EMCal: Minimal Energy Requirements

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ePIC Calorimetry Meeting

August 9, 2023

YR (and other) Input

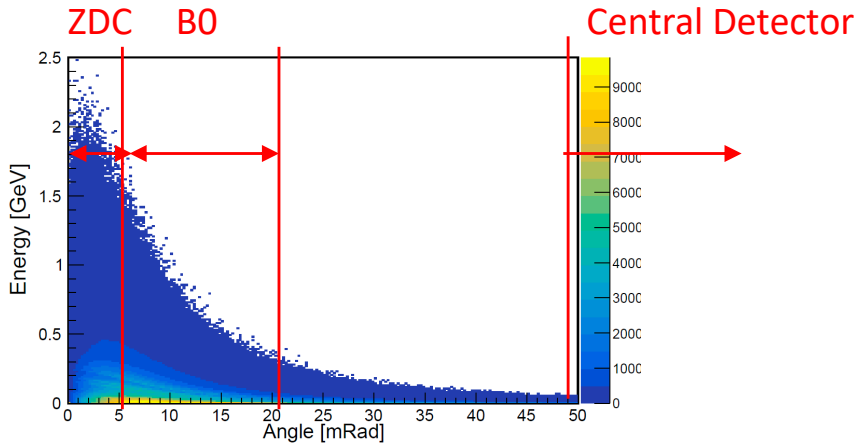
- YR/SIDIS: Feed-down to $\boldsymbol{\Lambda}$ from $\boldsymbol{\Sigma}^0 \rightarrow \boldsymbol{\Lambda\gamma}$: E_γ=200 MeV (400 MeV) at η<3 (η>3)

- YR/Jet: 200 MeV threshold in EMCal:
  "*good jet energy scales and missing transverse energy resolutions*"

- YR/Diffractive: separating coherent and incoherent interaction:
  "*Photon detectors must be able to detect photons with MeV energies in the nuclear rest frame, corresponding to 100 MeV in the lab frame.*"
  However: it relates mainly to far forward acceptance (B0, ZDC)

- My study / Inclusive (DIS electron reco): Bremsstrahlung photon reco down to 50 MeV is desirable in backward EMCal
  However: this study was done for 3T magnet with discrete material location; studies for ePIC configuration showed 100 MeV threshold should be good enough

From Barak Schmookler:
De-excitation Photons 18 GeV e + 110 GeV /A ^{238}U



The contribution of central detector to such photon detection is negligible

Requirements for EMCal E_{min}

	E-endcap	Barrel	H-endcap
YR: Table 10.6	50 MeV	50 MeV	50 MeV
YR: Table 3.1, 11.40	50 MeV	100 MeV	50 MeV
Project: EIC Det Requirements	50 MeV	100 MeV	100 MeV

Central tower hit in the center, absorbs ~80% of EM shower energy, leaving the rest 20% distributed among ~4 towers => 5% of the shower energy per towers.

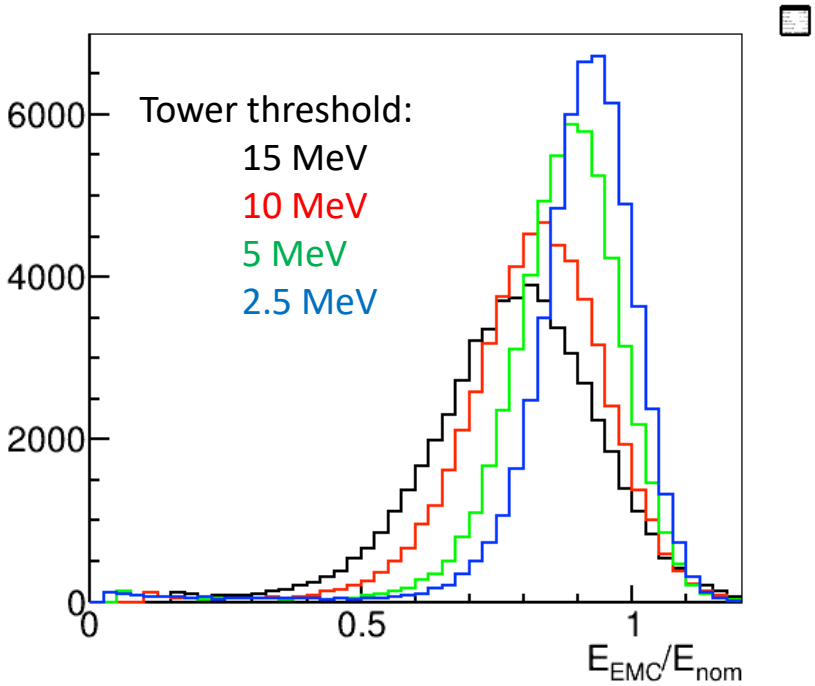
E_{cl} = 100 MeV => E_{twr}=5 MeV
E_{cl} = 50 MeV => E_{twr}=2.5 MeV

E_{twr} affects both the efficiency and resolution

In the following: Single particle simulation (no multiplicity, no background)

γ reco in backward EMCal

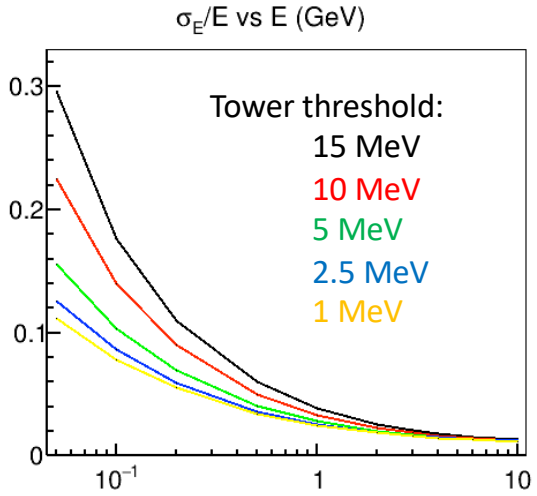
100 MeV

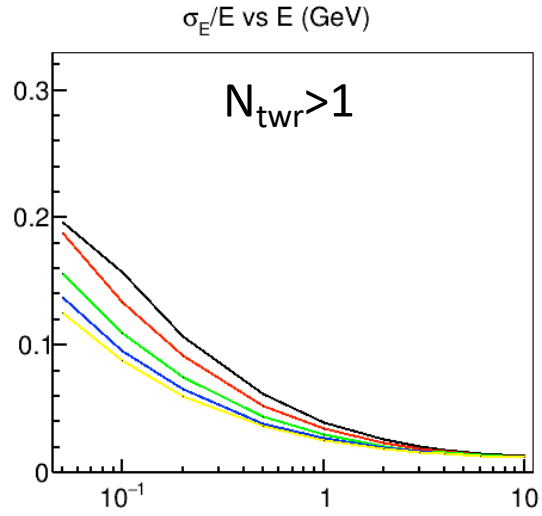


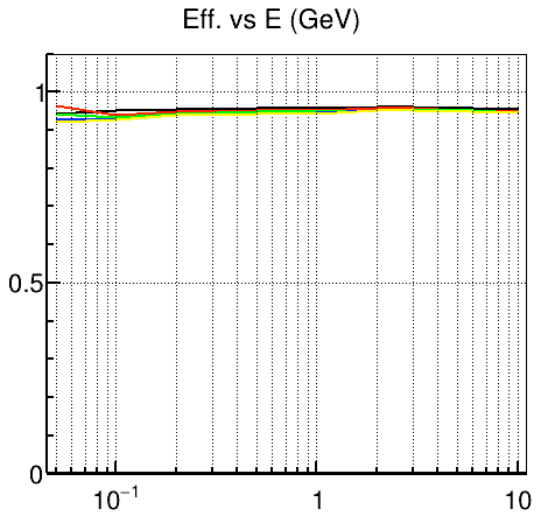
Fraction of clusters with 1 tower

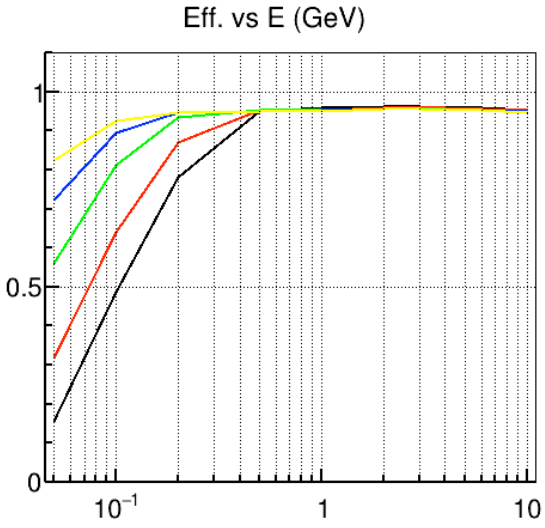
Tower Threshold	50 MeV	100 MeV
15 MeV	84%	50%
10 MeV	67%	34%
5 MeV	42%	15%
2.5 MeV	24%	6%
1 MeV	13%	2%

γ reco in Backward EMCal





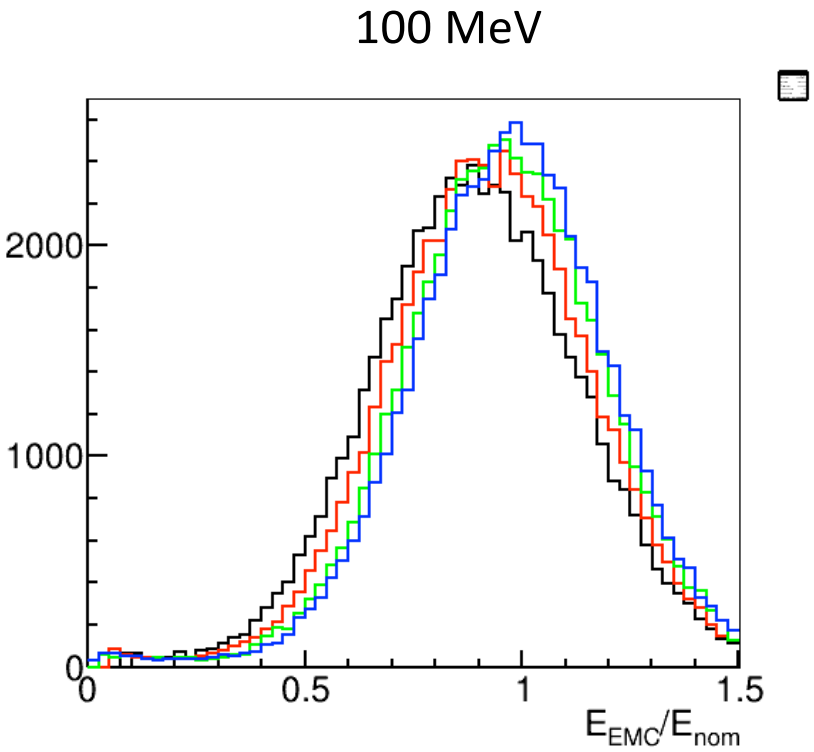


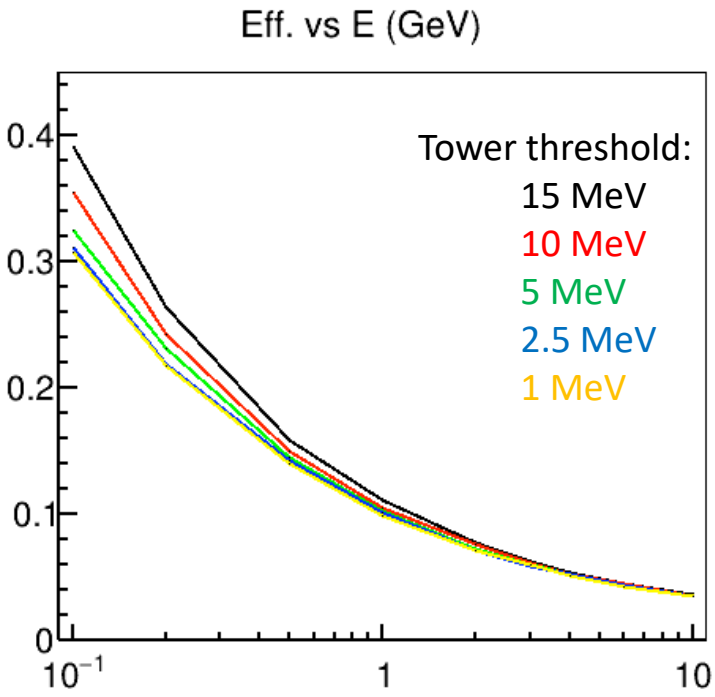


Backward EMCal (PWO):

If we accept clusters of 1 tower => 5 MeV threshold looks acceptable

γ reco in Forward EMCal





Forward EMCal (W/SciFi):

If we accept clusters of 1 tower => 15 MeV threshold looks acceptable

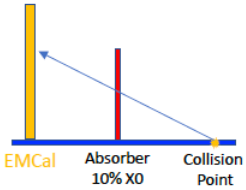
Backup

e reco in backward EMCal 1

Eff loss due to Bremsstrahlung radiation coupled with energy threshold in EMCal: below (Mean-2sigma) Energy sum in the EMCal is used (single e simulation)

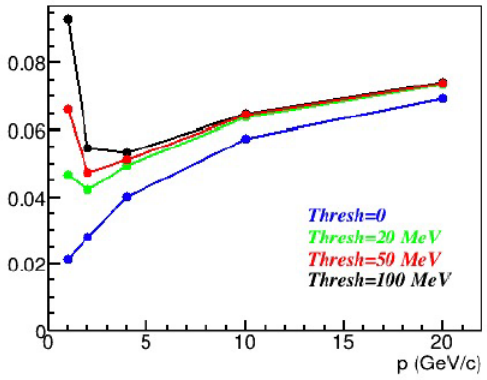
From my presentation in Aug 2021 for ATHENA and ECCE

Energy sum: cluster threshold effect



A lot of low energy radiated photons
=> sensitivity to energy threshold

Eff loss vs p



Minor effect at p>5 GeV/c
Sharply increasing effect at p<2 GeV/c

Need to measure photons to as low energy as possible (down to 20-50 MeV)

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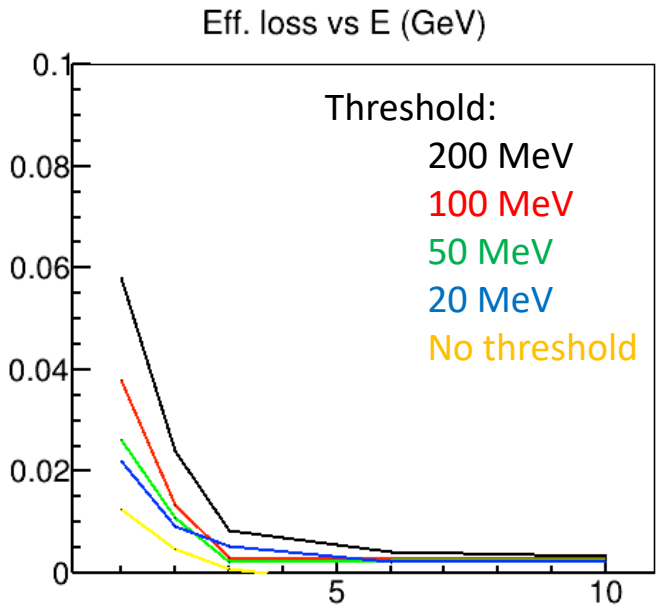
3T solenoid
10% of material at one spot in z

Additional loss due to cluster energy threshold, for 1 GeV e:
50 MeV: 4%
100 MeV: 7%

e reco in backward EMCal 2

Eff loss due to Bremsstrahlung radiation coupled with energy threshold in EMCal: below (Mean-2sigma) Energy sum in the EMCal is used (single e simulation)



Baseline (no material no threshold) subtracted

ePIC:

1.7T

"Realistic" material distribution (3-5% X0 away from EMCal)

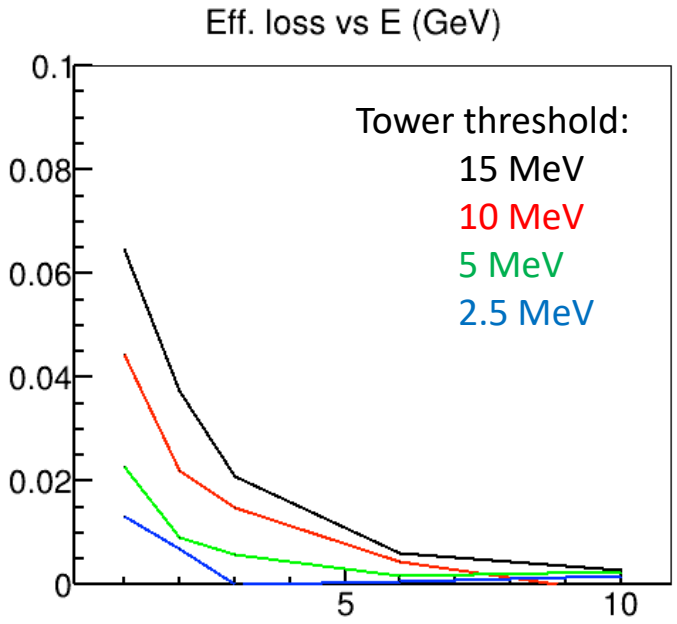
Additional loss due to cluster energy threshold, for 1 GeV e:
50 MeV: 2.5%
100 MeV: 4%

Need to measure photons down to 50-100 MeV

e reco in backward EMCal 2

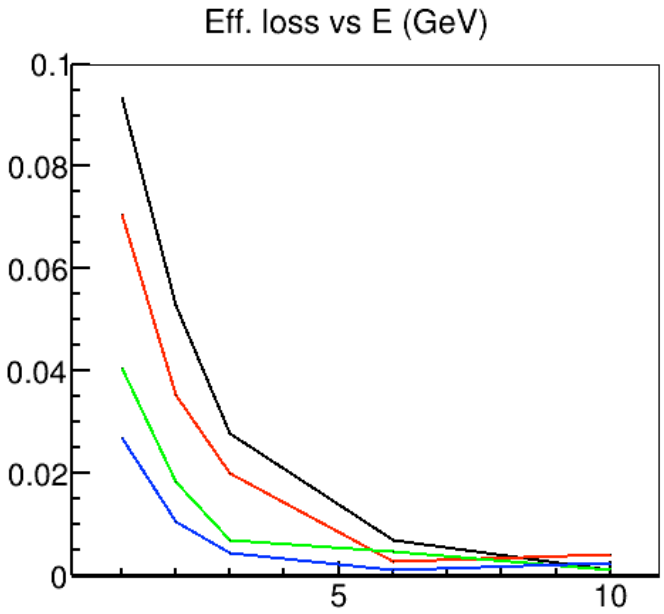
Eff loss due to Bremsstrahlung radiation coupled with energy threshold in EMCal: below (Mean-2sigma)
Energy sum in the EMCal is used (single e simulation)

Consider all clusters with towers above threshold



Threshold of 10 MeV and below looks acceptable

Consider all clusters with towers above threshold, >=2 towers



Threshold of 5 MeV and below looks acceptable