

# EMCal di-photon mass distribution

Tim Rinn (BNL)

Anthony Hodges, Abraham Holterman, Apurva Narde, and Anne Sickles (UIUC)

On behalf of the EMCal team

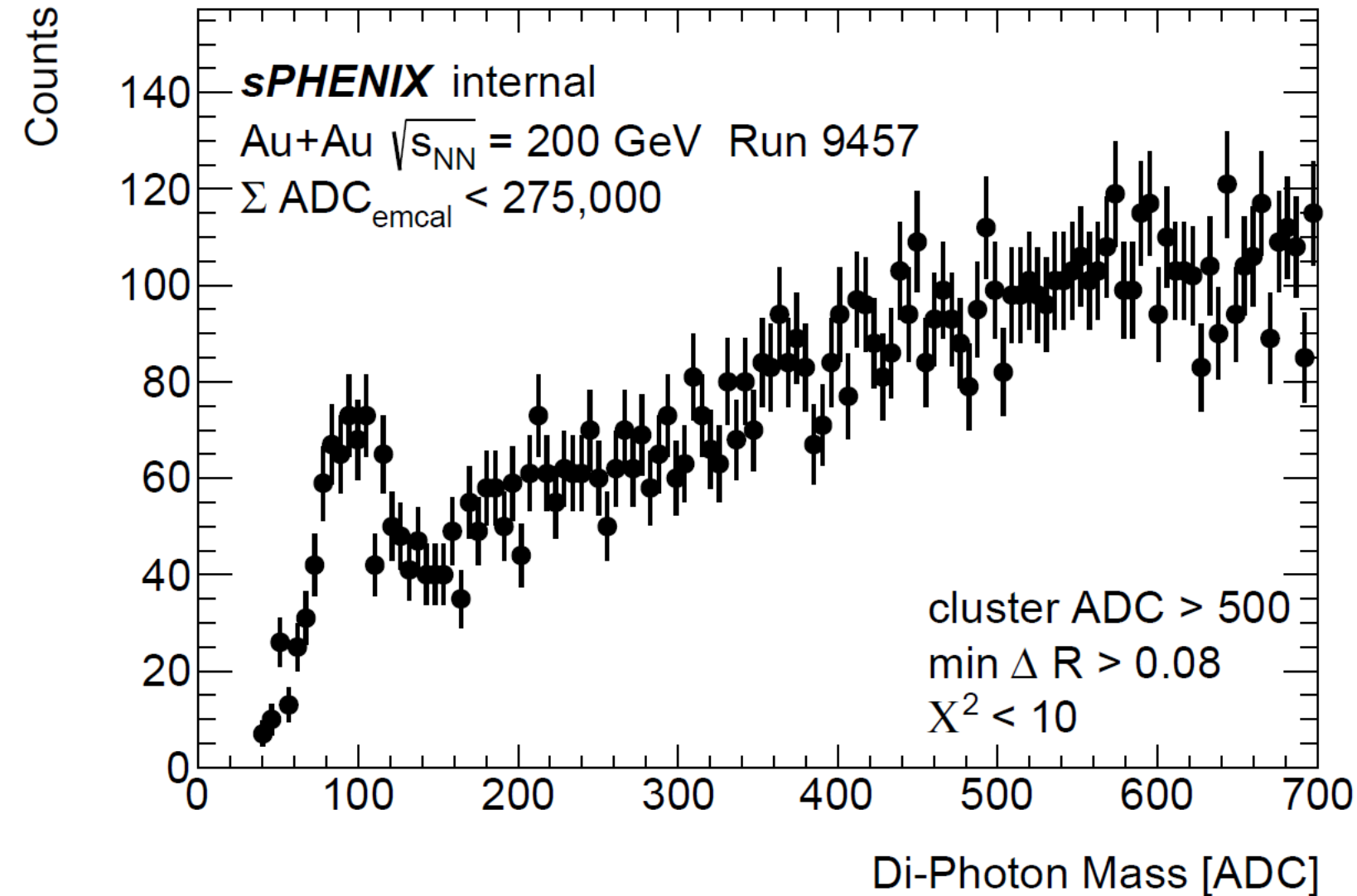
# Key Documentation and data sets:

- Analysis was presented in the general meeting on 6/9/23:
  - <https://indico.bnl.gov/event/19821/contributions/77446/attachments/47915/81297/EMCal%20Commissioning%20Status.pdf>
- Supporting note available on invenio at:
  - <https://sphenix-invenio.sdcc.bnl.gov/records/yfhd4-23y52>
- PRDF Files used available at:
  - /sphenix/lustre01/sphnxpro/commissioning/emcal/beam/beam\_seb00-00009457-0000.prdf
- DST files used available at:
  - /sphenix/user/trinn/produced\_data/run\_9457/
    - Contains 56,000 events

# Analysis Summary:

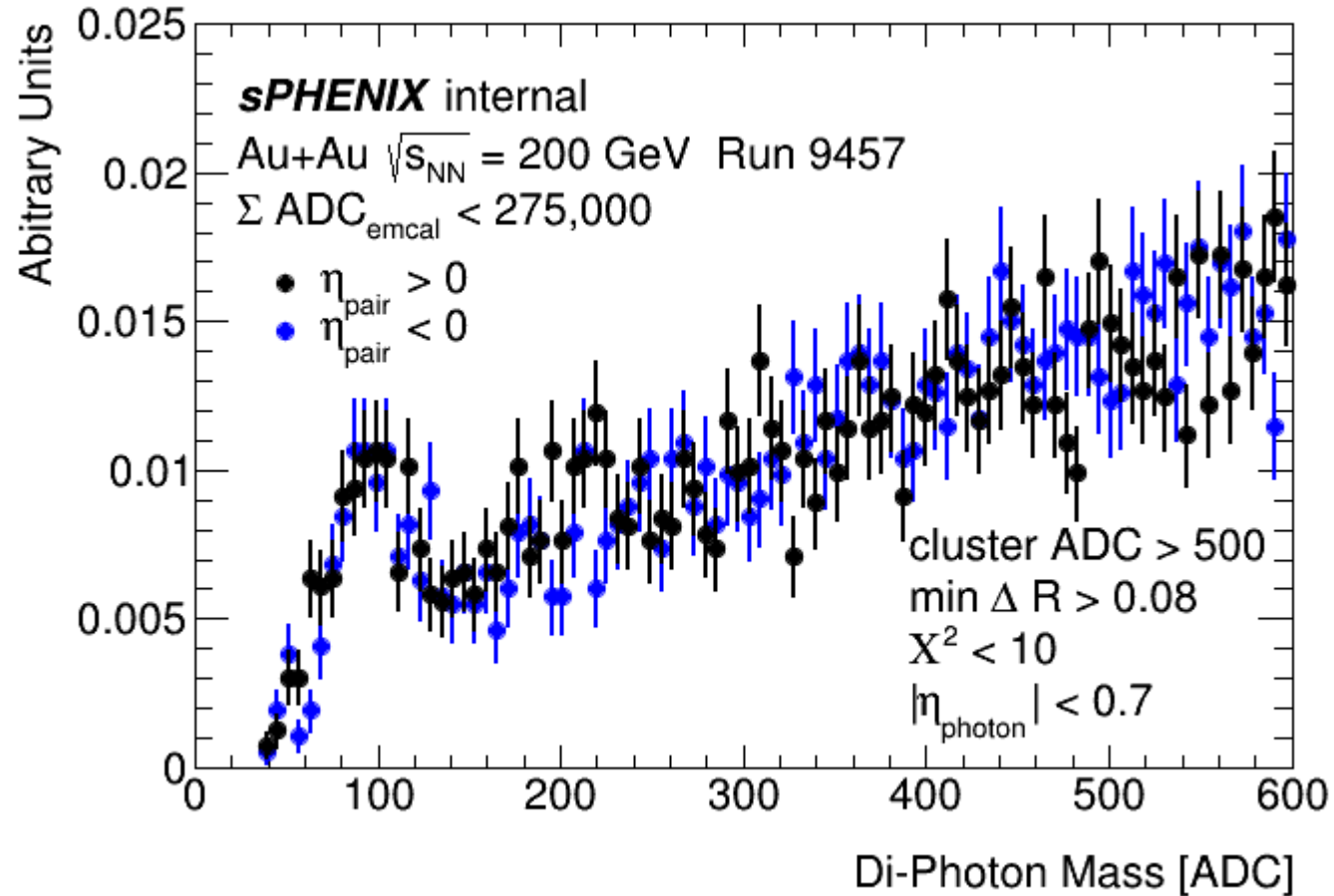
- PRDFs processed with nominal calorimeter tower building module
  - Using “CaloWaveformProcessing::FAST” method for characterization
- Misaligned packets and hot towers were masked using an analysis package (also created nodes required for cluster building code):
  - [https://github.com/sPHENIX-Collaboration/analysis/tree/master/EMCal-commissioning/emcal\\_tower\\_masking/](https://github.com/sPHENIX-Collaboration/analysis/tree/master/EMCal-commissioning/emcal_tower_masking/)
- Clusters were built using the RawClusterBuilderTemplate
  - <https://github.com/sPHENIX-Collaboration/coresoftware/blob/master/offline/packages/CaloReco/RawClusterBuilderTemplate.cc>
- The following event and cluster level cuts were applied:
  - $500 < \text{Cluster E} < 16,000 \text{ ADC}$
  - $|\eta_{cluster}| < 0.7$
  - Cluster  $\chi^2 < 10$
  - Total EMCal E  $< 275,000 \text{ ADC}$
- The following cluster pair cuts were applied:
  - $\Delta R > 0.08$
  - Energy imbalance  $< 0.8$

# Approval requested figure 1.)



Diphoton mass distribution  
Reconstructed from a single run  
containing 56,000 events

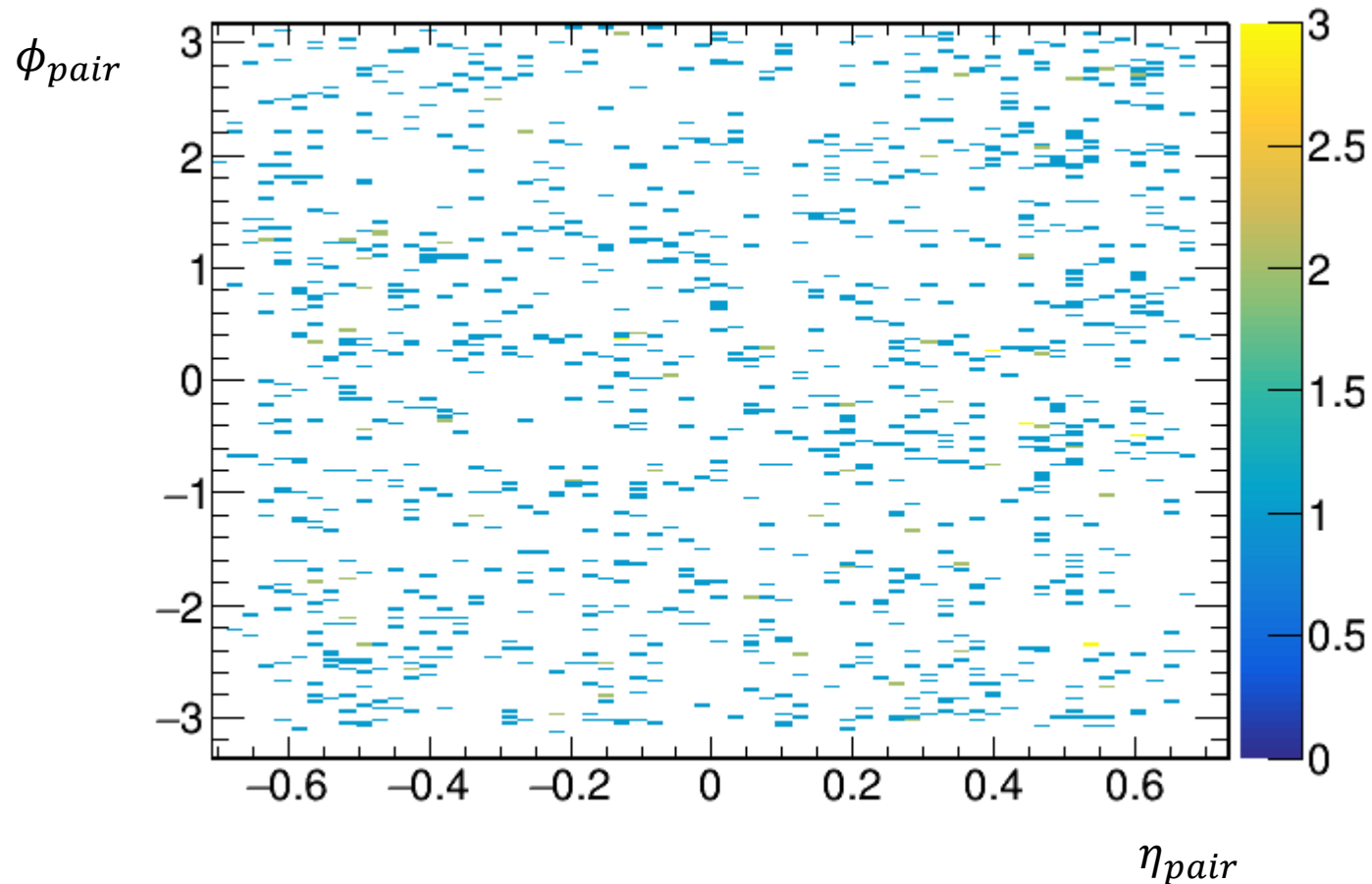
# Approval requested figure 2.)



Diphoton mass distribution  
split between two  $\eta$  regions  
to demonstrate stability

backups

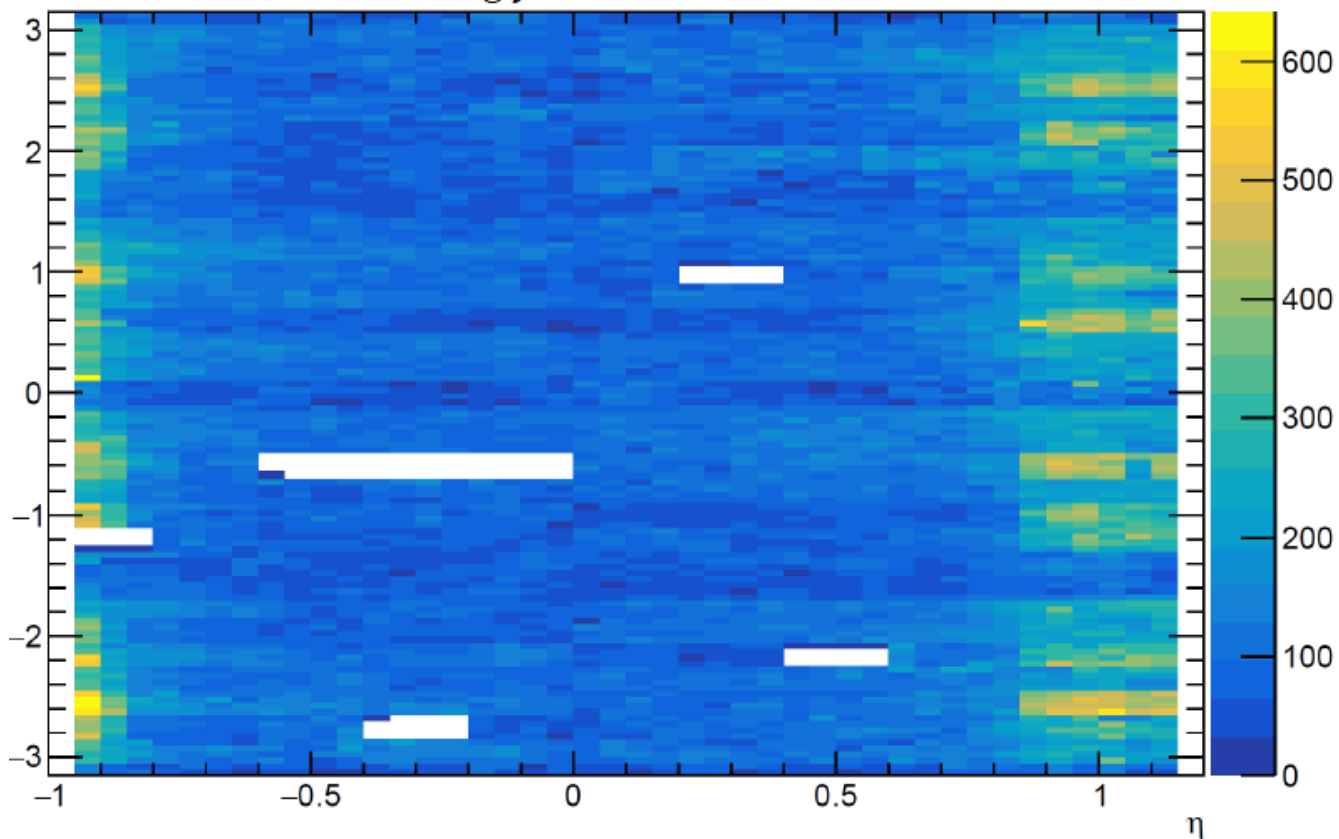
# Di-photon pair eta-phi distribution



Looked at the  $\eta - \phi$  distribution for di-photon pairs within the  $\pi^0$  mass region

# Cluster selection for di-cluster mass distributions:

$\eta - \phi$  distribution of clusters with  
 $500 < \text{energy} > 16000$  ADC and  $X^2 < 10$

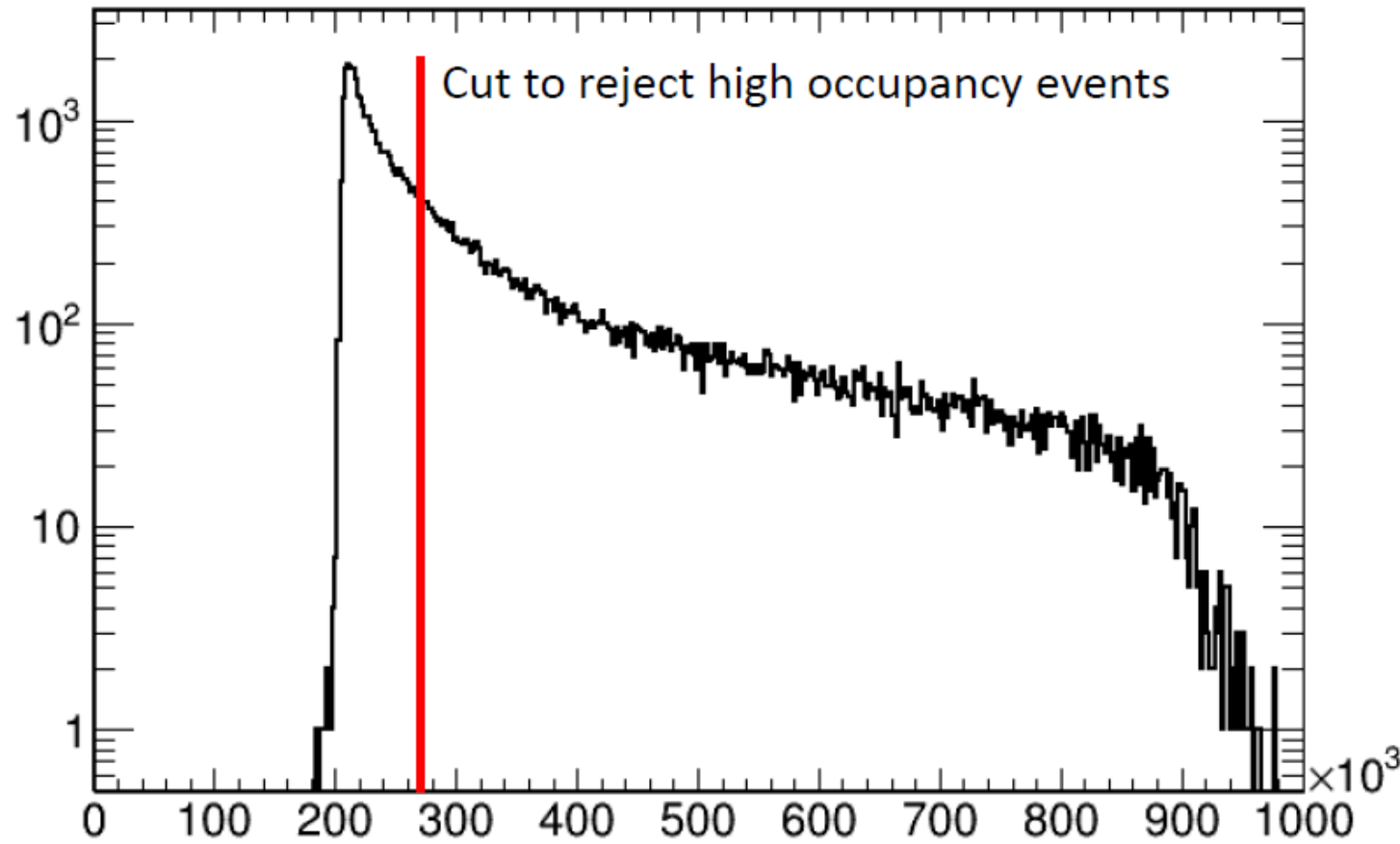


In order to select well formed photonic clusters in the area of the emcal with uniform acceptance:

- Photon tagging with  $X^2 < 10$
- Cluster pair  $\Delta R > 0.08$
- Minimum cluster energy 500 ADC
- $|\eta| < 0.7$



# Reducing combinatorics: $\Sigma$ ADC cuts

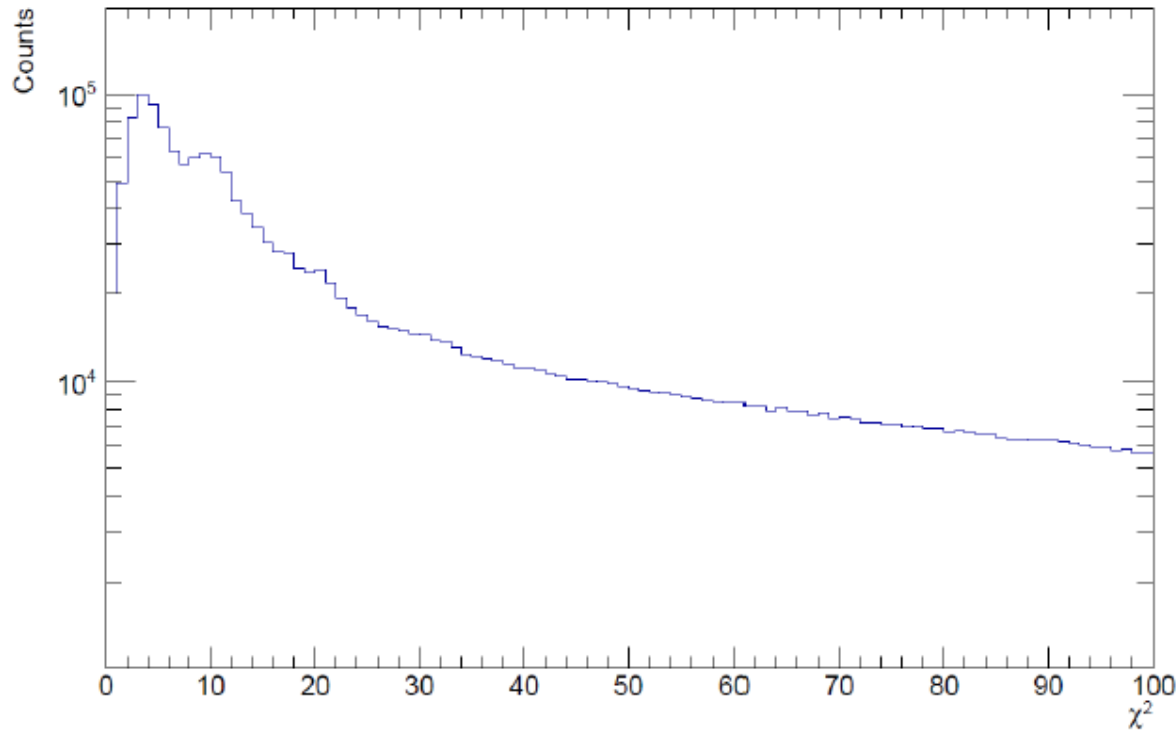


- We can use the  $\Sigma$  of CEMC ADC values as proxy for event activity
  - No MBD in these data sets to enable independent centrality selection
- Introduced cut on  $\Sigma$  CEMC ADC to reject high occupancy events
  - Reject approximately 45% of events

# Cluster $\chi^2$ distribution

Run 9457

Cluster  $\chi^2$  ( $500 \leq \text{ADC} < 16000$ )



Cluster  $\chi^2$  distribution

Clusters are selected to have  $\chi^2 < 10$  to provide a clean photon sample

Several variations were looked at (up to about  $\sim 16$ ) to ensure that we were not sensitive to this exact threshold