



EMC Simulation Studies: update on geometry effects

SuperB Collaboration Workshop

Full Simulation
parallel session

LNF
2/12/2009

C. Cecchi - S. Germani*
Università di Perugia & INFN

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CASSA RISPARMIO PERUGIA



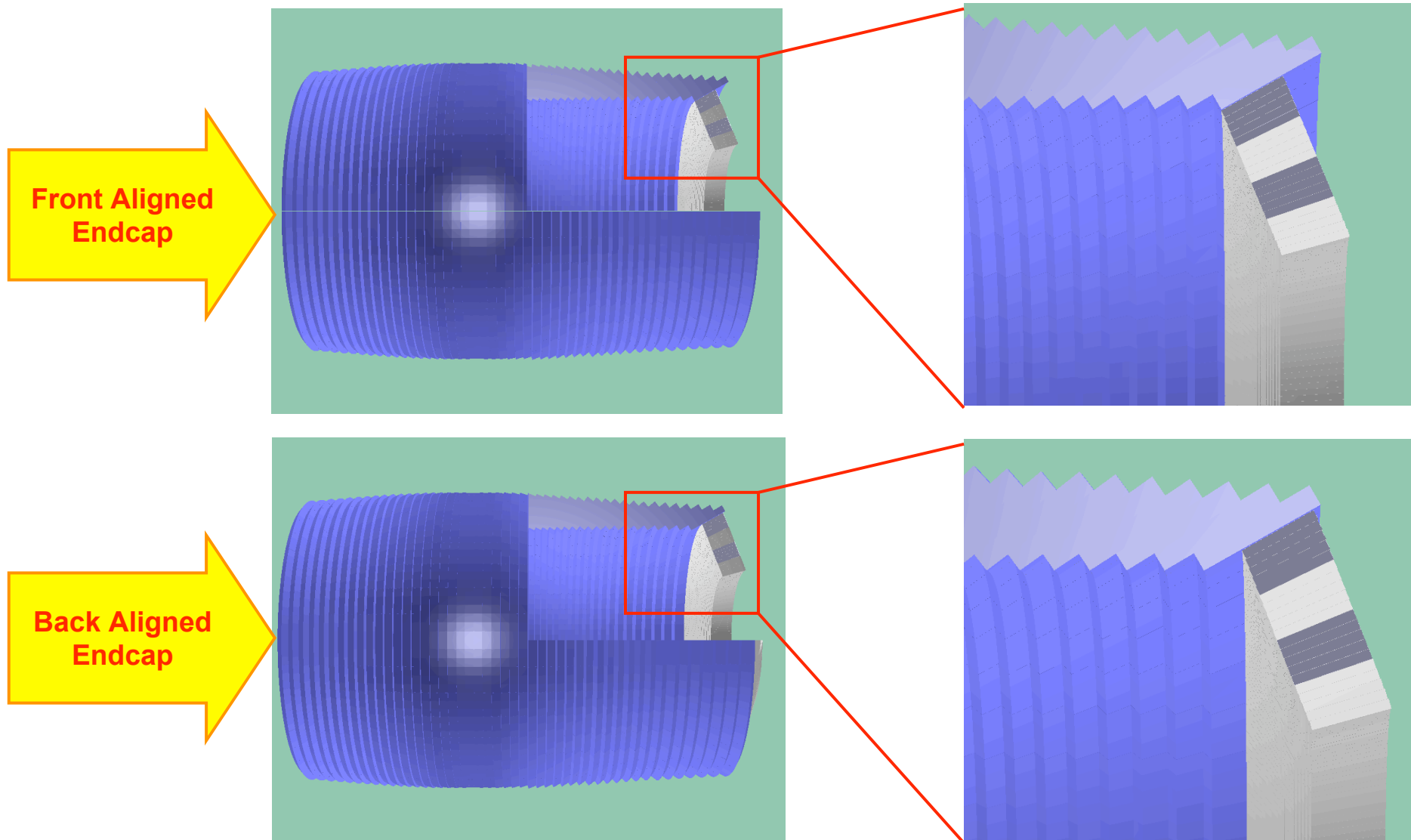
Outline



- Geometry effects
 - Endcap Position effects
 - Fwd PID thickness effects
- Clustering Algorithm
 - Cluster Size in Barrel and Fwd
 - Tuning
- Conclusions and Outlook

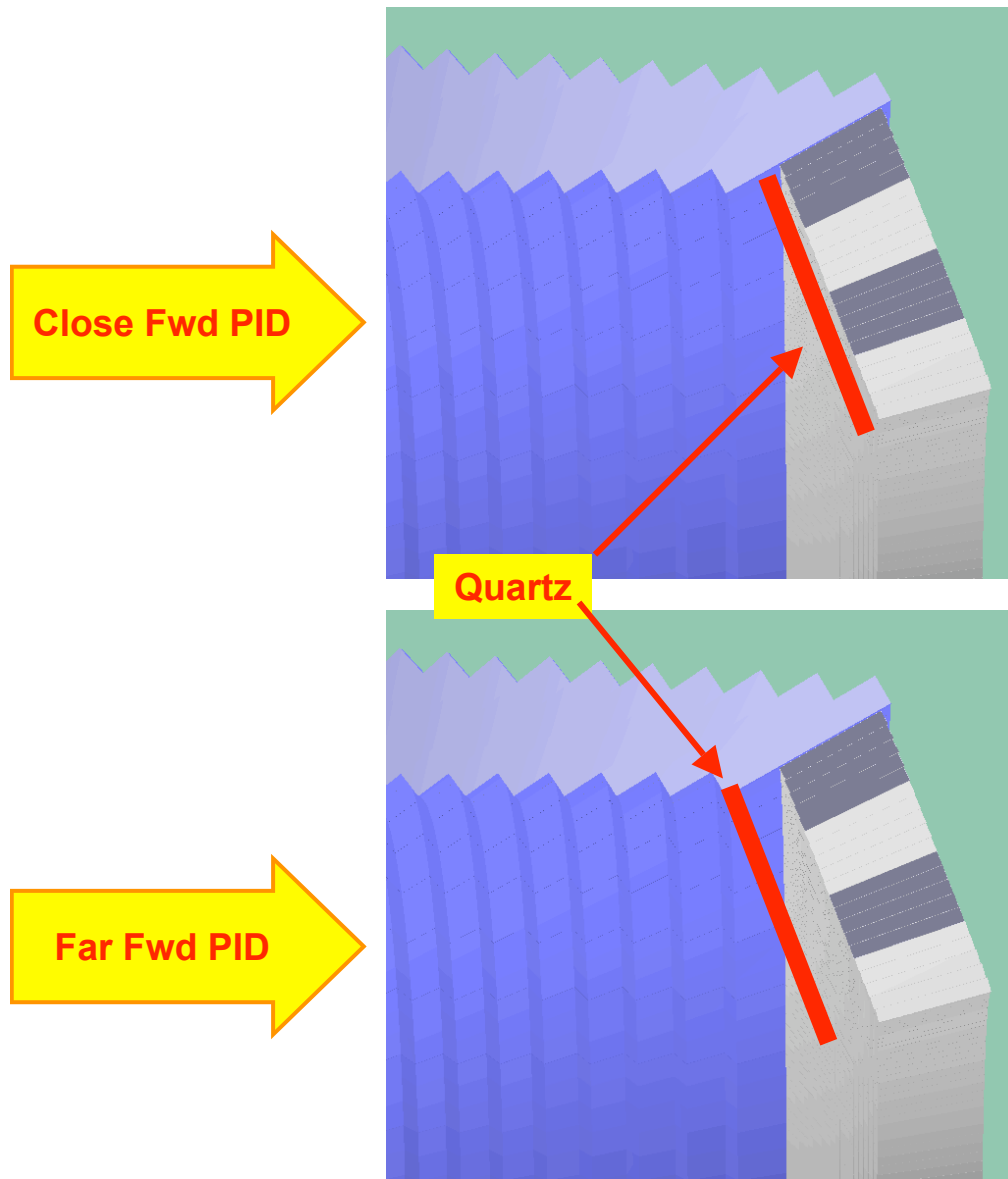


Barrel + Fwd Endcap alignment options





Forward PID simulated options



- Calorimeter with back aligned endcap
- Fwd PID simulated as passive material:
 - Variable thickness quartz layer
- Two options for PID positions:
 - Close to the Fwd Endcap surface
 - Far from the Fwd Endcap surface

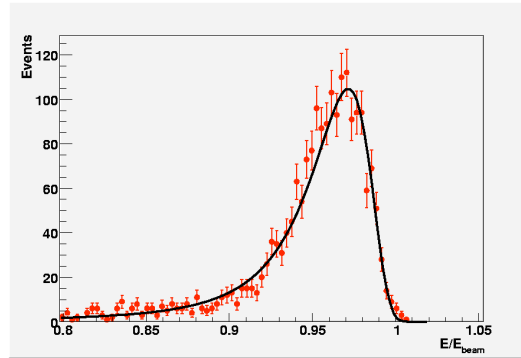
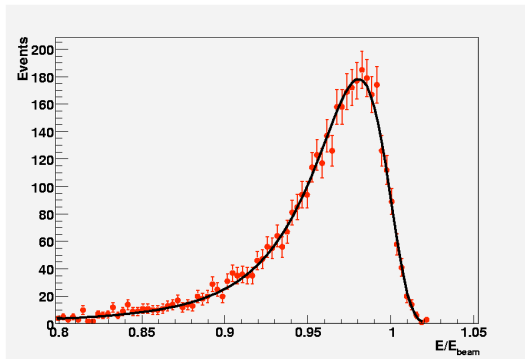


Fit Functions

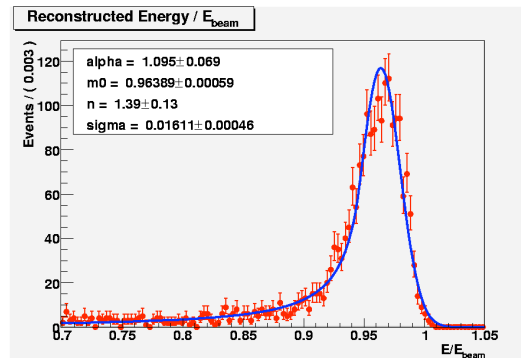
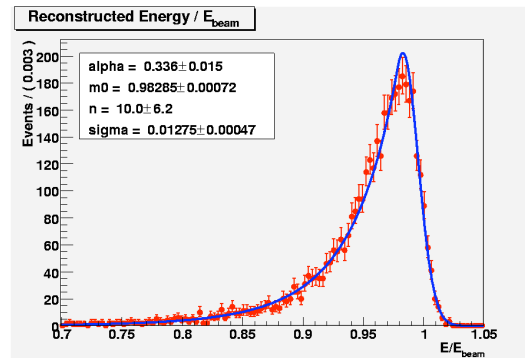


100 MeV γ

1 GeV γ



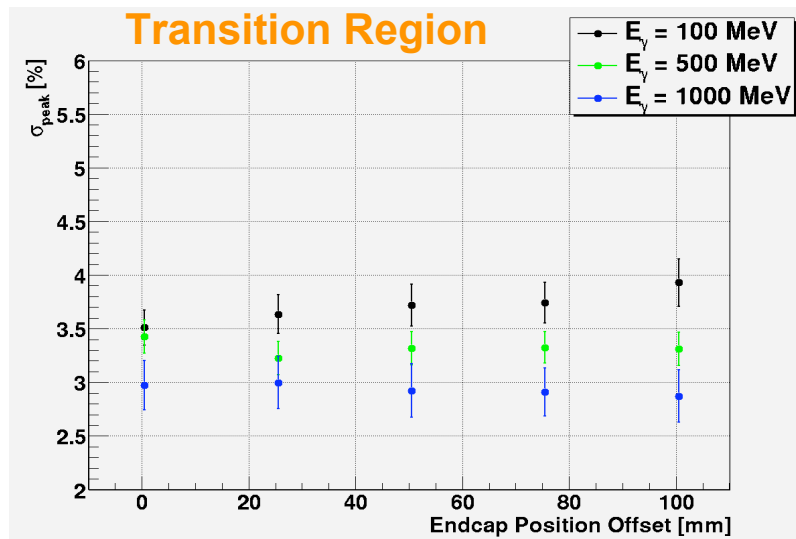
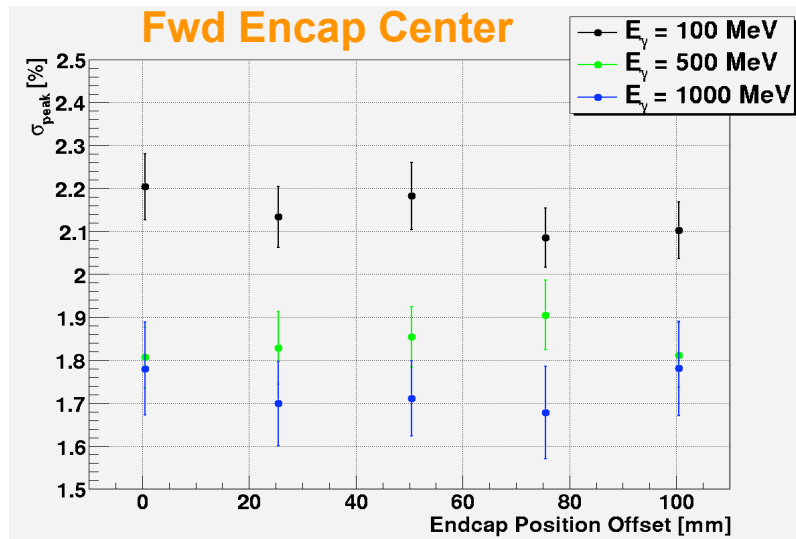
Asymmetric Gauss Function



Crystal Ball Function

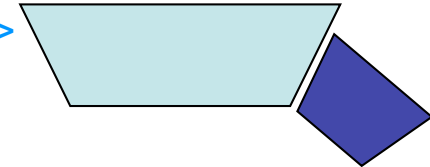


Energy Resolution vs Fwd Endcap Position

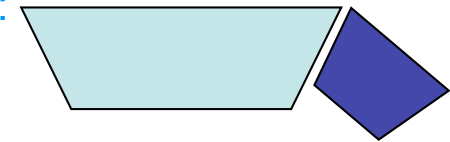


- Scan Energy resolution as a function of Forward Endcap position with respect to the Barrel

– 0 mm Offset ->



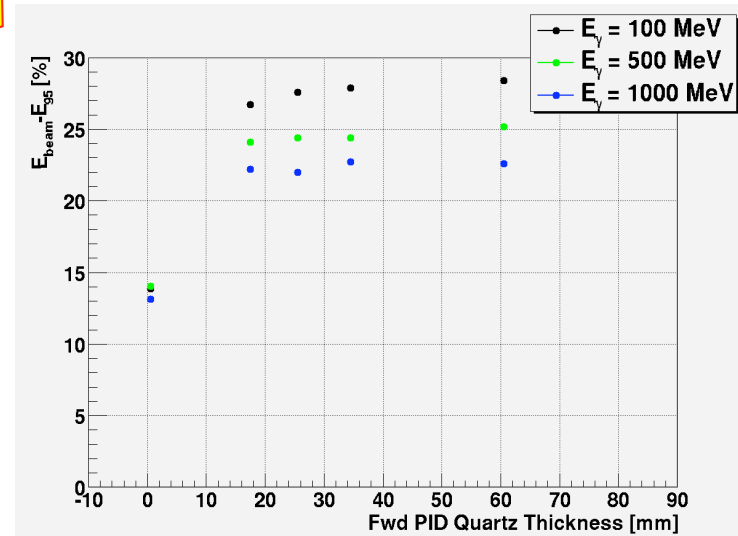
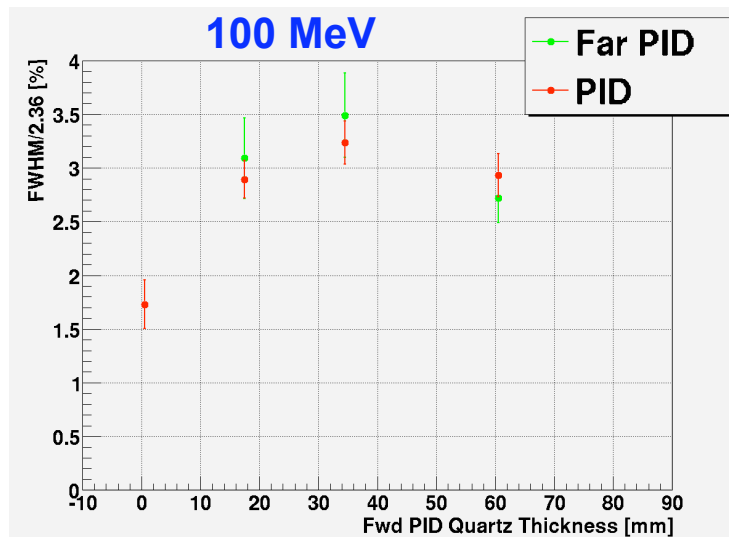
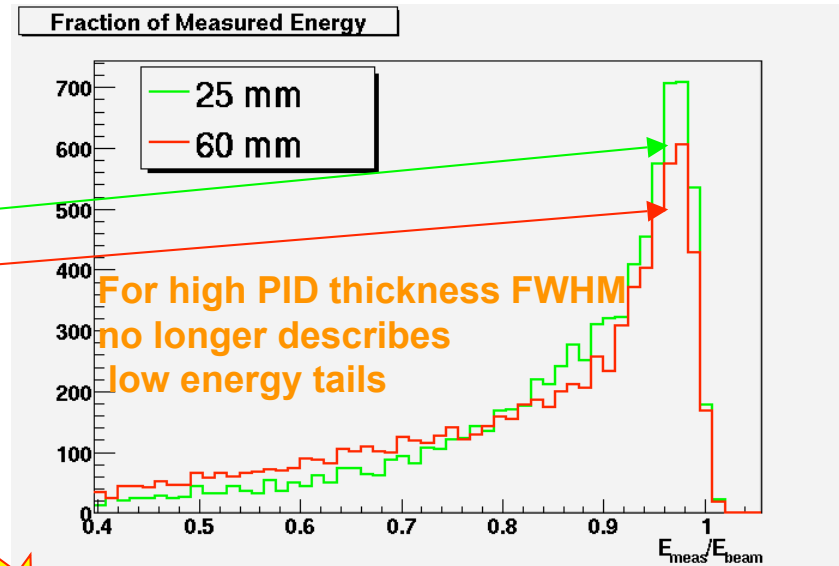
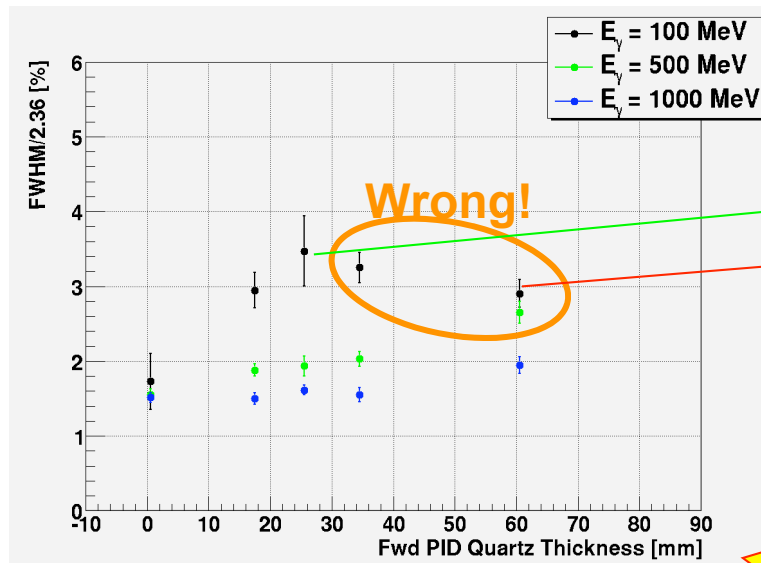
– 100 mm Offset:



- The Endcap position seems to have an effect on the energy resolution close to the transition region at low energies



Eres vs Fwd PID thickness

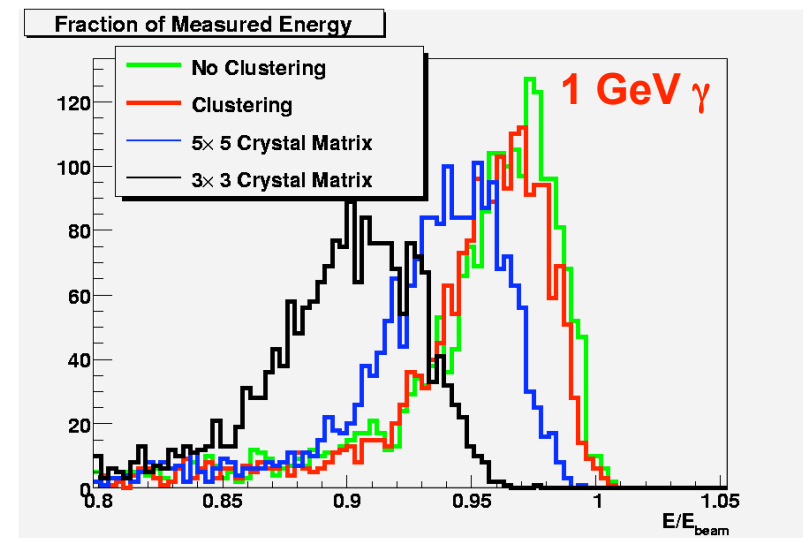
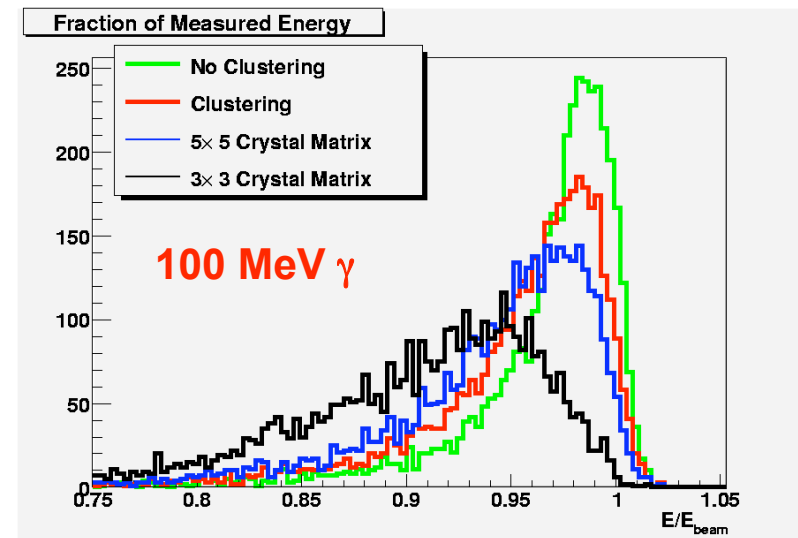




Clustering



- No Clustering:
 - $E_{\text{crystal}} > 1 \text{ MeV}$
 - Same as slac meeting
- Clustering :
 - Clustering algorithm as (supposed to be) in BaBar:
 1. Start from maximum energy crystal
 2. Look for crystal around ME Xtal
 3. Sum crystal energy if $E > \text{digi threshold}$ (0.2 - 0.5 MeV)
 4. If a Crystal around the ME one has $E > \text{seed threshold}$ (2-3 MeV) look around it too
 - Adapted for LSO
- 5 x 5 - 3 x 3 Matrix
 - Take maximum energy crystal and a matrix of crystal around it





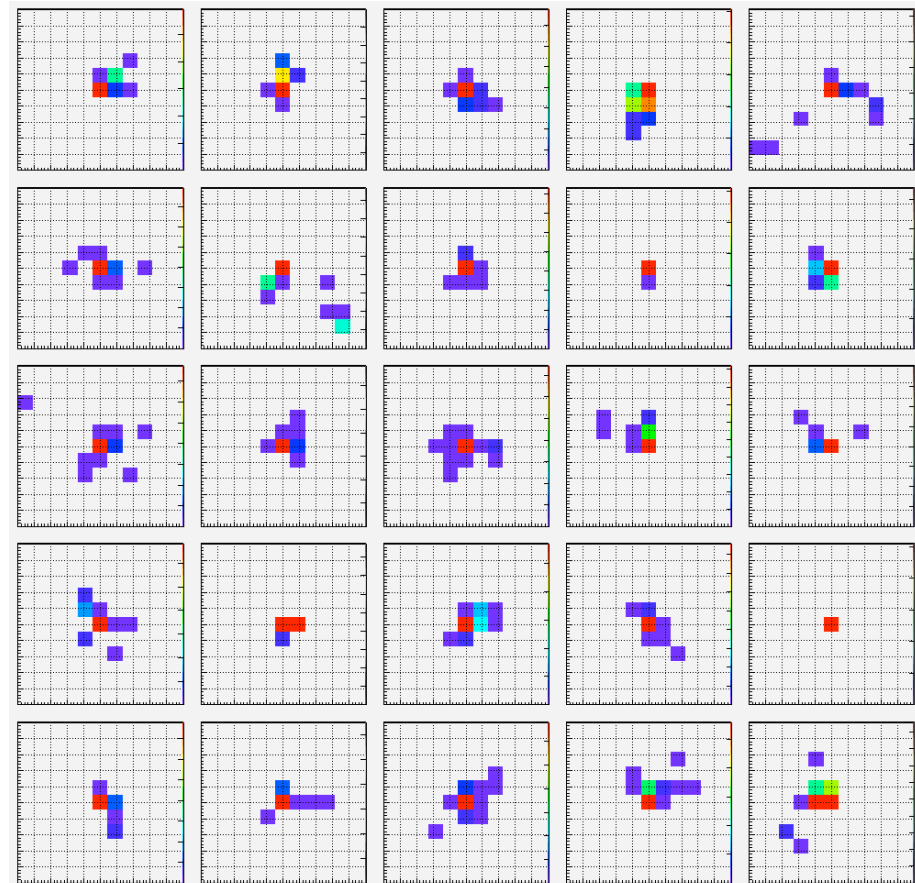
Clusters Fwd - Barrel 100 MeV



- Measured energy in crystals around the maximum energy one (ϕ - θ plane)
- Plot centered on the maximum energy crystal

Fwd

Barrel

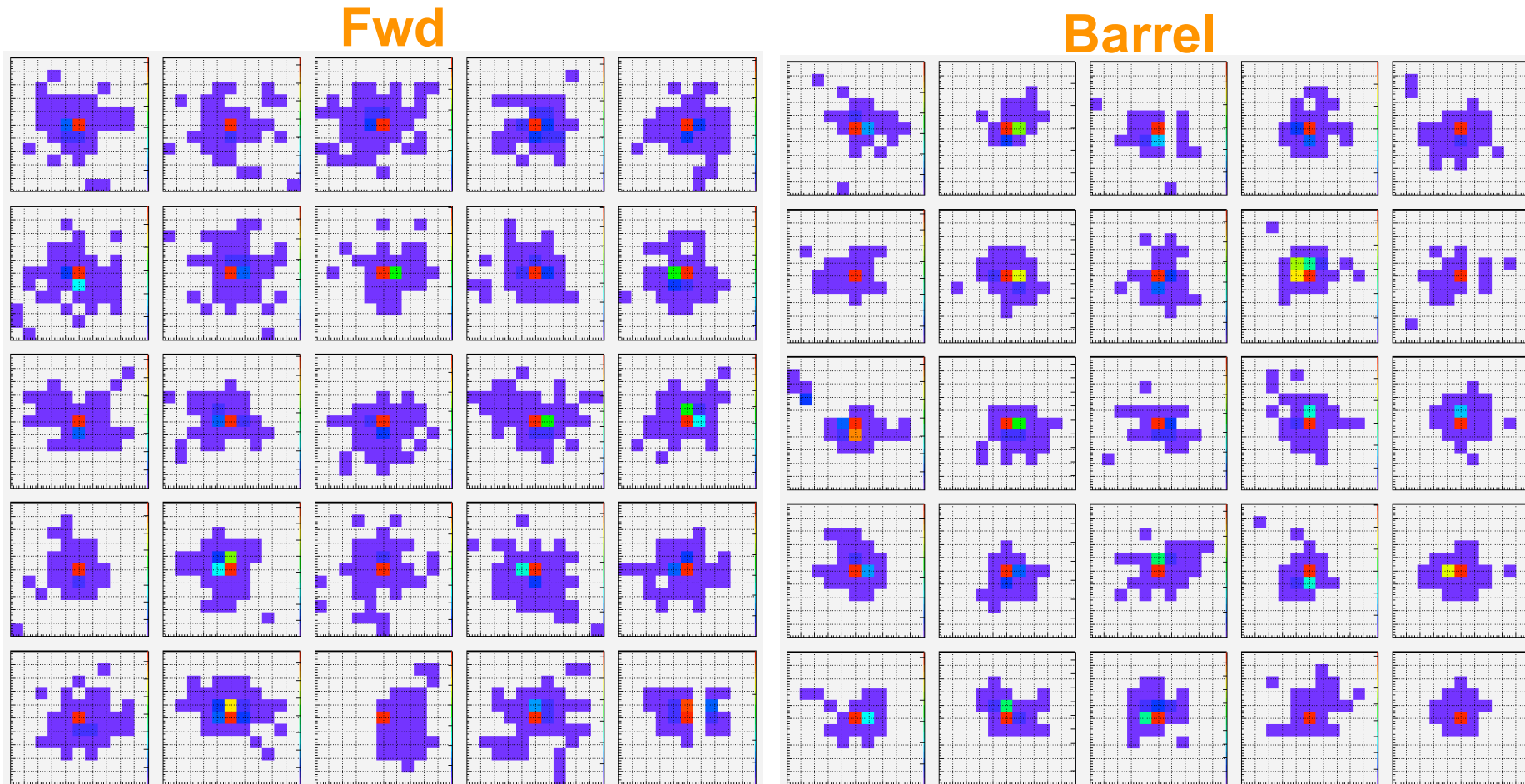




Clusters Fwd - Barrel 1000 MeV



- Measured energy in crystals around the maximum energy one (ϕ - θ plane)
- Plot centered on the maximum energy crystal



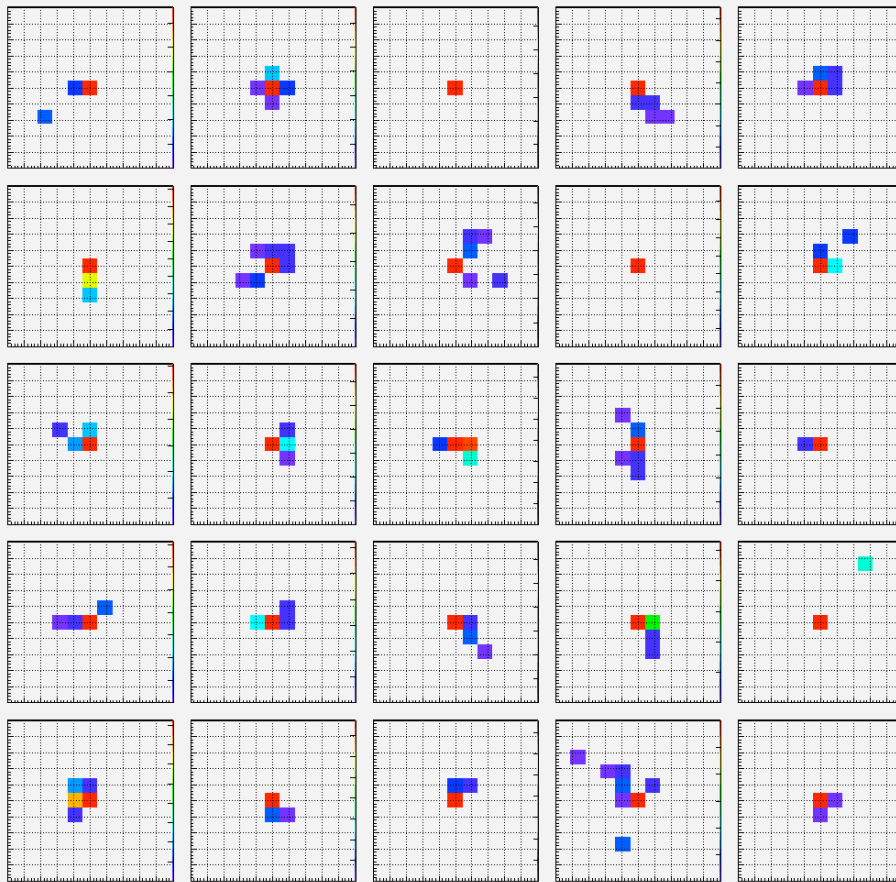


Seed Fwd 100 MeV

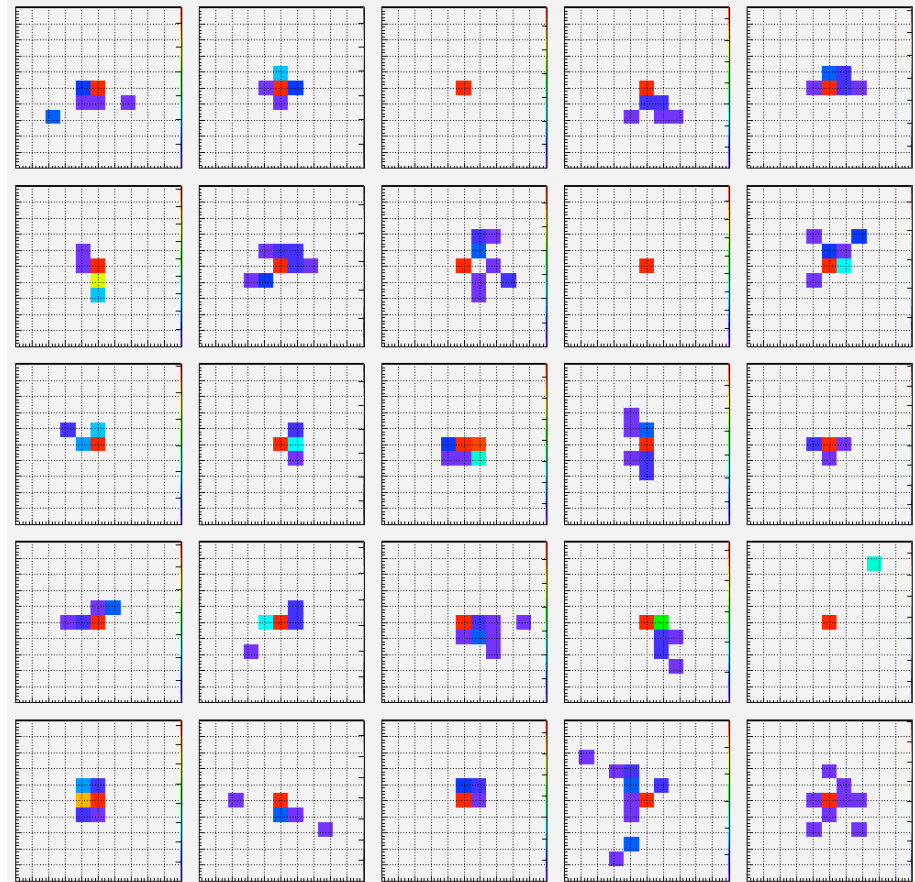


- Measured energy in crystals around the maximum energy one (ϕ - θ plane) for crystal above the seed threshold
- Plot centered on the maximum energy crystal

Seed Thr = 2 MeV



Seed Thr = 1 MeV



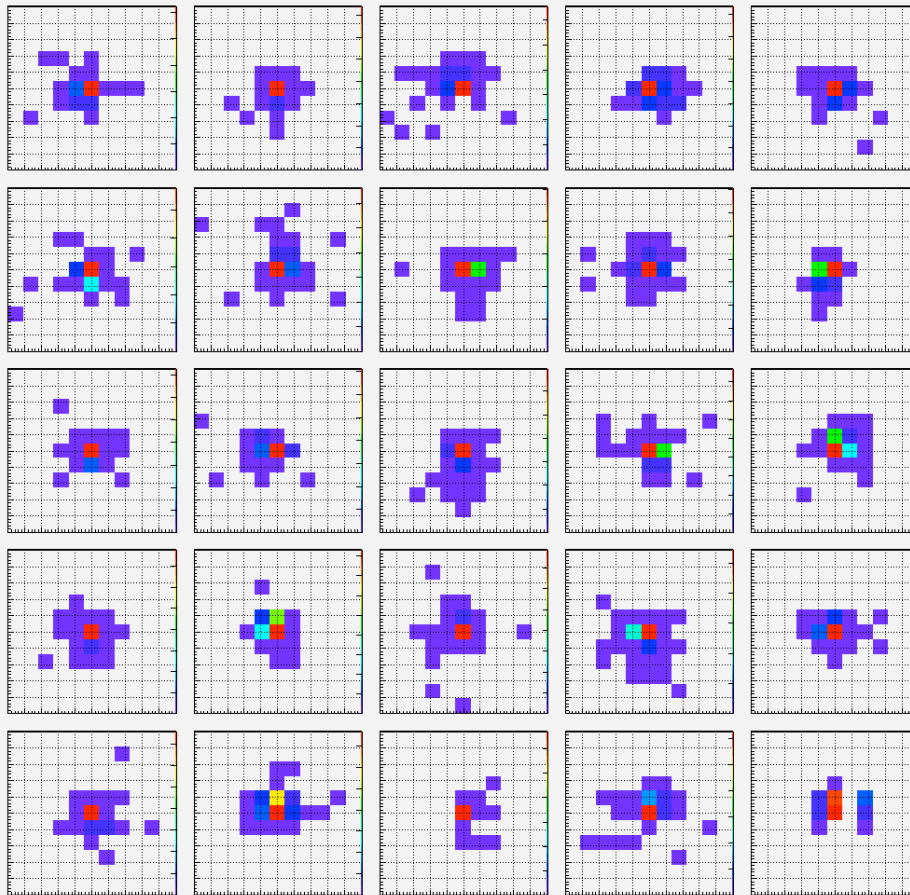


Seed Fwd 1000 MeV

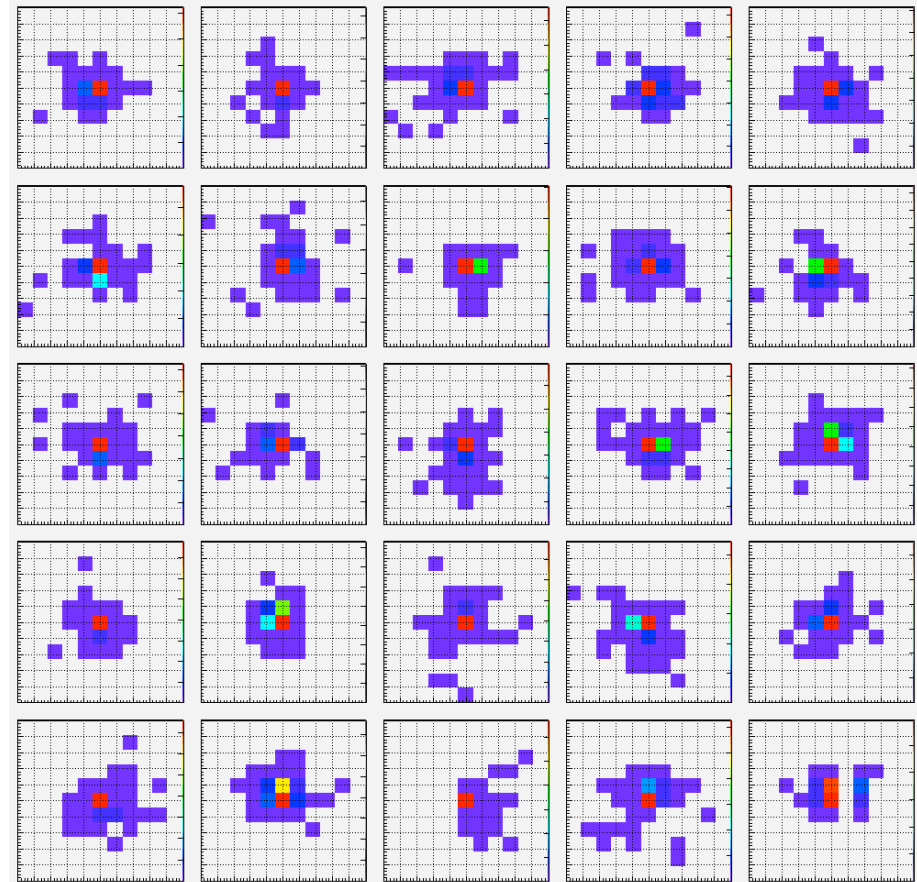


- Measured energy in crystals around the maximum energy one (ϕ - θ plane) for crystal above the seed threshold
- Plot centered on the maximum energy crystal

Seed Thr = 2 MeV



Seed Thr = 1 MeV

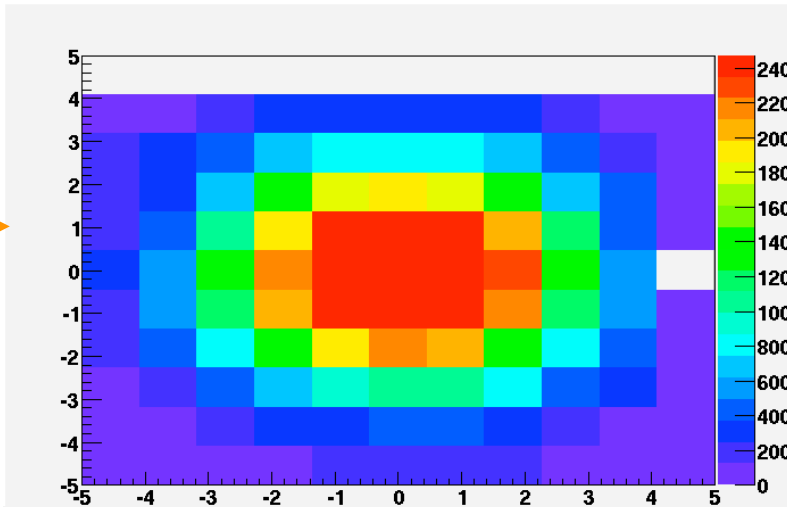




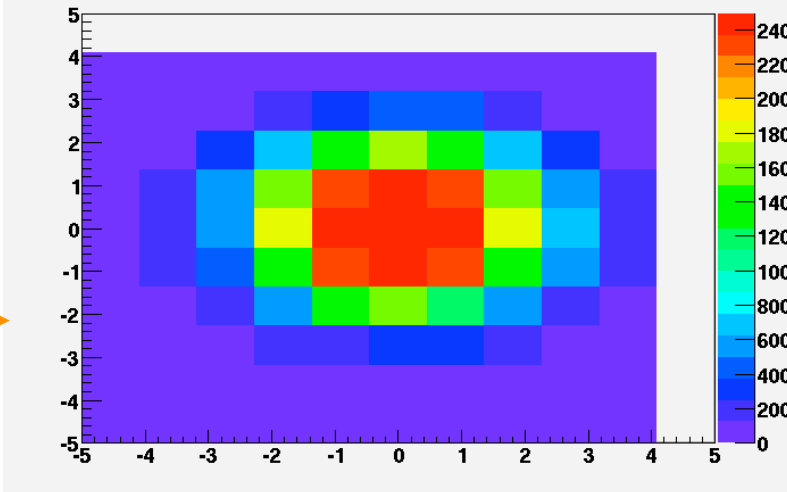
Cristal distance from Max (1 GeV)



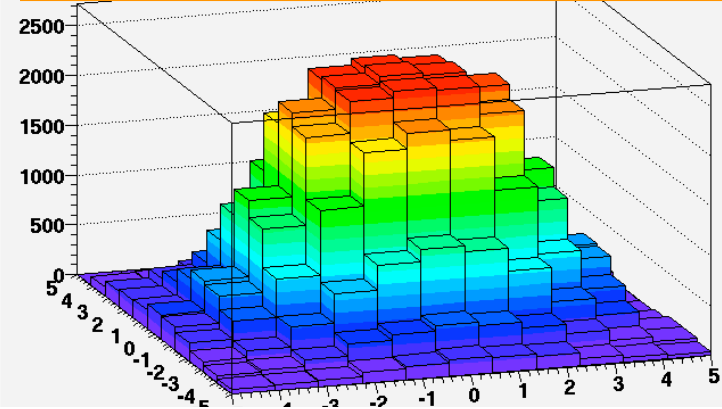
Fwd →



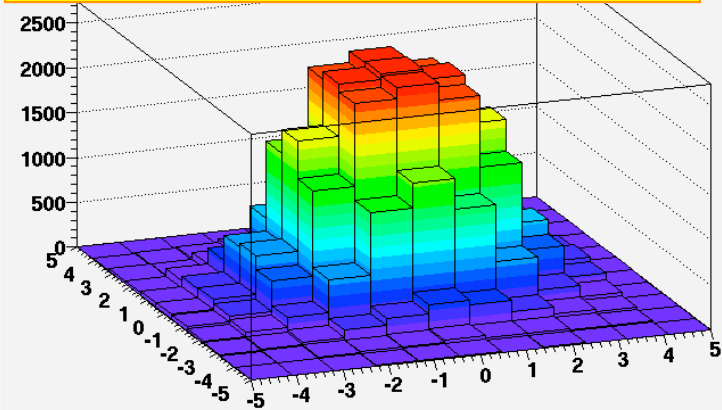
Barrel →



Minimum LSO Crystals size $\sim 0.9-1 R_M$



Minimum CsI Crystals size $\sim 1.3 R_M$

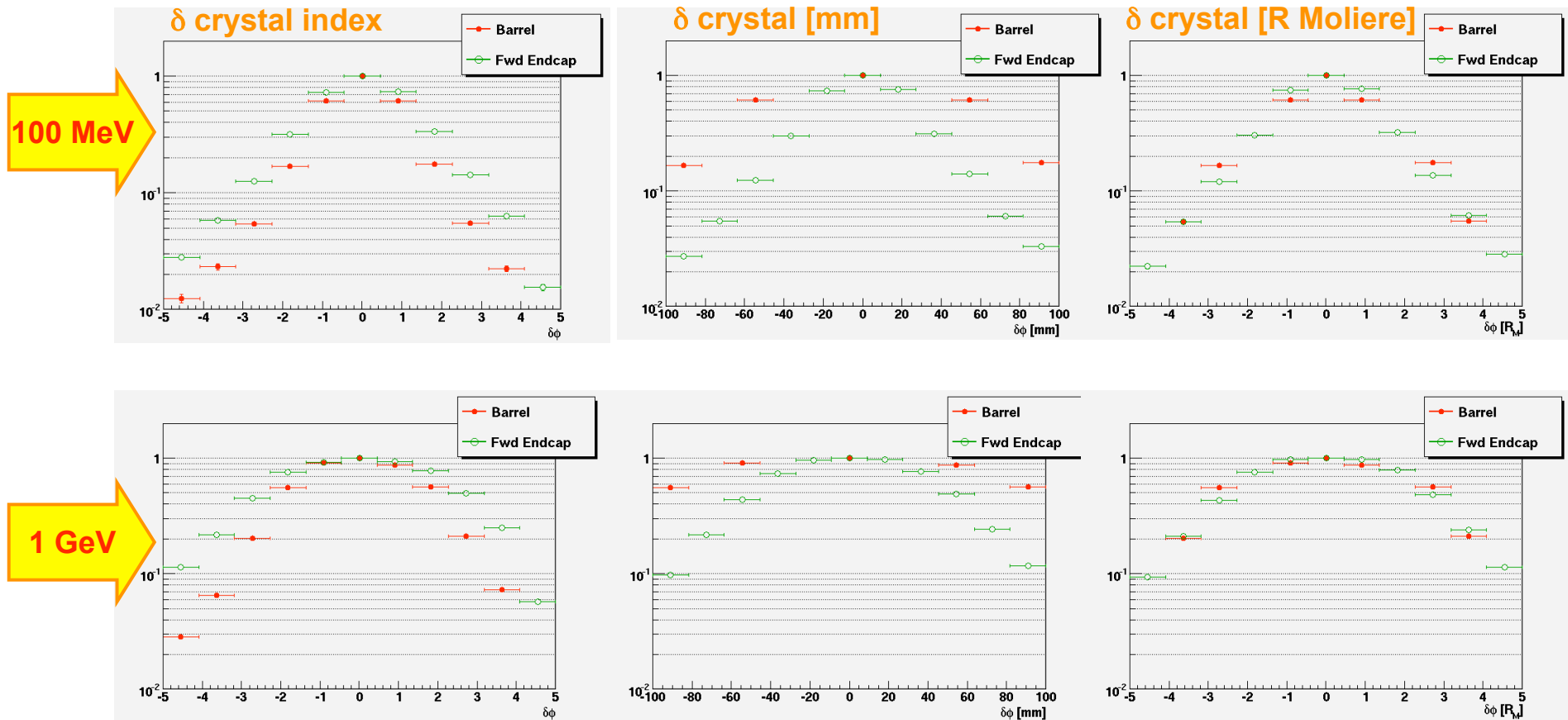




Crystal distance from Maximum - Projection



- Projection (ϕ) of crystal distance from maximum energy crystal
- Distribution centered on the maximum energy crystal



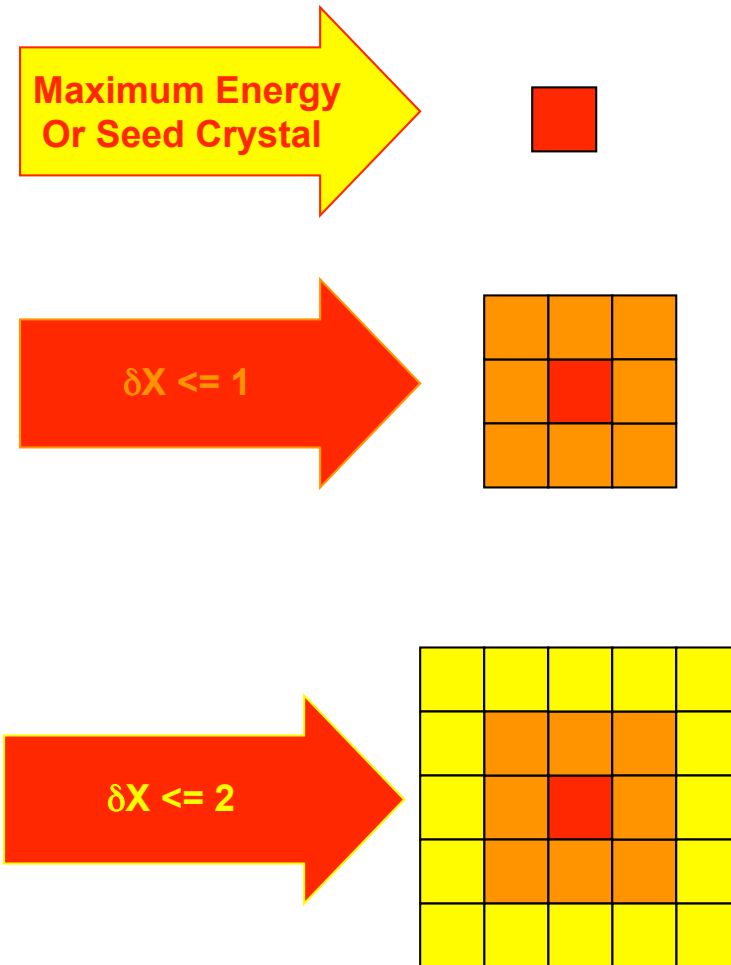
The Fwd Endcap has a wider distribution in terms of number of crystals but in term of Moliere Radii thw width is the same for Barrel and Encap



Clustering Tuning



- Energy resolution vs seed threshold
- Energy resolution vs distance from seed crystal
 - Include crystals above digi and seed thresholds with $\delta X \leq 1$
 - Include crystals above digi and seed thresholds with $\delta X \leq 2$

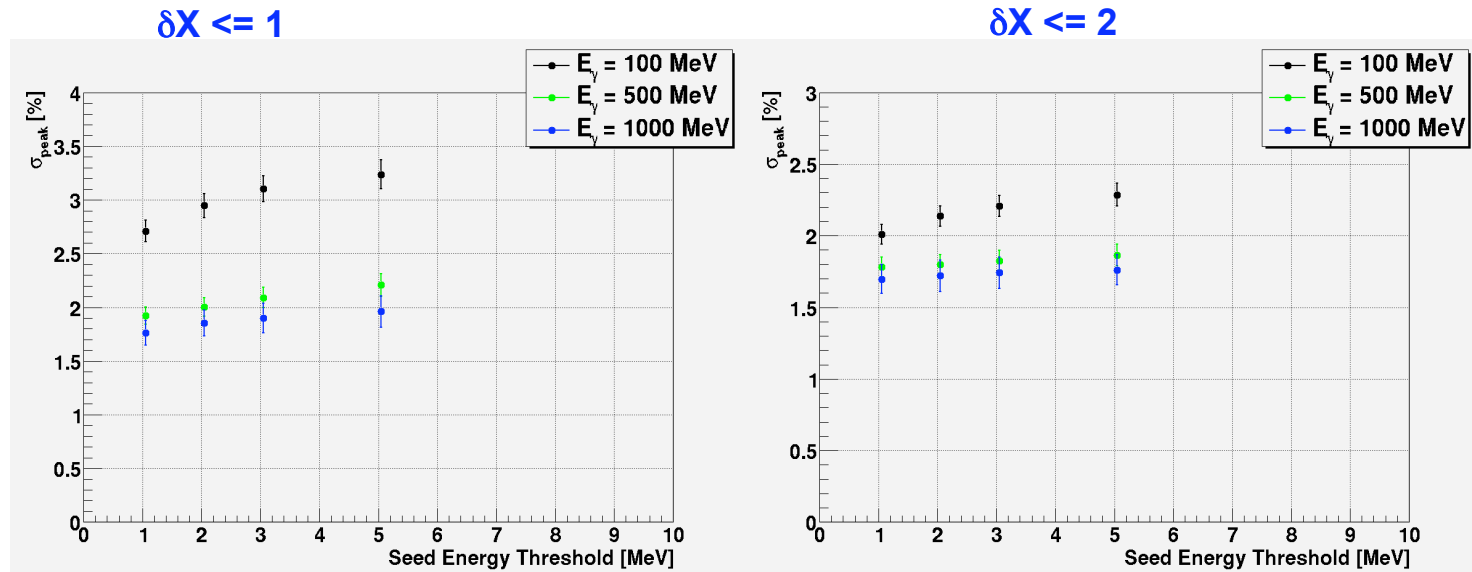




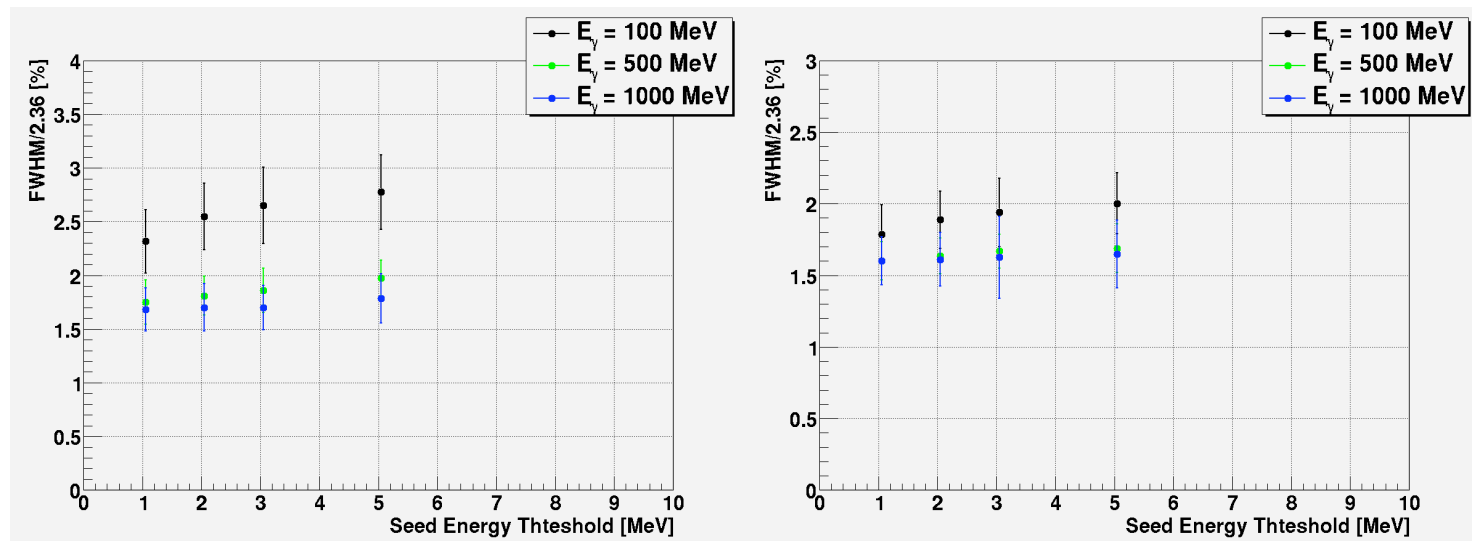
Seed Threshold Scan - Fwd



Asymm. Gauss



Crystal Ball

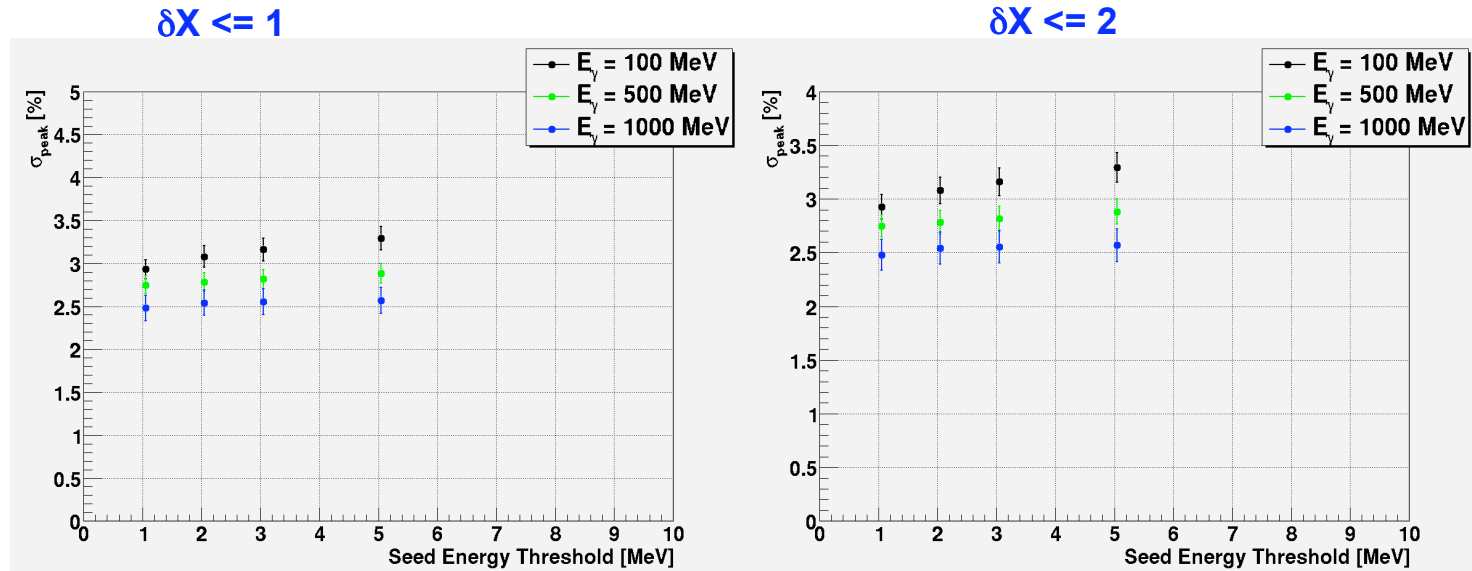




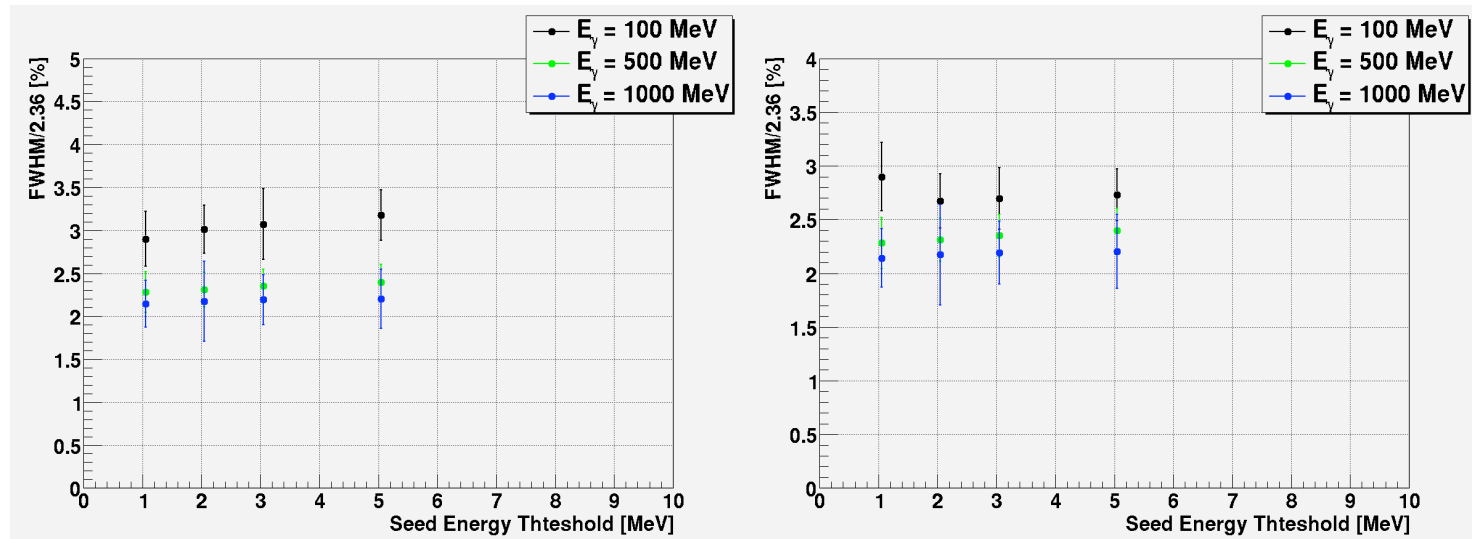
Seed Threshold Scan - Barrel



Asymm. Gauss



Crystal Ball

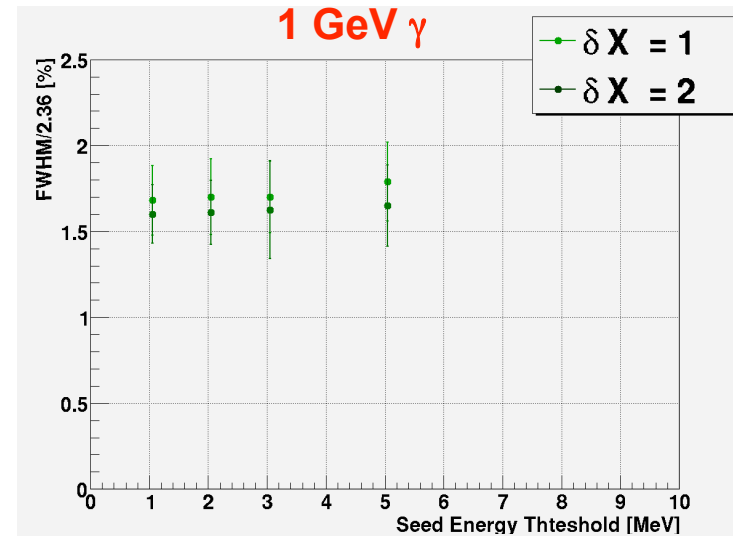
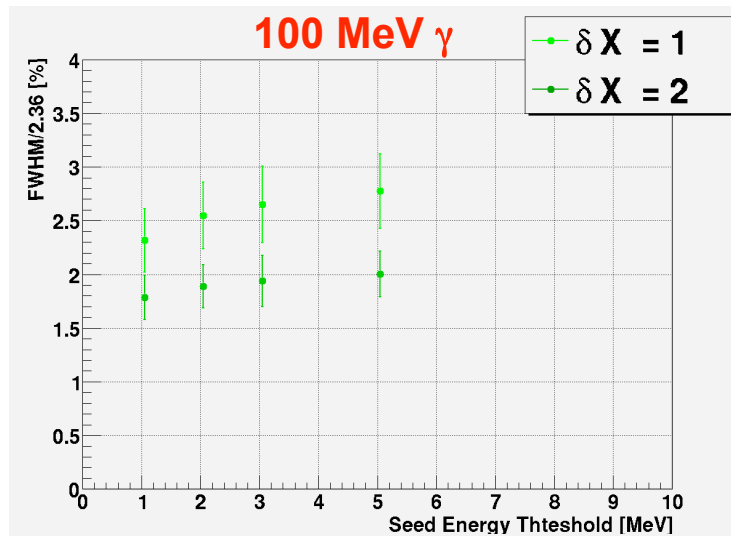




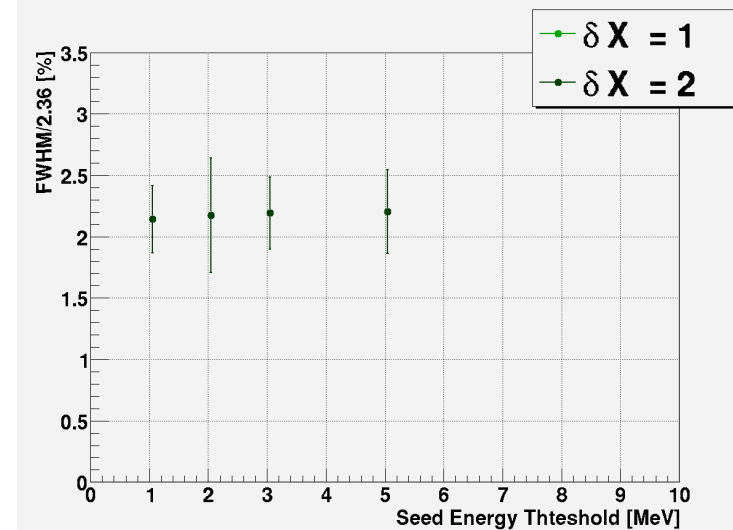
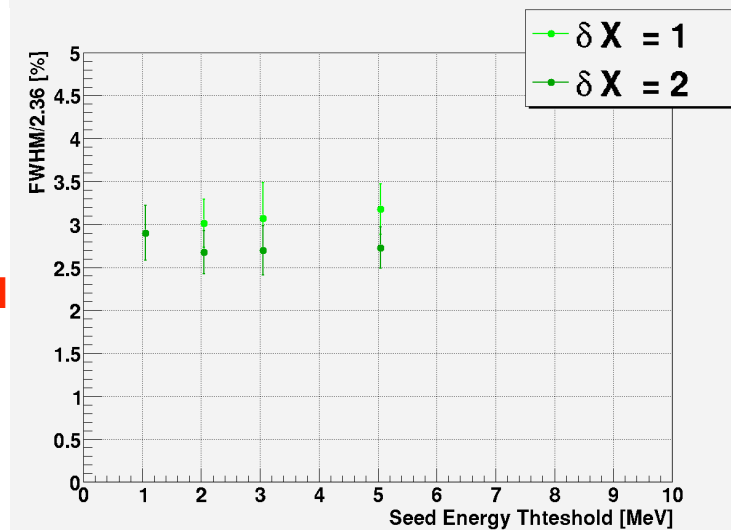
Seed Threshold Scan δX 1 -2



Fwd



Barrel



- Including crystals with $\delta X \leq 2$ gives non negligible improvement at low energy for the Fwd Endcap
- Need to check what happens with background



Conclusions



- Adding the clustering algorithm:
 - The Fwd Endcap position seems to have an impact on energy resolution in the region close to the Barrel-Endcap transition
 - The PID material seems to have a non negligible effect on the energy resolution
 - Distance of fwd PID material from EMC have additional effect
- Clustering algorithm
 - Looking at 2 ring around the seed crystal seems to have a non negligible improvement for the Fwd Endcap
- Realistic background and signal is necessary for clustering algorithm optimization and performance evaluation
- Next steps:
 - Better description for low energy tails
 - Algorithm performance for π^0
 - Adding Fake background (?)
 - Adding other particles in the same event(?)
 - Other algorithm(?)