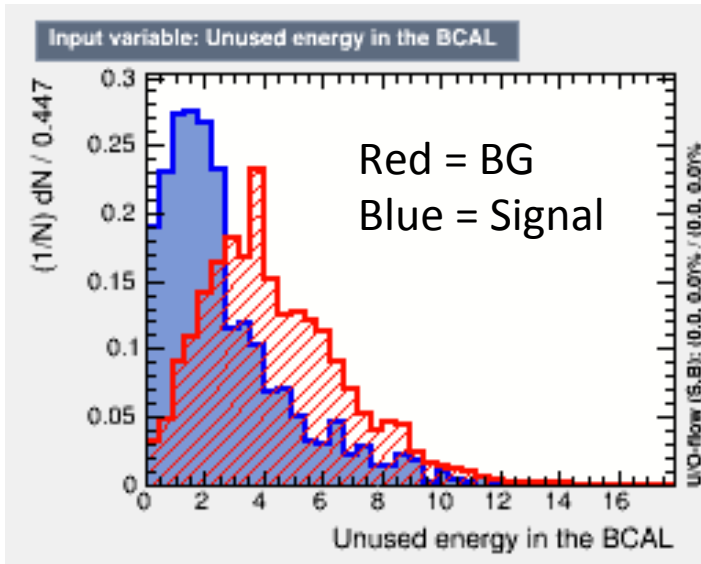


# TMVA BDT Analysis

- Next, I ran signal and background through the multivariate analysis (right now, I only have 10k signal and background events)
- Table shows variables with highest discriminating power

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: Rank : Variable                : Variable Importance
: -----
: 1 : Unused__BCAL                : 1.021e-01
: 2 : PiPlus1__NDF_Tracking       : 7.053e-02
: 3 : Photon__Timing_FOM          : 6.862e-02
: 4 : Photon__Energy_FCAL         : 6.784e-02
: 5 : Unused__FCAL                : 6.382e-02
: 6 : PiPlus2__NDF_Tracking       : 6.220e-02
: 7 : PiMinus__NDF_Tracking       : 6.014e-02
: 8 : PiPlus2__DCdEdx_FOM         : 5.790e-02
: 9 : PiPlus1__Timing_FOM         : 5.602e-02
: 10 : Unused__Max_KPlus_FOM       : 5.524e-02
: 11 : PiPlus2__Timing_FOM         : 5.289e-02
: 12 : Photon__Energy_BCAL         : 5.242e-02
: 13 : Unused__Max_KMinus_FOM      : 5.198e-02
: 14 : PiPlus1__DCdEdx_FOM         : 4.692e-02
: 15 : Unused__Max_Proton_FOM      : 4.585e-02
: 16 : PiMinus__DCdEdx_FOM         : 4.315e-02
: 17 : PiMinus__Timing_FOM         : 4.237e-02
: 18 : FOM_KinFit                  : 0.000e+00
: -----
```

# Discriminating Variables



# Next Steps

- Continue to search for discriminating variables
- Find out or estimate the eta' cross section for a correct signal to background ratio (branching fraction for  $\eta' \rightarrow \gamma \pi^+ \pi^-$  known as 29.3%)