EMC Photon Position Reconstruction

pandaROOT Analysis $\bar{p}p \longrightarrow \pi^0\pi^0\eta \longrightarrow 6\gamma$

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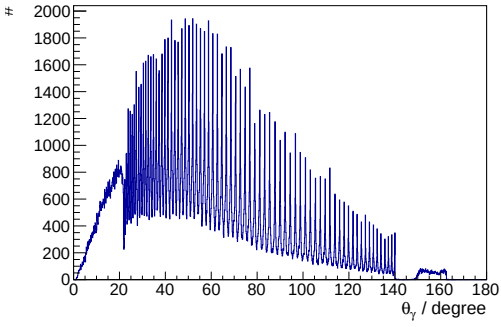
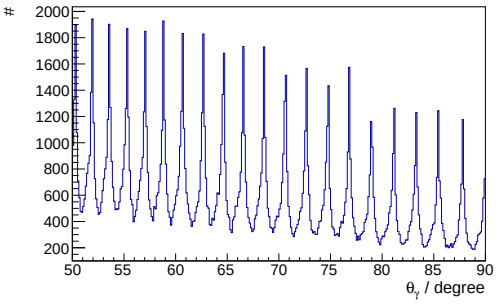
Photon angular distribution

- simulation of $\bar{p}p \longrightarrow \pi^0\pi^0\eta \longrightarrow 6\gamma$
- 500 000 events at 1.94 GeV beam momentum
- **issue**: spikes in θ for reconstructed photons

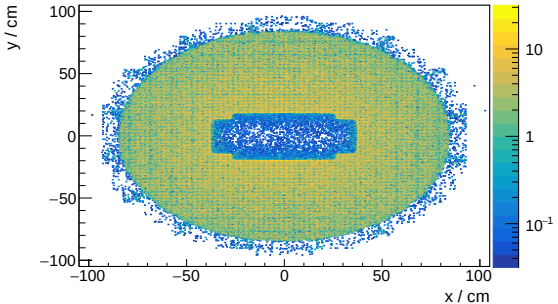


(a) reconstructed photon position in θ



(b) reconstructed photon position in θ for $50° - 90°$

Forward-Endcap photon positions



(a) Energy weighted map of depositions in the forward endcap in x- and y-direction

- Forward-Endcap:

  different crystal alignment than in EMC barrel

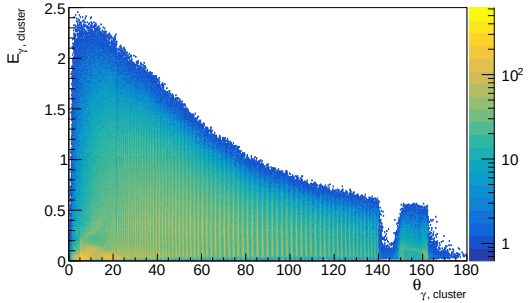
- spike related matrix structure visible in x- and y-direction

Spike correlation

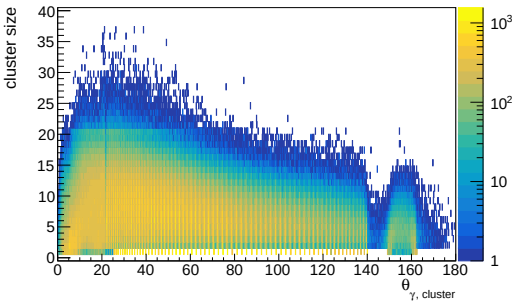
- more statistics located at spike-correlated θ positions

  $\longrightarrow$ nearly match θ positions of **crystal centres**

- spikes not only correlated to **low-energy clusters** or **single-crystal clusters**



(a) cluster energy in terms of the angle θ



(b) cluster size in terms of the angle θ

Cluster position method - Lilo

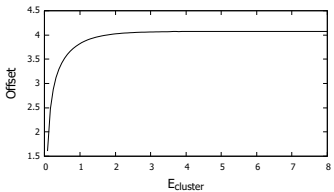
- **linear-logarithmic** weighting of the cluster position
- linear weighting if not at least 2 reasonable (> 0) logarithmic weights are found

$$W_{log}^{crystal} = \text{Offset} + \log\left(\frac{E_{\text{crystal}}}{E_{\text{cluster}}}\right), \text{ with } \log\left(\frac{E_{\text{crystal}}}{E_{\text{cluster}}}\right) : [-\infty, 0]$$

- to avoid a negative logarithmic weight, lilo method uses an **offset**

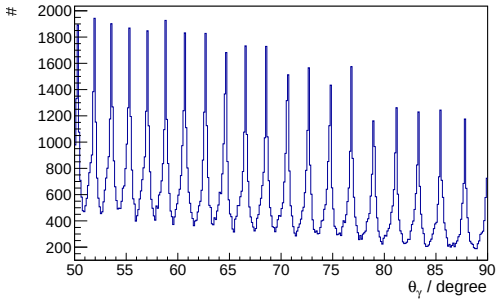
$$\texttt{Offset} = \texttt{OffsetParmA} - \texttt{OffsetParmB} \cdot e^{-\texttt{OffsetParmC} \cdot E_{\text{cluster}}^{1.171}} \cdot E_{\text{cluster}}^{-0.534}$$

$\longrightarrow$ fine tuning the offset may improve spikes on peaks

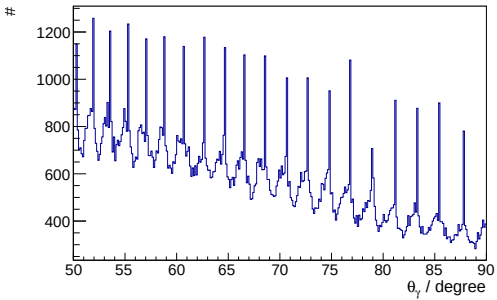


Lilo offset tuning

- does a change in the offset improve the spikes on the peaks ?



(a) `OffsetParmA` = 4.071 (default)



(b) `OffsetParmA` = 5.0

Summary

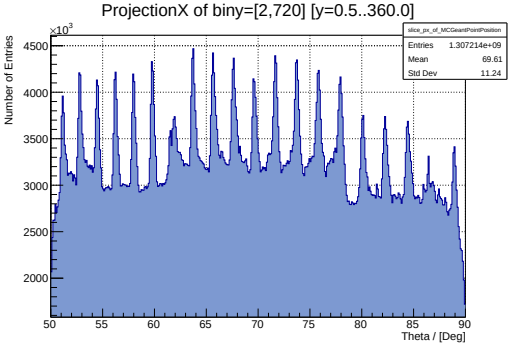
- How was the offset function in the Lilo-method determined ?
- What is a good quality measure for the Lilo-method/offset ?

  $\longrightarrow$ (e.g. θ-residuals, θ_{gen} vs θ_{rec})
- Is an optimization of the method itself needed ?
- Bonn group will take care of FWEC position reconstruction,

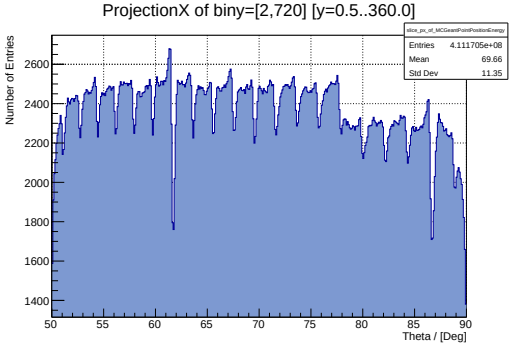
  EMC Barrel, BWEC ?

MC generated position points

- spikes are also visible in generated data
- peaked spikes $\longrightarrow$ points transversing different volumes
- dips correlated with supermodule transitions (plateaus correlated with barrel geometry?)

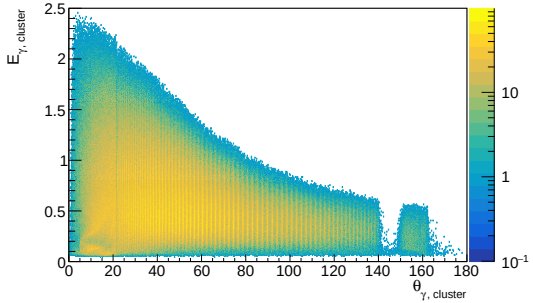


(a) MC generated position points in θ

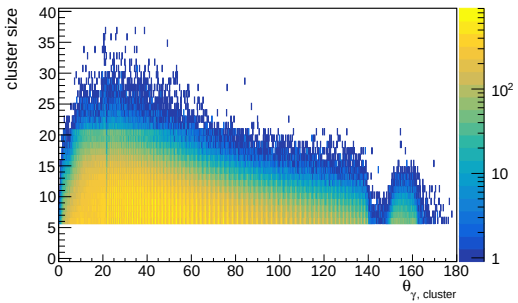


(b) MC generated points in θ with **energy deposition**

Spike correlation



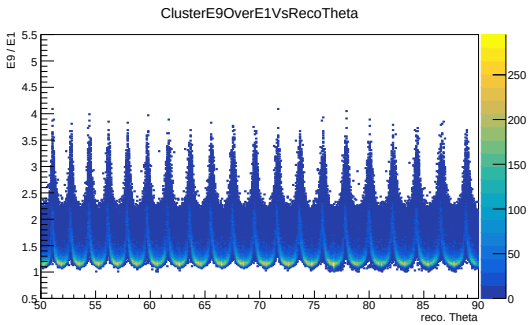
(a) cluster energy in terms of the angle θ for a cluster size of more than 5 crystals



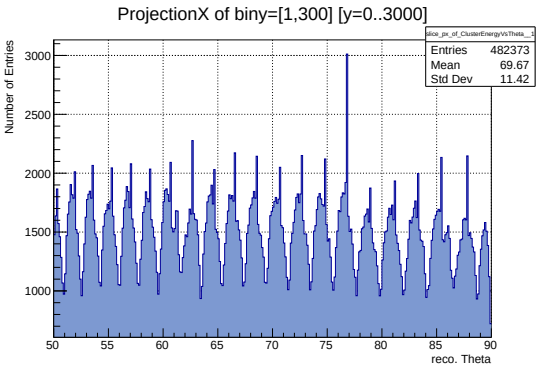
(b) cluster size in terms of the angle θ for a cluster size of more than 5 crystals

Cluster position method - Lilo

- very sensitive to E9/E1
- shows single bins with very high statistics



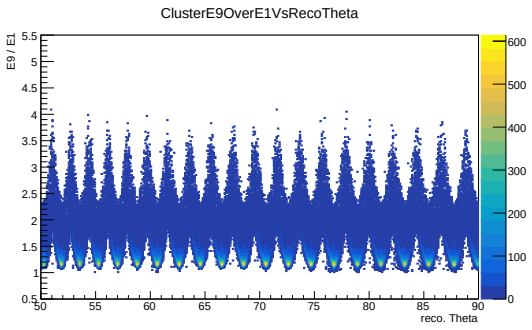
(a) E9/E1 vs reconstructed cluster position in θ



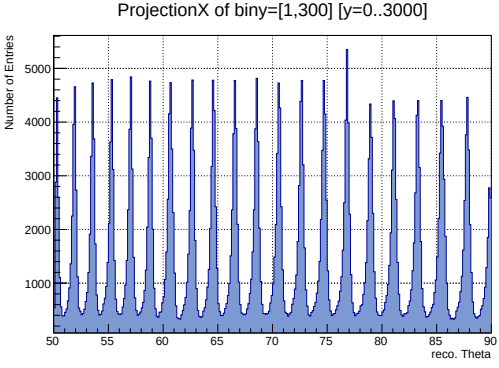
(b) cluster size vs reconstructed cluster position in θ

Cluster position method - Linear

- linear weighted θ-positions
- less sensitive to E9/E1
- no bin structure within the peaks



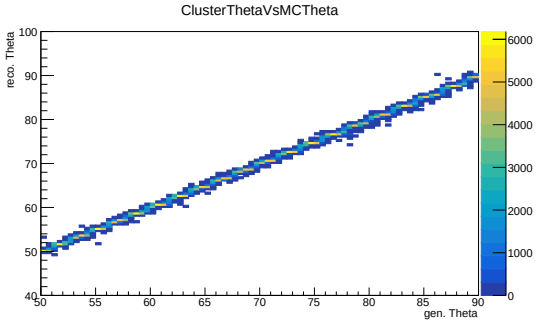
(a) E9/E1 vs reconstructed cluster position in θ



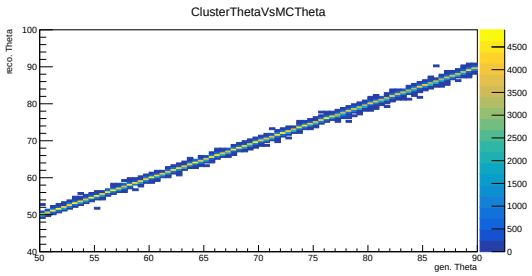
(b) cluster size vs reconstructed cluster position in θ

Cluster position method comparison

- **lilo method**: better correspondence between θ_{rec} and θ_{gen}
- **linear method**: steps in relation between θ_{rec} and θ_{gen}



(a) reconstructed vs generated cluster position in θ (linear method)



(b) reconstructed vs generated cluster position in θ (lilo method)