

# Updates on $\eta \rightarrow \gamma\gamma\pi^0$

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# Introduction

Conversion from ReactionFilter/DSelector to low level objects

- ReactionFilter applies more than 20 different selection criteria which are at worst:
  - ▶ Not documented
  - ▶ Not optimized
- Low level objects used
  - ▶ BCAL/FCAL/CCAL showers factories (basic)
  - ▶ Neutral showers factory (basic, combination of the 3 above factories)
  - ▶ Neutral particle hypothesis factory (intermediate, “distinguishes” between charges, photons, and neutrons)

Producing new simulation sets with

- Standard JEF geometry
- Without DIRC
- Without DIRC/TOF
- Without FDC/DIRC/TOF
- With FDC/DIRC/TOF and air between target and FCAL replaced by Helium

# Photon selection criteria

Events with 4 photons only

- BCAL, 6 ns within RF and cluster energy above 250 MeV
- FCAL, 3 ns within RF and cluster energy above 250 MeV
- CCAL not used
- TOF veto
  - ▶ TOF, 0.5 ns within RF to avoid removing events backsplashing
  - ▶  $|x_{\text{TOF}} - x_{\text{FCAL}}| > 6 \text{ cm}$  and  $|y_{\text{TOF}} - y_{\text{FCAL}}| > 6 \text{ cm}$

Without discarding events with out of sync photons/tracks but still be able to veto if needed non-reconstructed tracks creating a cluster in BCAL

# Proton selection criteria

Events with one track only, no PID and no timing selection criteria applied

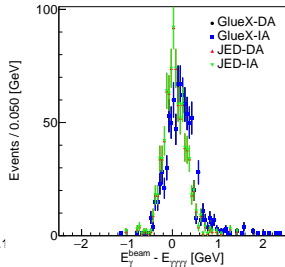
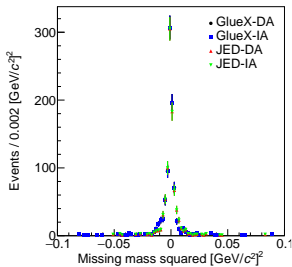
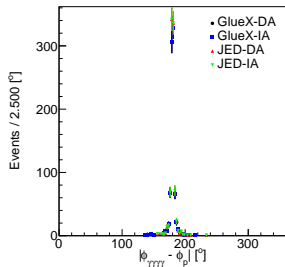
# $\gamma\gamma\pi^0$ selection criteria

Out of 4 photons, there are 6 combinations to reconstruct  $\gamma\gamma\pi^0$  final state

- For each combination, up to 7 different final states are reconstructed
  - ▶  $\pi^0\pi^0$
  - ▶  $\pi^0\eta$
  - ▶  $\pi^0\eta'$
  - ▶  $\eta\eta$
  - ▶  $\eta\eta'$
  - ▶  $\eta'\eta'$
  - ▶  $\gamma\gamma\pi^0$
- All final states passing the “mass” selection criteria are selected and their corresponding  $\chi^2 = \sum (\frac{m_{th} - m_{exp}}{\Delta m_{exp}})^2$  is calculated
- For each event, the final state with the best  $\chi^2$  is selected

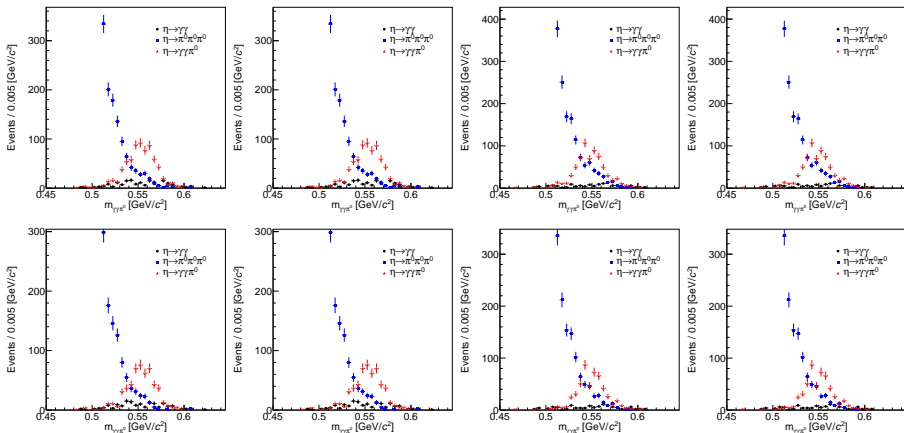
# $\gamma p \rightarrow \eta(\rightarrow \gamma\gamma\pi^0)p$ selection criteria

- Coplanarity fulfilled
- Missing mass squared consistent with zero
- Elasticity fulfilled



# $\gamma p \rightarrow \eta(\rightarrow \gamma\gamma\pi^0)p$ selection criteria

- Left two columns, JEF, right two columns GlueX
- Top row, no  $\pi^0\pi^0$  veto applied, bottom row,  $\pi^0\pi^0$  veto applied
- Odd column, IA, even column DA



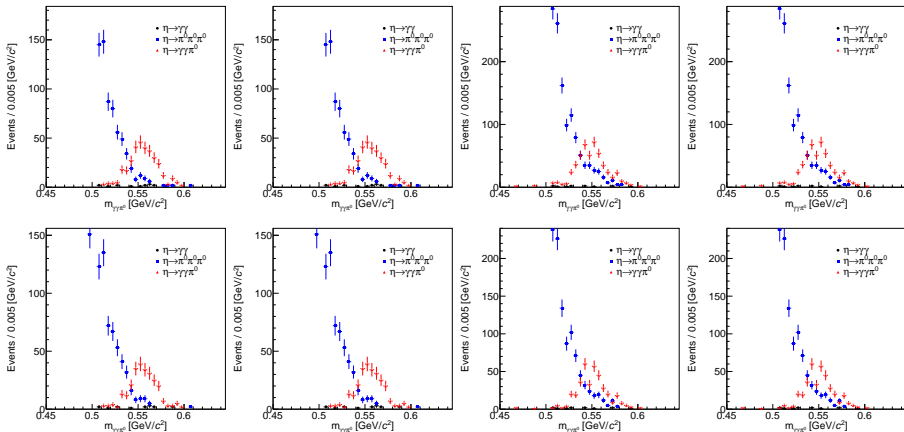
- No major difference between GlueX & JEF apart slightly better resolution
- $\chi^2$ -selection is reducing  $\eta \rightarrow \gamma\gamma$  efficiently



# $\gamma p \rightarrow \eta(\rightarrow \gamma\gamma\pi^0)p$ selection criteria

TOF veto applied

- Left two columns, JEF, right two columns GlueX
- Top row, no  $\pi^0\pi^0$  veto applied, bottom row,  $\pi^0\pi^0$  veto applied
- Odd column, IA, even column DA



- Major difference between GlueX & JEF, possibly a bug?
- A optimized TOF veto should slightly reduces the signal