$\eta \to 2\gamma\pi^0$ status

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Introduction

PrimEx-eta "veto" implemented in ijaegle-veto branch (halld_recon & gluex_root_analysis) and is currently reviewed by Sean, Simon, and Matt.

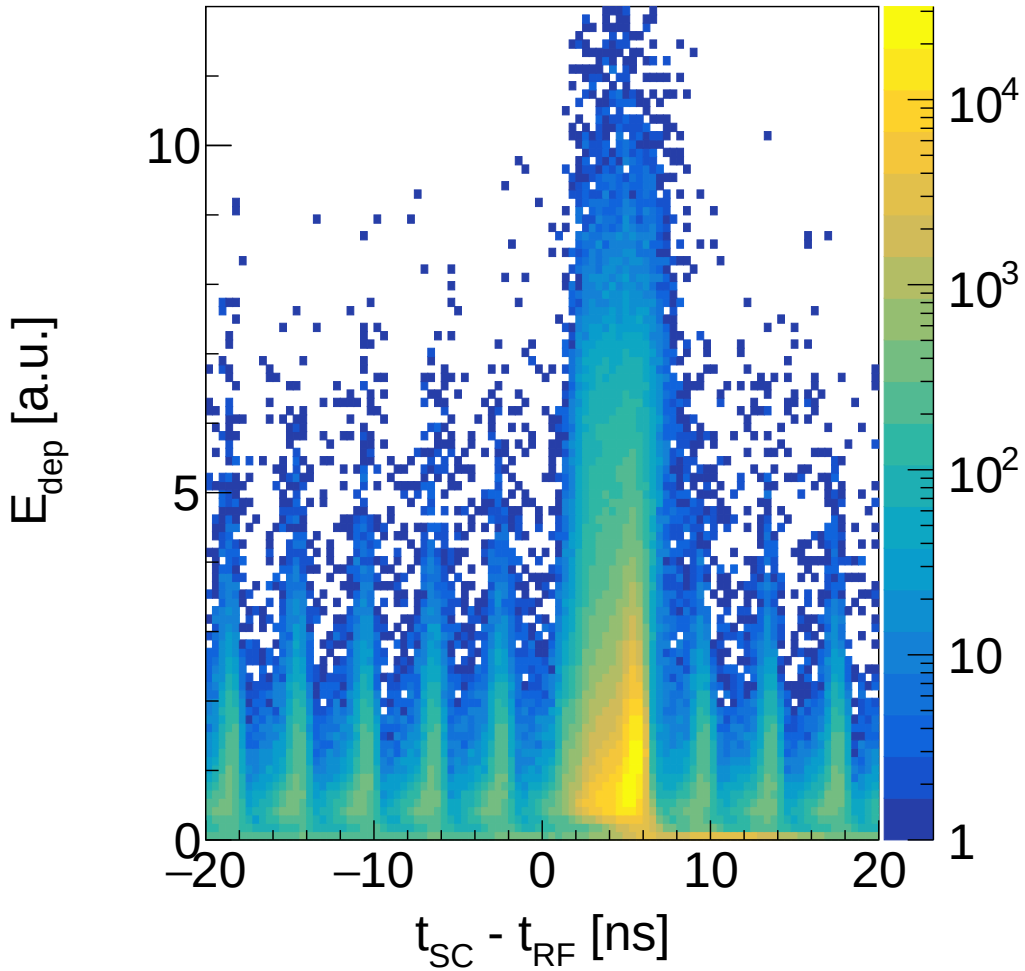
- Flag neutral showers which are not matched with a reconstructed tracks but match hits in SC and TOF
- Matching TOF & SC hits saved for $|\Delta x|/|\Delta y| < 10$ cm and $\Delta\phi < 25^o$, respectively

Increase signal sample by 50

SC veto

Select SC hits in coincidence with RF and an energy deposided above 0.2 in a.u.

- SC_RF_CUT_MIN = 1.0 ns
- SC_RF_CUT_MAX = 7.0 ns
- SC_Energy_CUT = 0.2 a.u.

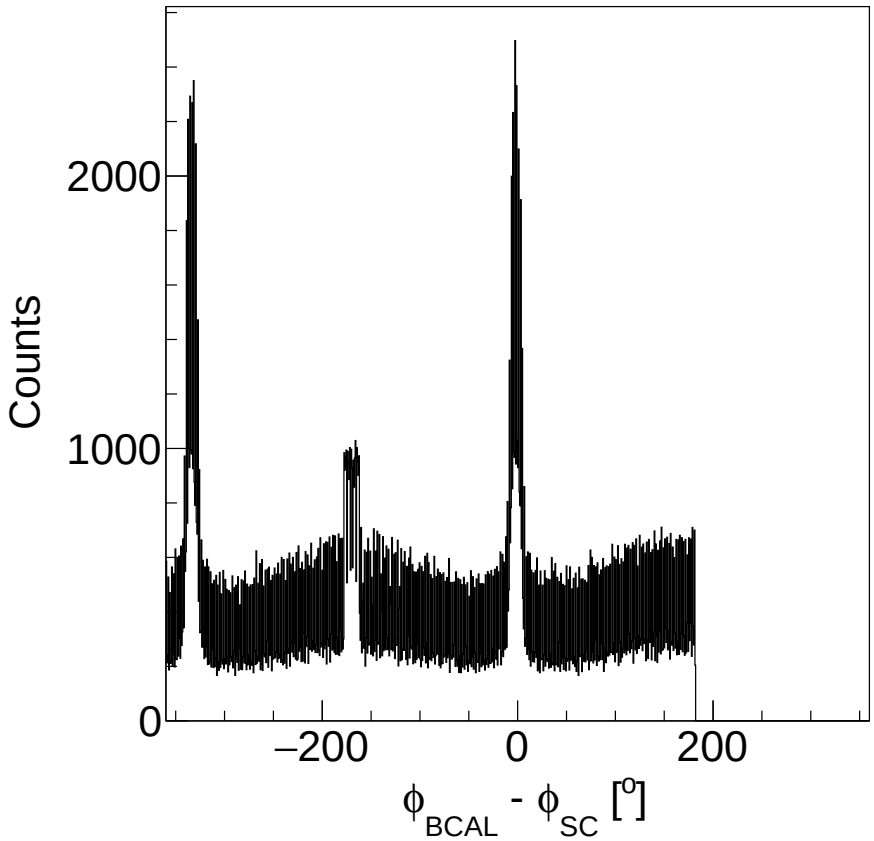


SC veto

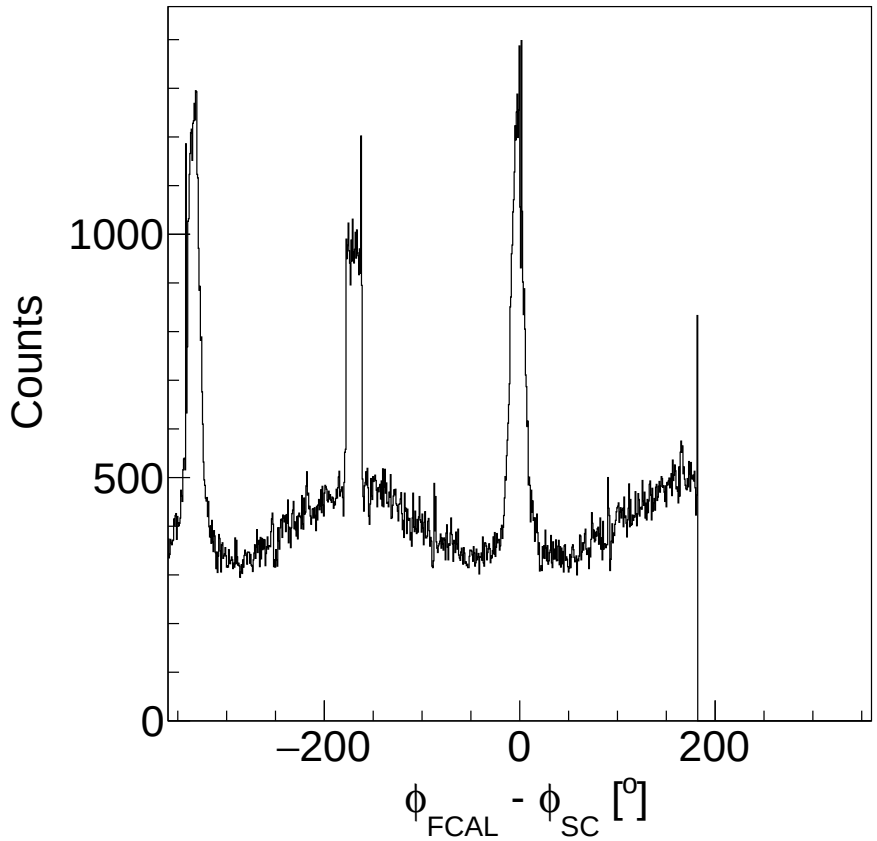
Then compare azimuthal angles between SC hits and BCAL/FCAL showers

- SC_FCAL_PHI_CUT $= 25^o$
- SC_BCAL_PHI_CUT $= 15^o$

- SC vs. BCAL (PrimEx-eta data set field off)



- SC vs. FCAL (PrimEx-eta data set field off)



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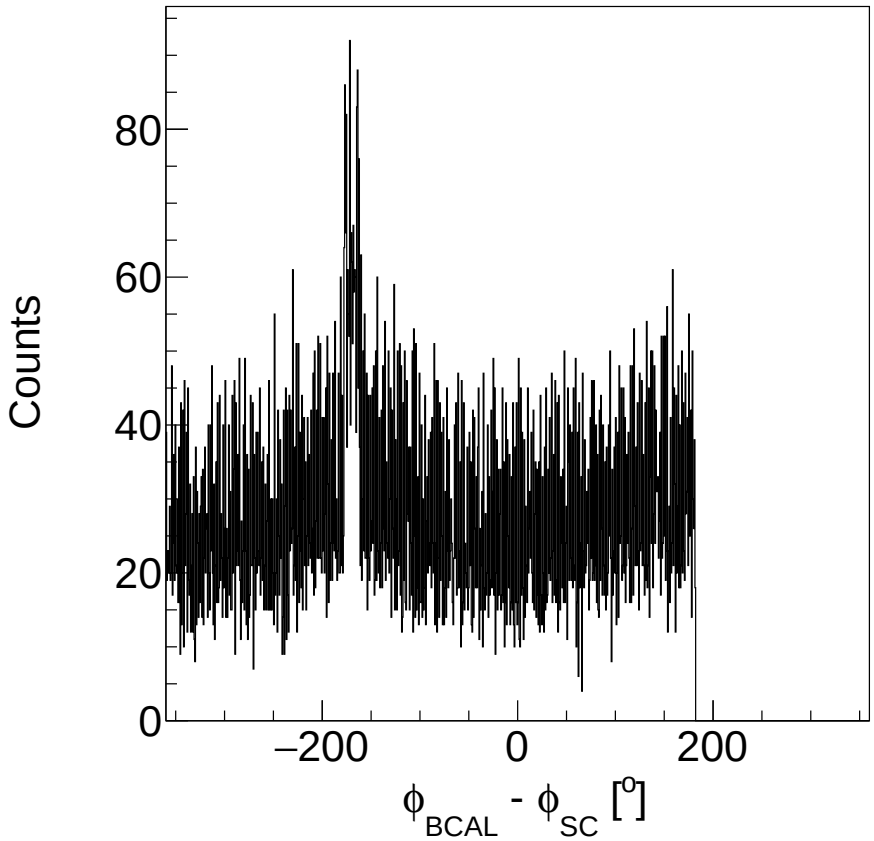
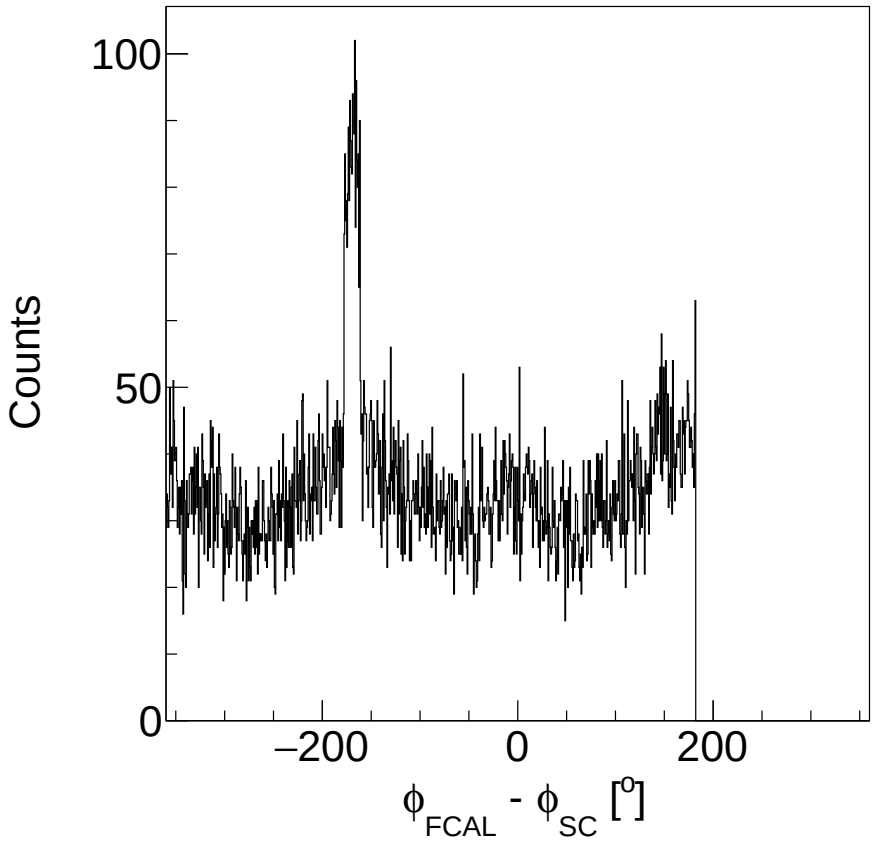


- SC vs. FCAL (PrimEx-eta data set field on)



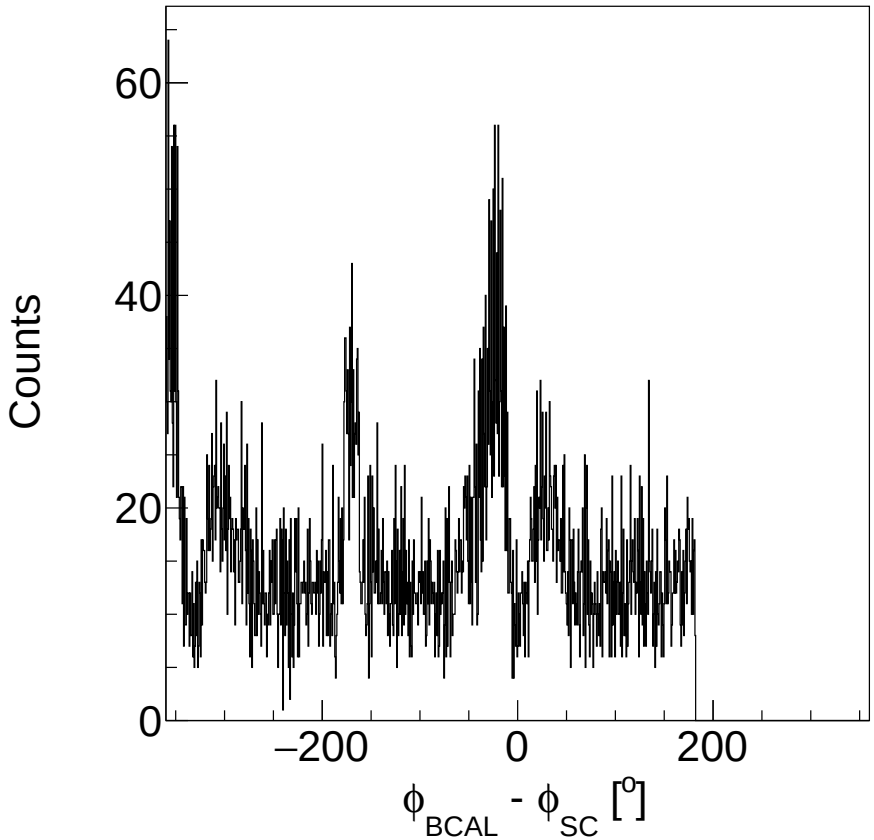
No visible contamination

SC veto

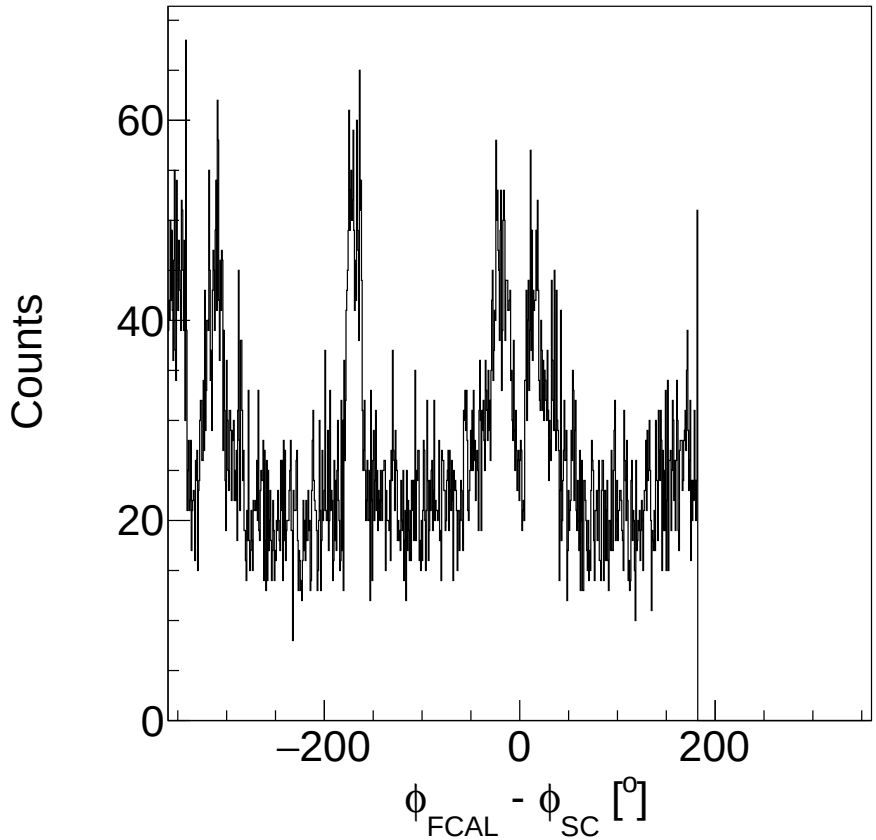
Then compare azimuthal angles between SC hits and BCAL/FCAL showers for shower match

- SC_FCAL_PHI_CUT $= 25^o$
- SC_BCAL_PHI_CUT $= 15^o$

- SC vs. BCAL (PrimEx-eta data set field on)



- SC vs. FCAL (PrimEx-eta data set field on)

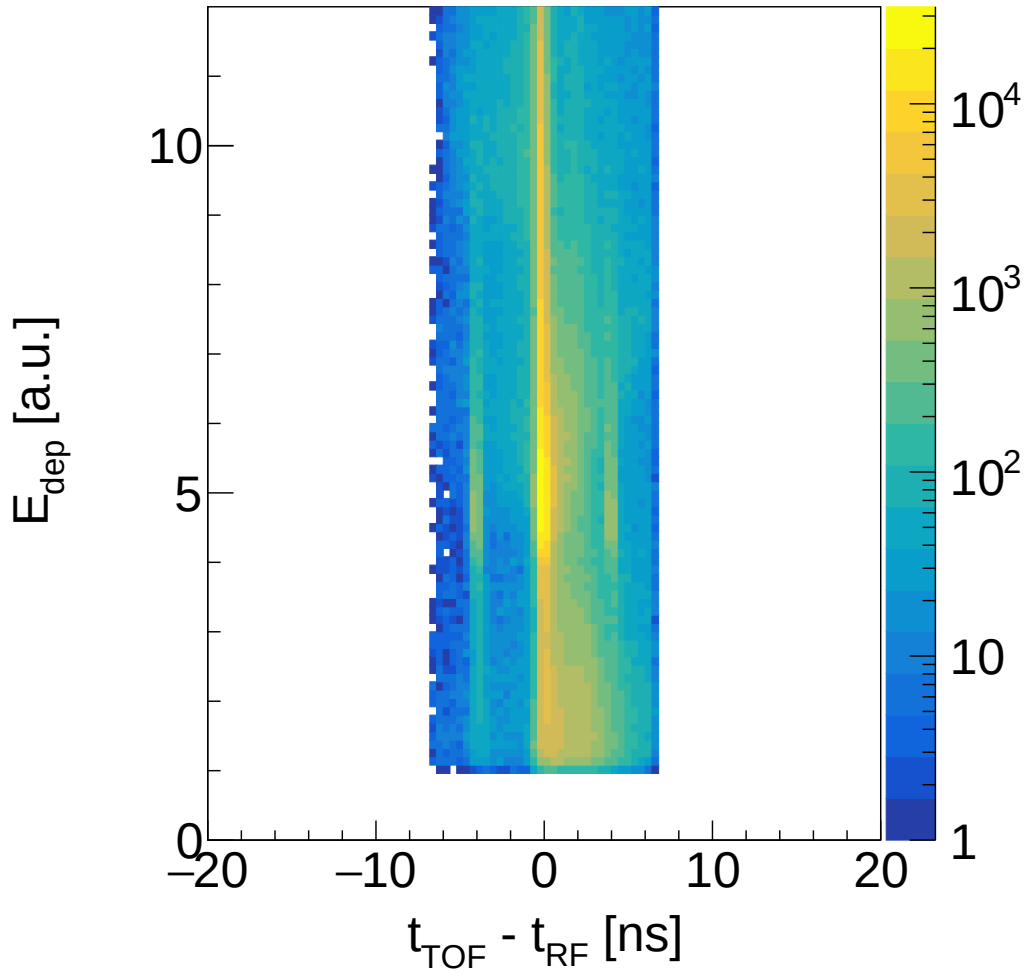


Magnetic field splits peak at zero and -330 into two

TOF veto

Select TOF hits in coincidence with RF

- TOF_RF_CUT = 6.5 ns

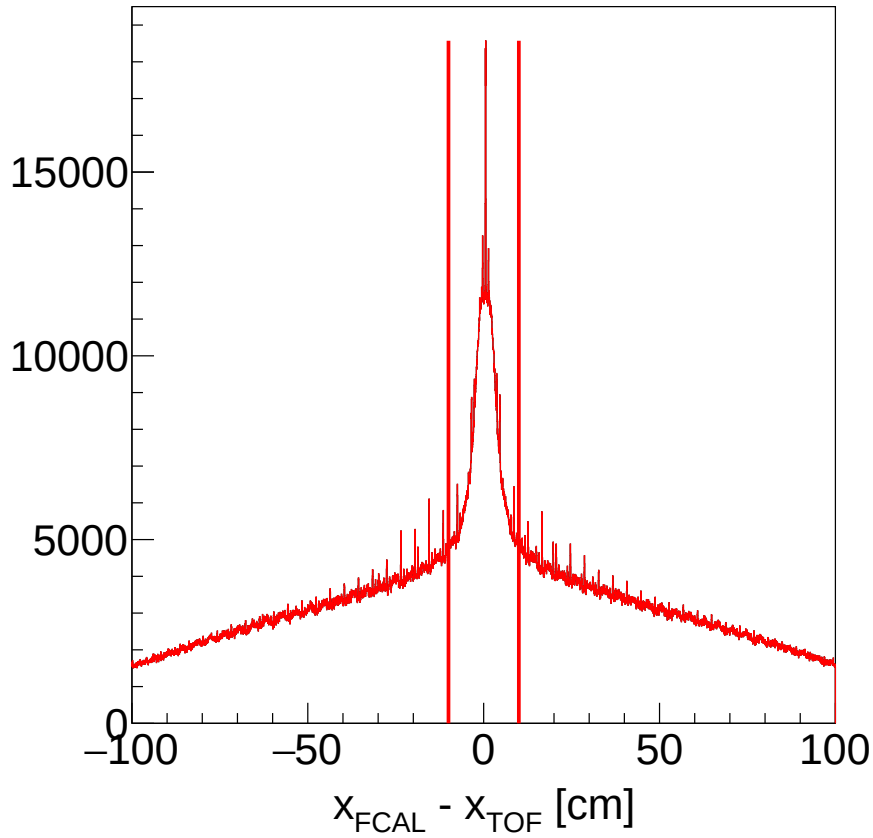


TOF veto

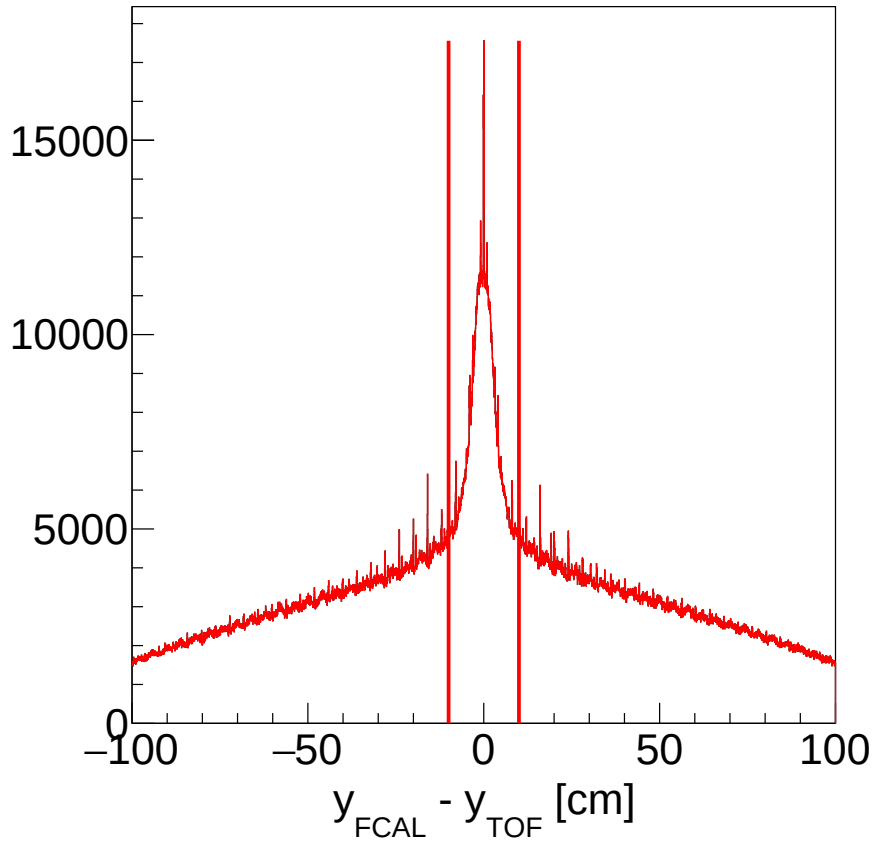
Then compare cartesian coordinates (x/y) between TOF hits and FCAL showers

- TOF_FCAL_x_match_CUT = 10 cm
- TOF_FCAL_y_match_CUT = 10 cm

- Δx (PrimEx-eta data set field off)



- Δy (PrimEx-eta data set field off)



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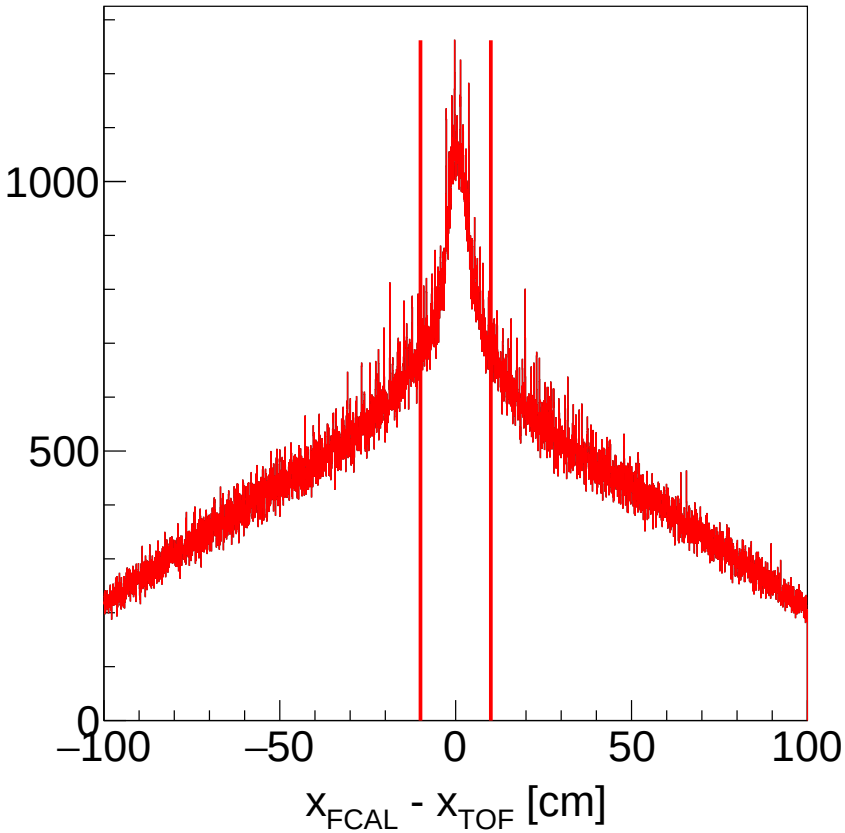
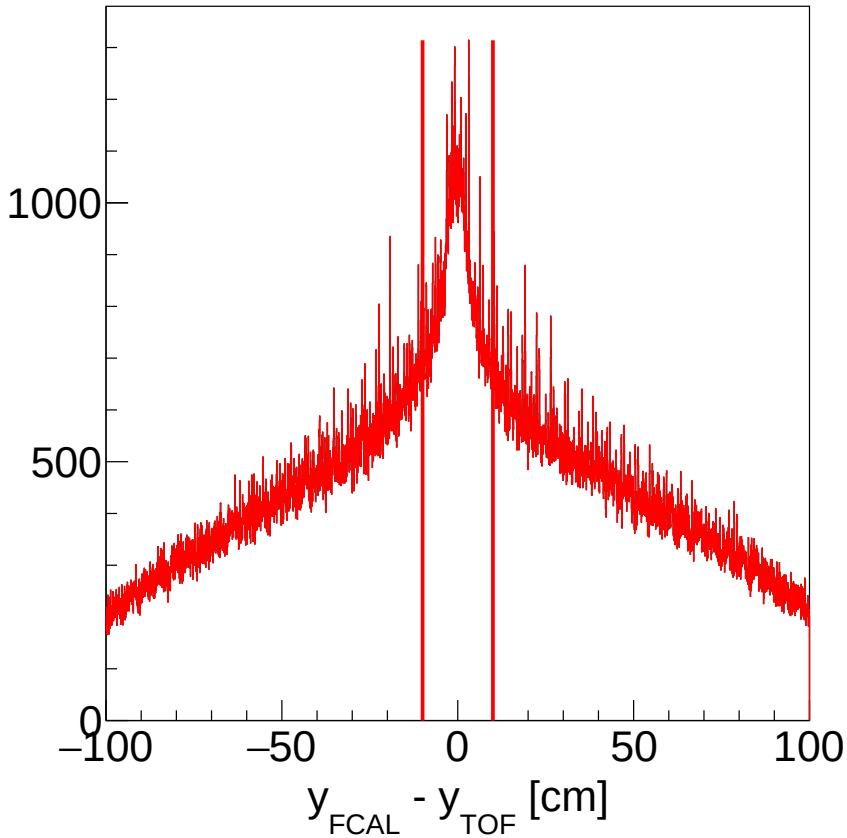


- Δy (PrimEx-eta data set field on)

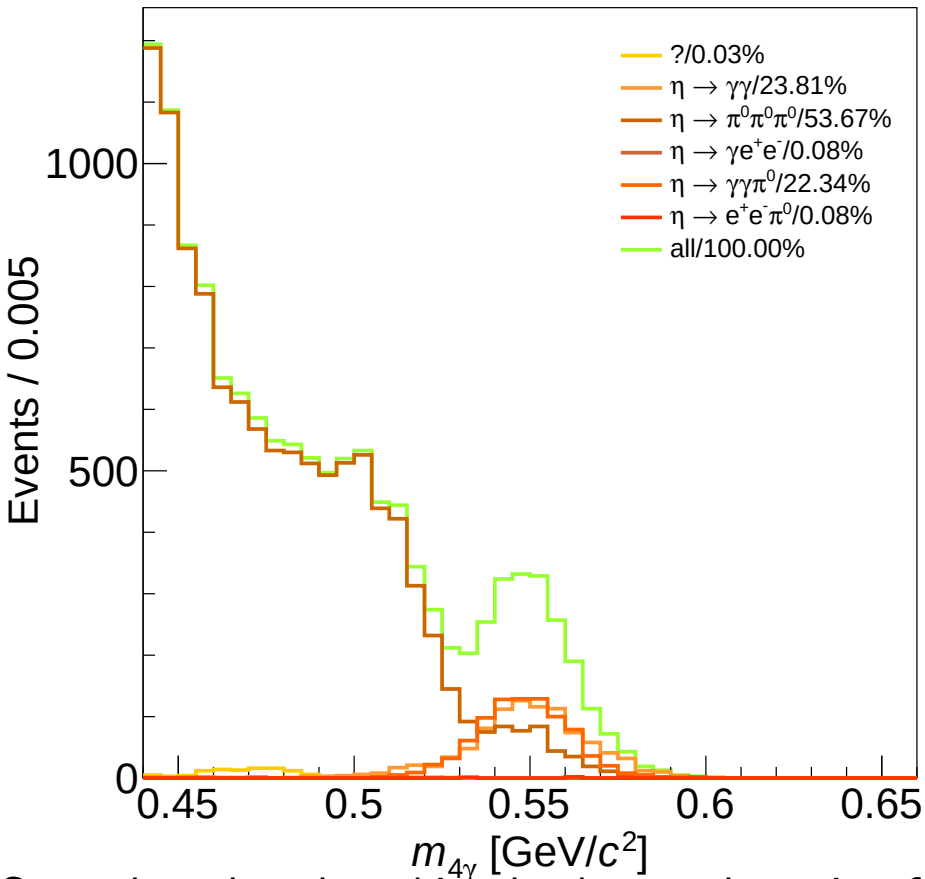


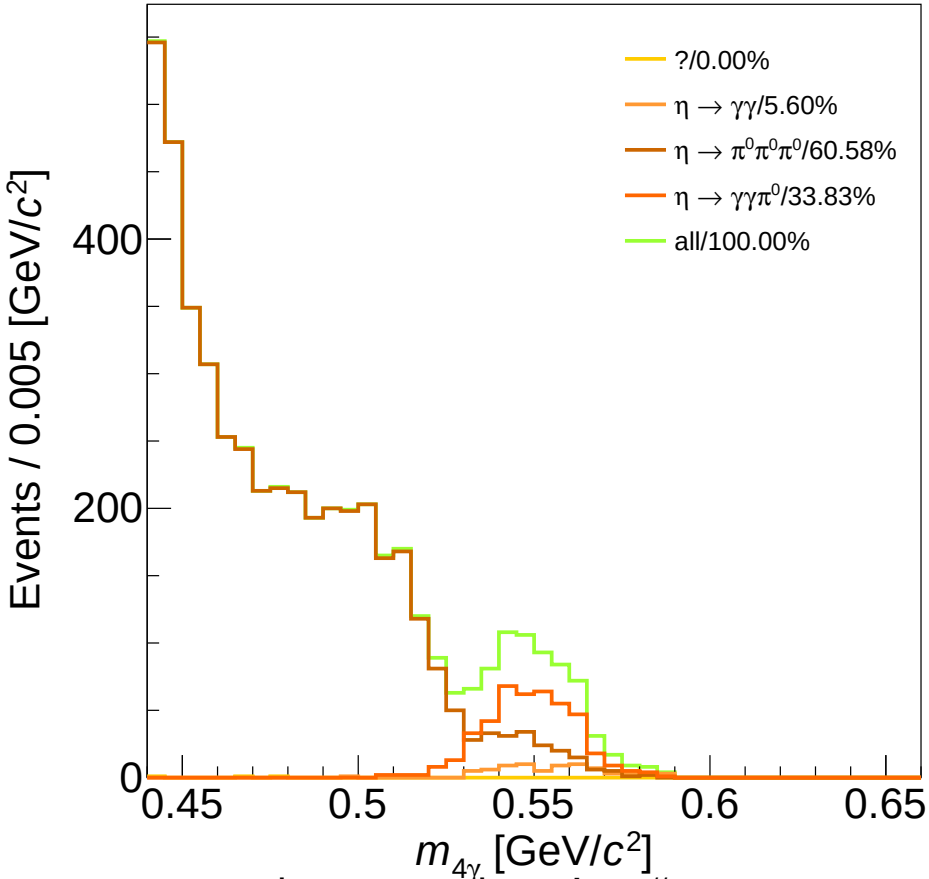
Large contamination of charge particles

Usefulness

Critical for GlueX/JEF (rare η decay) and PrimEx-eta if we want to use ReactionFilter/DSelector and also look at off neutron processes
Example: $\gamma p \to \eta p$ and $\eta \to 2\gamma\pi^0$

- Veto not applied (GlueX 2017-01 simulation)
- Veto applied (GlueX 2017-01 simulation)





Strongly reduced peaking background coming from $\eta \to \gamma\gamma$ where γ undergoing "gamma conversion" between the target and TOF

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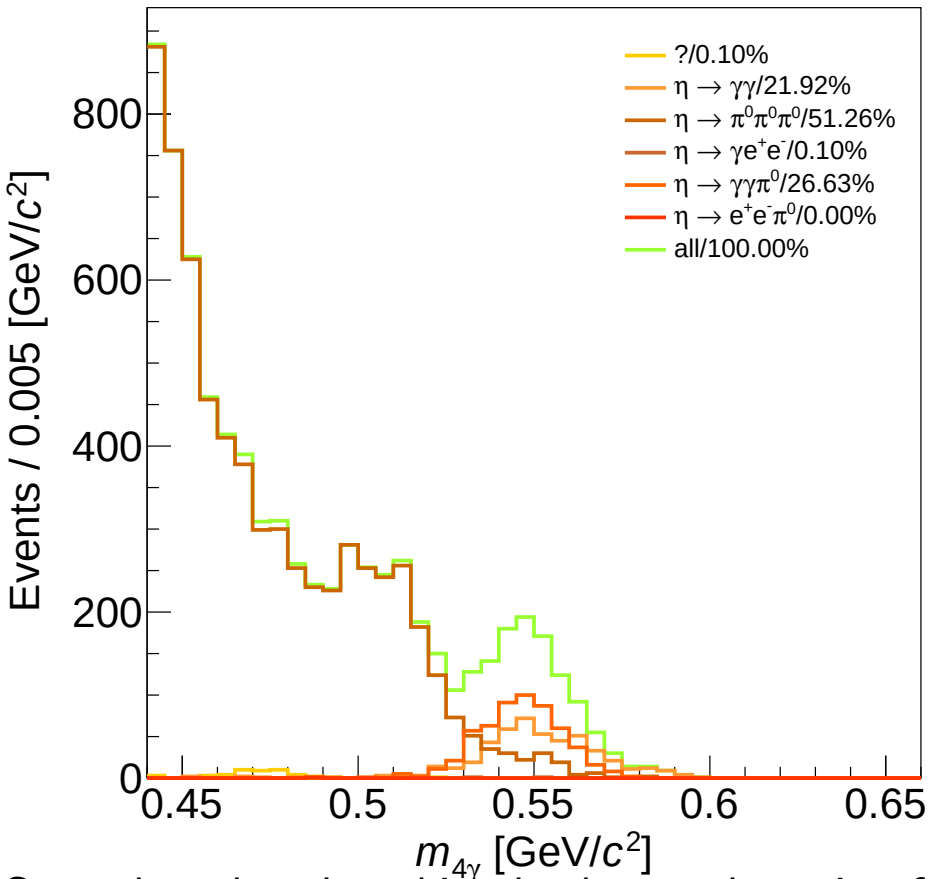
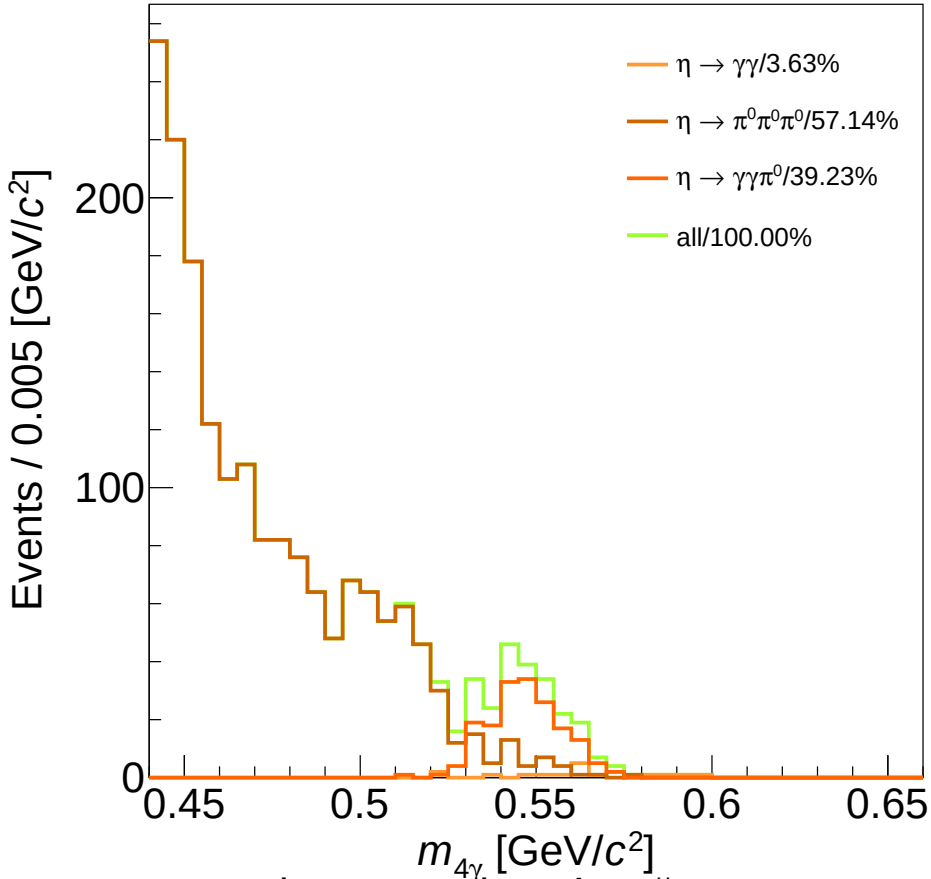


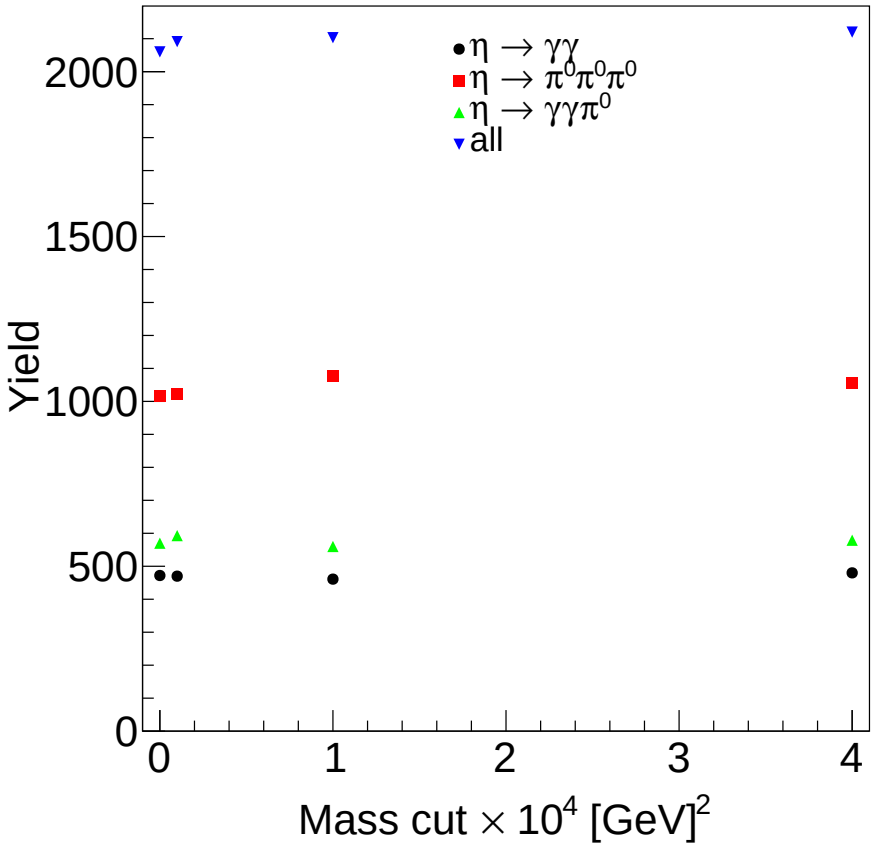


Strongly reduced peaking background coming from $\eta \to \gamma\gamma$ where γ undergoing "gamma conversion" between the target and TOF

Yield vs. cluster mass cut

Without and with TOF-veto applied

- Veto not applied (JEF simulation)



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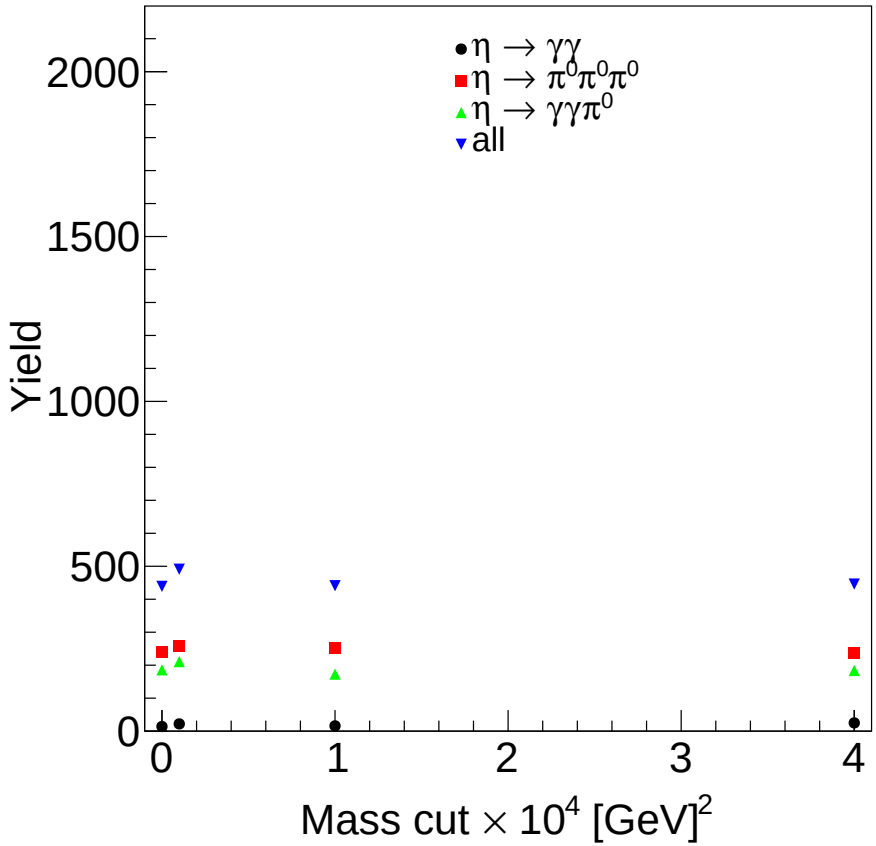
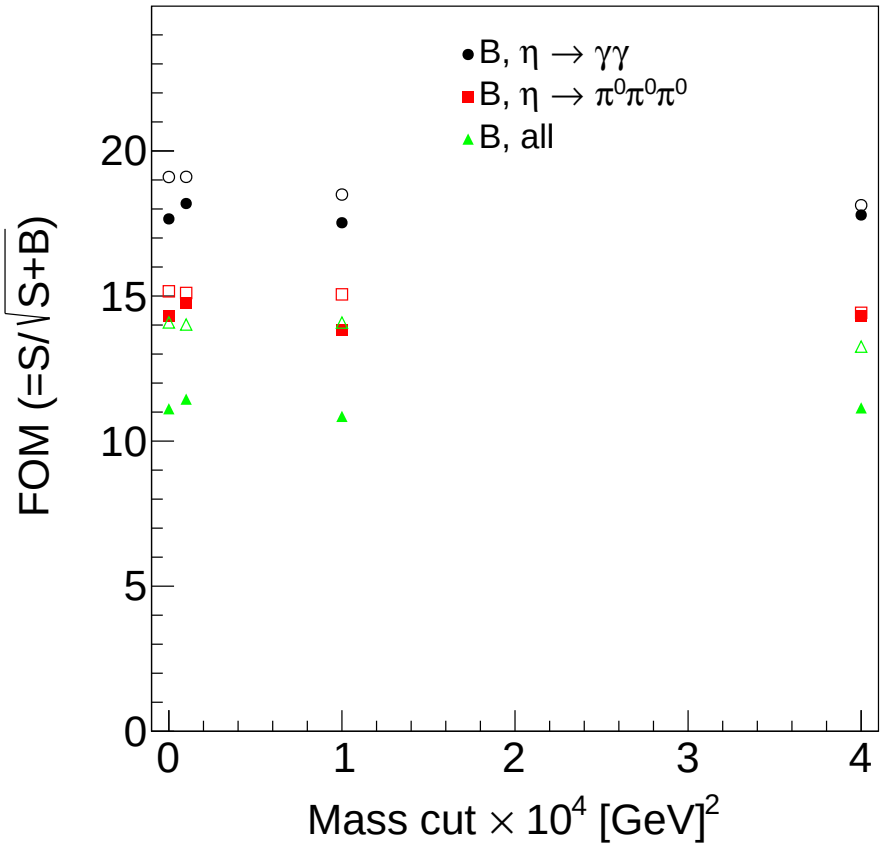


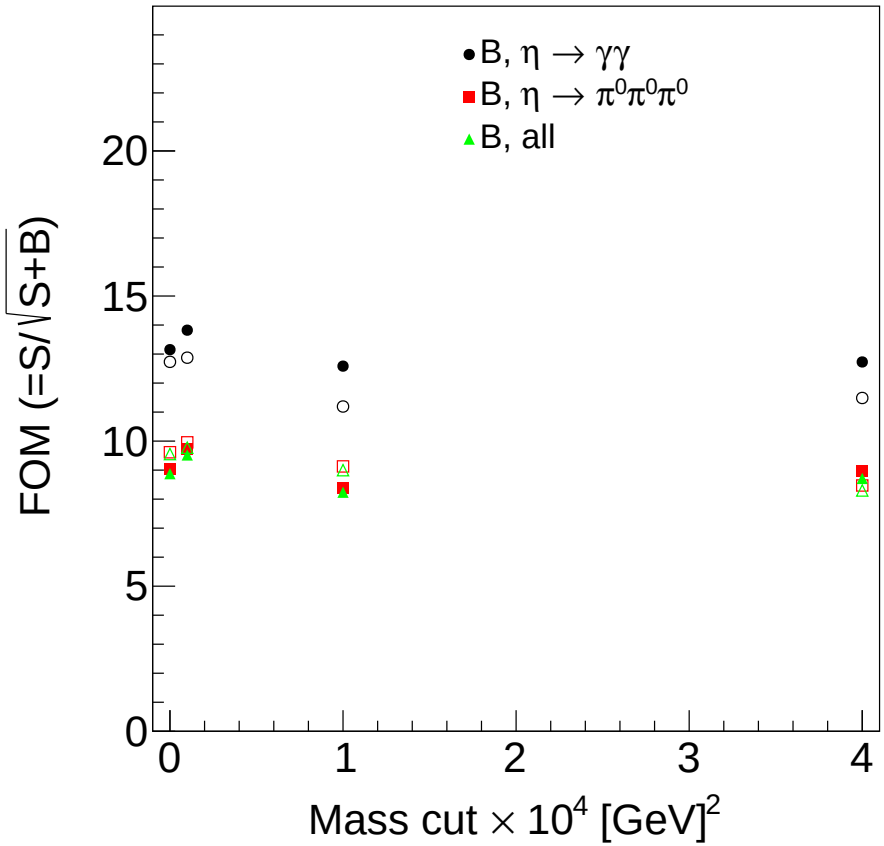
TOF-veto decreases the yield by a factor 4

FOM vs. cluster mass cut

Without and with TOF-veto applied, and without (point) and with BDT (open point) applied

- Veto not applied (JEF simulation)
- Veto applied (JEF simulation)



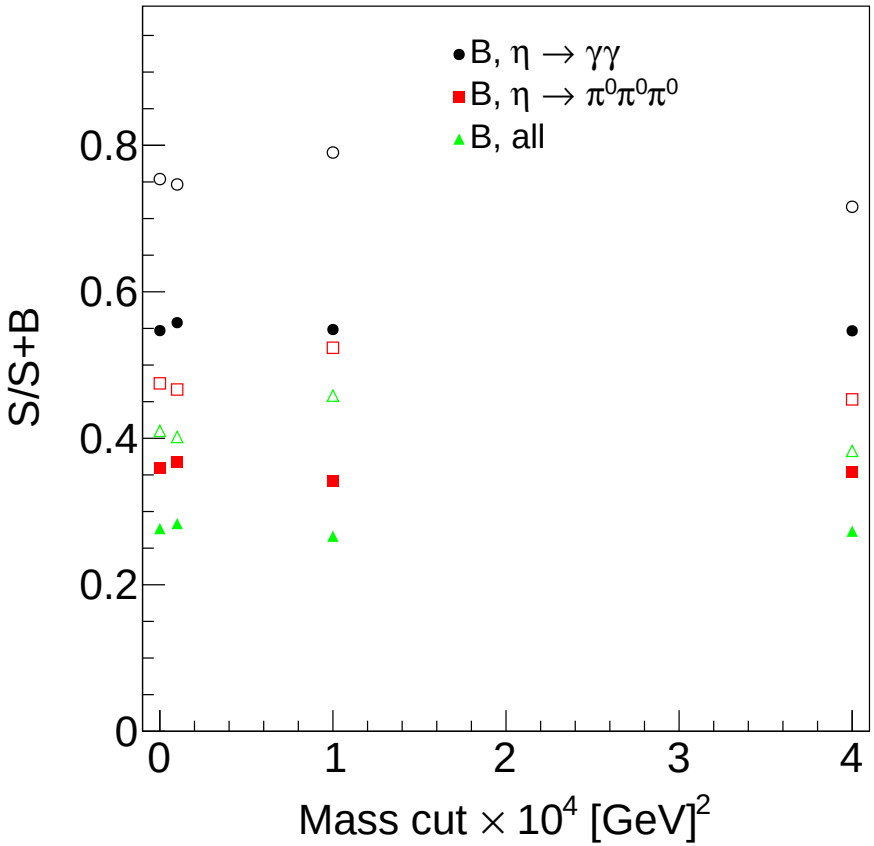


FOM not adequate

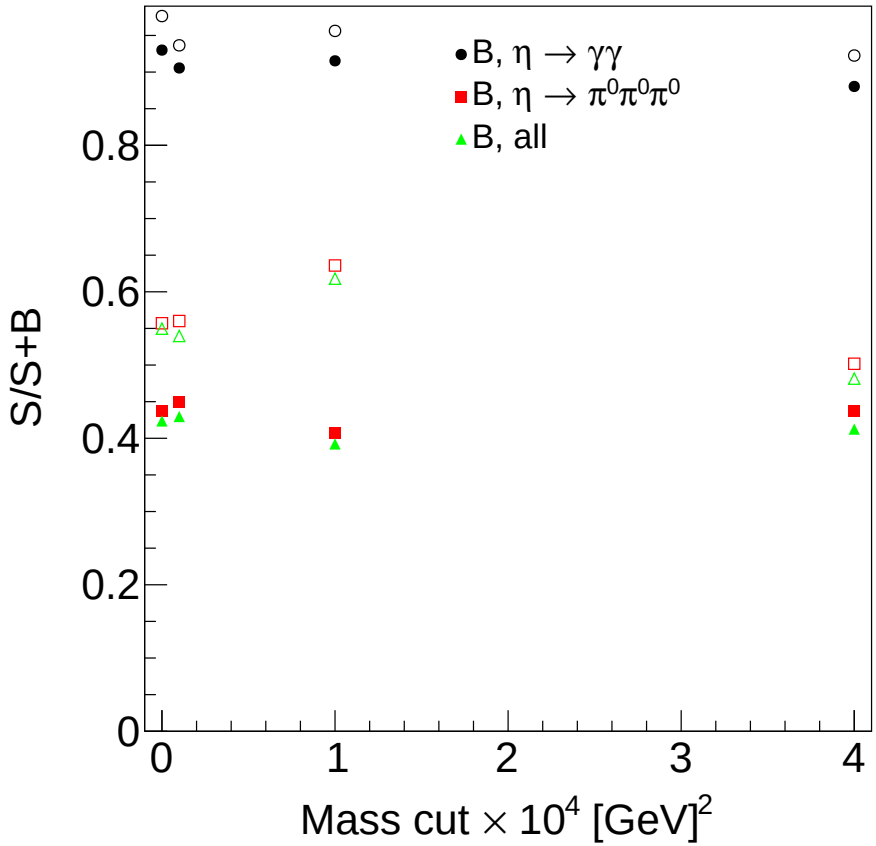
Signal over background vs. cluster mass cut

Without and with TOF-veto applied, and without (point) and with BDT (open point) applied

- Veto not applied (JEF simulation)



- Veto applied (JEF simulation)

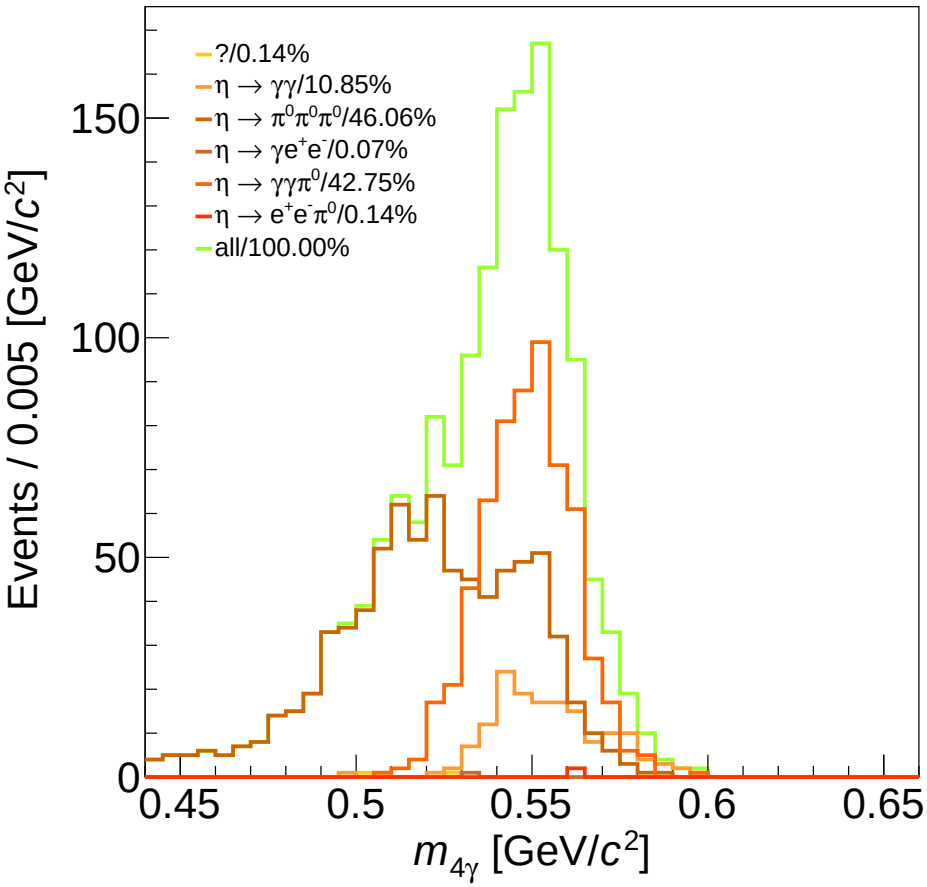


MVA might not be needed!

Improved MVA

Un-anticipated improvement of the MVA by increasing the signal sample by 50

- Veto not applied (GlueX 2017-01 simulation)



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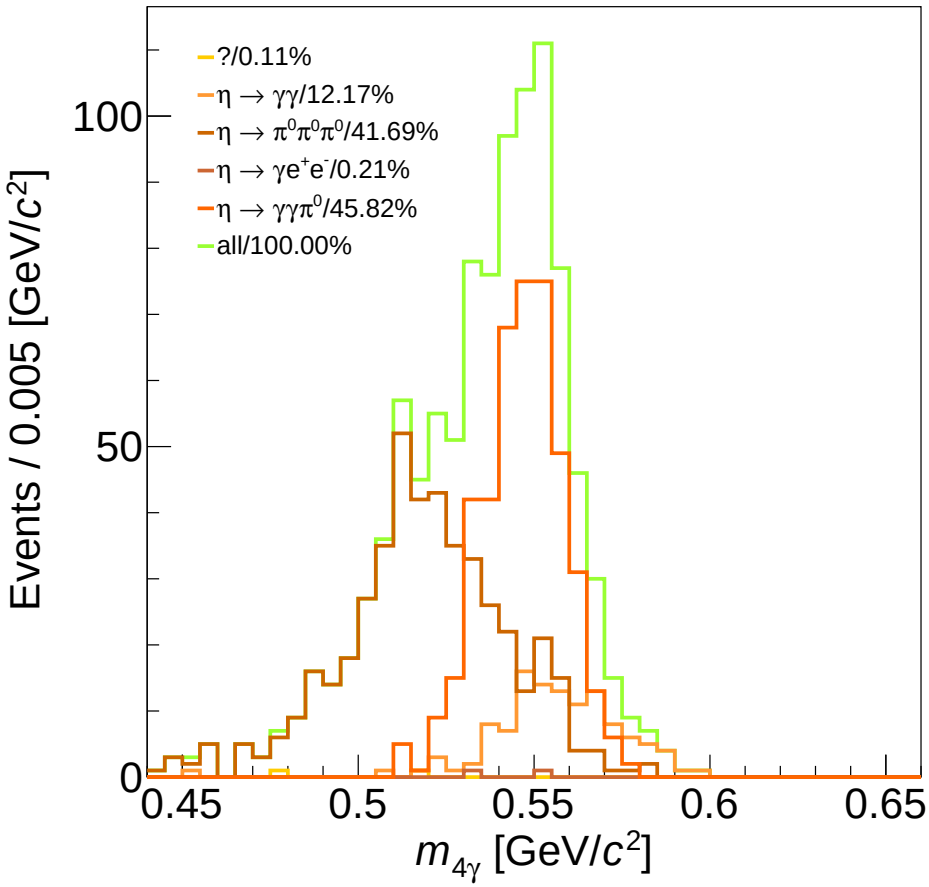

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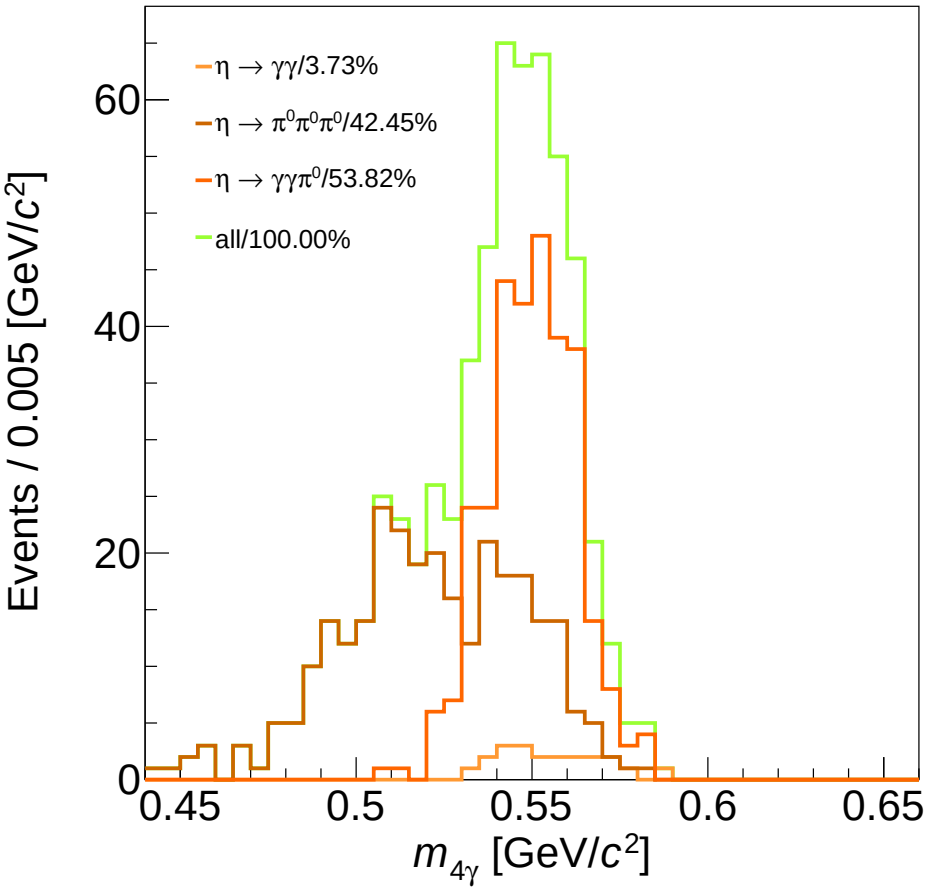

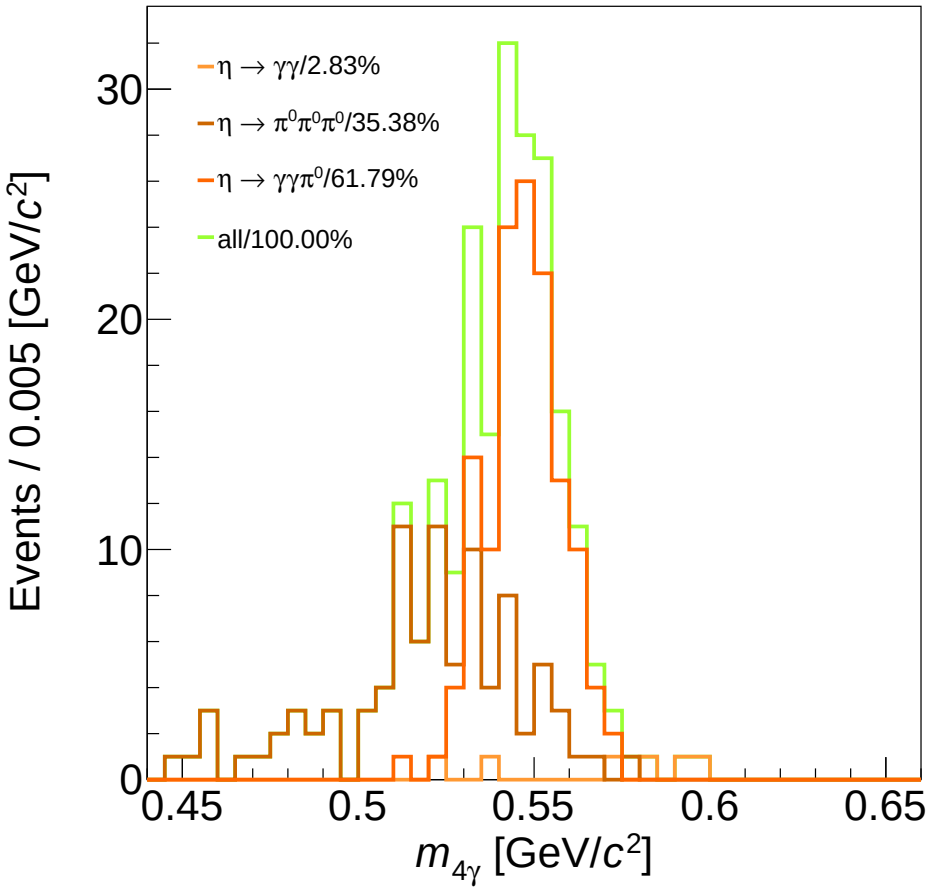

Conclusion

For first time some real improvements are seen for FCAL2 compared to FCAL1 ...
Not clear yet if veto-detector is needed for insert part not covered by TOF