Pion rejection in EEEMCal: Initial look at resolution

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News

- Pion rejection benchmark submitted as `https://github.com/eic/detector_benchmarks/pull/44`
- Excessive cluster splitting fix has made it into the upcoming 24.08 campaign `https://github.com/eic/EICrecon/pull/1554`

Pu-Kai's studies

Backward end-cap ECAL (energy & spatial resolution)

Energy resolution can be expressed:

$\sigma_E/E = \alpha \oplus \beta/\sqrt{E} \oplus \gamma/E$

α: radiation length, geometry
β: calorimeter techology
γ: noise level

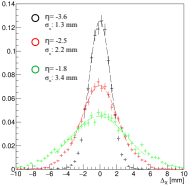
Spatial resolution can be expressed:

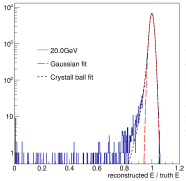
$\sigma_\chi = \delta \oplus \varepsilon/\sqrt{E} \oplus \Delta\sin\theta$

δ and ε: module size
Δ: radiation length

The simulation setup:
- Detector geometry: all central subsystems
- Particle: γ
- Energy reconstruction: island clustering
- For energy resolution: 0.5 ~ 20 GeV
- For spatial resolution, E: 1 ~ 20 GeV (fixed η), η: -2 ~ -3.2 (fixed E)

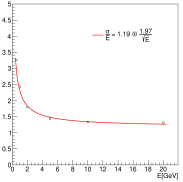
The σ_χ is better (6.5% → 17% of crystal width) as incoming angle is smaller (η: -1.8 ~ -3.6)



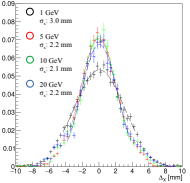


- σ_E/E is from the width of Gaussian and Crystalball functions

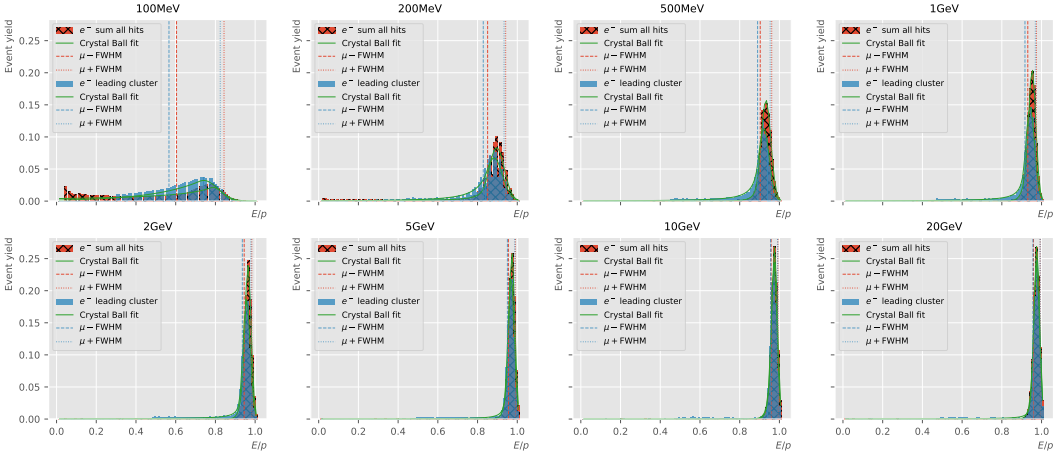
- The α and β from the YR. requirements are: 1.5, 2.5, respectively.



The σ_χ is better (15% → 10% of crystal width) as particle's energy is larger (1 ~ 20 GeV)

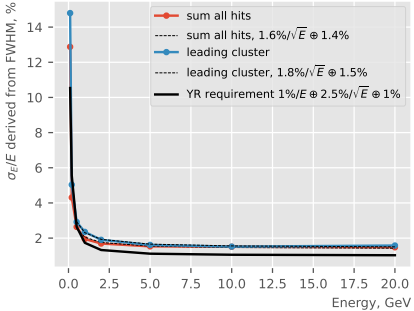


E/p


100MeV
200MeV
500MeV
1GeV
2GeV
5GeV
10GeV
20GeV
Event yield
E/p
e⁻ sum all hits
Crystal Ball fit
μ − FWHM
μ + FWHM
e⁻ leading cluster
Crystal Ball fit
μ − FWHM
μ + FWHM

Resolution

EPIC/RECO/24.04.0/epic_craterlake/SINGLE/{particle}/{energy}/130to177deg/{particle}_{energy}_130to177deg.{ix:04d}.eicrecon.tree.edm4eic.root



Here,

$$\frac{\sigma}{\mu} = \frac{\text{FWHM}}{2\sqrt{2\log(2)}\mu}$$

where μ is the peak position of the Crystal Ball fit (points for $E < 0.5$ GeV are not used)