

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

Igal Jaeglé

Thomas Jefferson National Accelerator Facility

for the GlueX Collaboration

February 16, 2024



Table of contents

- 1 Selection criteria
- 2 Reconstruction results
- 3 Physics Informed Neural Network

Selection criteria

Complete move from High-Level Objects (ReactionFilter/DSelector) to Low-Level Objects
Selection criteria:

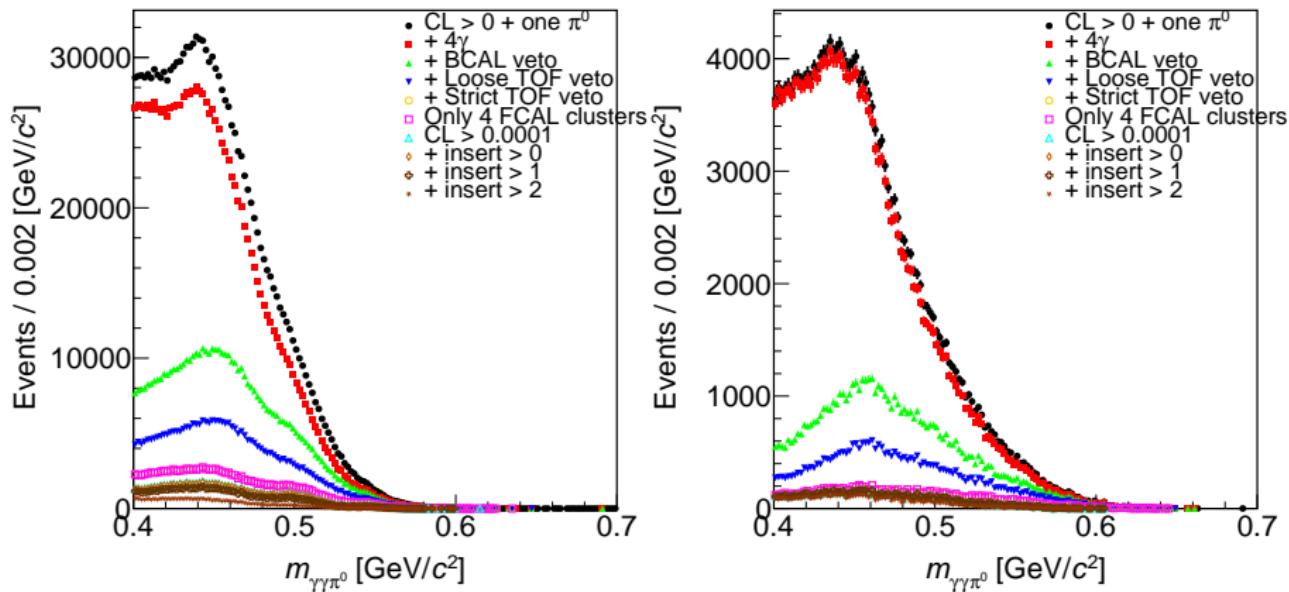
- 4 “photon” hypotheses DNeutral_Shower with
 - ▶ $|t_\gamma^{\text{BCAL}} - t_{\text{RF}}| \leq 6 \text{ ns}$ & $|t_\gamma^{\text{CAL}} - t_{\text{RF}}| \leq 3 \text{ ns}$
 - ▶ $E_{\text{cluster}} \geq 250 \text{ GeV}$
- χ^2_{test} to select best $\gamma\gamma\pi^0$ combination and discriminate other possible final states ($\pi^0\pi^0$, $\pi^0\eta$, $\eta\eta$, $\pi^0\eta'$, $\eta\eta'$, $\eta'\eta'$)
- χ^2_{test} to select best track coplanar to $\gamma\gamma\eta$

Is tested on MC simulation of 2017-01 run periods

- 10M genEtaRegge $\eta \rightarrow \gamma\gamma\pi^0$
- 32.57M genEtaRegge $\eta \rightarrow \pi^0\pi^0\pi^0$
- 39.31M genEtaRegge $\eta \rightarrow \gamma\gamma$

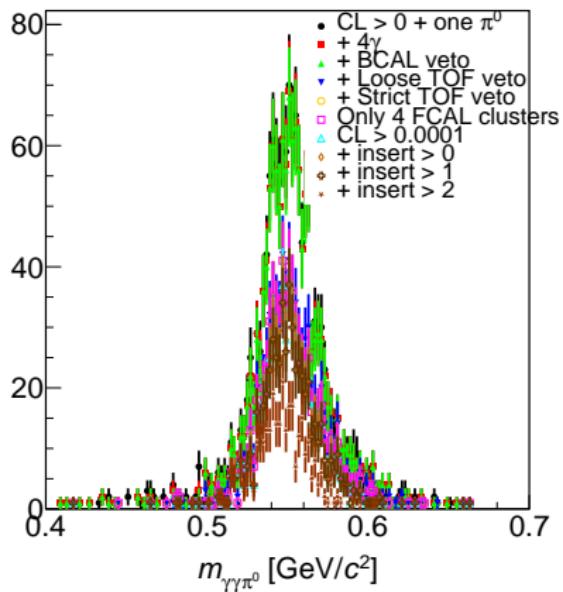
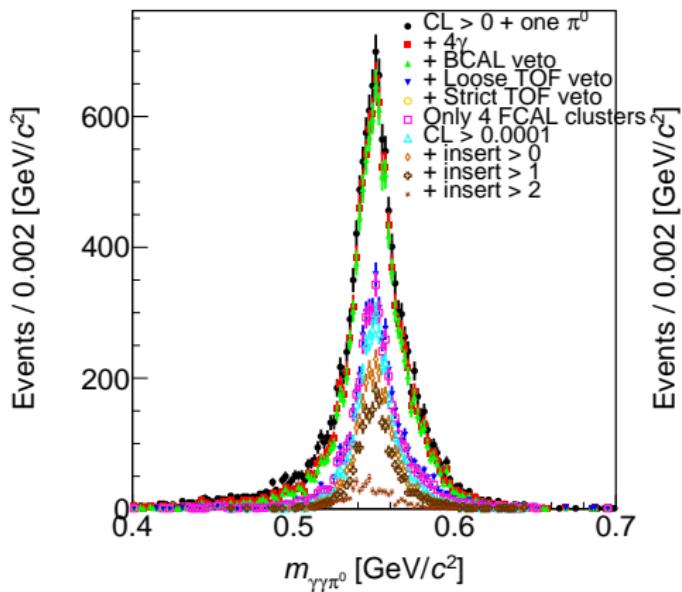
Reconstruction results

For exclusive (left) and inclusive (right) cases: bkg $\eta \rightarrow \pi^0\pi^0\pi^0$



Reconstruction results

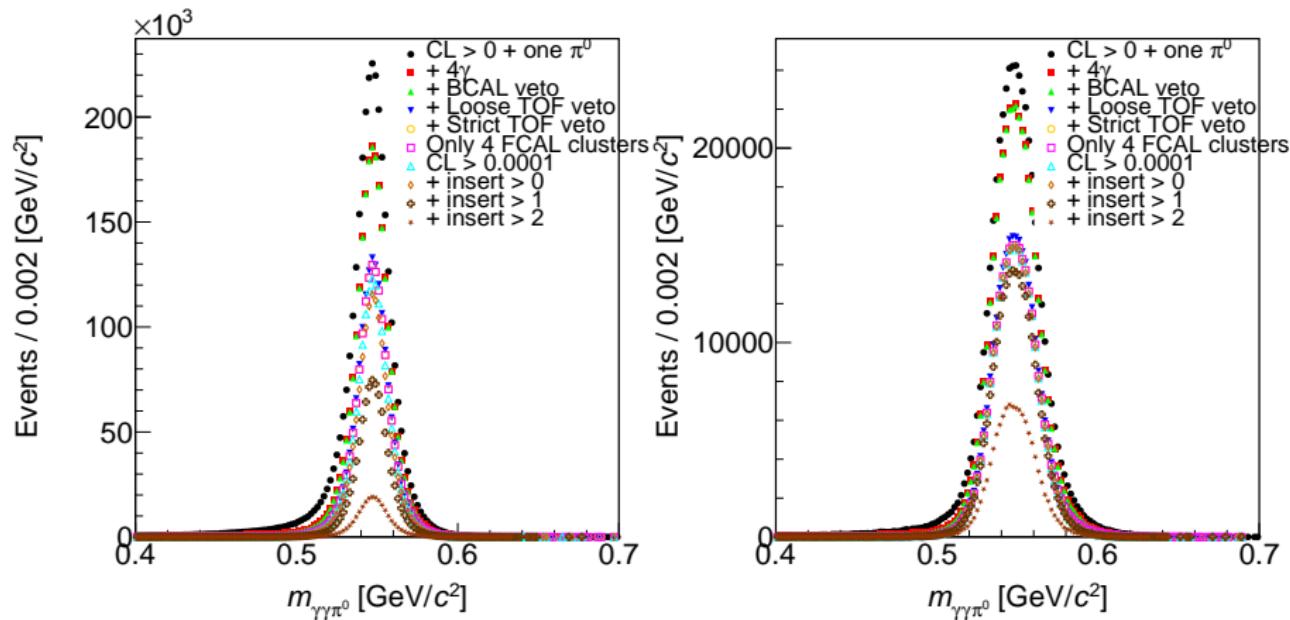
For exclusive (left) and inclusive (right) cases: bkg $\eta \rightarrow \gamma\gamma$



A bug in the TOF reconstruction was found recently

Reconstruction results

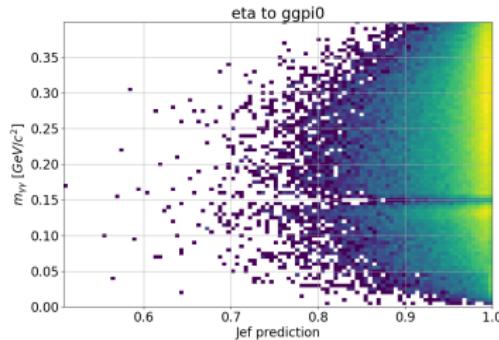
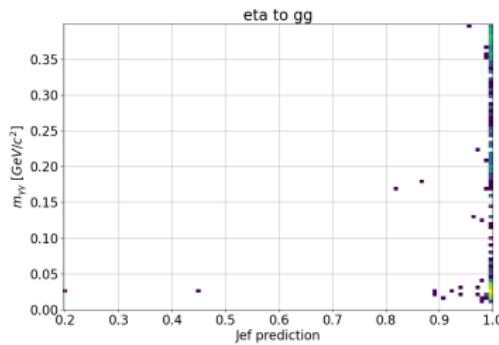
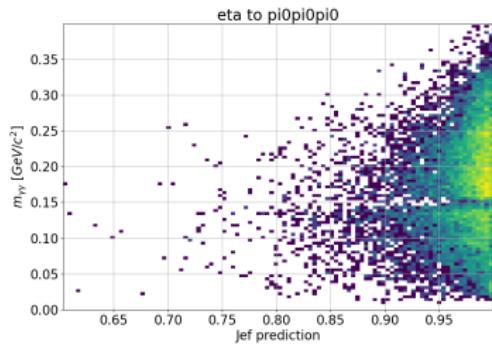
For exclusive (left) and inclusive (right) cases: signal $\eta \rightarrow \gamma\gamma\pi^0$



A bug in the TOF reconstruction was found recently

Physics Informed Neural Network

First steps with only FCAL shower features



Promising but results must hold after multiple training with slightly different initial states