

GARLIC and ILDopt

Marcel Reinhard
LLR – Ecole polytechnique



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GARLIC

Pre-Clustering via hit distance: RoI

Remove hits close to extrapolated tracks

Per RoI:

Seed finding: 2-dim energy projection of 7X0

Per Seed:

Core building (hits close to seed axis)

Neighbor clustering (front to back)

Simple verification (min.En/hits, distance track)

Gap correction

ANN rejection

Satellite merging

Additional iteration for big clusters

Final energy estimation





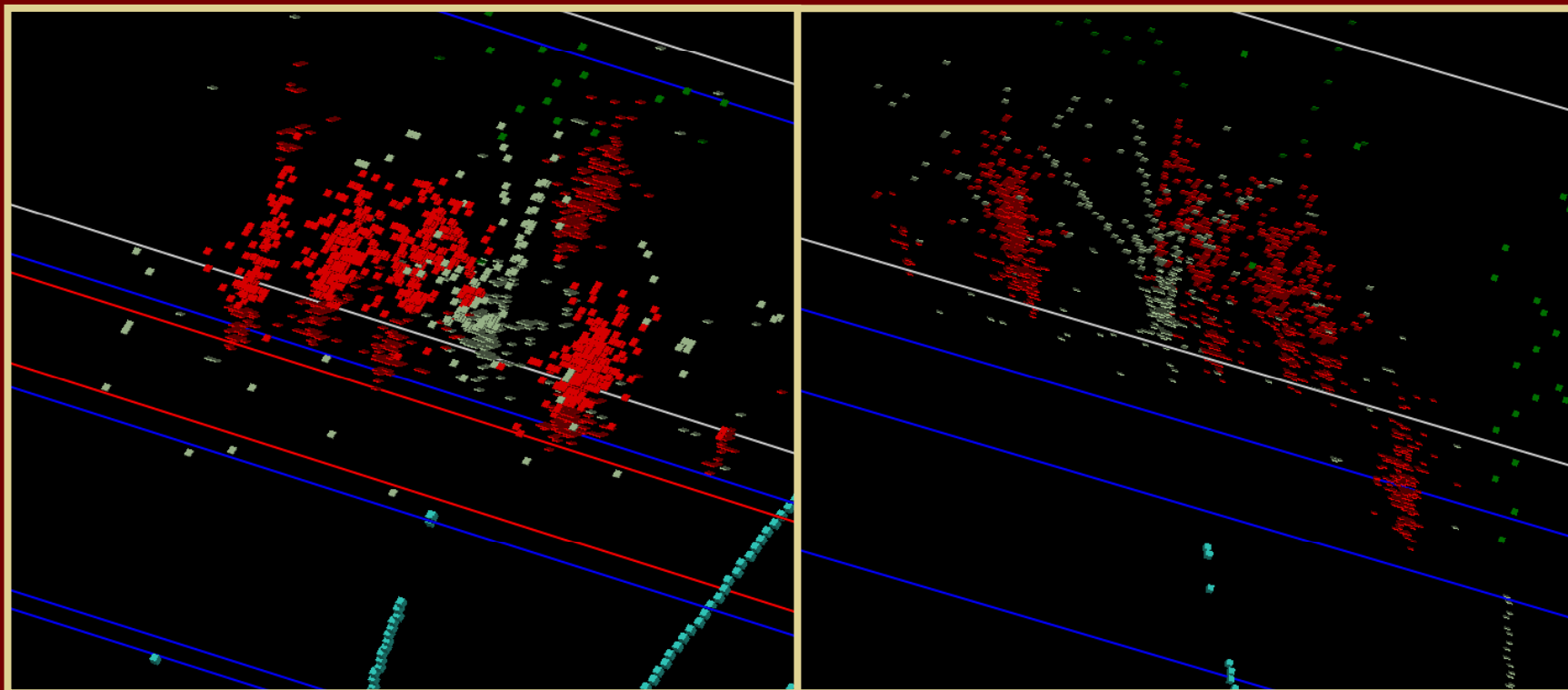
Whats new in GARLIC?



- Leakage correction: very difficult to parametrise
- PreShower hits in projection of the TPC endcap
 - $X_0 = 0.168$ (with projection on TPC electronics)
 - $X_0 = 0.034$ (elsewhere)
- Works on all cell sizes including gap correction
 - Tested 5×5 , 10×10 , 20×20 mm²



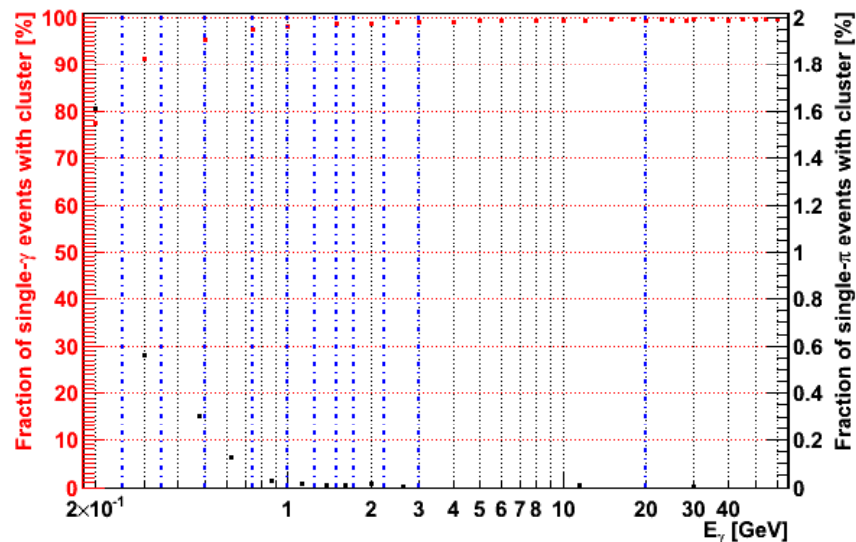
GARLIC for ILD



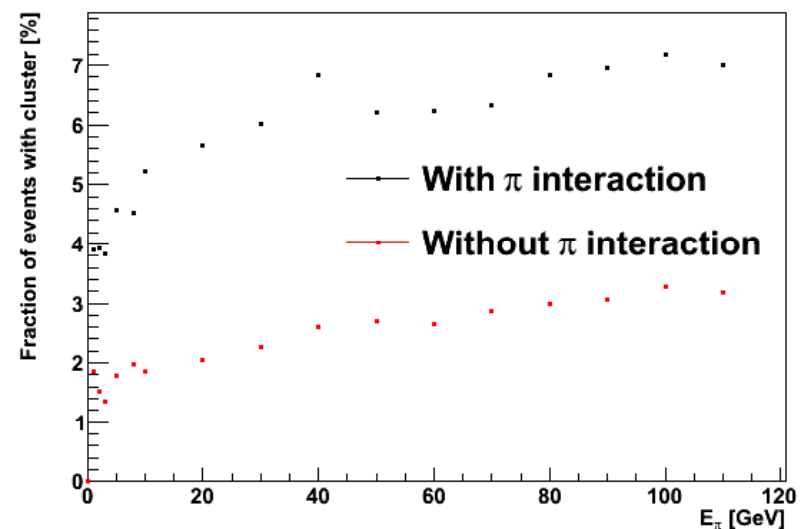
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Single particle efficiencies with cuts

Efficiency for γ clustering and rejection of artificial clusters from π 's in single particle events



Charged hadron events with fake clusters



Works down to 150MeV

Efficiency:

>96% @ 500 MeV

98.2% @ 1GeV

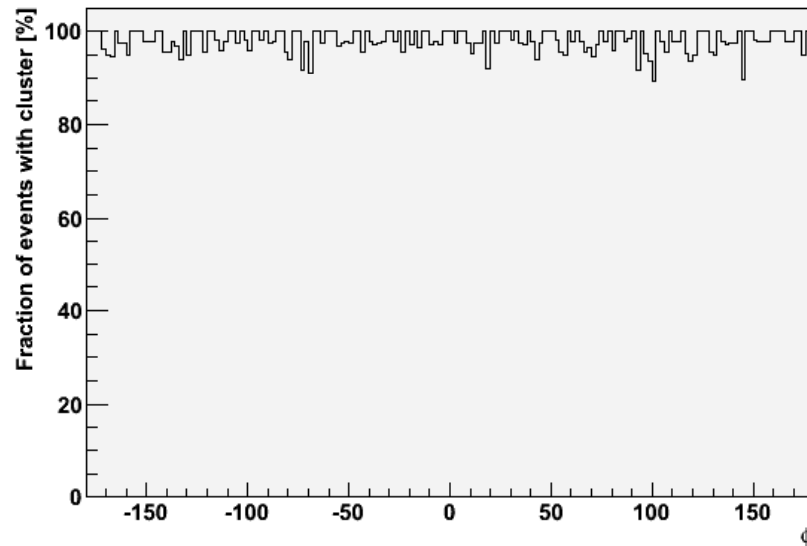
>99% for $E > 2\text{GeV}$

Pion interactions in tracker create fake clusters that are impossible to reject

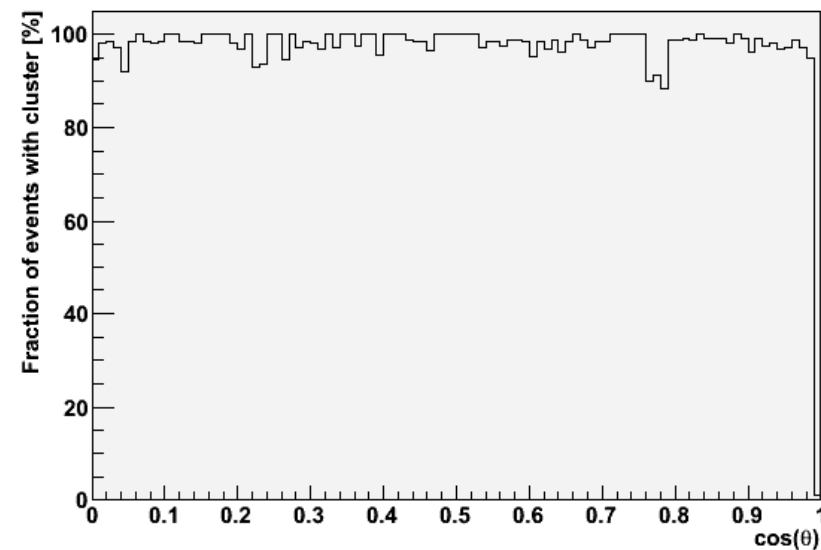


Efficiencies by angle: 1 GeV

Clustering efficiency at 1 GeV



Clustering efficiency at 1 GeV

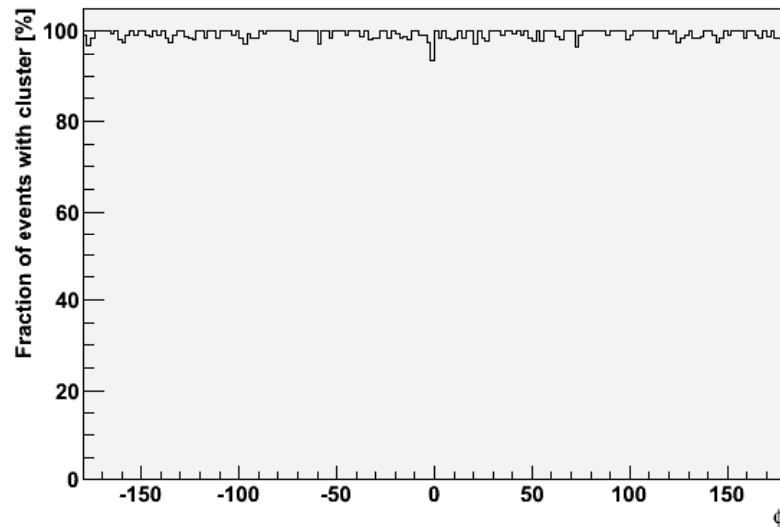


Flat in Φ
Gaps visible in θ

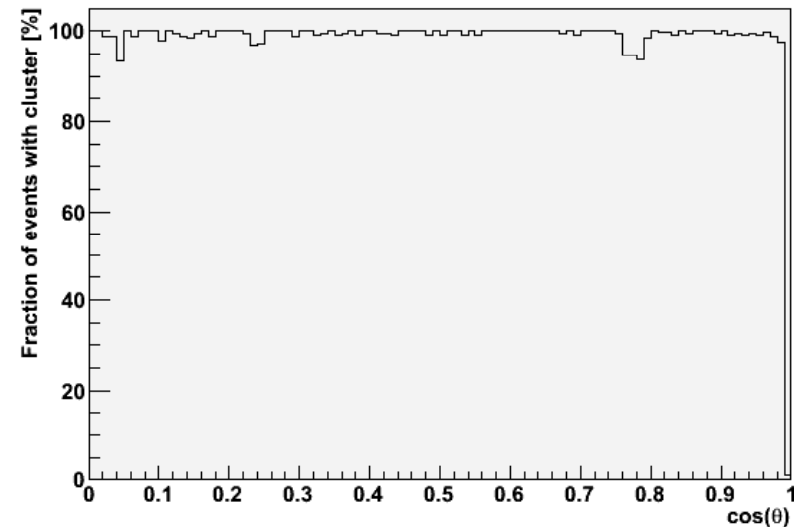
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Efficiencies by angle: 10GeV

Clustering efficiency at 10 GeV



Clustering efficiency at 10 GeV

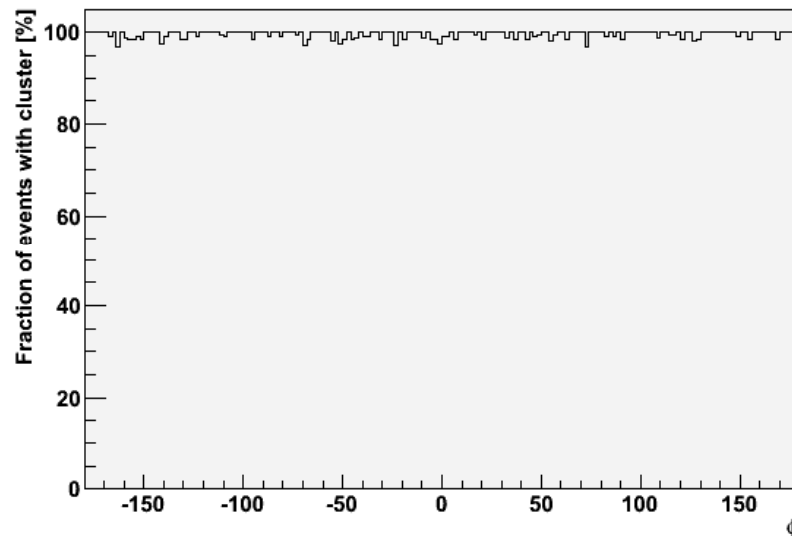


Flat in Φ
Gaps visible in θ

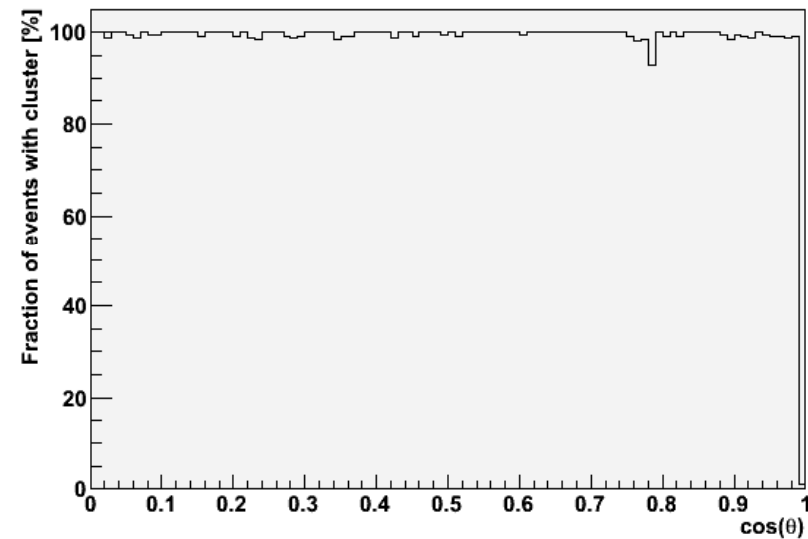
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Efficiencies by angle: 50GeV

Clustering efficiency at 50 GeV



Clustering efficiency at 50 GeV

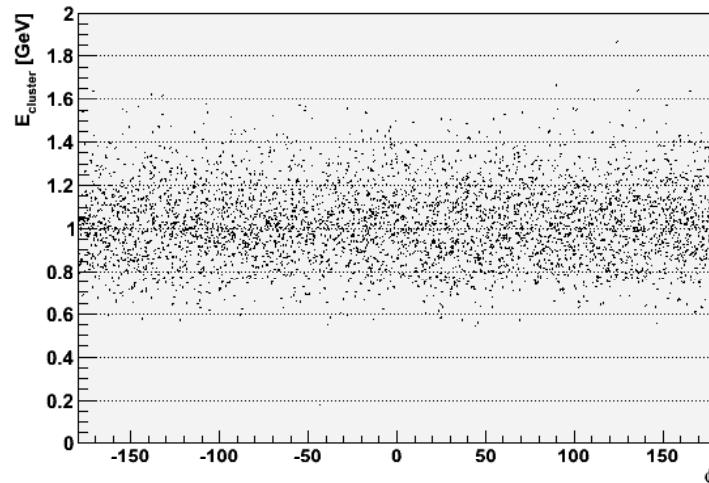


Flat in Φ
Barrel-Endcap overlap visible in θ

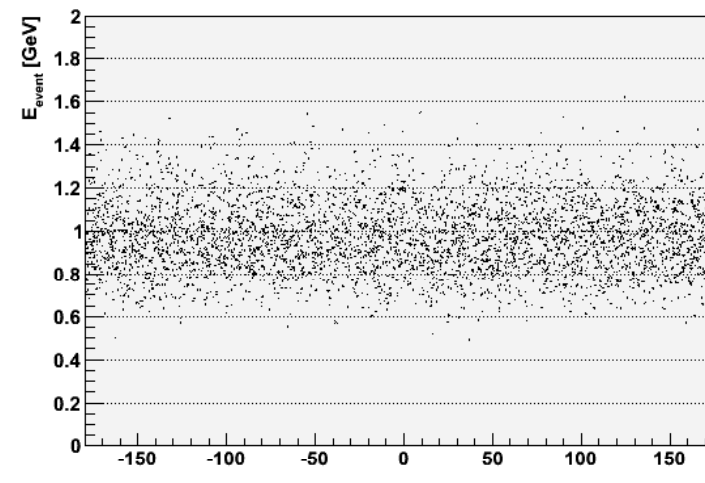
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Cluster energy in Φ : 1GeV

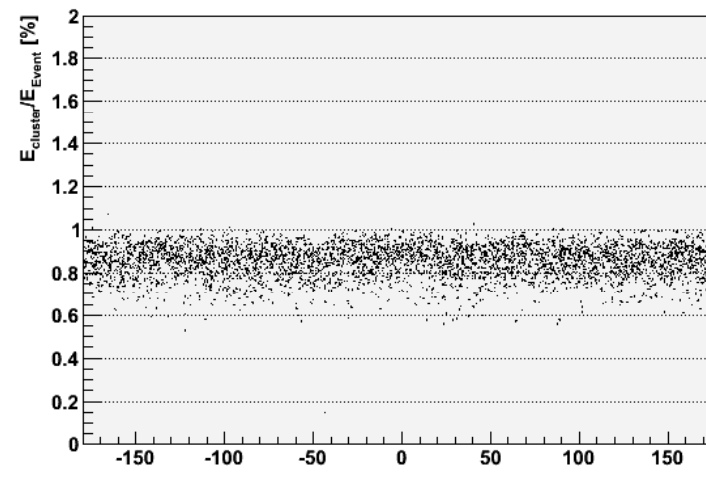
Clustered Energy vs ϕ at 1GeV



Energy deposit vs ϕ at 1GeV



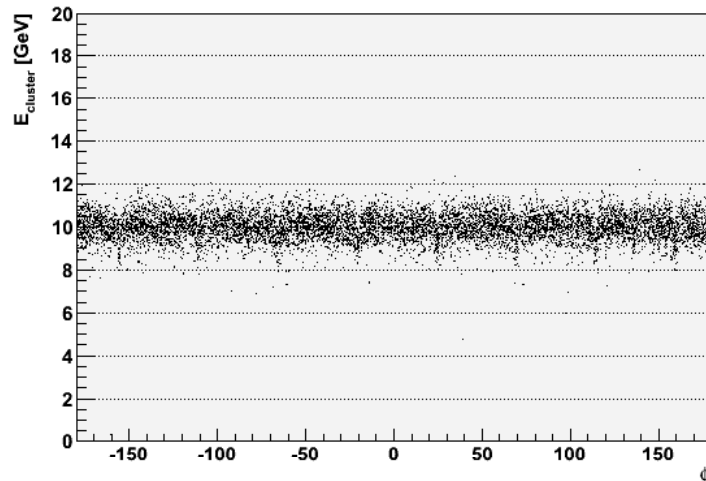
Fraction of energy deposit clustered vs ϕ at 1GeV



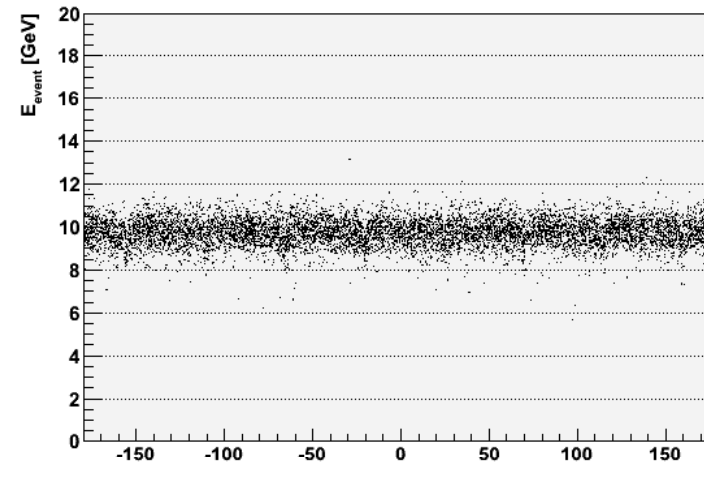
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Cluster energy in Φ : 10GeV

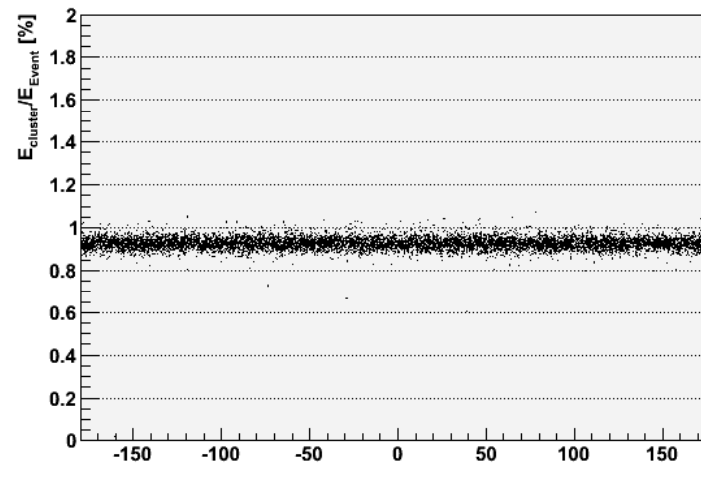
Clustered Energy vs ϕ at 10GeV



Energy deposit vs ϕ at 10GeV



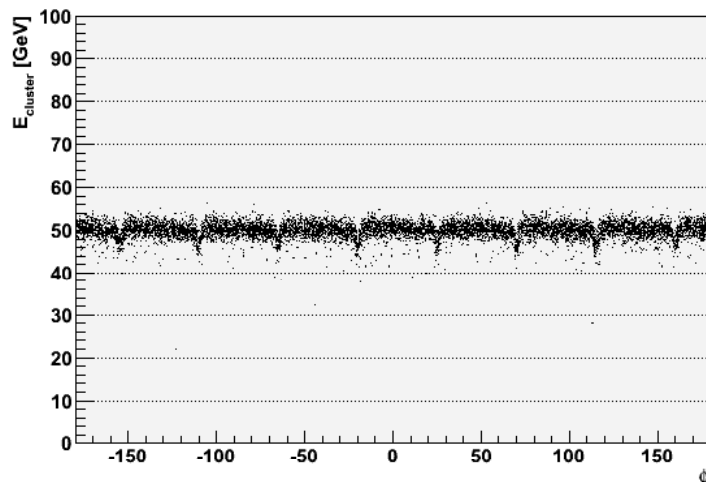
Fraction of energy deposit clustered vs ϕ at 10GeV



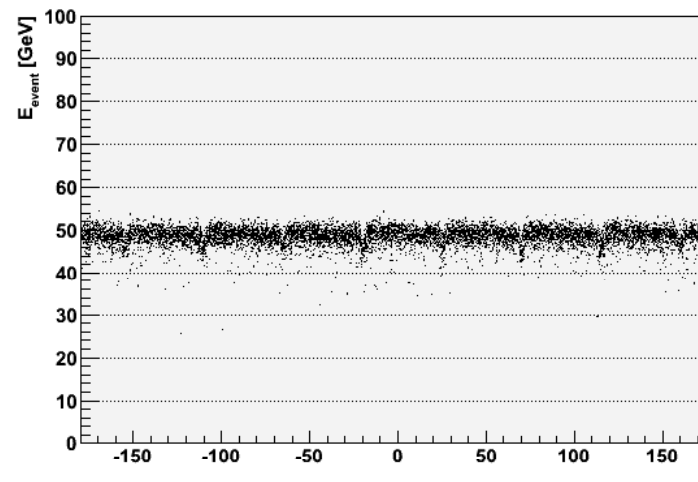
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Cluster energy in Φ : 50GeV

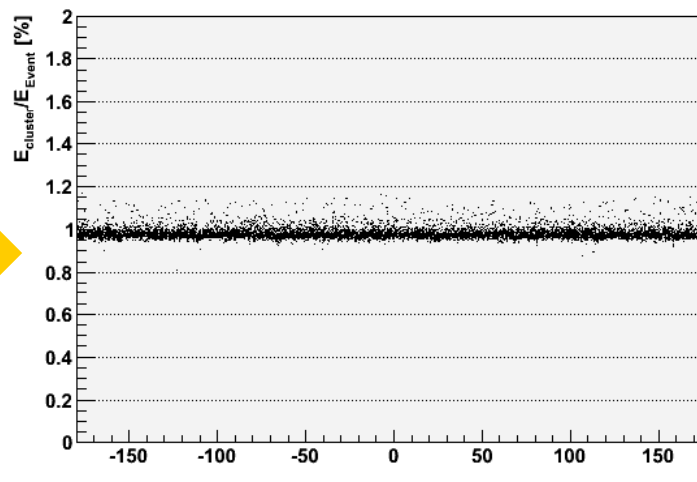
Clustered Energy vs ϕ at 50GeV



Energy deposit vs ϕ at 50GeV



Fraction of energy deposit clustered vs ϕ at 50GeV

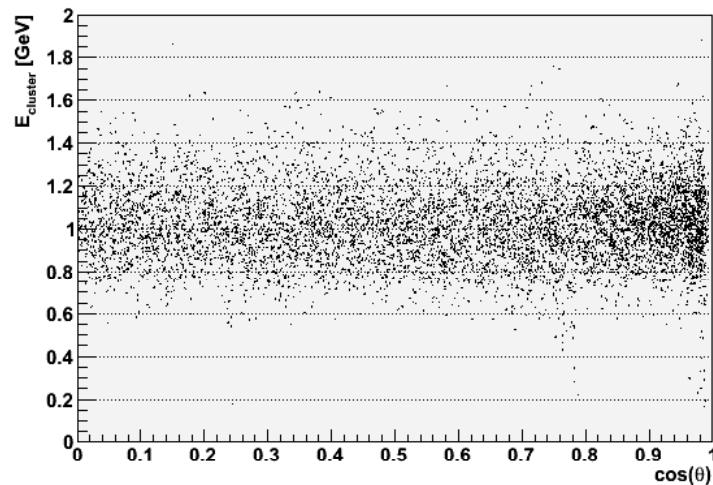


**Impact on resolution?
Local correction sufficient?
8 vs. 12-fold geometry?**

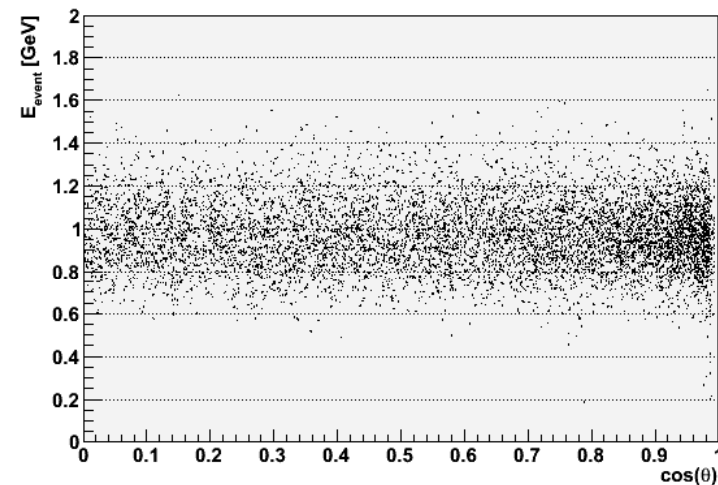
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Cluster energy in θ : 1GeV

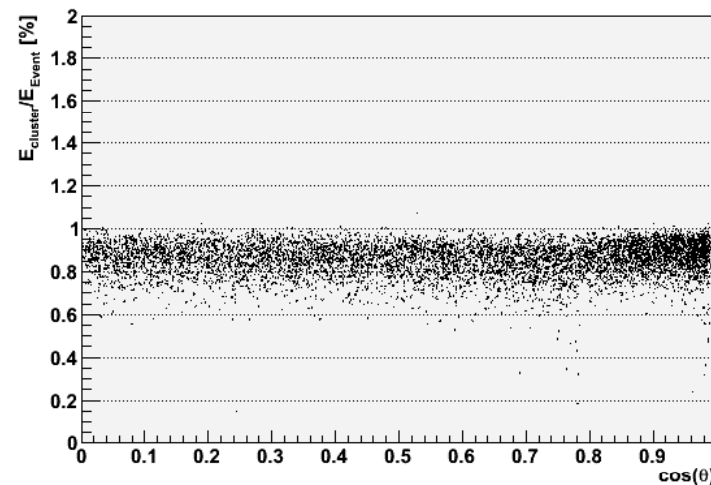
Clustered Energy vs θ at 1GeV



Energy deposit vs θ at 1GeV



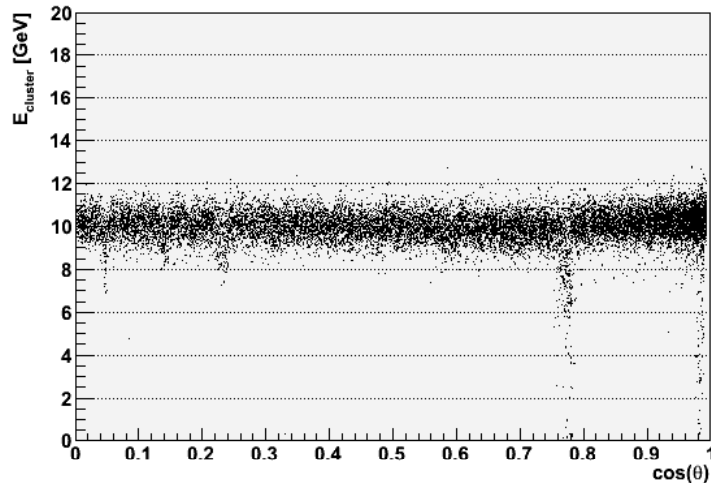
Fraction of energy deposit clustered vs θ at 1GeV



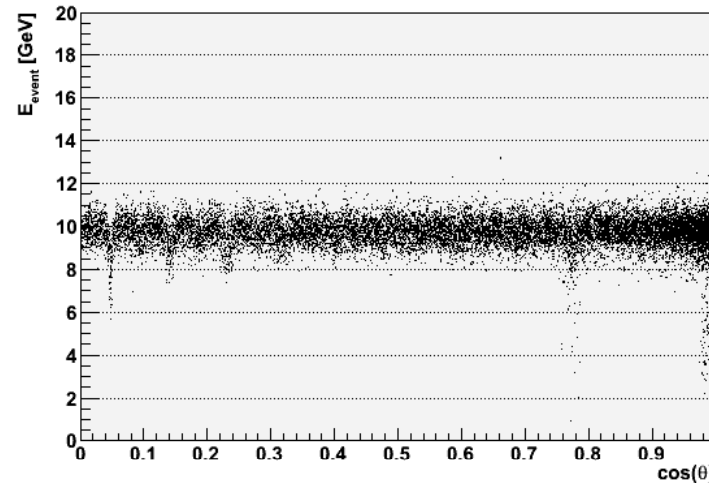
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Cluster energy in θ : 10GeV

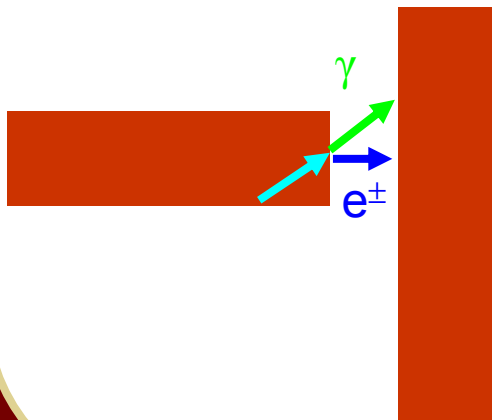
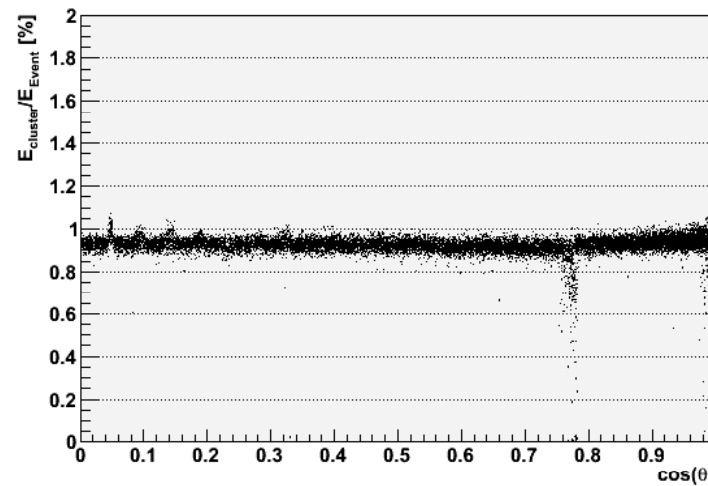
Clustered Energy vs θ at 10GeV



Energy deposit vs θ at 10GeV



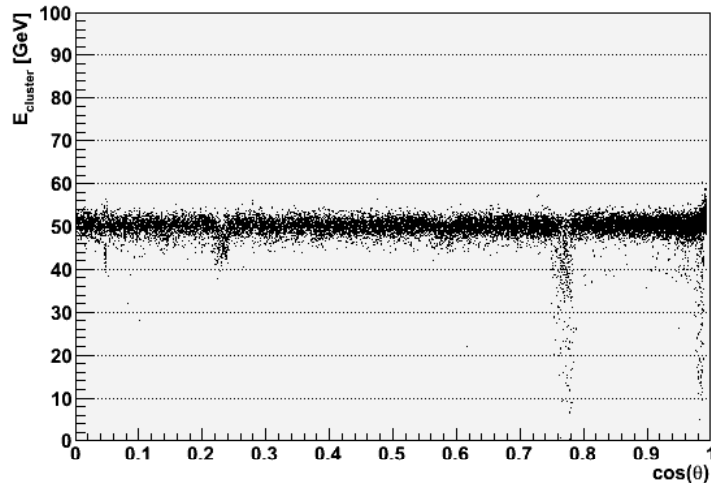
Fraction of energy deposit clustered vs θ at 10GeV



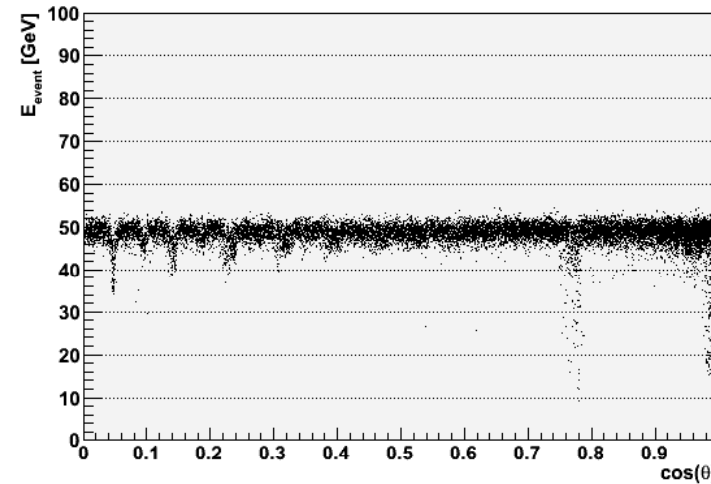
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Cluster energy in θ : 50GeV

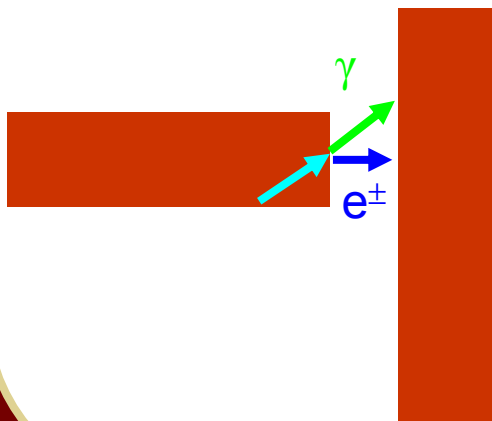
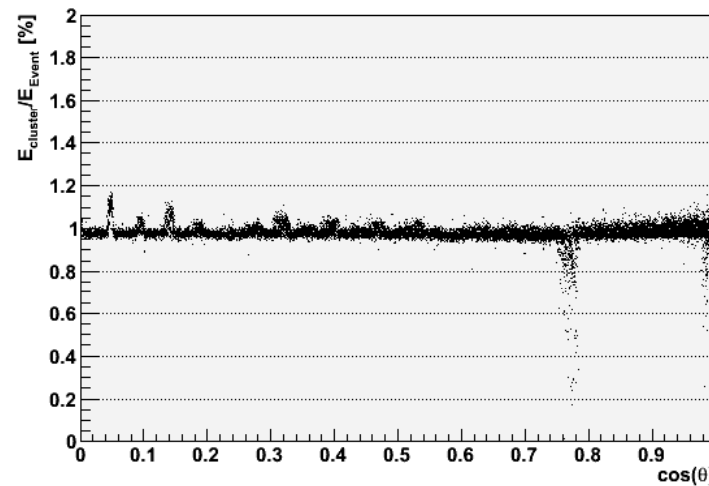
Clustered Energy vs θ at 50GeV



Energy deposit vs θ at 50GeV



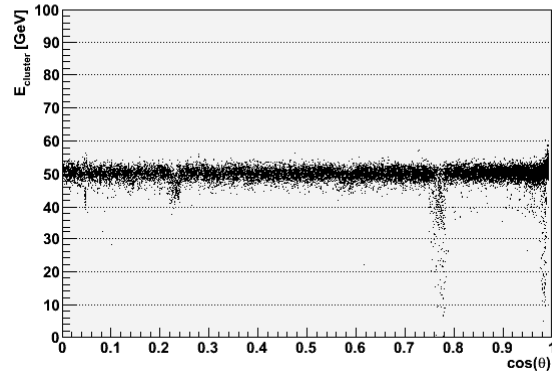
Fraction of energy deposit clustered vs θ at 50GeV



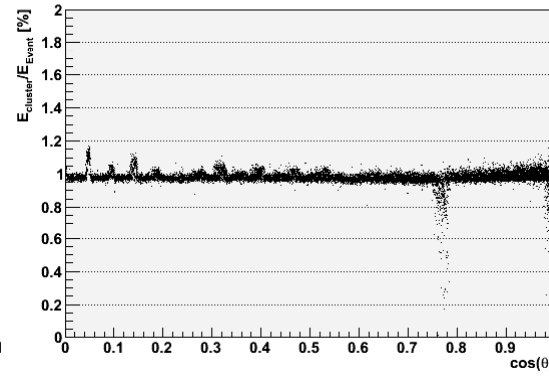
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Reduce Barrel-Endcap gap: 40mm

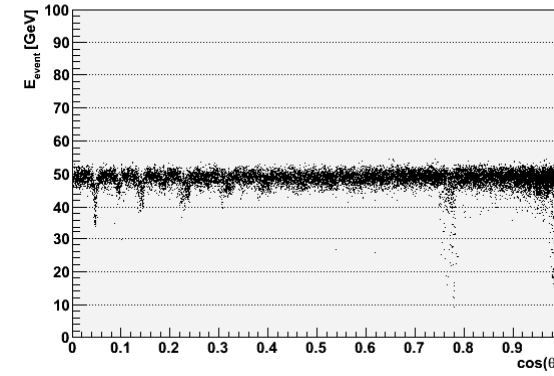
Clustered Energy vs θ at 50GeV



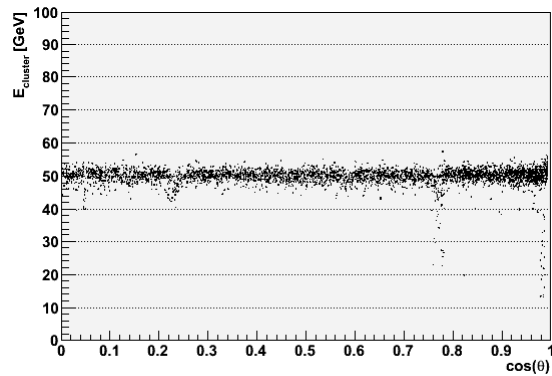
Fraction of energy deposit clustered vs θ at 50GeV



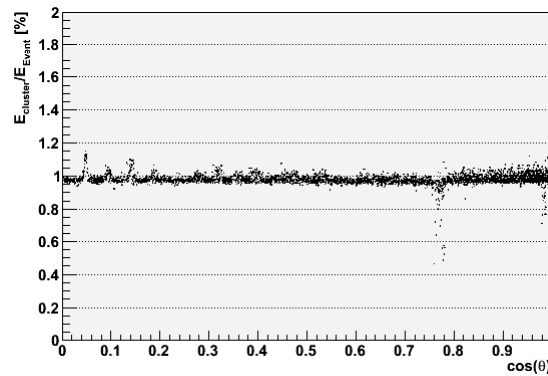
Energy deposit vs θ at 50GeV



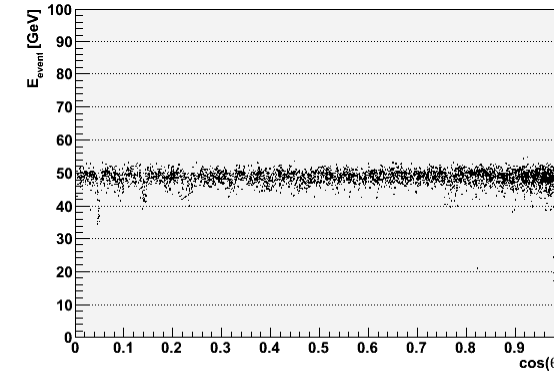
Clustered Energy vs θ at 50GeV_and reduced cable gap



Fraction of energy deposit clustered vs θ at 50GeV_and reduced cable gap



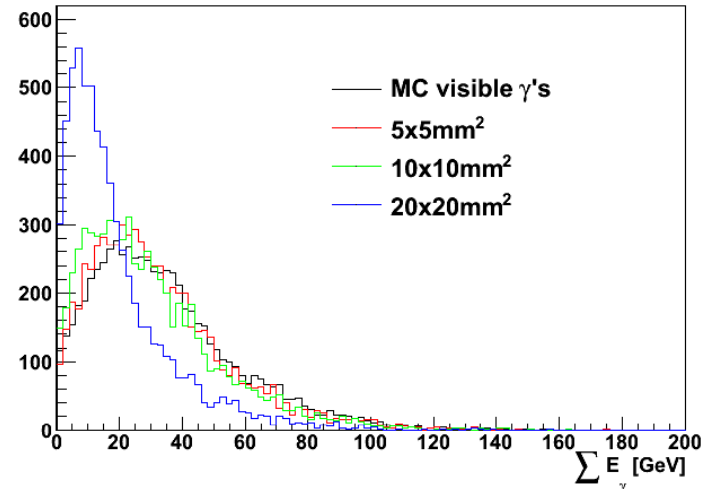
Energy deposit vs θ at 50GeV_and reduced cable gap



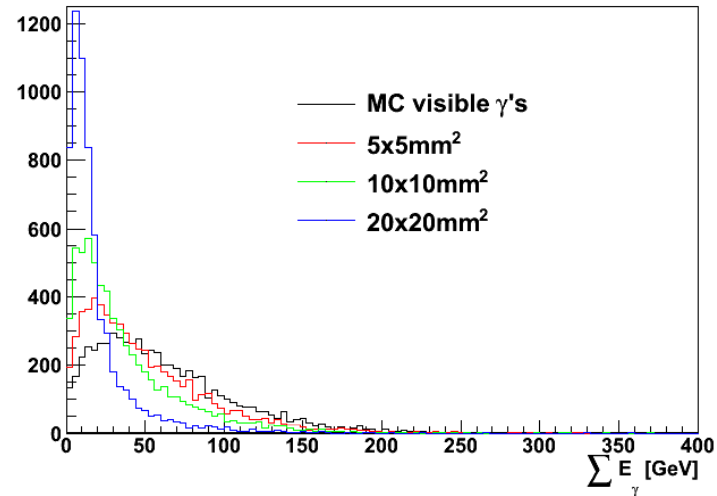
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Cell-size: $q\bar{q}$ events

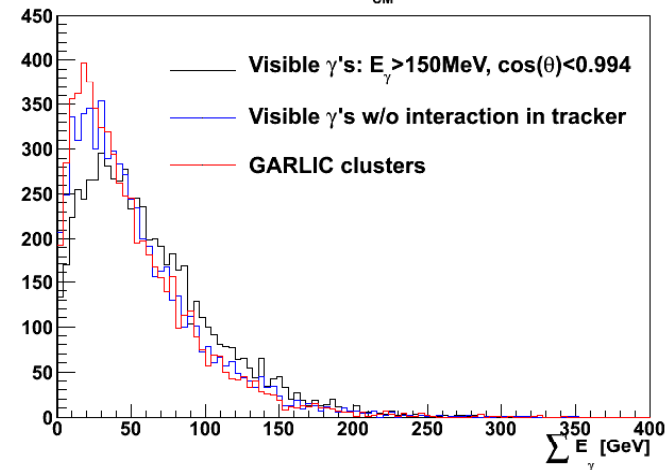
Energy from γ 's in di-jet events at $E_{CM} = 200\text{GeV}$



Energy from γ 's in di-jet events at $E_{CM} = 400\text{GeV}$

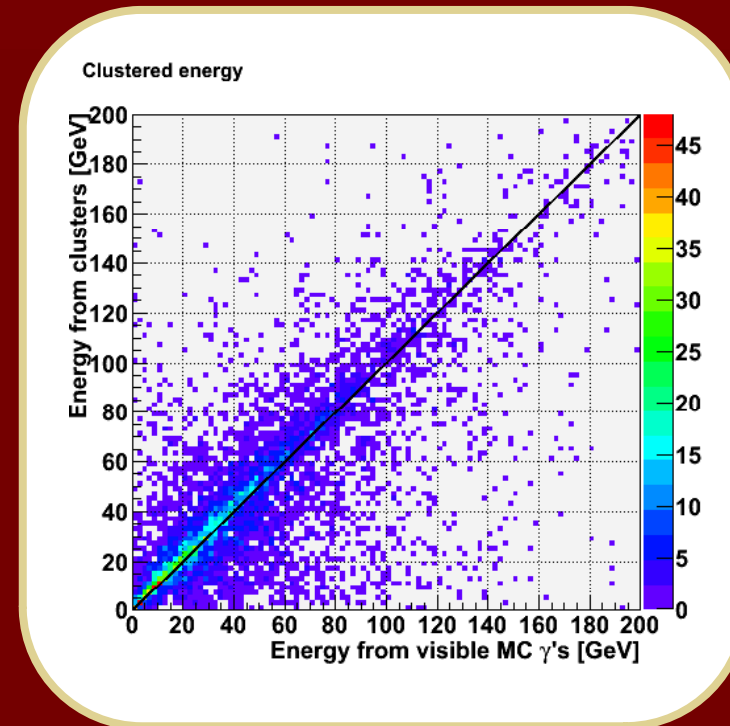
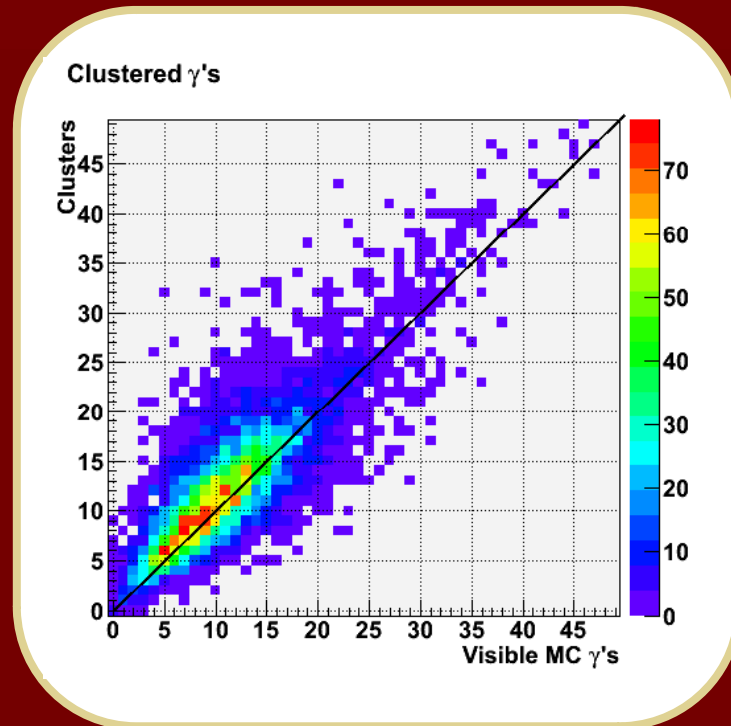


Energy from γ 's in di-jet events at $E_{CM} = 400\text{GeV}$



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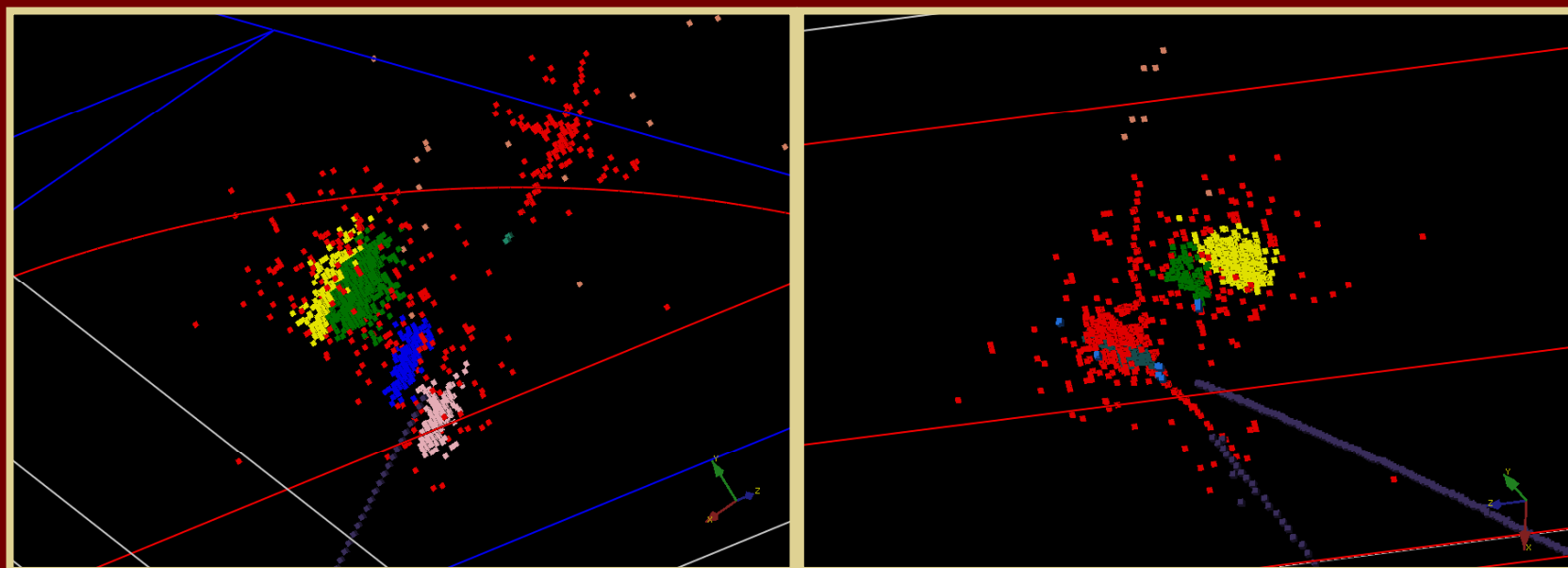
Performance: $q\bar{q}$ at 400GeV



Pion interactions not suppressed
Reasonable performance



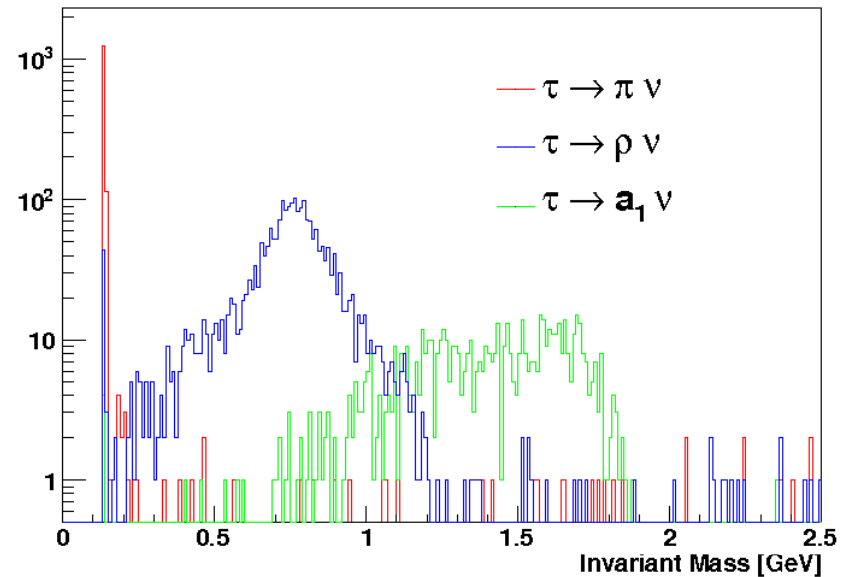
GARLIC on τ 's



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$ZH \rightarrow \mu\mu \tau\tau$

Invariant mass of τ decay products



	π sim	ρ sim	A1 sim
π Rec	90.8	1.9	0.6
ρ Rec	1.1	86.5	10.9
a1 Rec	8.1	11.6	88.5



Outlook

- Refine gap-correction
- Use hit count for low energy
- Develop better leakage correction
- PreShower hits negligible for resolution, differences in populations need to be checked
- 8 or 12-fold geometry? Need to look at loss in energy resolution
- How much can the Barrel-Endcap-gap be reduced? Alternatively need an approach to cluster among “2 ways”
- How to deal with π interactions?
- $\pi/\rho/a_1$ separation for different cell-sizes