EMC Bump splitting

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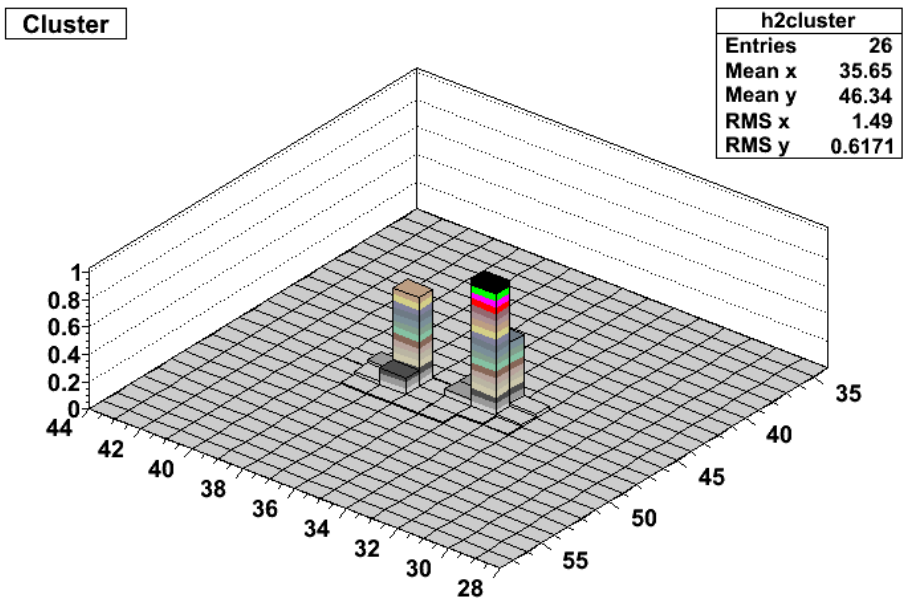
Bump splitting



π^0 with high energy can produce in EMC single cluster with two local maxima (bumps) for each of the γ from the decay $\pi^0 \rightarrow \gamma\gamma$

Two step algorithm:

1. Finding of local maxima
2. Digis are shared between bumps in iterative procedure.

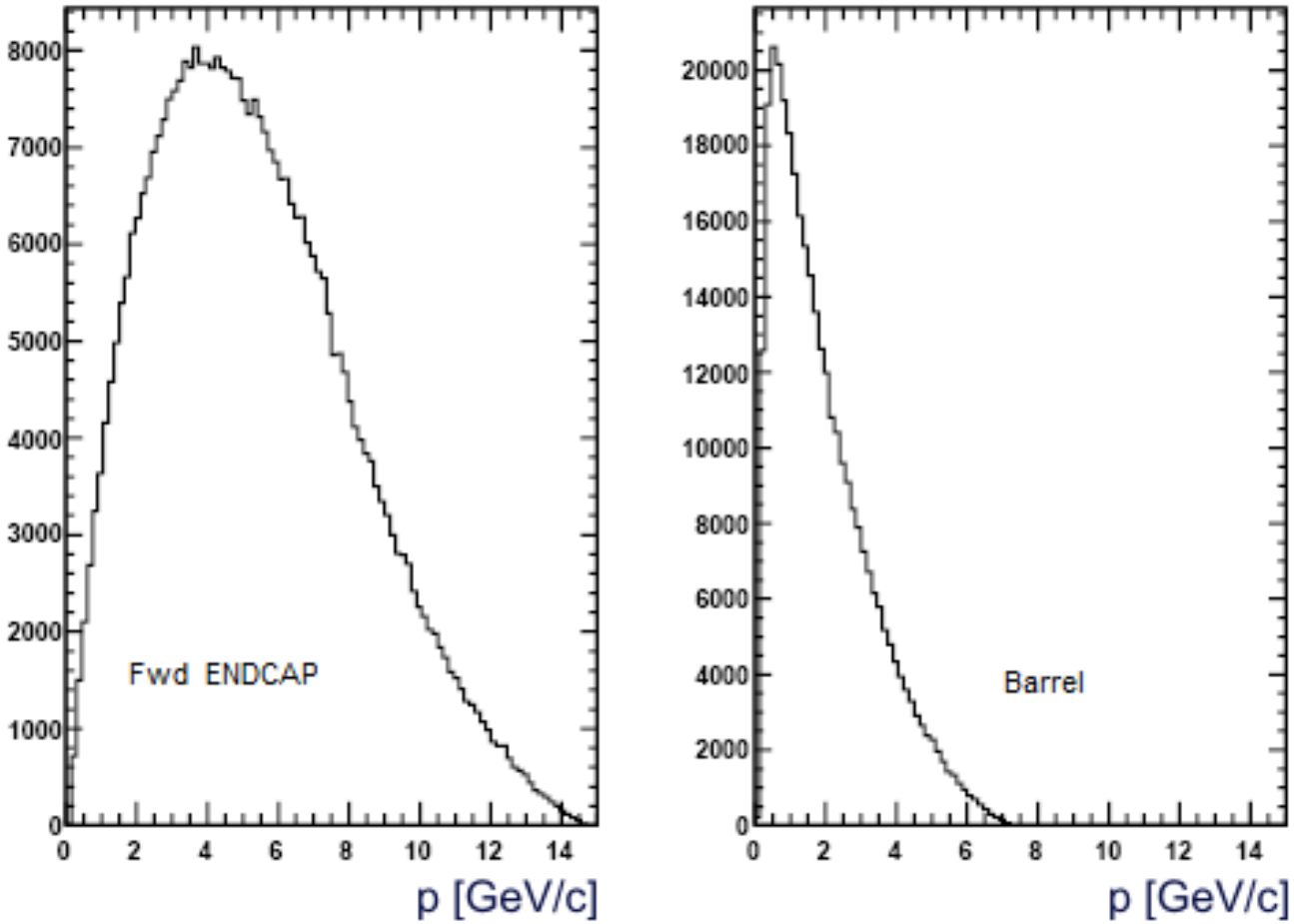
Weights

$$w_{i,d} = \frac{E_d \cdot e^{-2.5 \cdot r_{i,d}/R_m}}{\sum_j E_d \cdot e^{-2.5 \cdot r_{j,d}/R_m}}$$

where $r_{i,d}$ - distance between d-th digi and i-th bump, R_m - Moliere radius of the material.

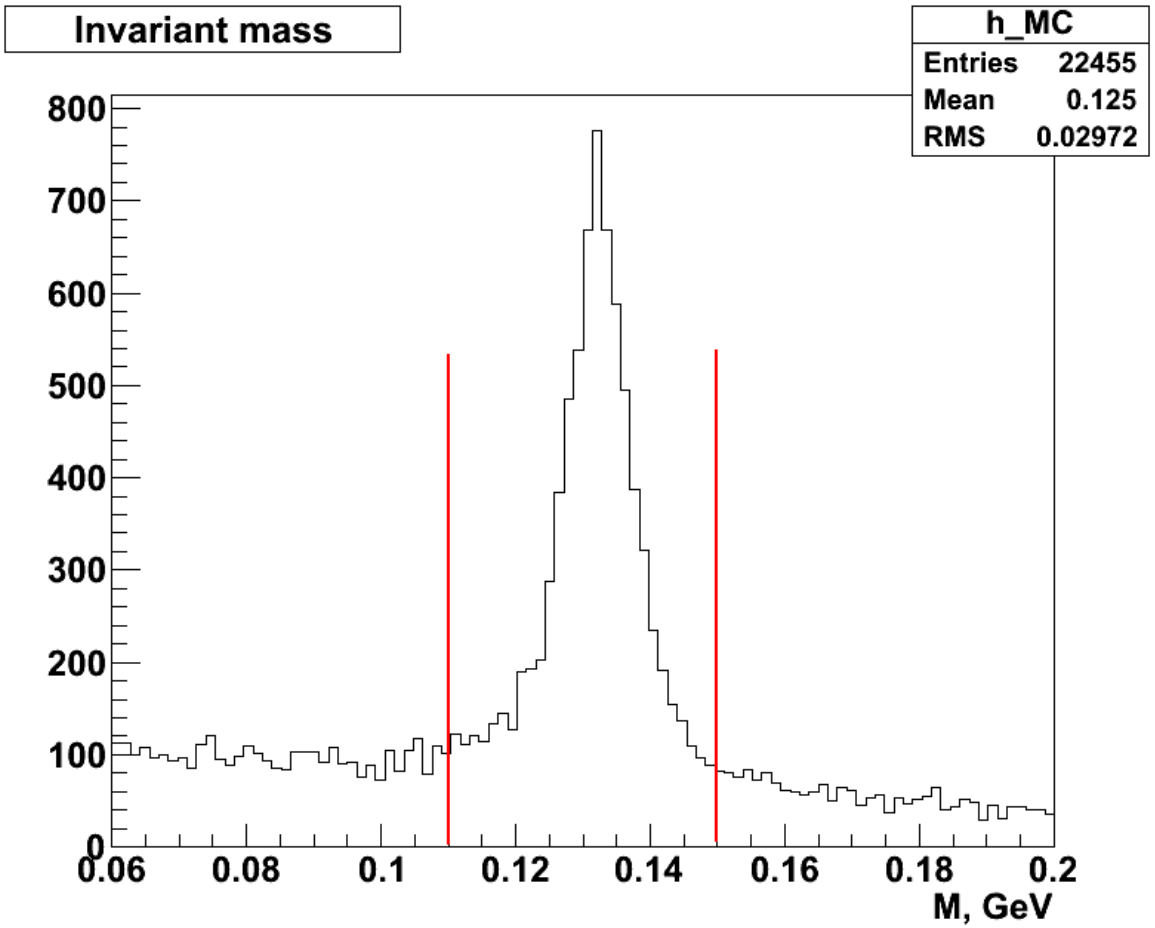
π^0 in EMC

π^0 energy spectrum for p=15 GeV/c antiproton beam



Technical Design Report for Panda EMC, p. 35

Forward endcap



Mass reconstructed in range [0.115;0.155] *GeV*.
Energy threshold - 30 *MeV*.

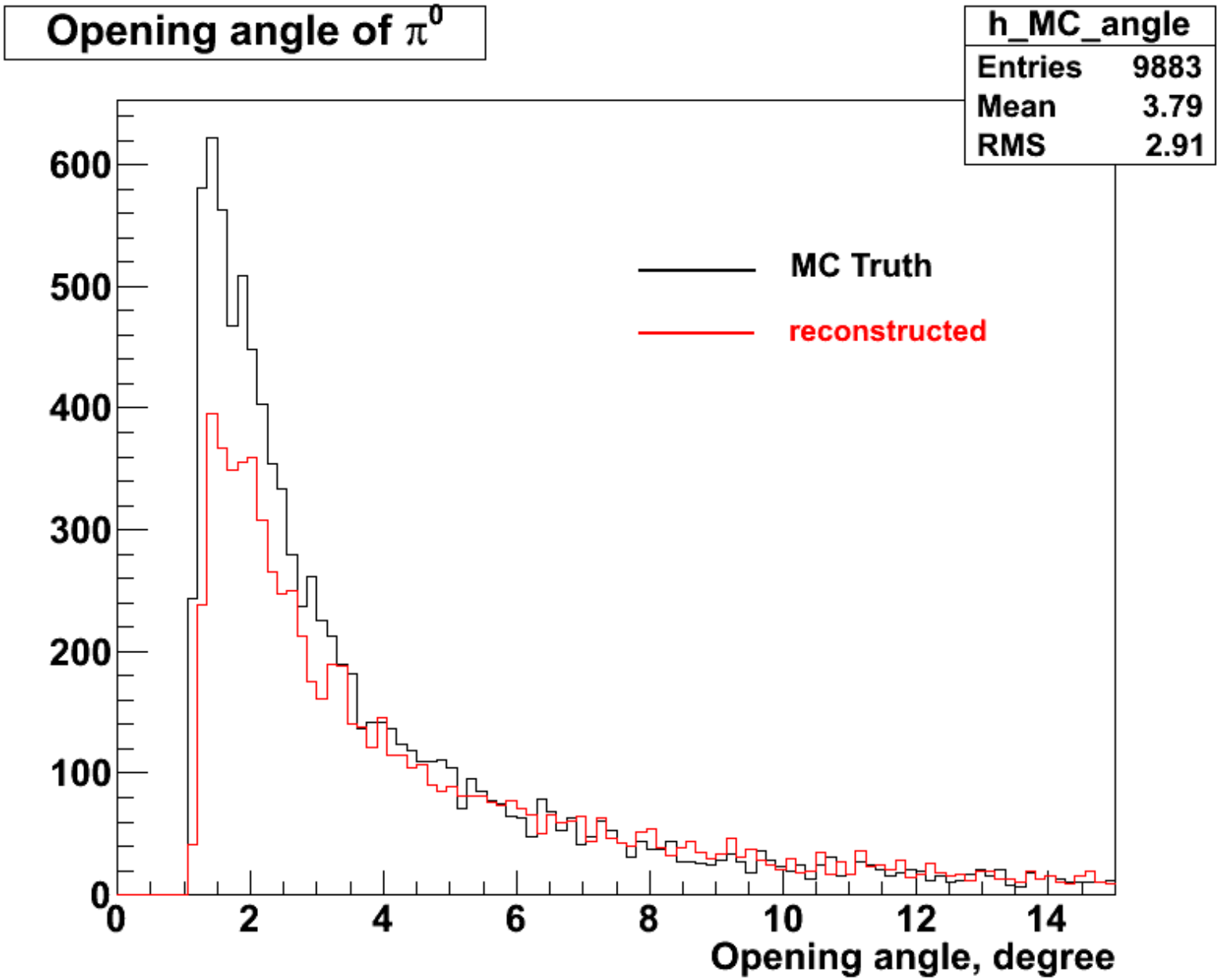
Angular granularity of crystals $\sim 0.5^\circ$.

Generated events

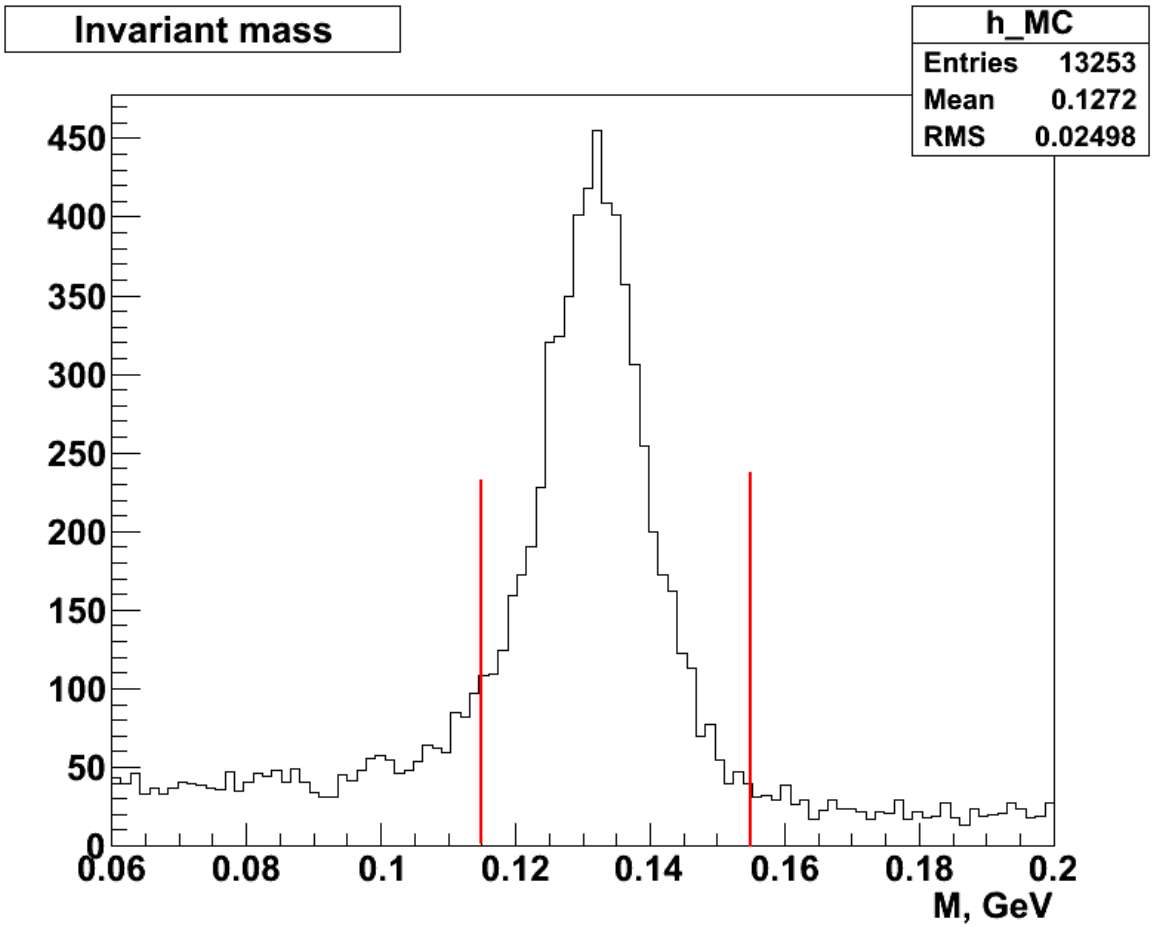
10000 π^0
Energy: 1-14 *GeV*
θ:14°, ϕ:0-360°
Geant 3 simulation with the whole PANDA geometry

Efficiency of π^0 reconstruction - 80.0 %.
Efficiency of π^0 reconstruction (w/o bump splitting) - 26.8 %.

Forward endcap - Reconstruction of opening angle



Barrel



Mass reconstructed in range [0.115;0.155] *GeV*.
Energy threshold - 30 *MeV*.

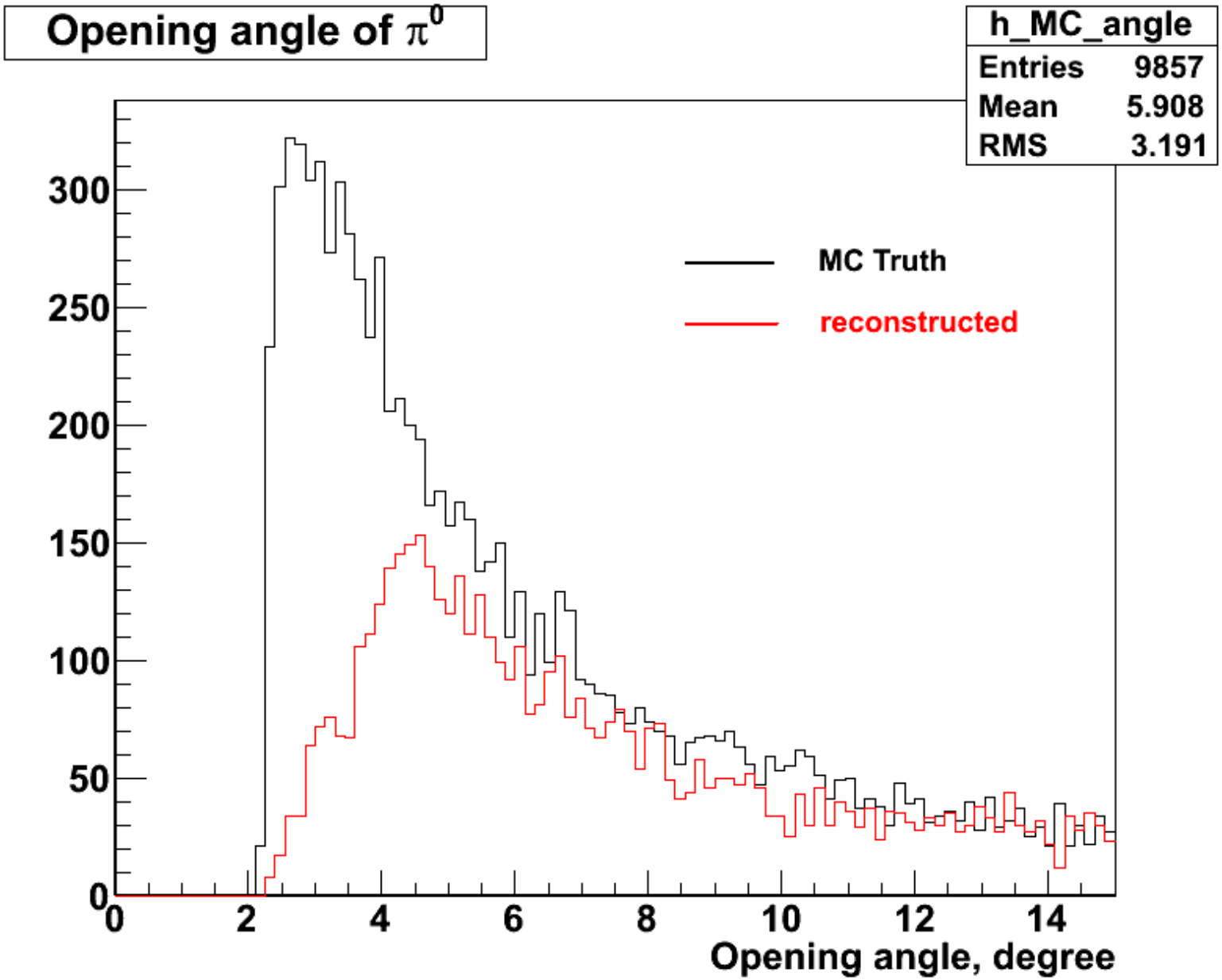
Angular granularity of crystals - 0.7-2.0 °.

Generated events

10000 π^0
Energy: 1-7 *GeV*
θ:30-130°, ϕ:0-360°
Geant 3 simulation with the whole PANDA geometry

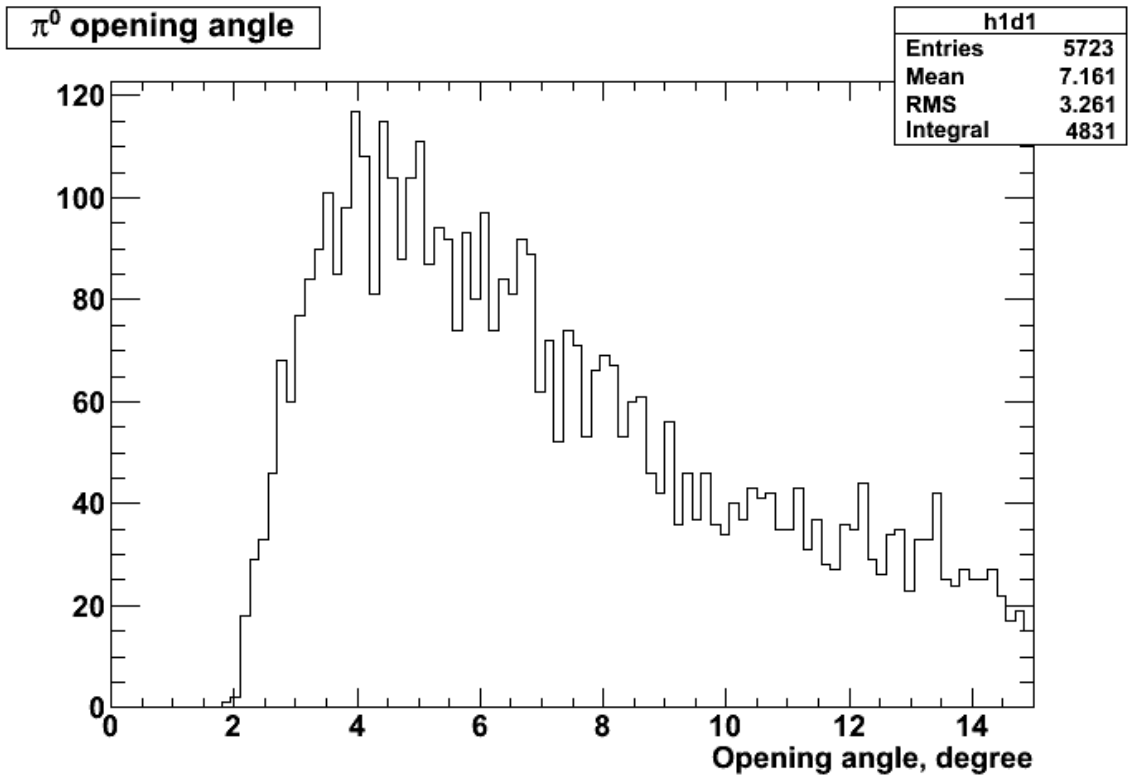
Efficiency of π^0 reconstruction - 61.5 %.
Efficiency of π^0 reconstruction (w/o bump splitting) - 20.1%.

Barrel - Reconstruction of opening angle



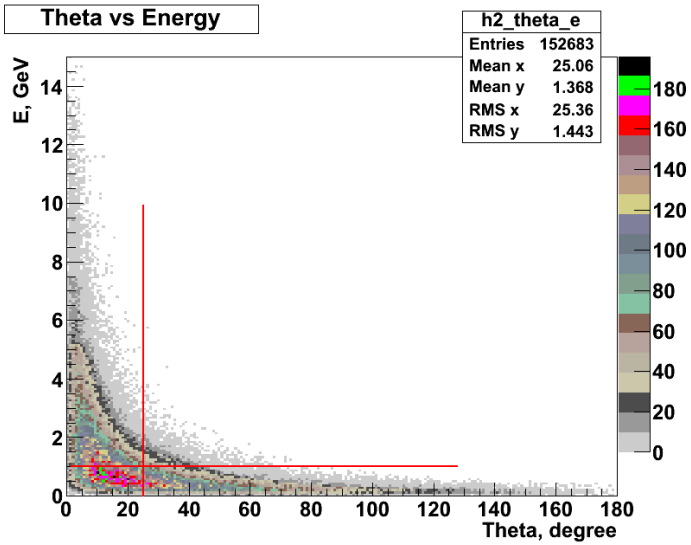
Babar framework - Reconstruction of opening angle

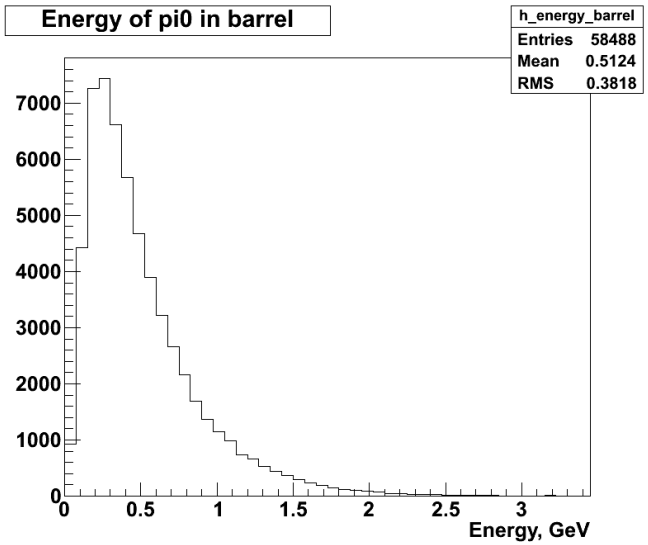
Geant 4 simulation with the whole Panda geometry of π^0 with E=1-7 GeV, θ=30-130°

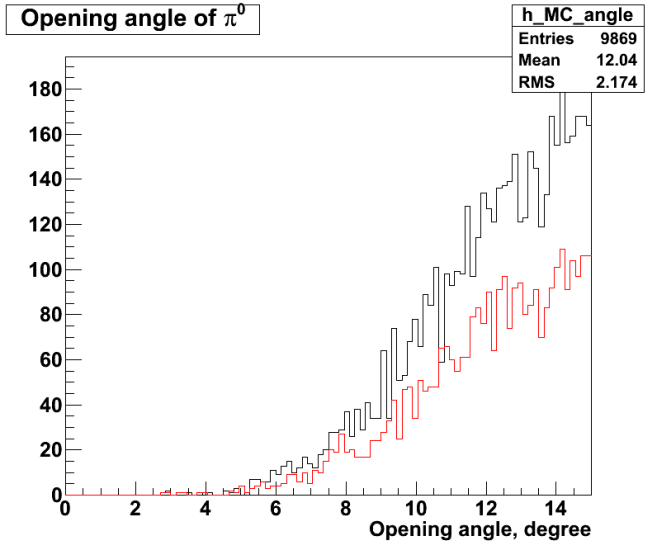


π^0 reconstruction efficiency within range [0.115;0.155] *GeV* - 58.2 % vs 61.5% in pandaroot.

π^0 distribution from DPM at 15 GeV/c



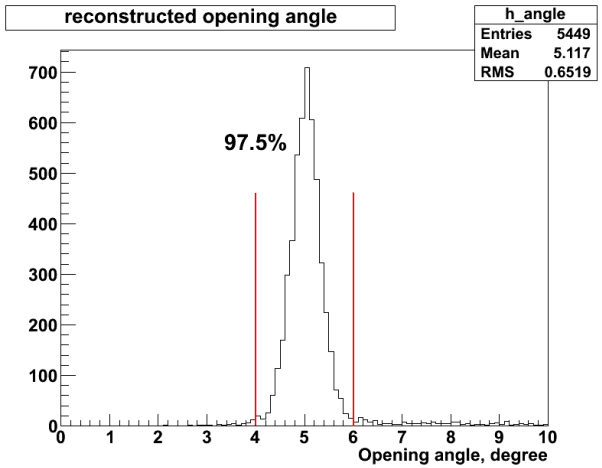


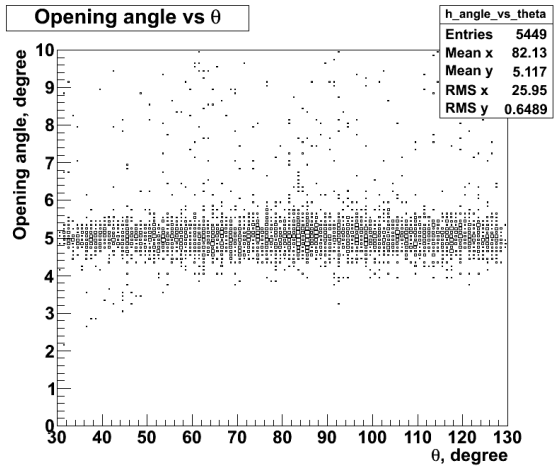


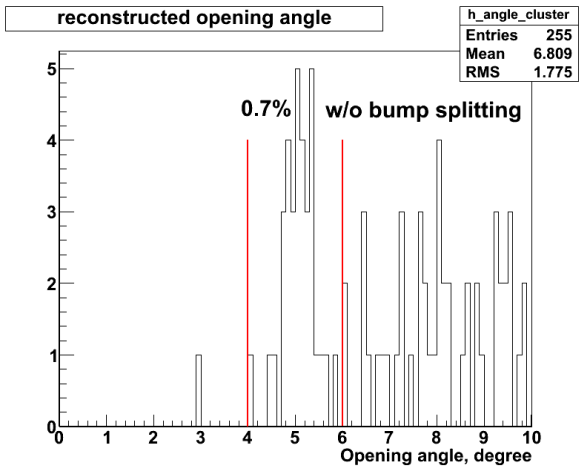
π^0 reconstruction efficiency - 74 %
with and without bump splitting

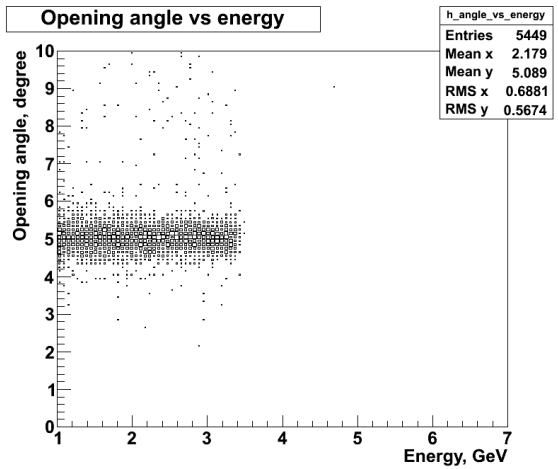
2 γ's with fixed angular distance $\alpha = 5^\circ$

Two γ's with fixed angular distances $\alpha = 1, 2, 3, 4, 5^\circ$ (5000 events for each) have been produced in pandaroot for with equal energy E=0.5-3.5 GeV (1-7 GeV total energy), θ=30-130° with EMC detector geometry only.

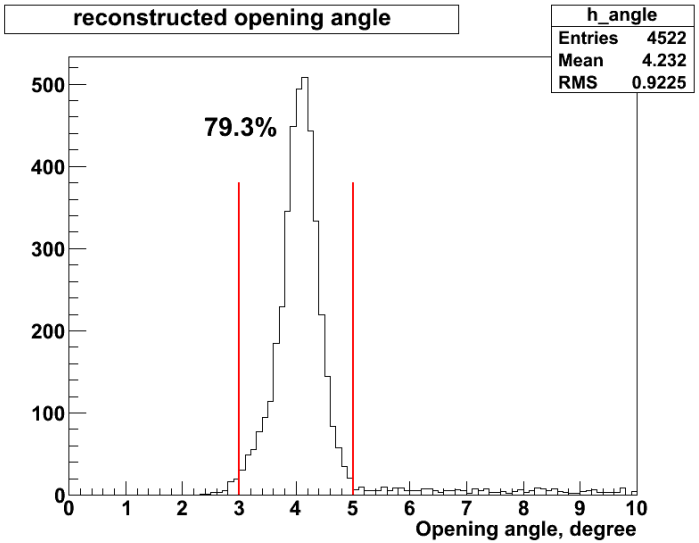


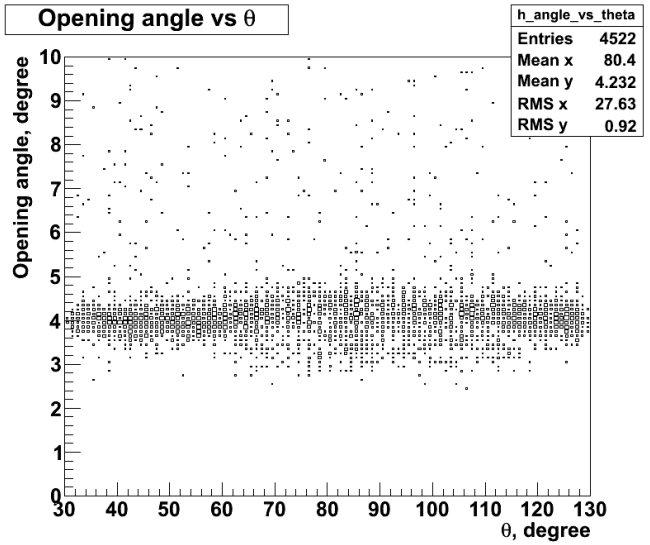


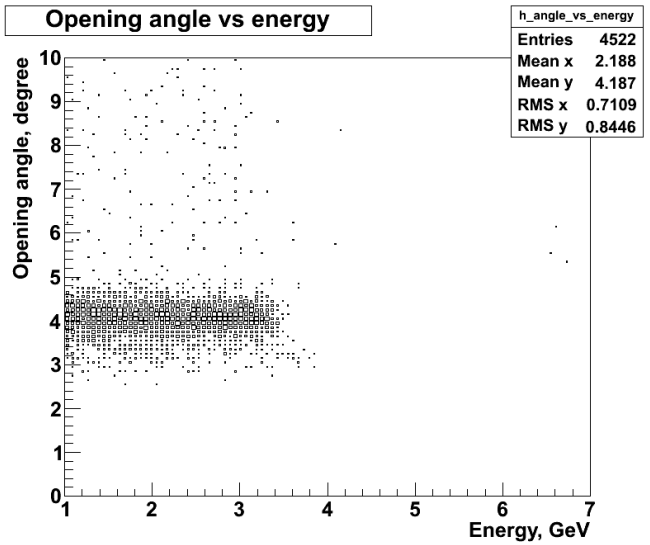




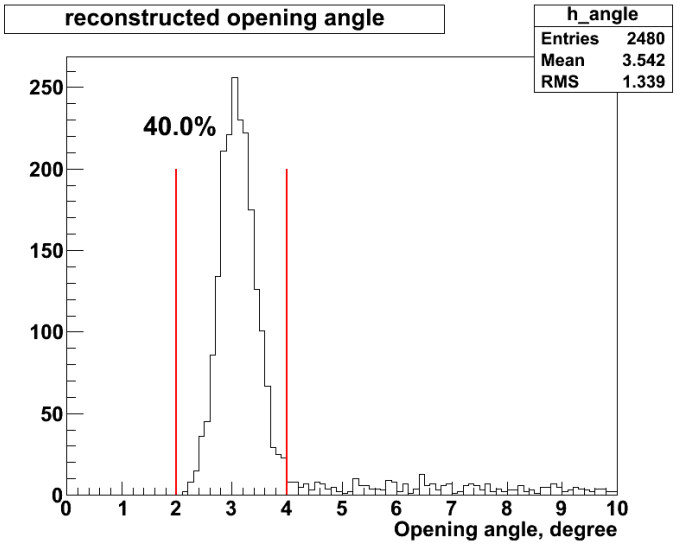
2 γ's with fixed angular distance $\alpha = 4°$

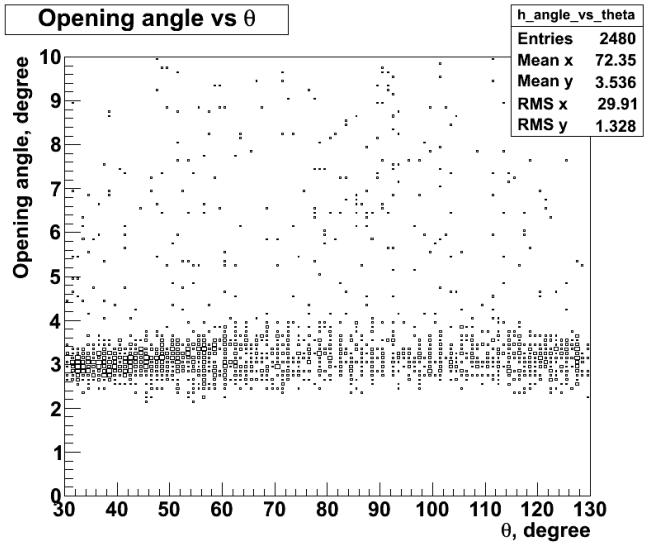


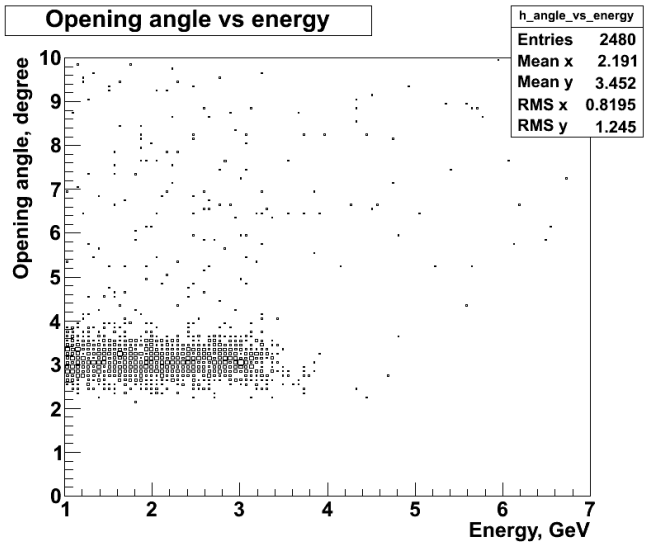




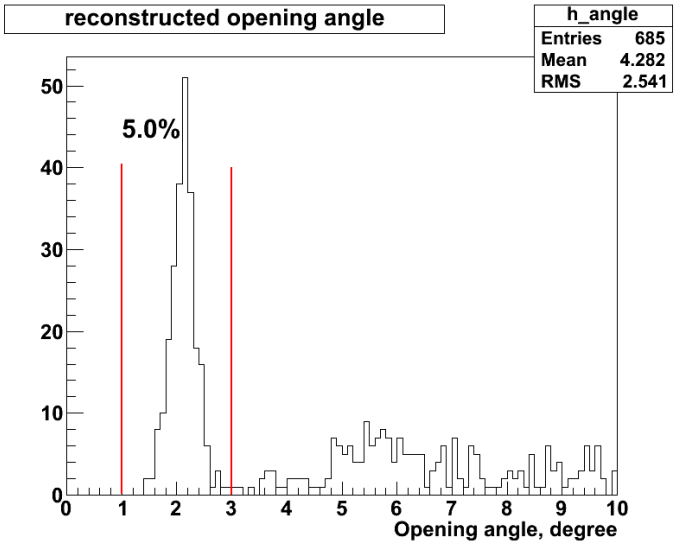
2 γ's with fixed angular distance $\alpha = 3^\circ$

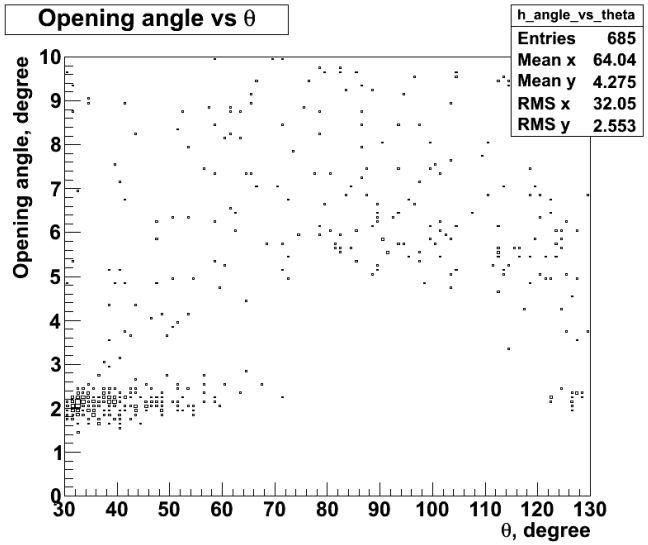


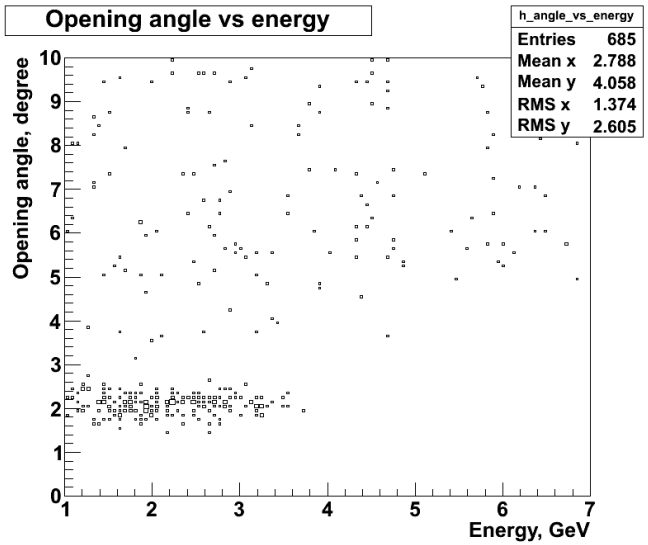




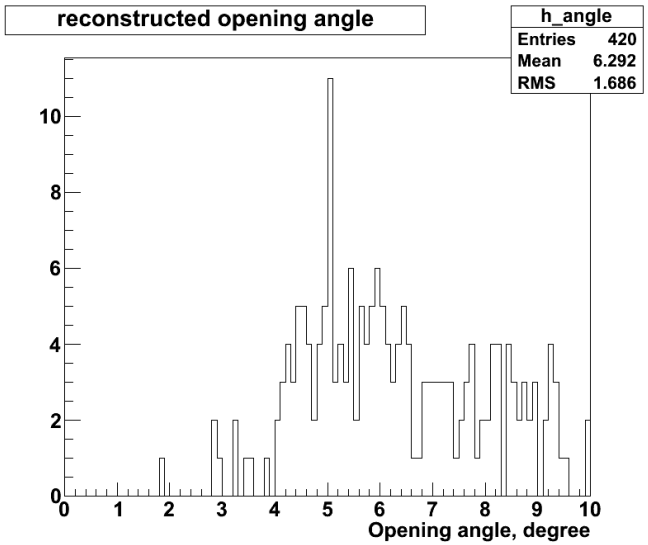
2 γ's with fixed angular distance $\alpha = 2^\circ$

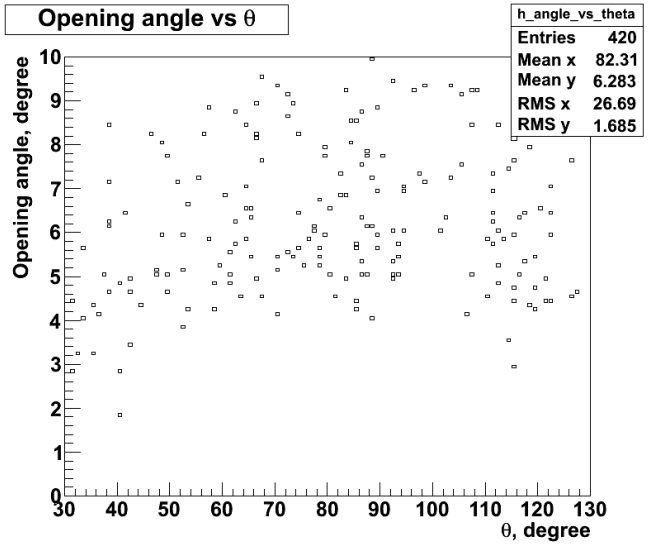


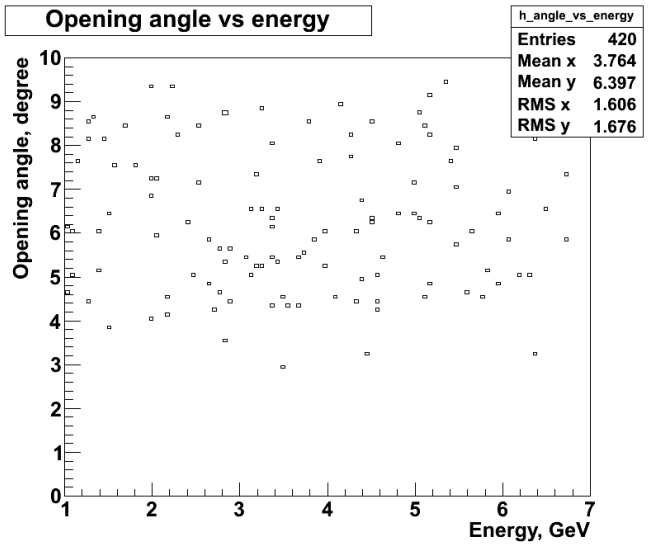




2 γ's with fixed angular distance $\alpha = 1^\circ$







Summary

- Bump splitting algorithm demonstrate similar performance in pandaroot and Babar framework.
- Realistic distribution of background π^0 from DPM decrease requirements on bump splitting performance in barrel region, where EMC granularity is lower.