OmegaPi0 Efficiency

November 28 2023
Open Analysis Discussion
Karthik Suresh

Details

```
Reaction1 1_14__m1_1_7_8_9_14
Reaction1:Flags B4_T0_S1_M7_F1
```

- MC
  - 10Million events, Fall 2018 data
  - All of it shown here
  - tree_gpi0pippimmissg__B4_F1_T0_S1_M7
- Data
  - Analysis Launch Fall2018 Ver20
  - tree_gpi0pippimmissg__B4_F1_T0_S1_M7
  - All of it shown here

The reaction is:

$$p\gamma \to p\pi^0\omega \to \pi^+\pi^-\pi^0$$

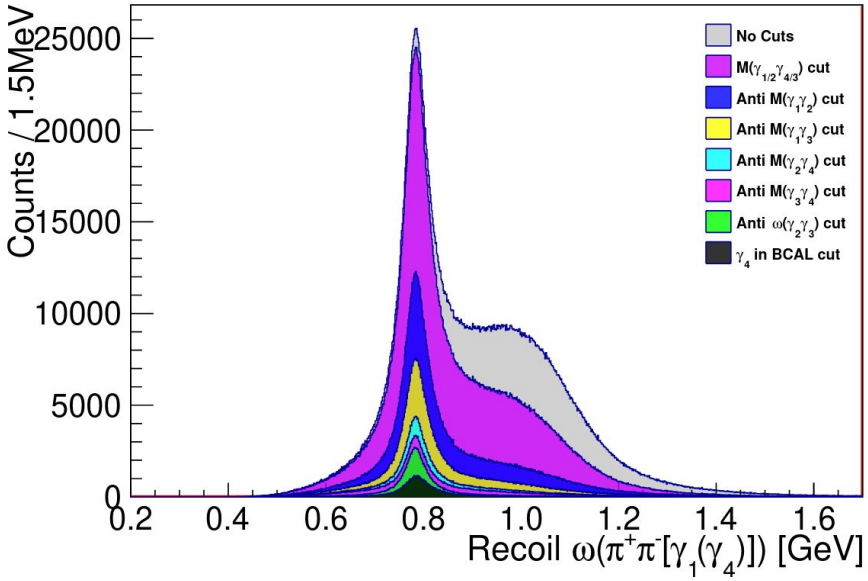
The reaction in ReactionFilter is;

$$p\gamma \to p\pi^0[\gamma_2\gamma_3]\pi^+\pi^-\gamma_1(\gamma_4)$$

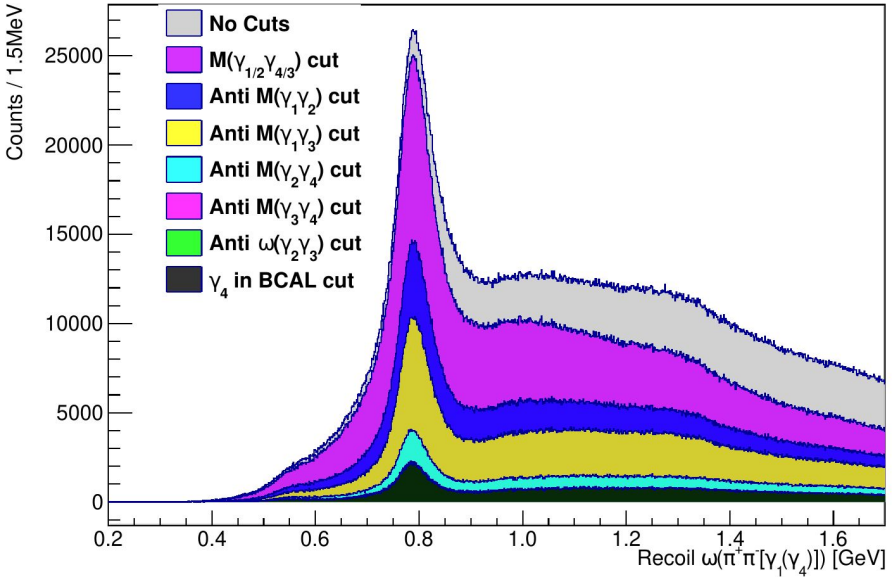
Cut Name	Value Absolute
π^0_{ij} cut ij = [14, 23]	$M(\pi^0) - M(\gamma_i\gamma_j) \leq 0.100$ GeV
Anti π^0_{ij} ij = [12, 13, 24, 34]	$M(\pi^0) - M(\gamma_i\gamma_j) \geq 0.100$ GeV
ω_{14} cut	$M(\omega) - M(\pi^+\pi^-(\gamma_1\gamma_4)) \leq 0.025$ GeV
Anti ω_{ij} cut ij = [12, 13, 23, 24, 34]	$M(\omega) - M(\pi^+\pi^-(\gamma_1\gamma_4)) \geq 0.025$ GeV

Recoil mass (Missing)

Fall 2018 MC - b1 Simulations

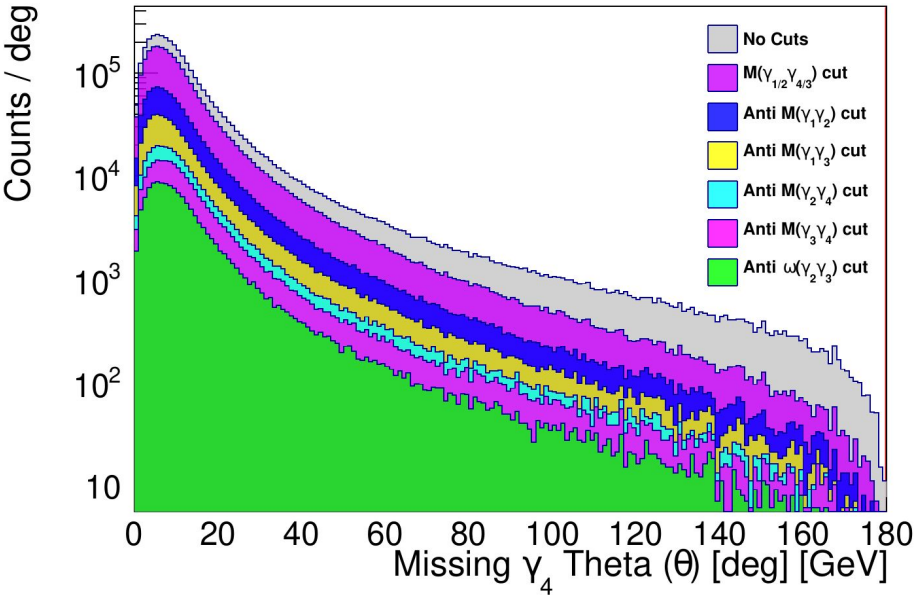


Fall 2018 Data

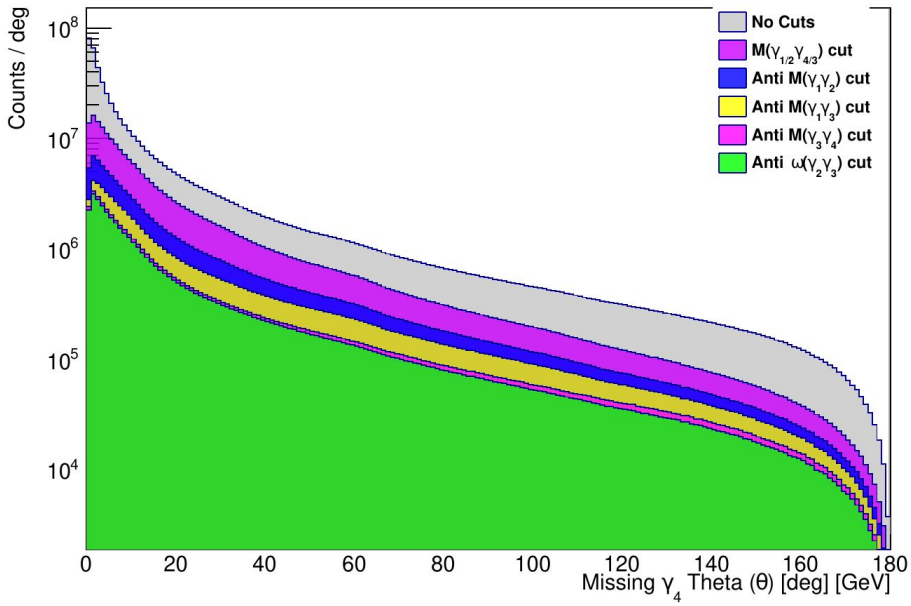


Theta distribution

Fall 2018 MC - b1 Simulations

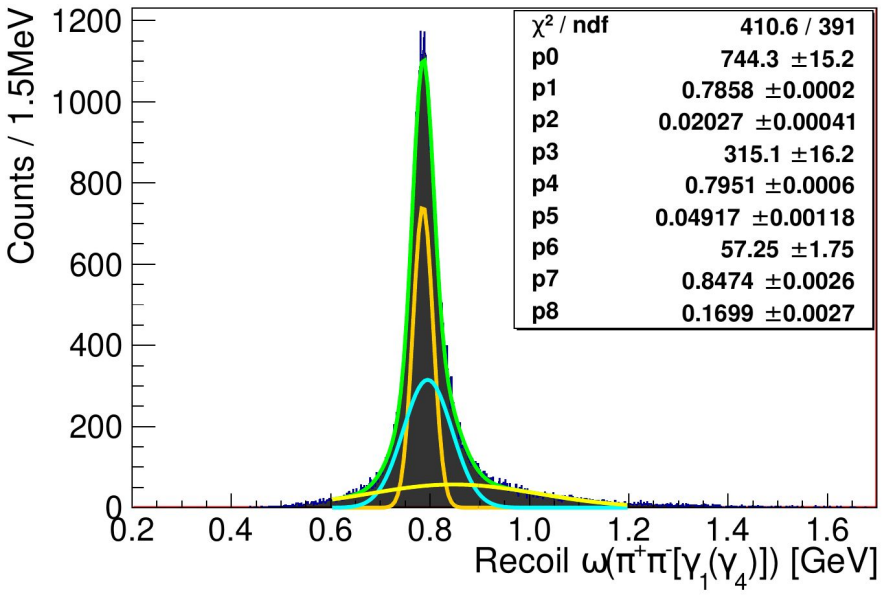


Fall 2018 Data

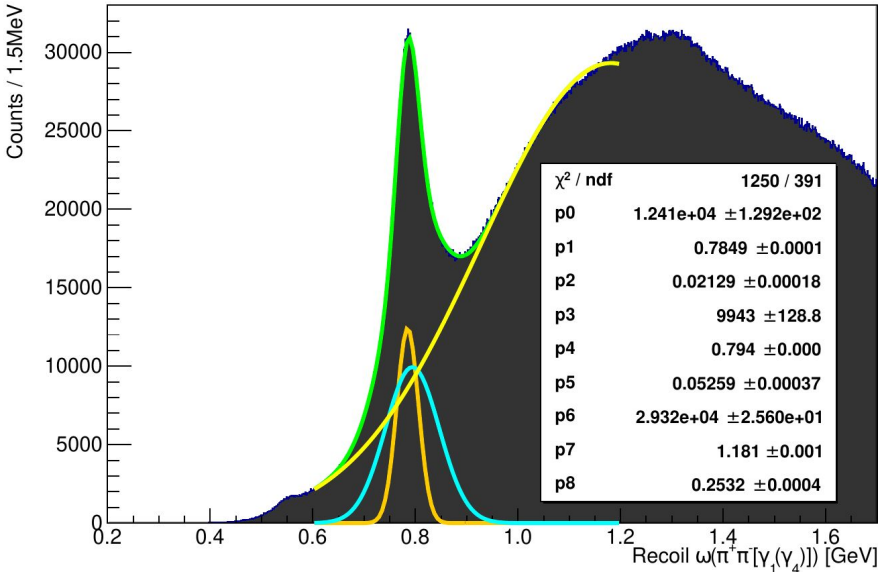


After all Cuts

Fall 2018 MC - b1 Simulations



Fall 2018 Data

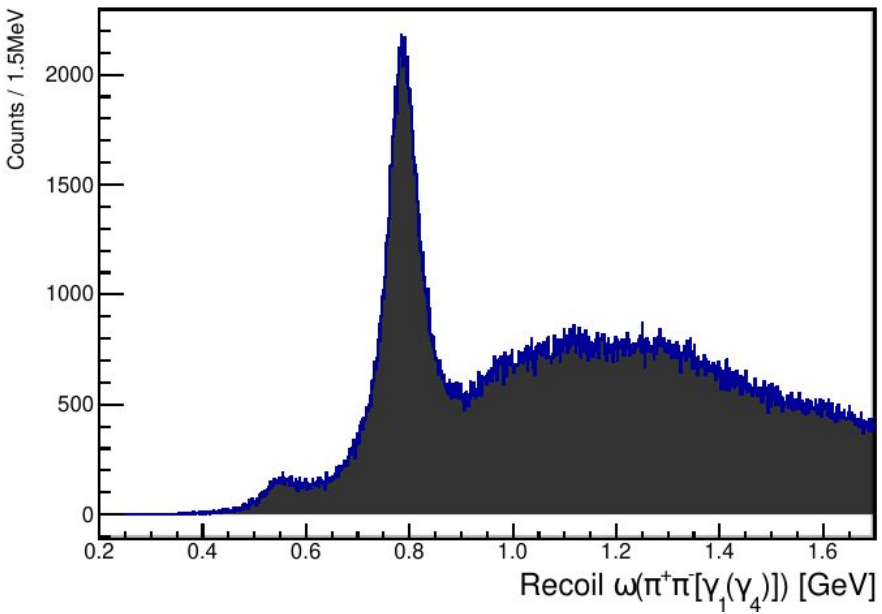


Current recipe to compute efficiency

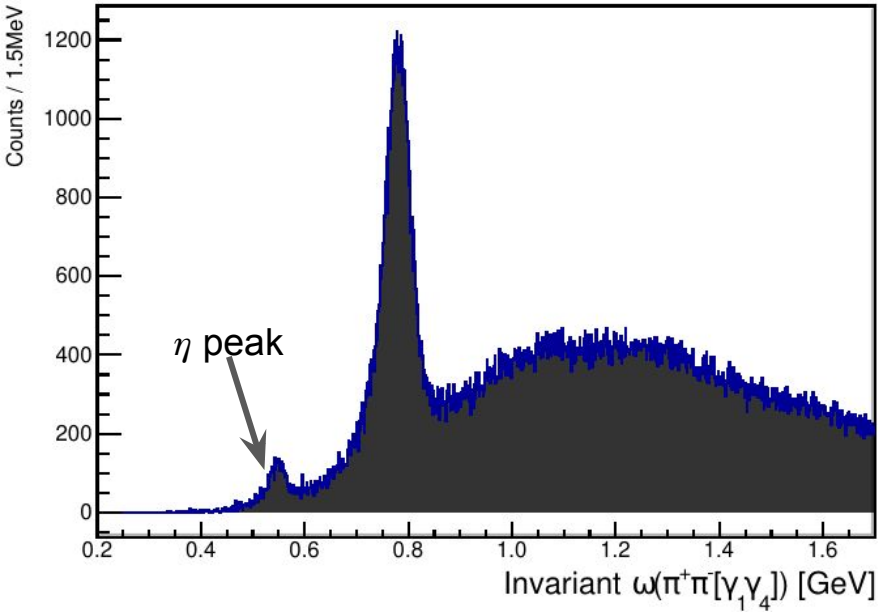
$$\epsilon = \frac{\omega_{inv}}{\omega_{inv} + \omega_{miss}; 1\ shower}$$

Fall 2018 Data

The “Denominator”



The “Numerator”



$$\overrightarrow{P_4}(\omega_{Recoil}) = \overrightarrow{P_4}(\gamma) + \overrightarrow{P_4}(p) - \{\overrightarrow{P_4}(p') + \overrightarrow{P_4}(\pi^0[\gamma_2\gamma_3])\}$$

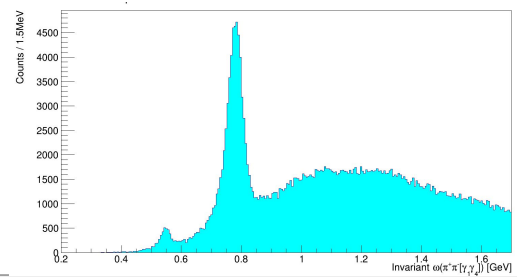
$$\overrightarrow{P_4}(\omega_{inv}) = \overrightarrow{P_4}(\pi^+) + P_4(\overrightarrow{\pi^-}) + \overrightarrow{P_4}(\pi^0[\gamma_1\gamma_4(found)])$$

Breaking into momentum and theta bins (Invariant Mass)

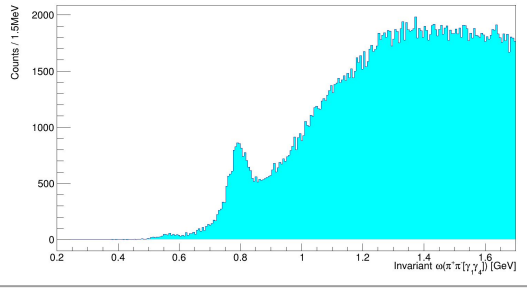
3 p bins

10 thea bins **10 - 11°** —Unlike eta study. Can stretch theta coverage to 60° in a few bins— **55 - 60°**

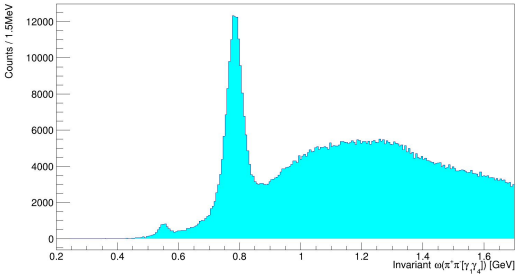
0.1 - 0.5 GeV



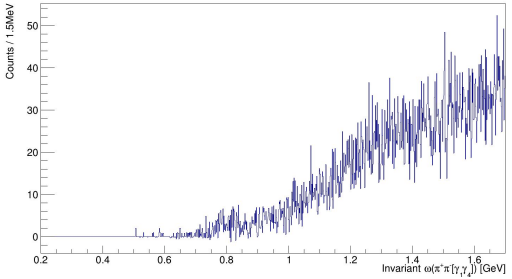
– .. –
Signal “extracted” up to 60°



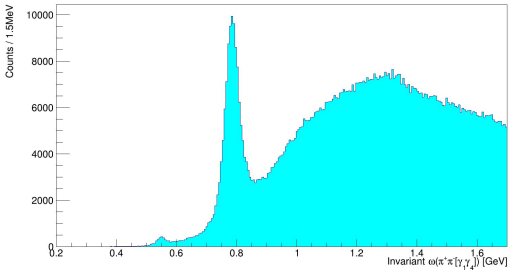
0.5 - 1.0 GeV



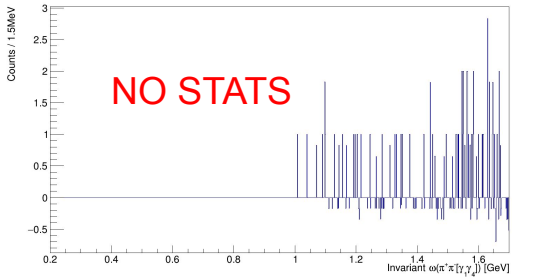
Signal “extracted” up to 45°



1.0 - 3.0 GeV



Signal “extracted” up to 30°



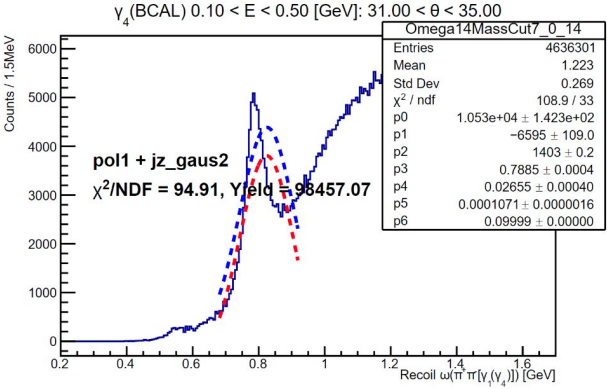
Trying out various fits to capture the background

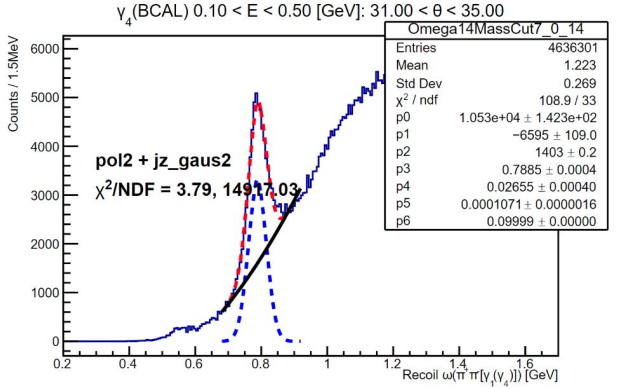
3 Fit functions have been tried so far.

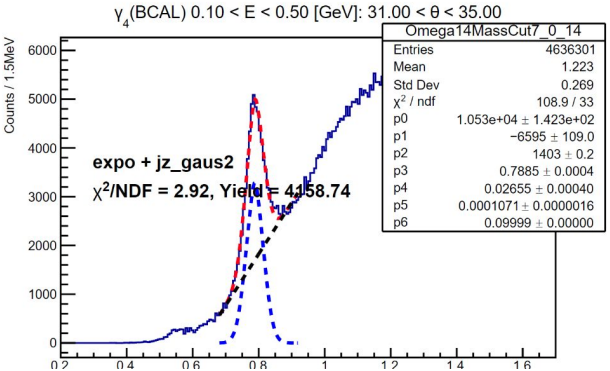
[Double Gaussian with constrained mean and Total intensity] with an exponential of degree 2 seems to model the spectrum well.

Choosing Fit Function dynamically based on Chi2/NDF

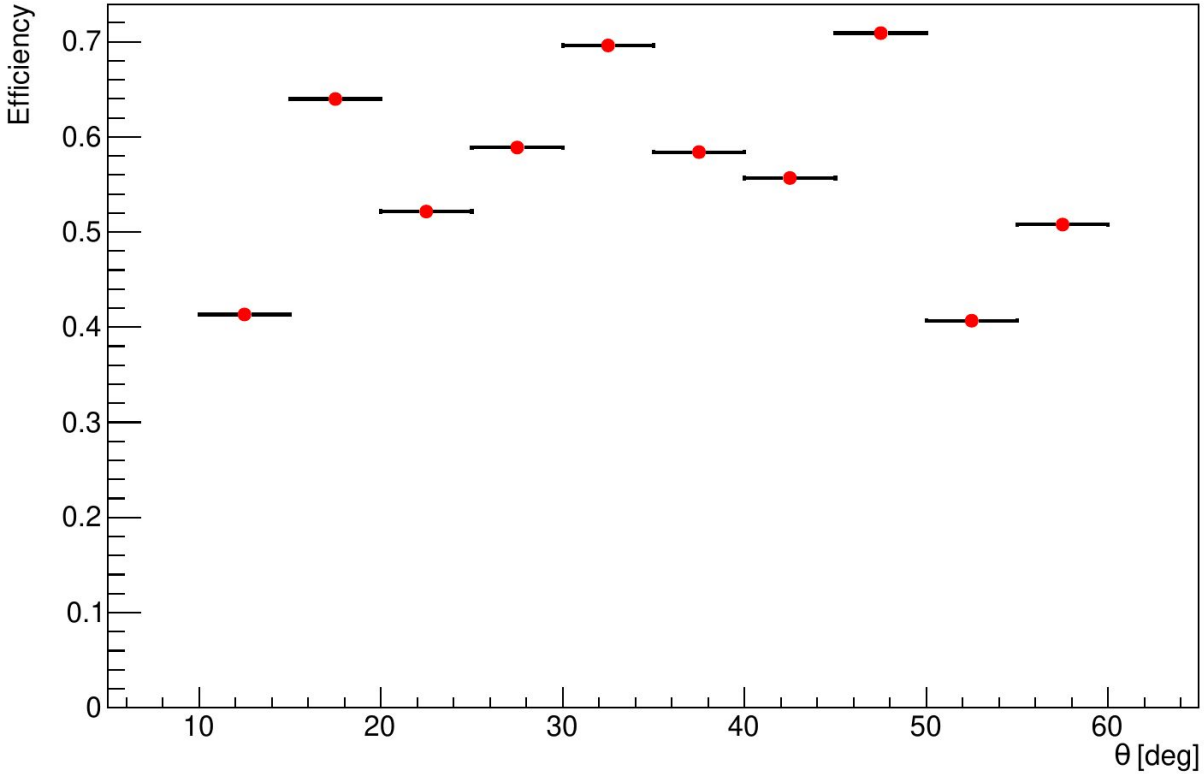
Each Fit repeated 20 times with Random initialized parameters.



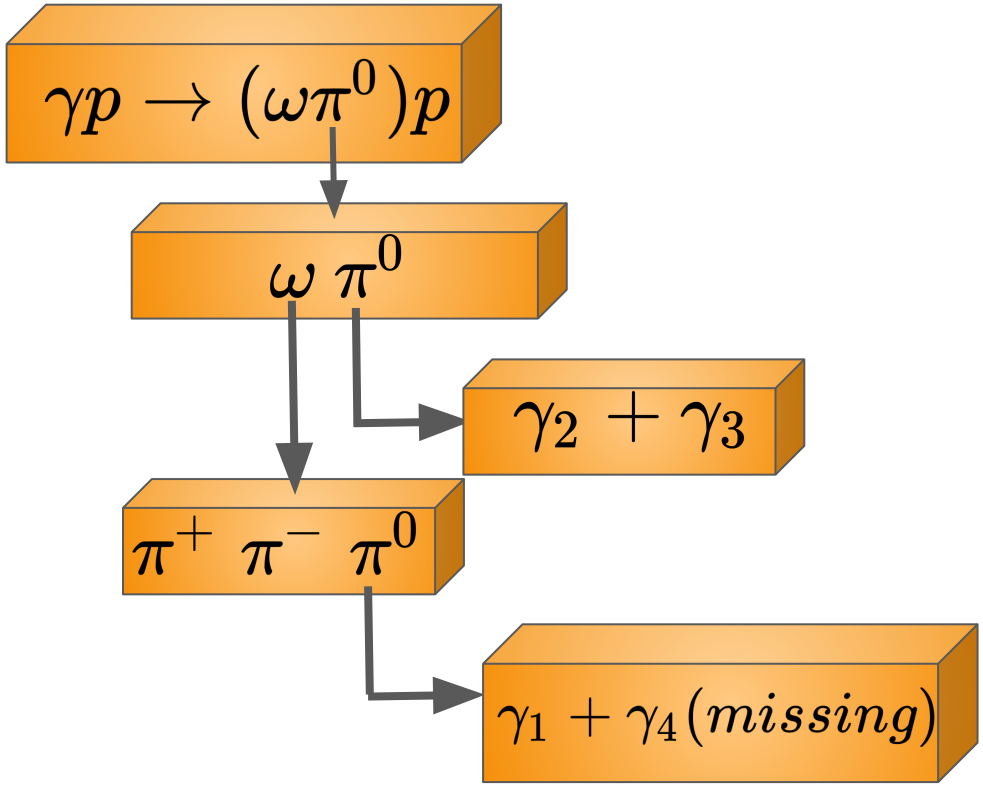




Certainly need to improve with Caution



"Preliminary" efficiency for
$0.10 < p_{\gamma} < 0.50$ GeV



γ_4

- Point into the BCAL
- Use fitted yields of ω to check if found

Method 1

- Work with missing ω mass before and after loose 2γ cuts.

$$\epsilon = \frac{\omega_{miss};\ 4\ good\ showers}{\omega_{miss};3\ or\ 4\ good\ showers}$$

Method 2

- Fit invariant ω mass if missing photon found
- Else fit missing ω mass.

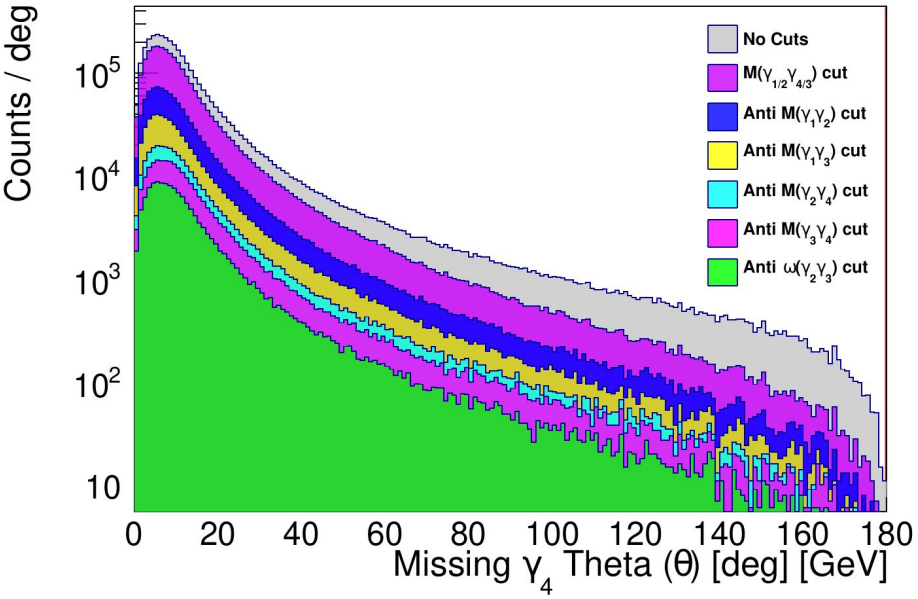
$$\epsilon = \frac{\omega_{inv}}{\omega_{inv} + \omega_{miss};\ 1\ shower}$$

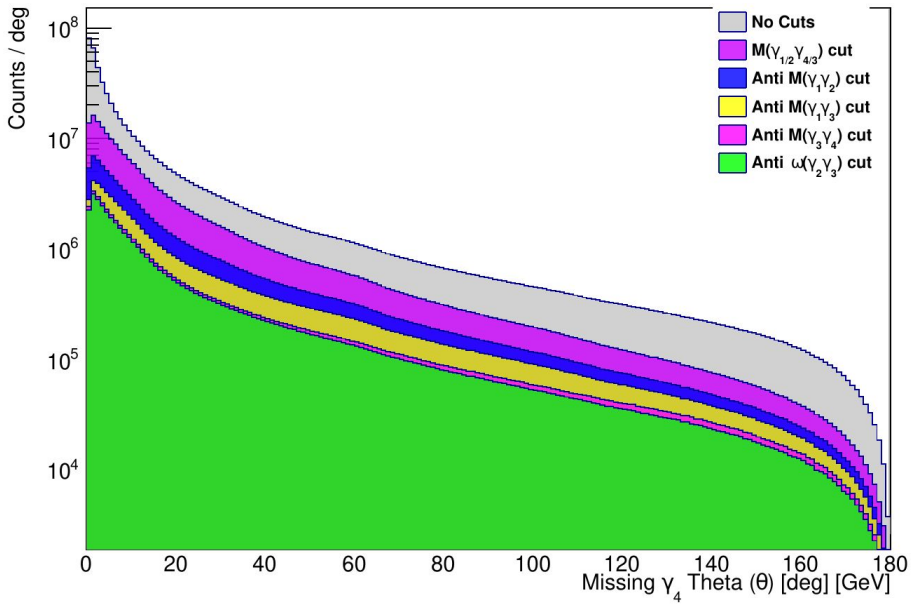
- Charged tracks π^+, π^-, p
- 2 photons corresponding to Bachelor π^0
- Another neutral shower is found along with an extra shower which makes up π^0 of the ω

- Pros : Promising statistics compared to all other studies
- Con : Fitting the ω tricky. Still working on finalizing the fitting function to extract Signal Yield

Promising statistics in this channel

Also, May be show a plot on higher theta spectrum where one cannot see eta but can see omega peak





Details

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Reaction1:Flags B4_T0_S1_M7_F1
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- Data
  - Analysis Launch Fall2018 Ver20
  - tree_gpi0pippimmissg__B4_F1_T0_S1_M7
  - About 15% of data is shown here

The reaction is:

$$p\gamma \to p\pi^0\omega \to \pi^+\pi^-\pi^0$$

The reaction in ReactionFilter is;

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Configuration

```
# add the plugins to be included in the analysis of the *.hddm data file
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PLUGINS ReactionFilter,mcthrown_tree

# for simulation, specify the mc variation to retrieve the correct calibration constants
JANA_CALIB_CONTEXT variation=mc
#REST:DATAVERSIONSTRING recon_RunPeriod-2017-01_ver03
#ANALYSIS:DATAVERSIONSTRING analysis_RunPeriod-2017-01_ver32

#ANALYSIS:DATAVERSIONSTRING analysis-2017_01-ver32
#NALYSIS:DATAVERSIONSTRING analysis-2018_08-ver04
#REST:DATAVERSIONSTRING recon_RunPeriod-2017-01_ver03
#ANALYSIS:DATAVERSIONSTRING analysis_RunPeriod-2017-01_ver035

# if requested multiple threads/cores in qlogin or qsub command then use multithreading
NTHREADS 8

# List possible reactions to study in ReactionFilter plugin
# The format follows
# https://halldsvn.jlab.org/repos/trunk/scripts/monitoring/launch/jana_analysis.config

#Reaction1 1_14__7_7_8_9_14
#Reaction1:Flags B4

#COMBO:MAX_NEUTRALS 10
#Reaction1:Flags B4 T10

Reaction1 1_14__m1_1_7_8_9_14
Reaction1:Flags B4_T0_S1_M7_F1
```