$\eta \to \pi^0\gamma\gamma$, selection critiria

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Table of contents

Selection critiria

9 possible variables identified (so far)

- Coplanarity between η and p
- Mass conservation
- Extra energy
- Unused tracks
- $\pi^0\gamma\gamma$ invariant mass
- Cluster number below 4.5^o
- Vertex z and r
- Proton momentum

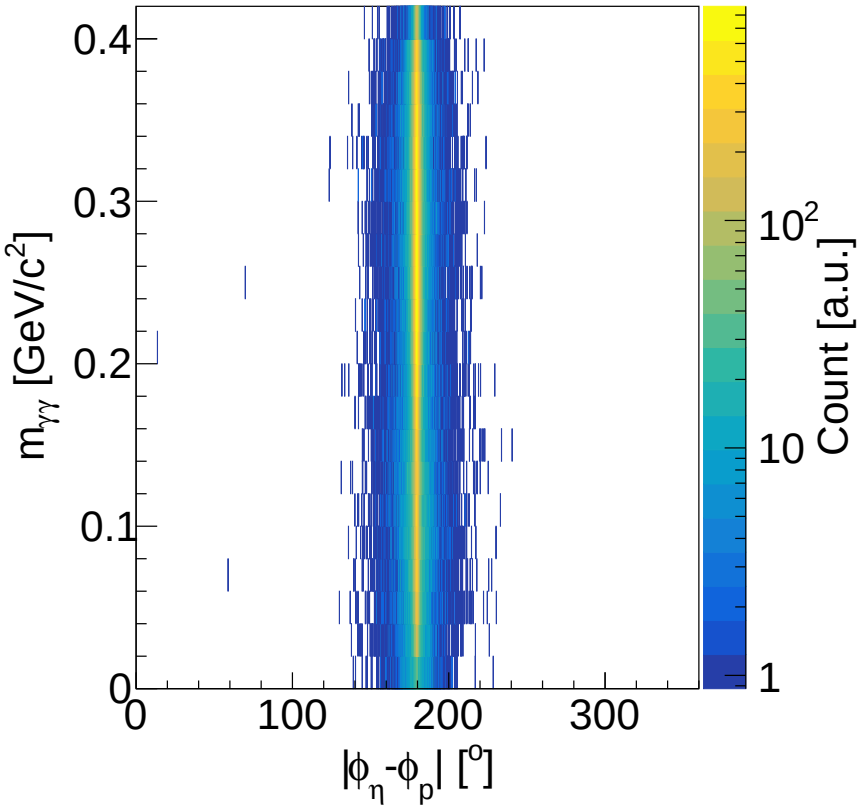
optimized by the Figure-Of-Merit (FOM), $\mathrm{N_{sig}}/\sqrt{\mathrm{N_{sig}} + \mathrm{N_{nkg}}}$

- Signal, sig: $\eta \to \pi^0\gamma\gamma$, BR $= 0.00027$
  - genEtaRegge, 1M events thrown
  - $\mathrm{N_{sig}} = \mathrm{N_{rec}} \times BR(\eta \to \pi^0\gamma\gamma)/BR(\eta \to \pi^0\pi^0\pi^0)$
- Background, bkg: $\eta \to \pi^0\pi^0\pi^0$, BR $= 0.3257$
  - genEtaRegge, 1M events thrown
  - $\mathrm{N_{sig}} = \mathrm{N_{rec}}'$
- FOM for each $m_{\gamma\gamma}$

Coplanarity between η and p

$m_{\gamma\gamma}$ vs. coplanarity between η-candidate and p for:

- Signal



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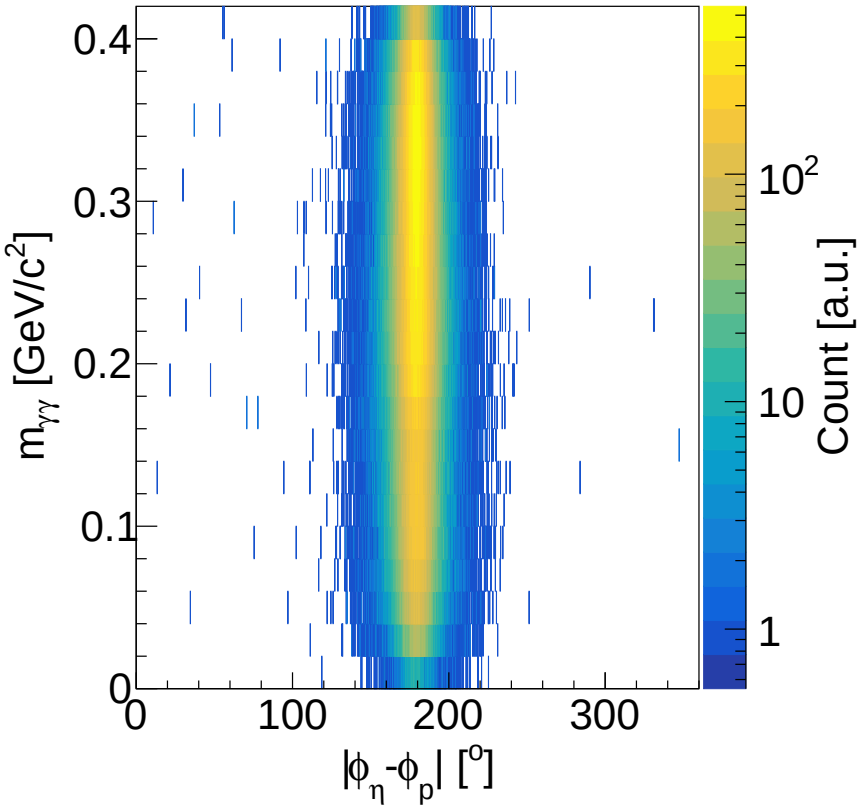
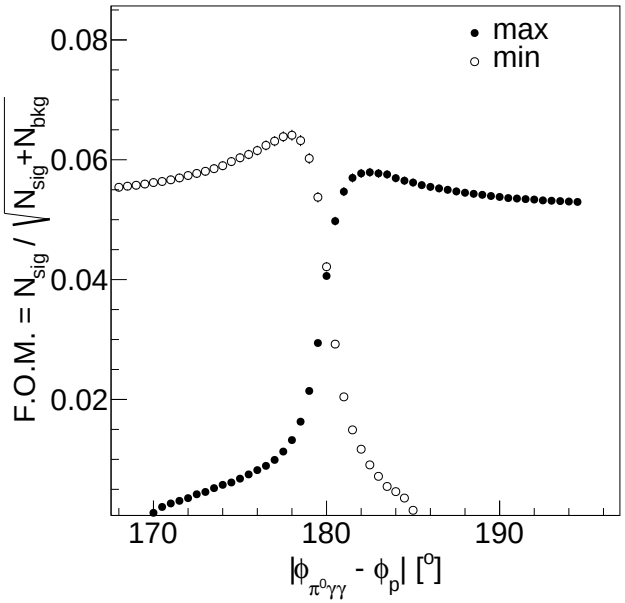
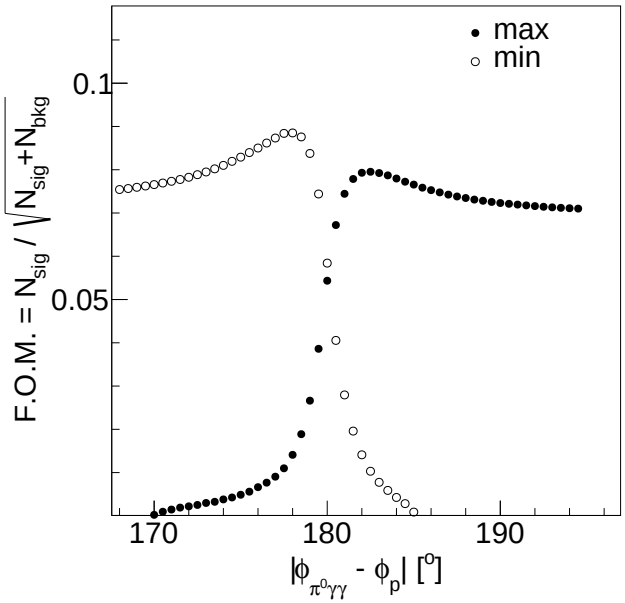


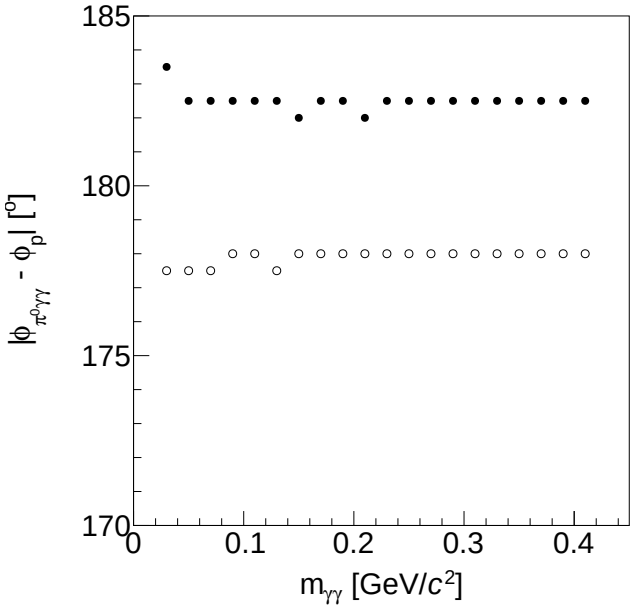
Coplanarity between η and p

FOM vs. coplanarity between η-candidate and p for:

- $m_{\gamma\gamma} = 110$ MeV/c^2
- $m_{\gamma\gamma} = 310$ MeV/c^2
- Selection critiria vs. $m_{\gamma\gamma}$





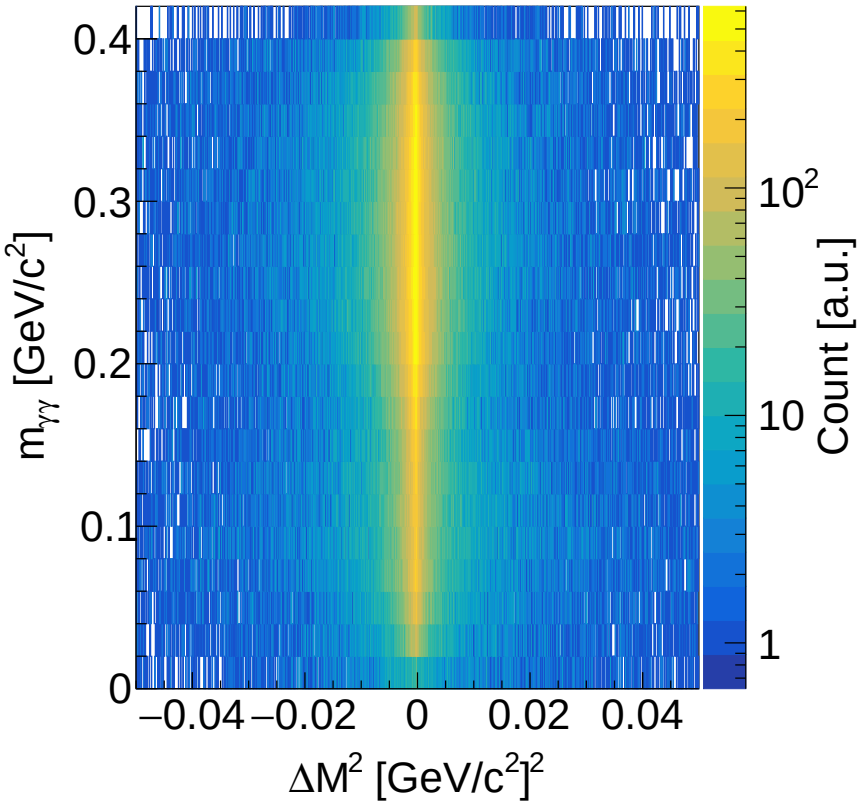


- Find lower value
- Find upper value

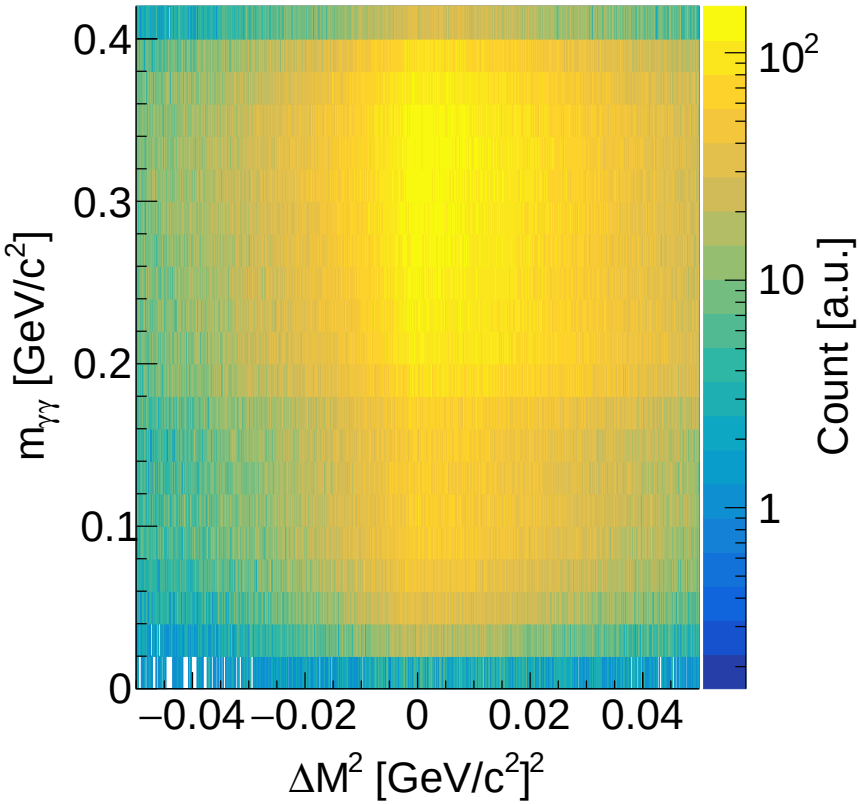
Mass conservation

$m_{\gamma\gamma}$ vs. mass conservation, ΔM^2, for:

- Signal



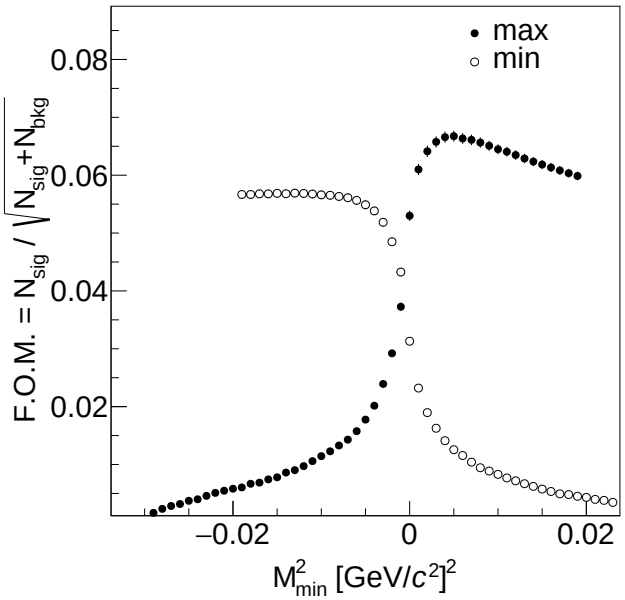
- Background

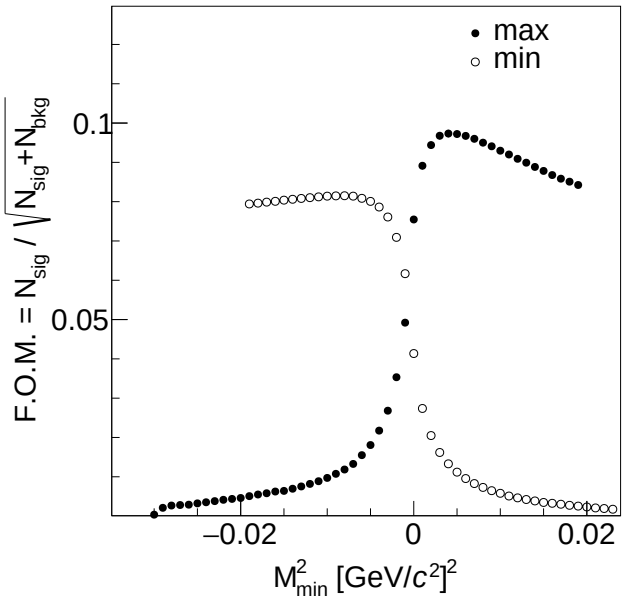


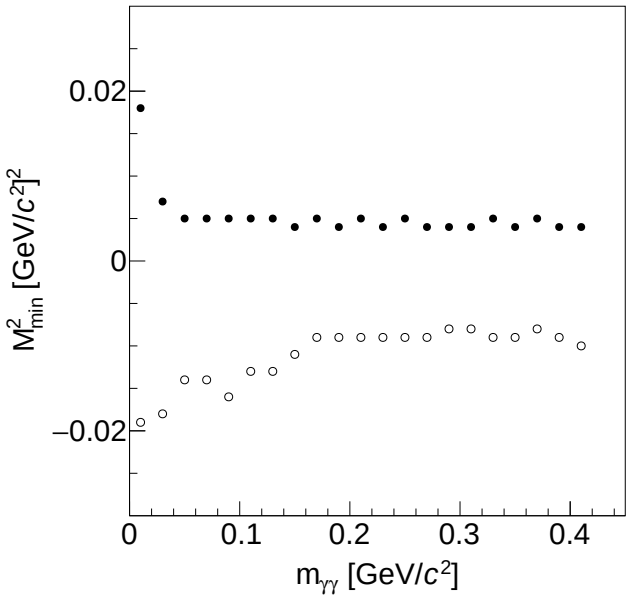
Mass conservation

FOM vs. mass conservation for:

- $m_{\gamma\gamma} = 110$ MeV/c^2
- $m_{\gamma\gamma} = 310$ MeV/c^2
- Selection critiria vs. $m_{\gamma\gamma}$





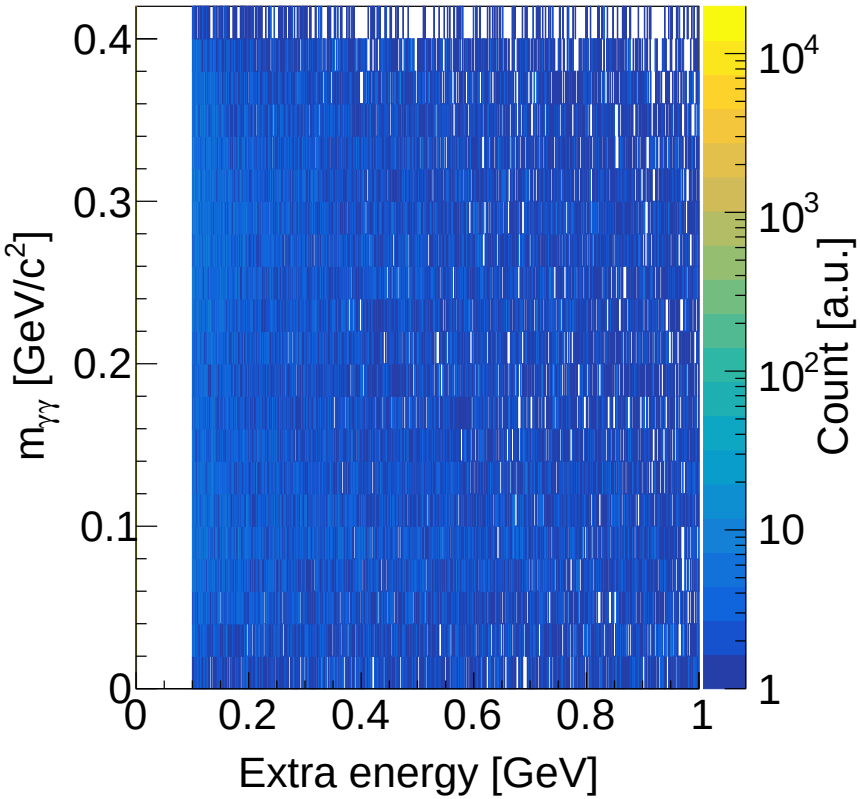


- Find lower value
- Find upper value

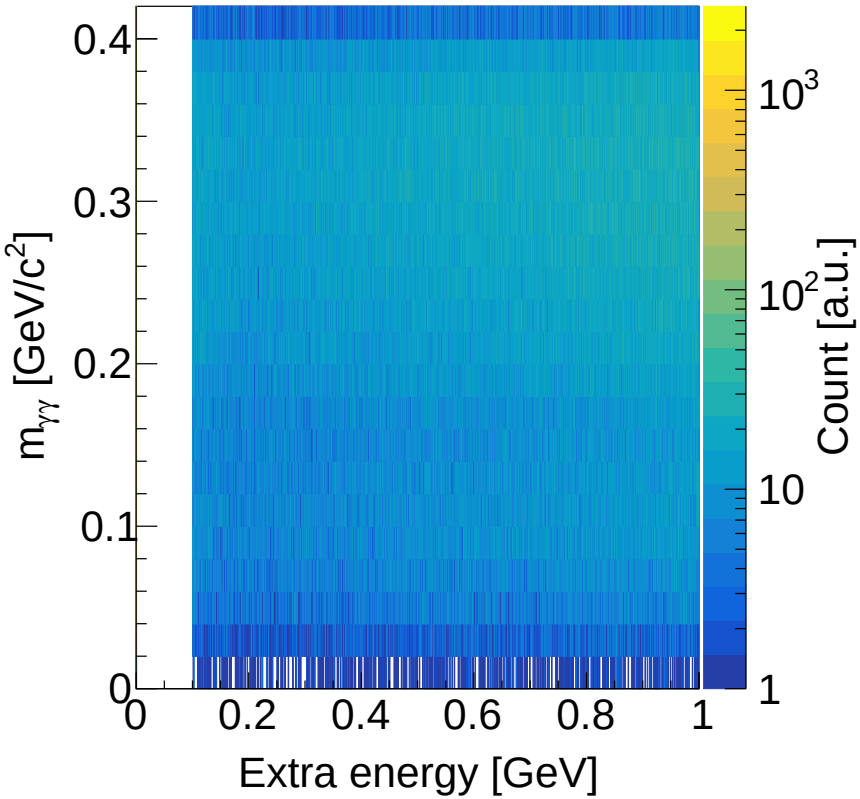
Extra energy

$m_{\gamma\gamma}$ vs. extra energy for:

- Signal



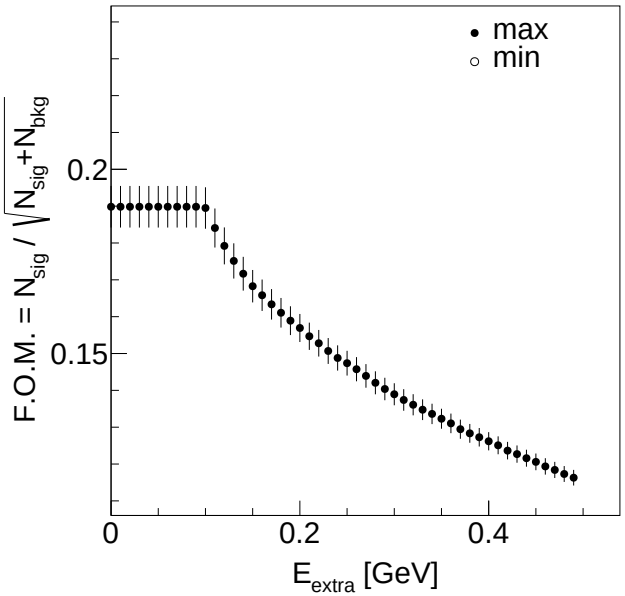
- Background

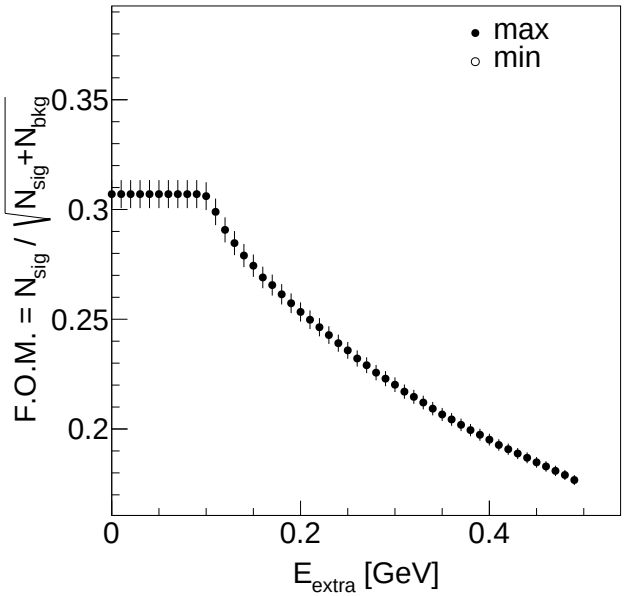


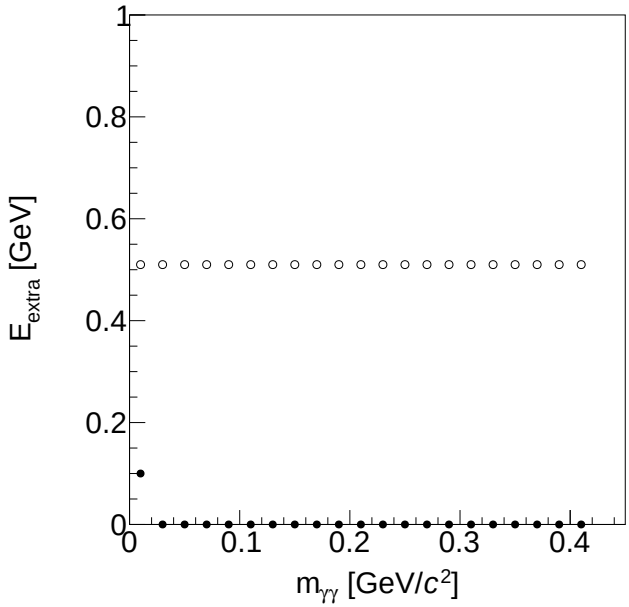
Extra energy

FOM vs. extra energy for:

- $m_{\gamma\gamma} = 110$ MeV/c^2
- $m_{\gamma\gamma} = 310$ MeV/c^2
- Selection critiria vs. $m_{\gamma\gamma}$





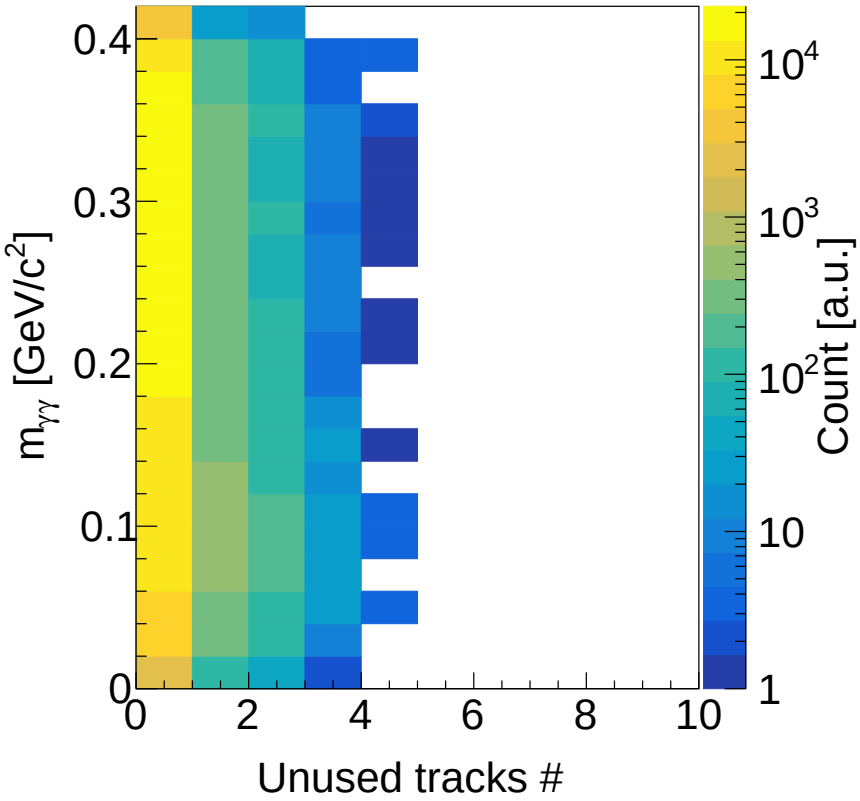


- Find value

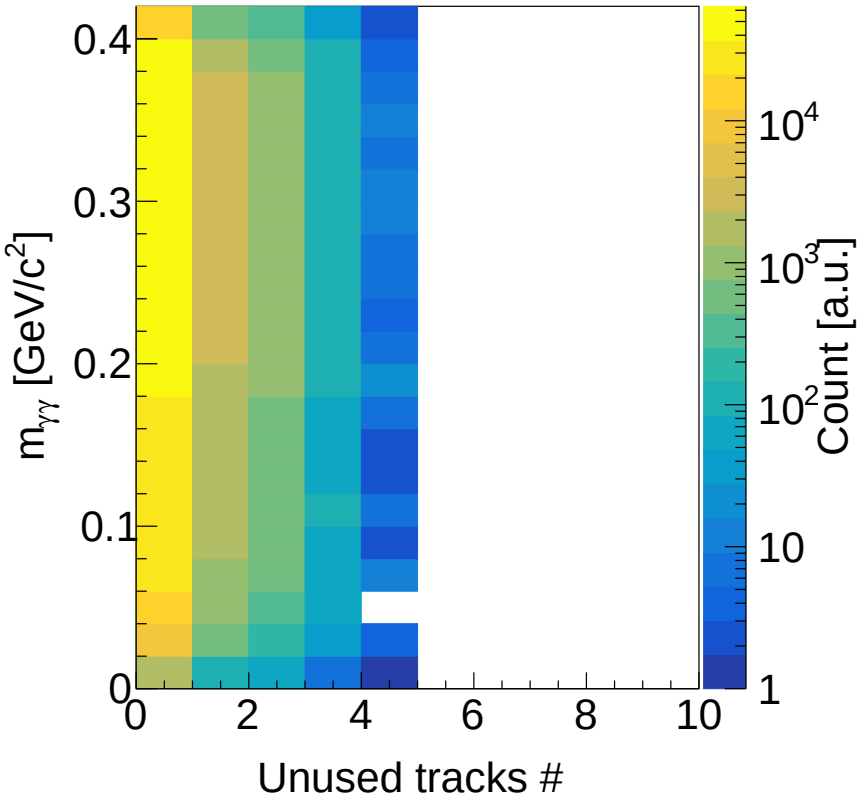
Unused track number

$m_{\gamma\gamma}$ vs. unused track number for:

- Signal



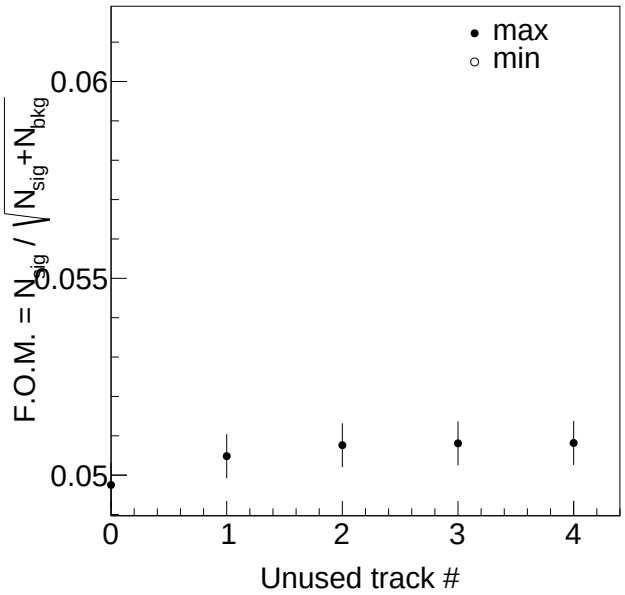
- Background

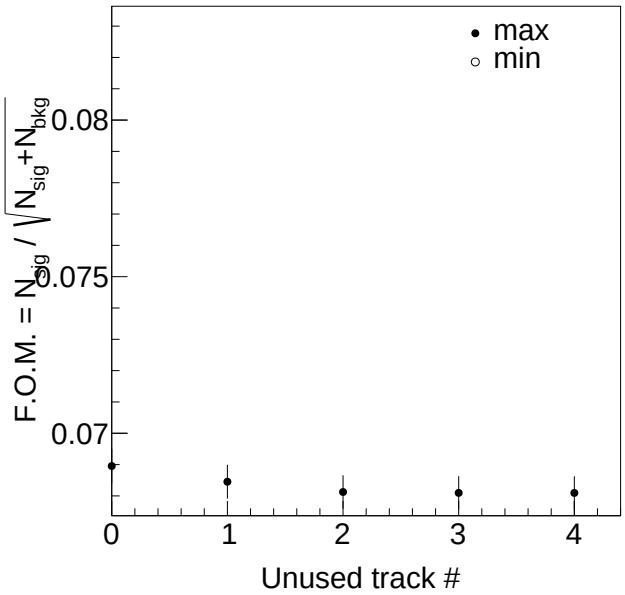


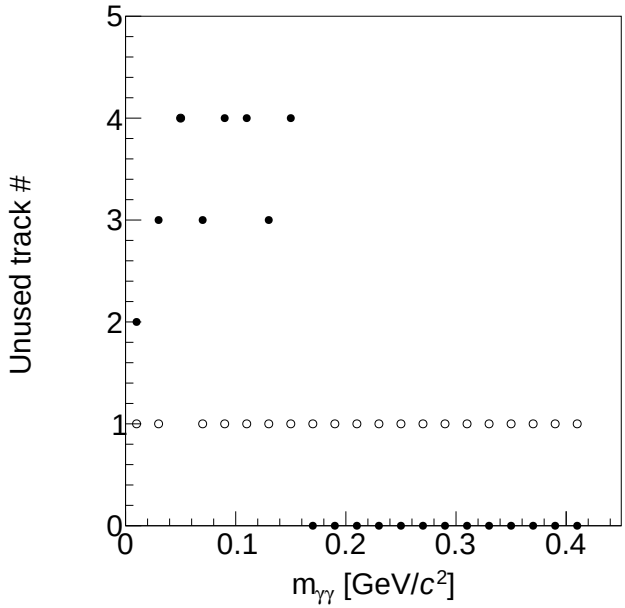
Unused track number

FOM vs. unused track number for:

- $m_{\gamma\gamma} = 110$ MeV/c^2
- $m_{\gamma\gamma} = 310$ MeV/c^2
- Selection critiria vs. $m_{\gamma\gamma}$





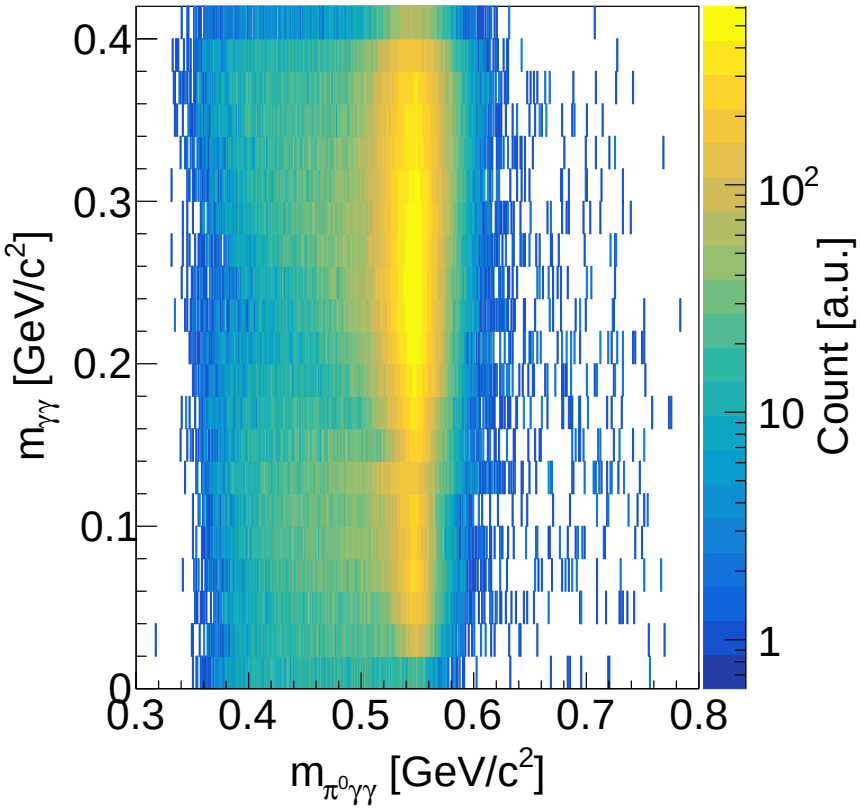


- Find value

$\pi^0\gamma\gamma$ invariant mass

$m_{\gamma\gamma}$ vs. $\pi^0\gamma\gamma$ invariant mass for:

- Signal



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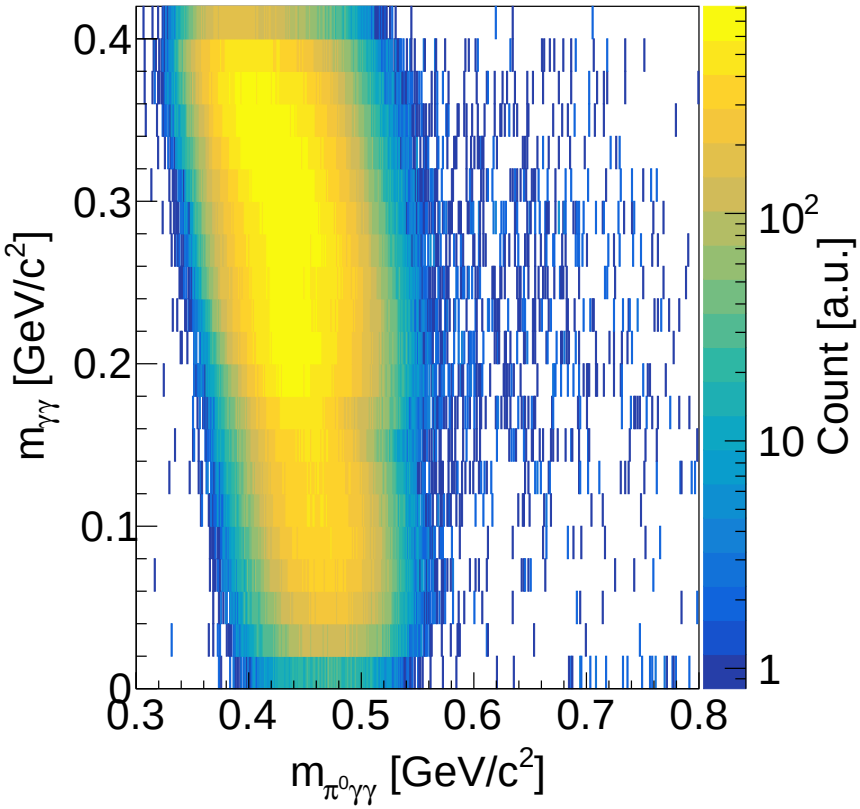
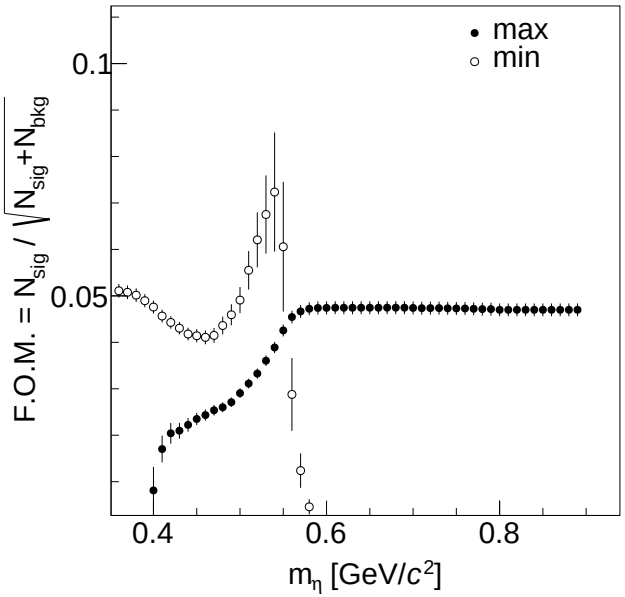
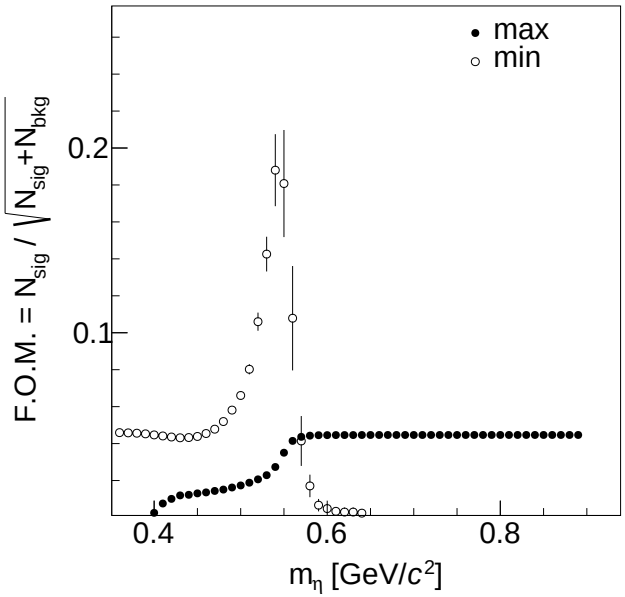


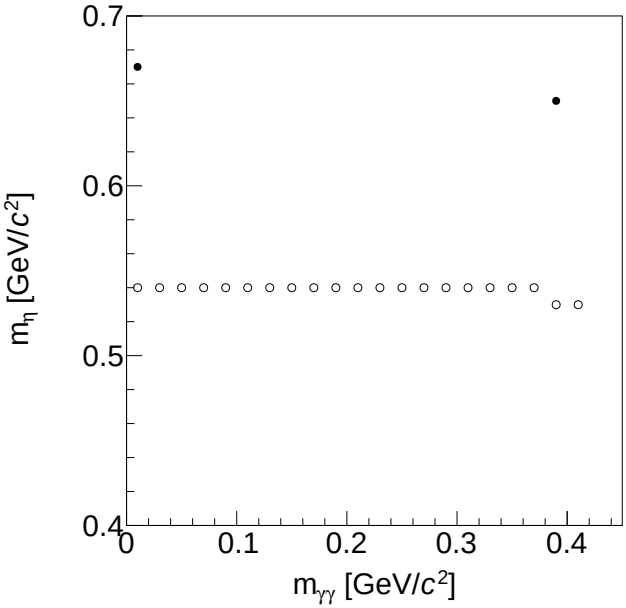
$\pi^0\gamma\gamma$ invariant mass

FOM vs. $\pi^0\gamma\gamma$ invariant mass for:

- $m_{\gamma\gamma} = 110$ MeV/c^2
- $m_{\gamma\gamma} = 310$ MeV/c^2
- Selection critiria vs. $m_{\gamma\gamma}$





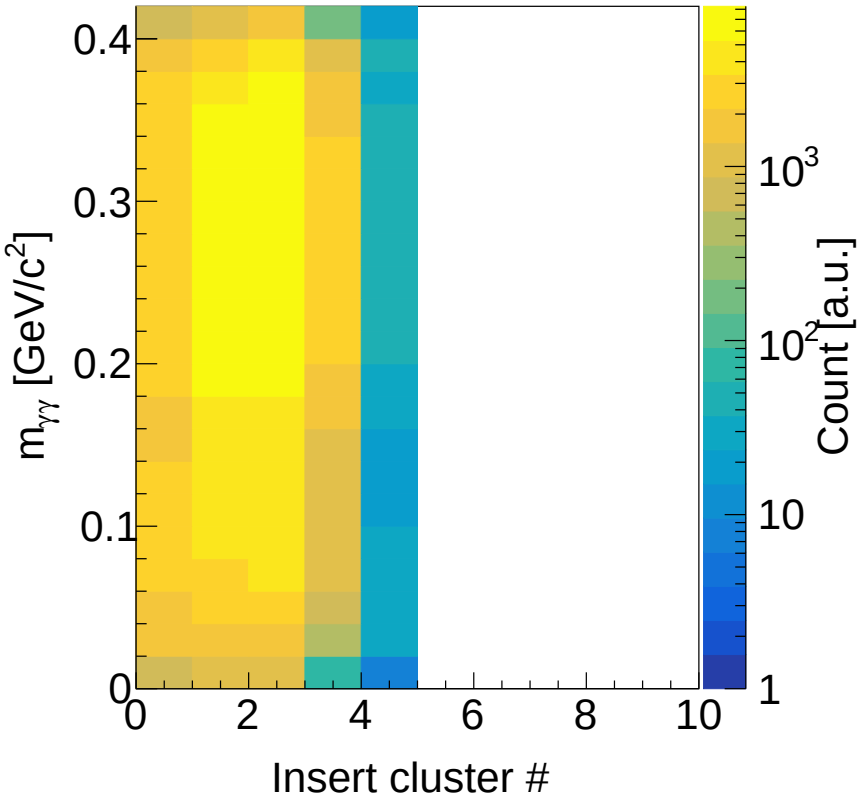


- Find lower value
- Find upper value

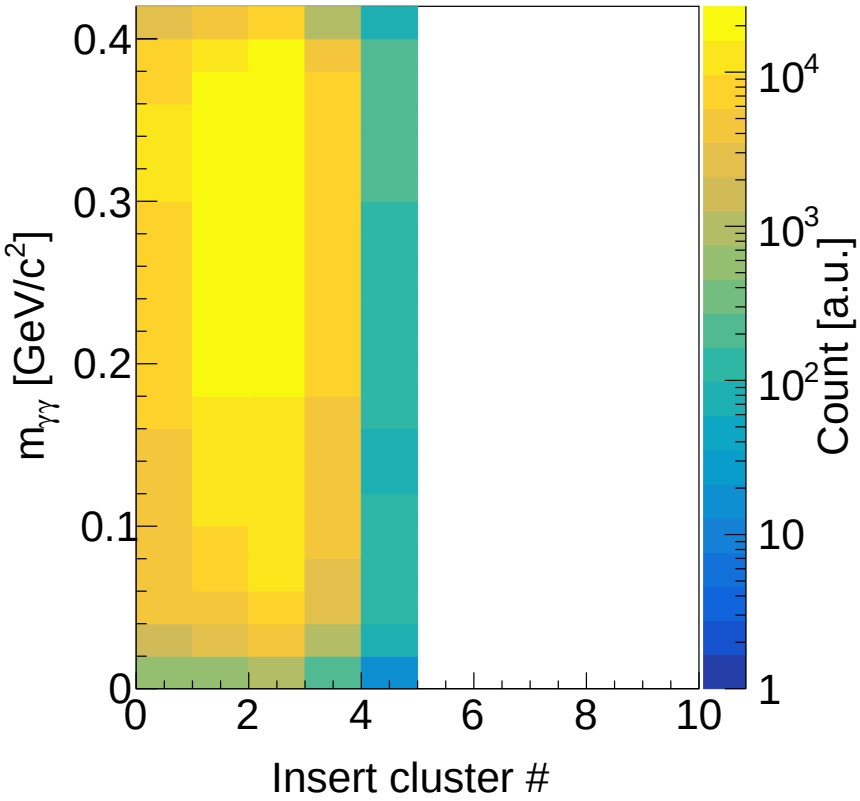
Cluster number below 4.5^o

$m_{\gamma\gamma}$ vs. cluster number below 4.5^o for:

- Signal



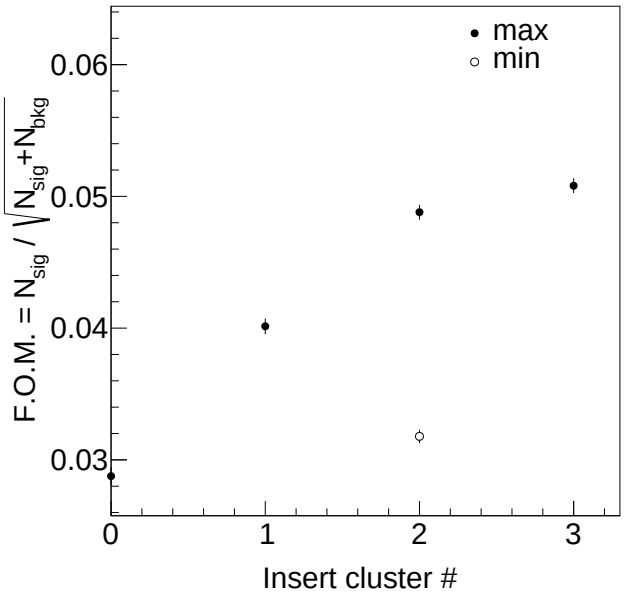
- Background

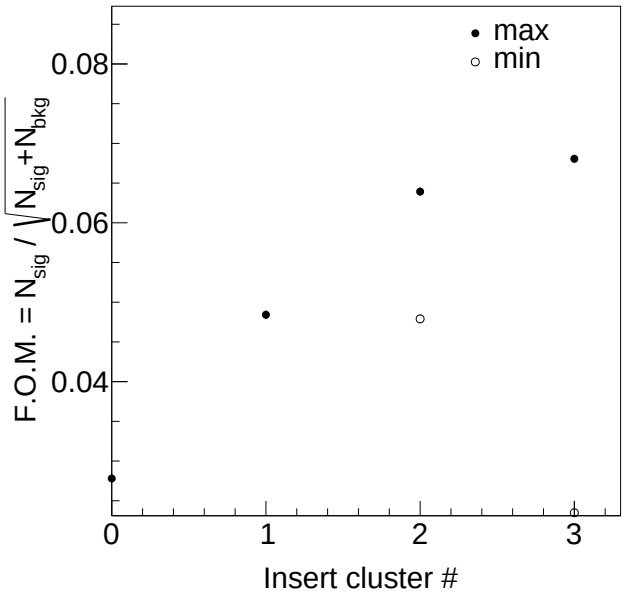


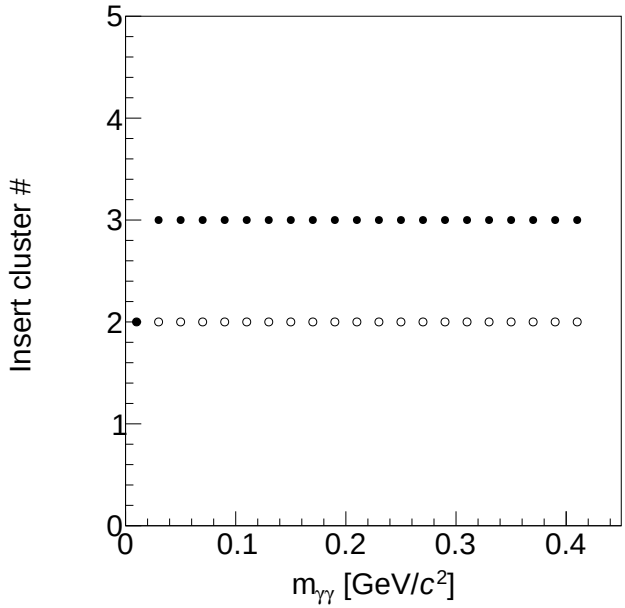
Cluster number below 4.5^o

FOM vs. cluster number below 4.5^o for:

- $m_{\gamma\gamma} = 110$ MeV/c^2
- $m_{\gamma\gamma} = 310$ MeV/c^2
- Selection critiria vs. $m_{\gamma\gamma}$





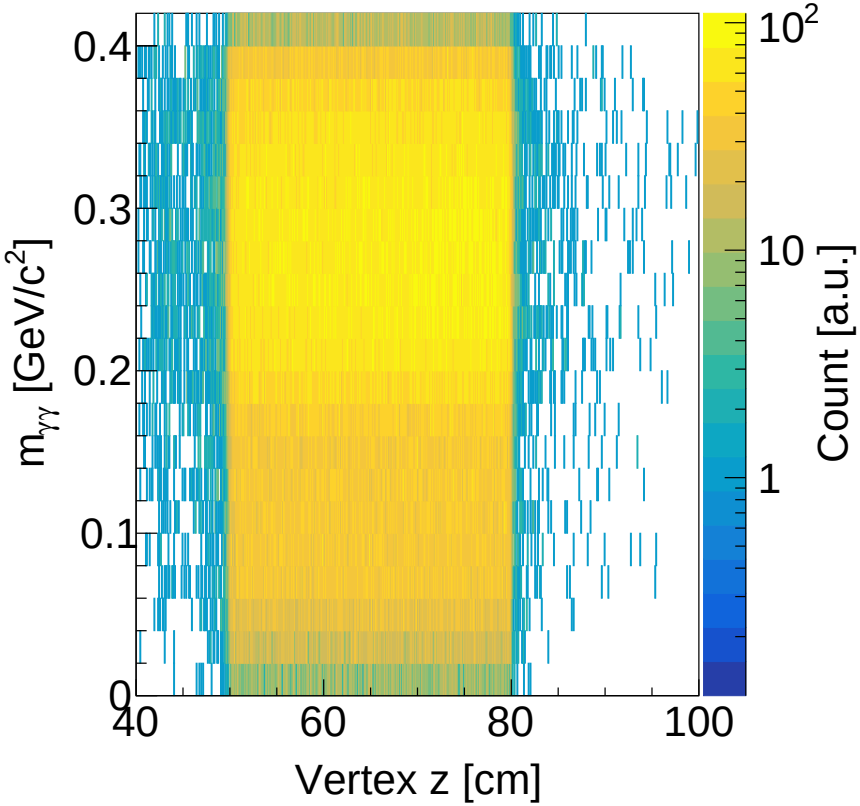


- Find lower value
- Find upper value

Vertex production z

$m_{\gamma\gamma}$ vs. vertex production z for:

- Signal



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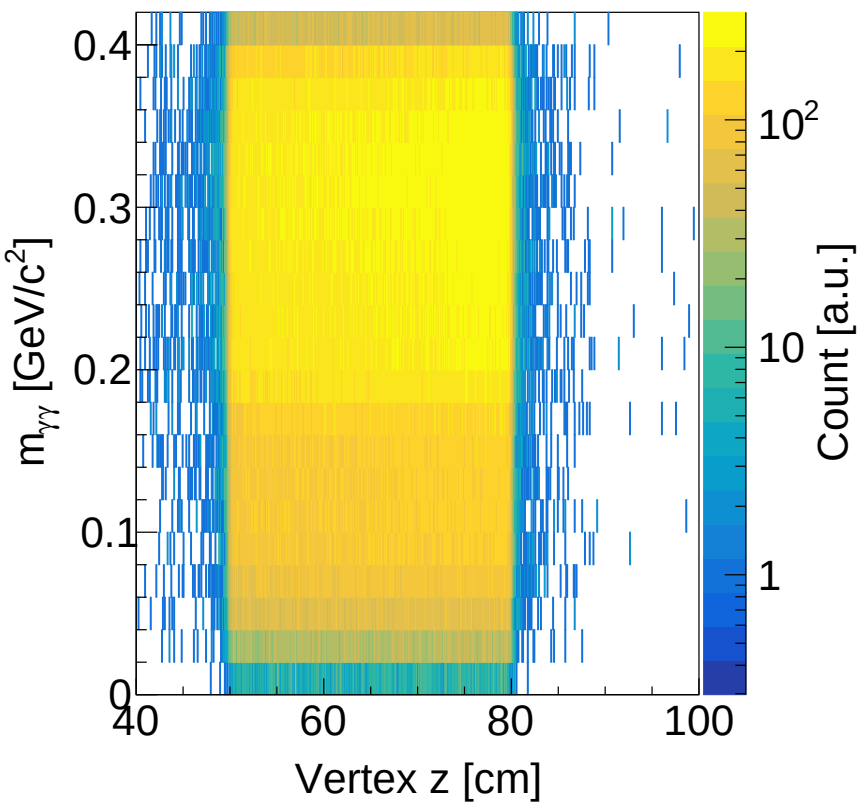
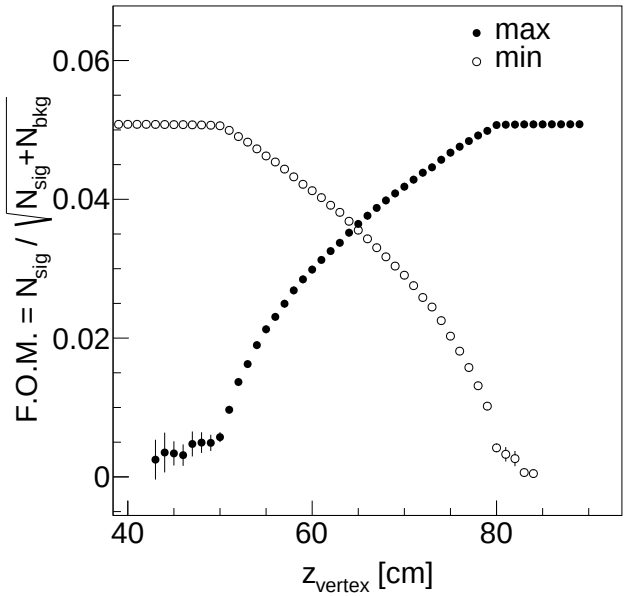
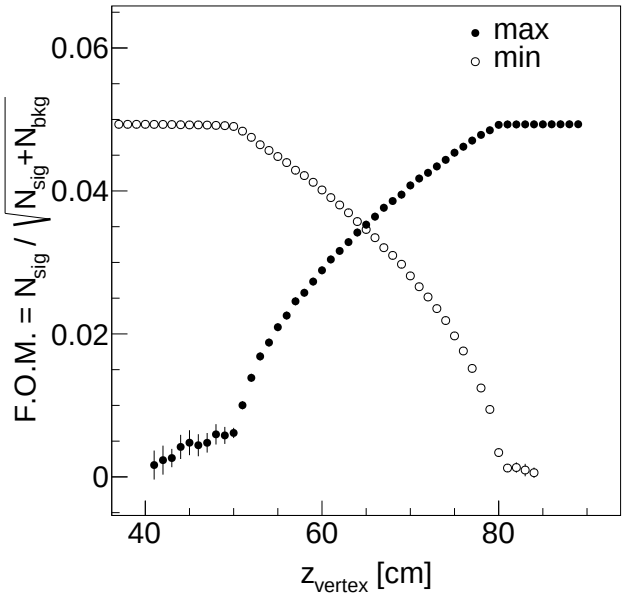


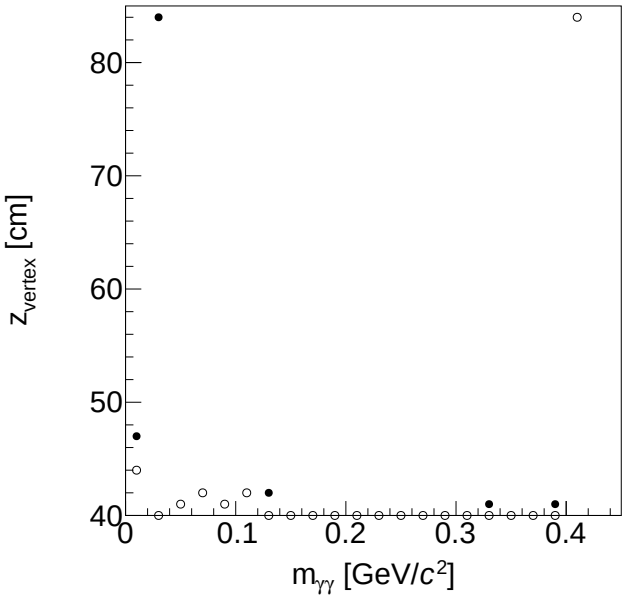
Vertex production z

FOM vs. vertex production z for:

- $m_{\gamma\gamma} = 110$ MeV/c^2
- $m_{\gamma\gamma} = 310$ MeV/c^2
- Selection critiria vs. $m_{\gamma\gamma}$





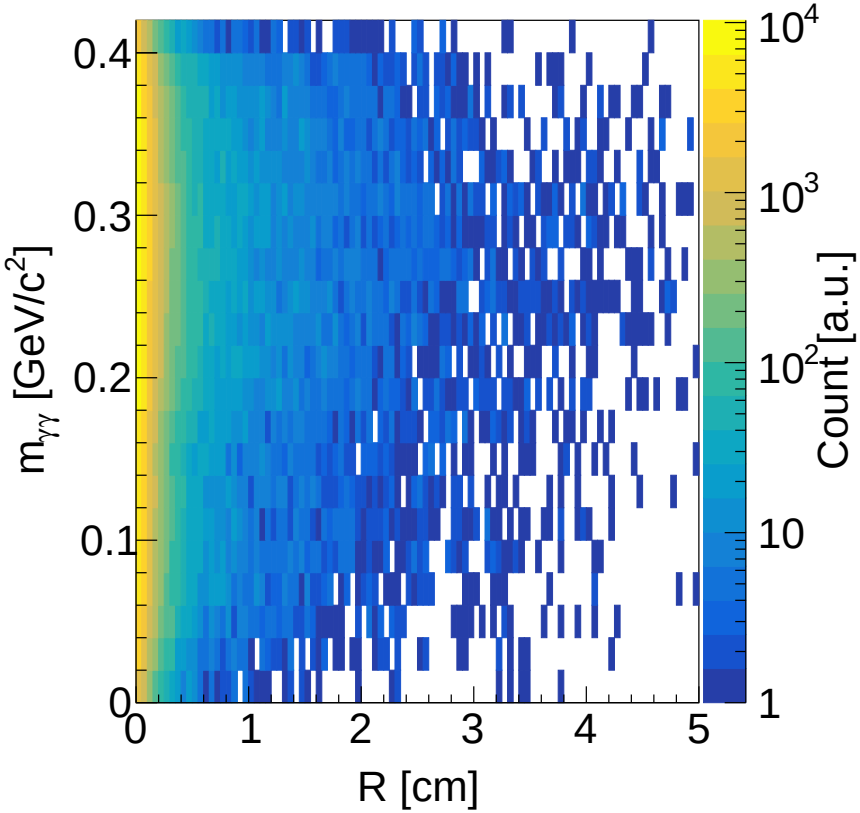


- Find lower value
- Find upper value

Vertex production r

$m_{\gamma\gamma}$ vs. vertex production r for:

- Signal



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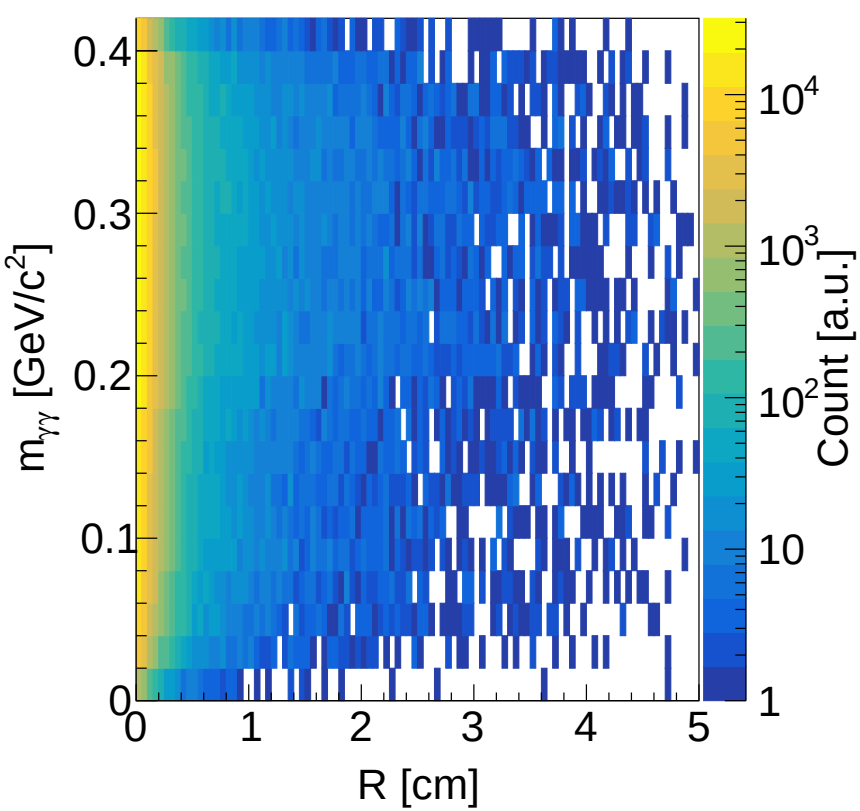
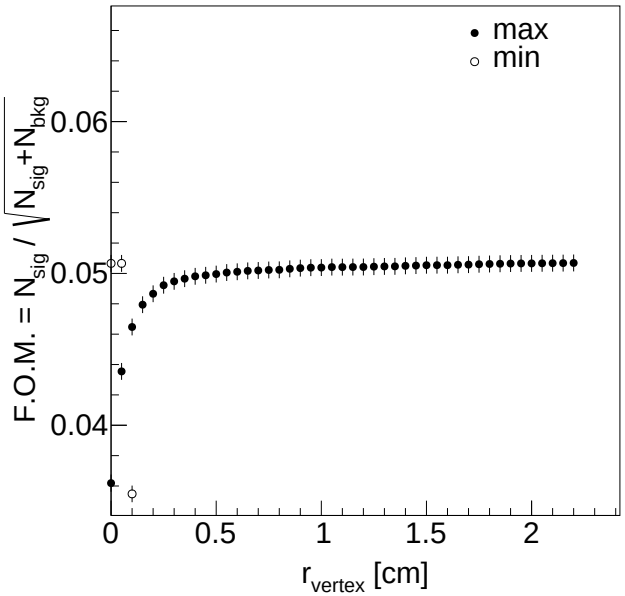
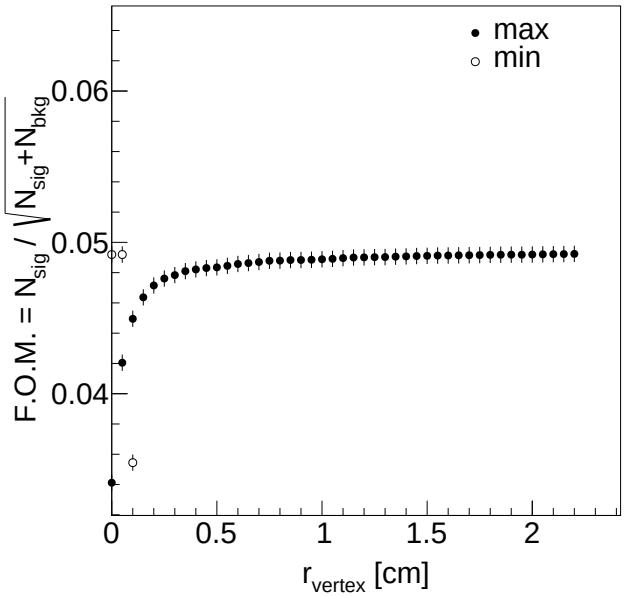


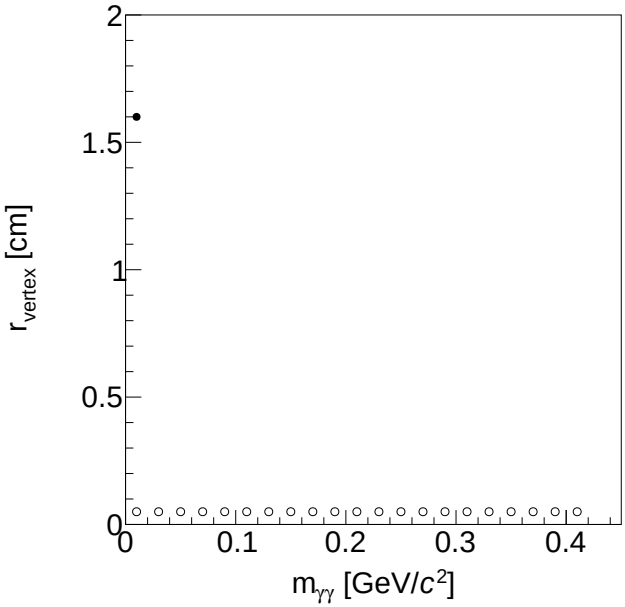
Vertex production r

FOM vs. vertex production r for:

- $m_{\gamma\gamma} = 110$ MeV/c^2
- $m_{\gamma\gamma} = 310$ MeV/c^2
- Selection critiria vs. $m_{\gamma\gamma}$





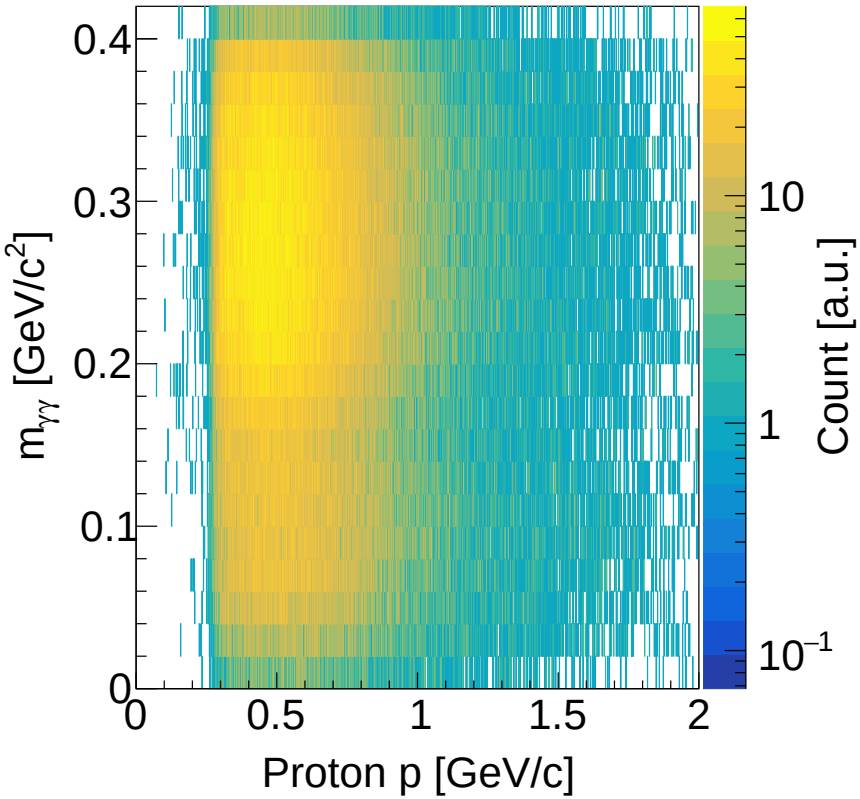


- Find lower value
- Find upper value

Proton momentum

$m_{\gamma\gamma}$ vs. proton momentum for:

- Signal



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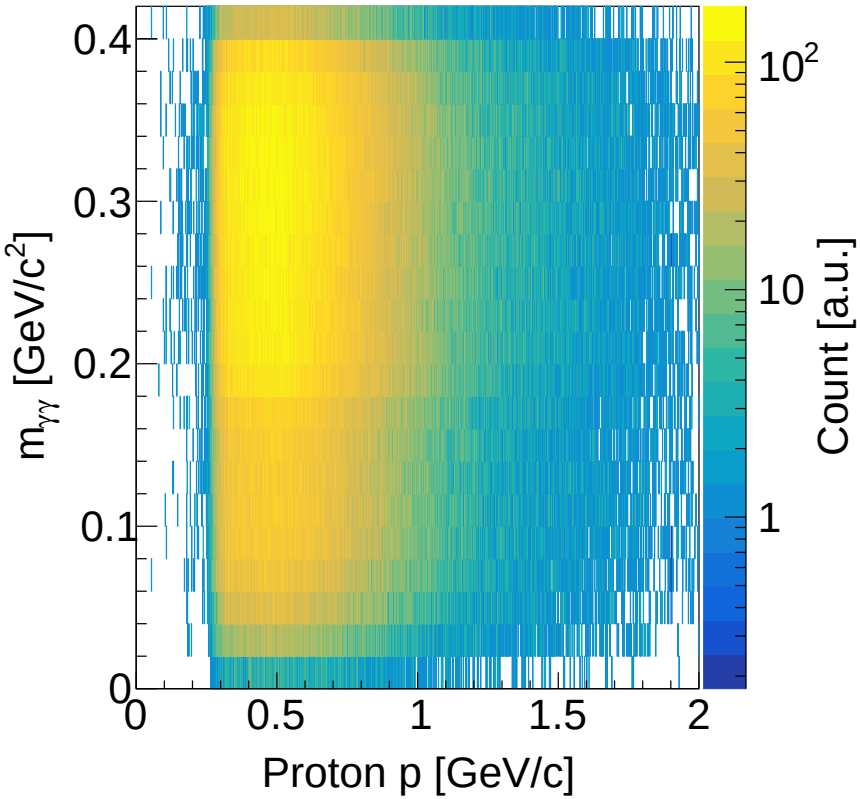
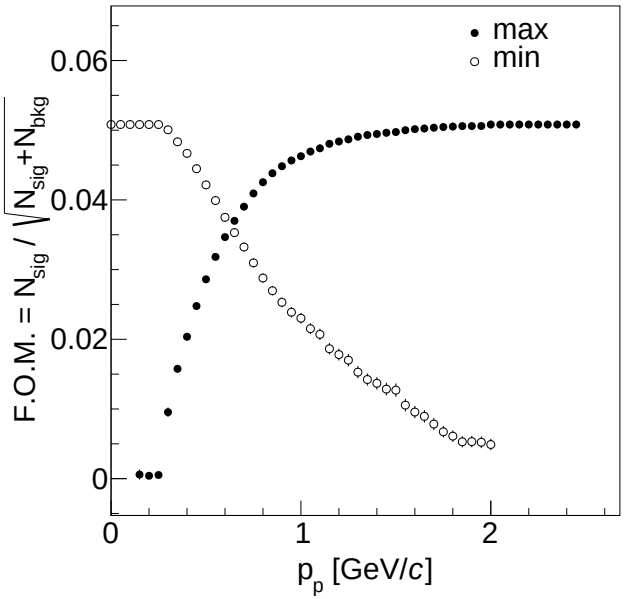
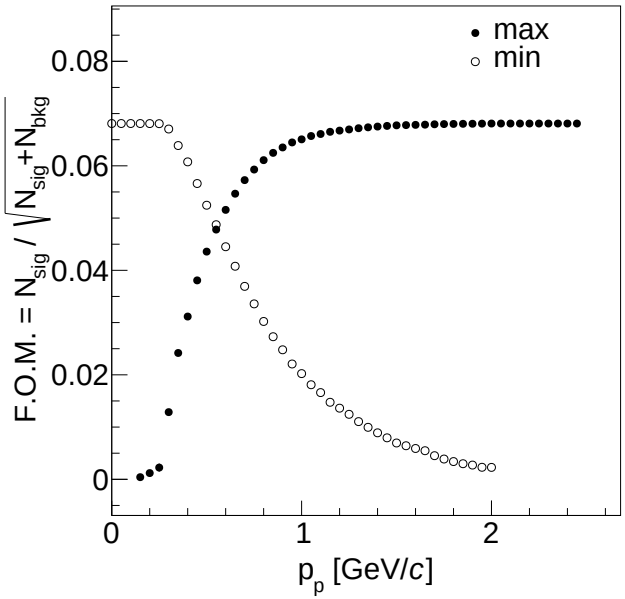


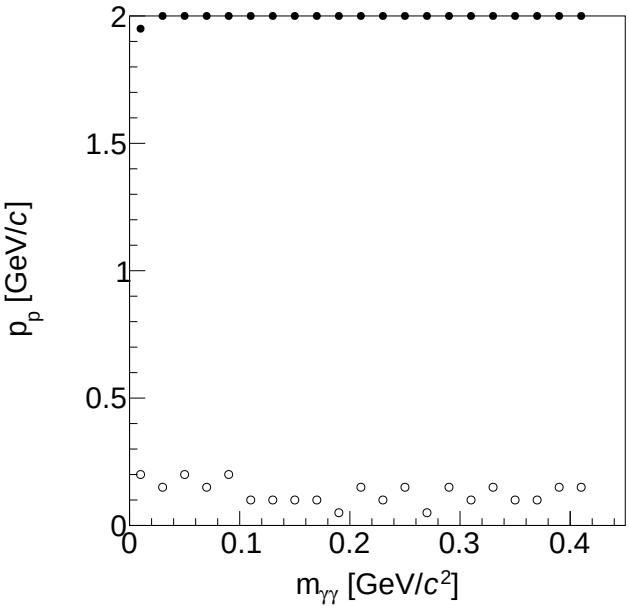
Proton momentum

FOM vs. proton momentum for:

- $m_{\gamma\gamma} = 110$ MeV/c^2
- $m_{\gamma\gamma} = 310$ MeV/c^2
- Selection critiria vs. $m_{\gamma\gamma}$





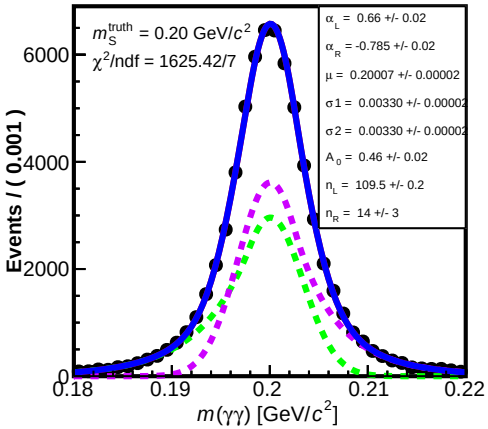


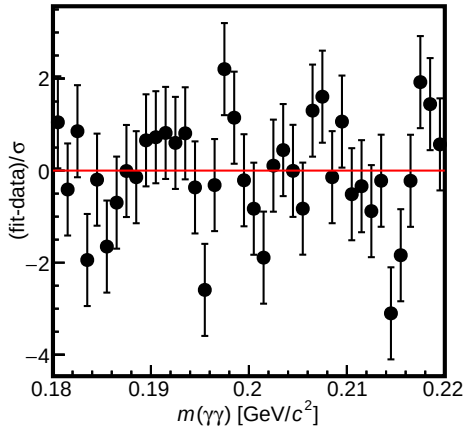
- Find lower value
- Find upper value

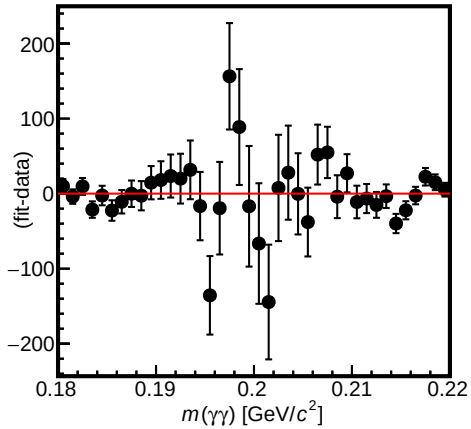
Signal PDF

Jared started the effort to determine the signal PDF

- Will start with 2 Crystal Balls with common mean and two different widths
- 200 MeV/c^2 S







Conclusion

Selection critiria:

- Hand-made guides by FOM (started)
- MVA (to do list)

PDF for:

- Signal (started)
- Background will start once the non-smooth distribution is understood

Proposed logo version 2