Update on reconstruction in SPD ECAL

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SPD Physics & MC meeting

31.03.2021

Plan

- Studies on ECAL resolution for smaller ECAL sizes (< 40 cm)
- ECAL reconstruction in the new SPDROOT release

Thickness of ECAL barrel module

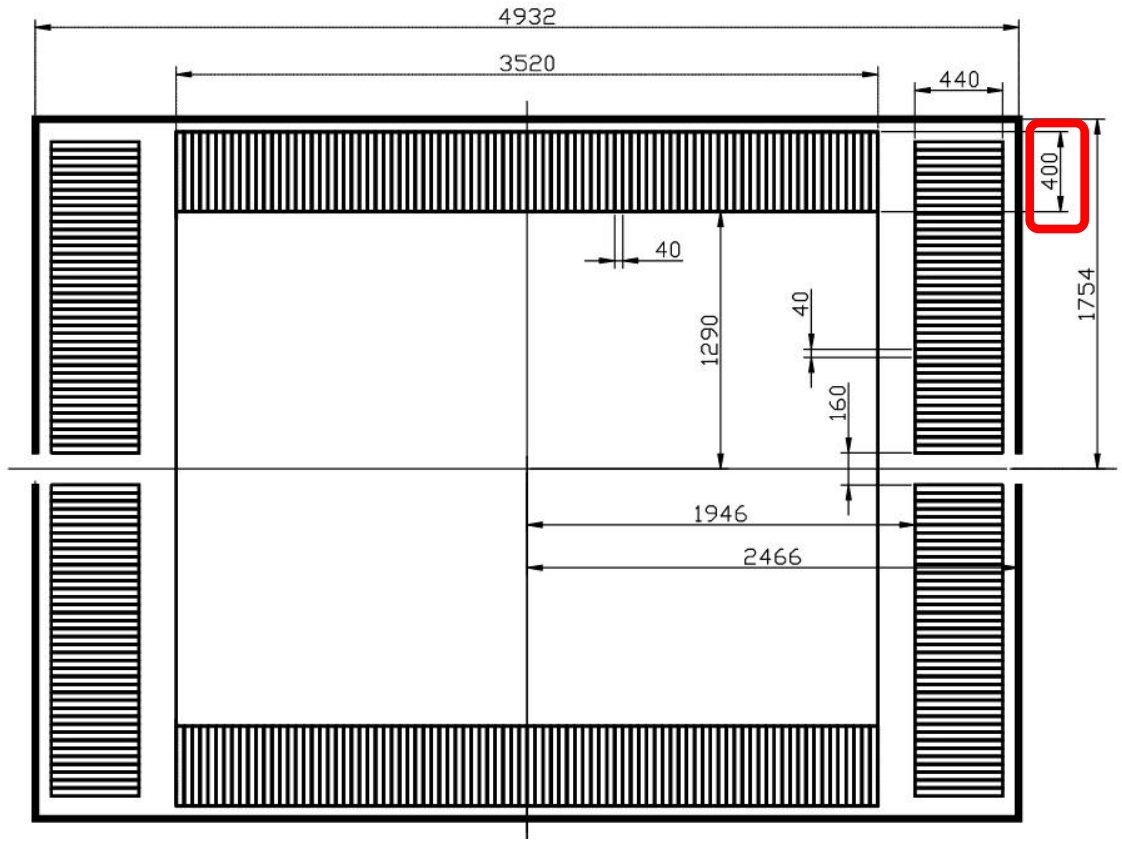
Possibly has to be shrunk from **40 cm → 36 cm**

Current setup:

200×(1.5 mm scint. **+ 0.5** mm lead)

Possible modifications:

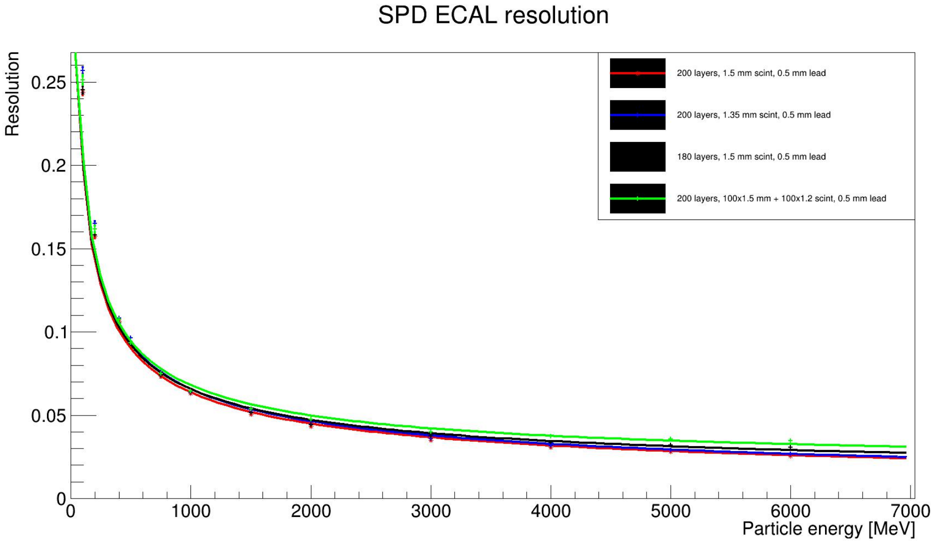
- **180×(1.5 + 0.5)**
- **200×(1.35 + 0.5)**
- **100×(1.5 + 0.5) + 100x(1.2 + 0.5)**

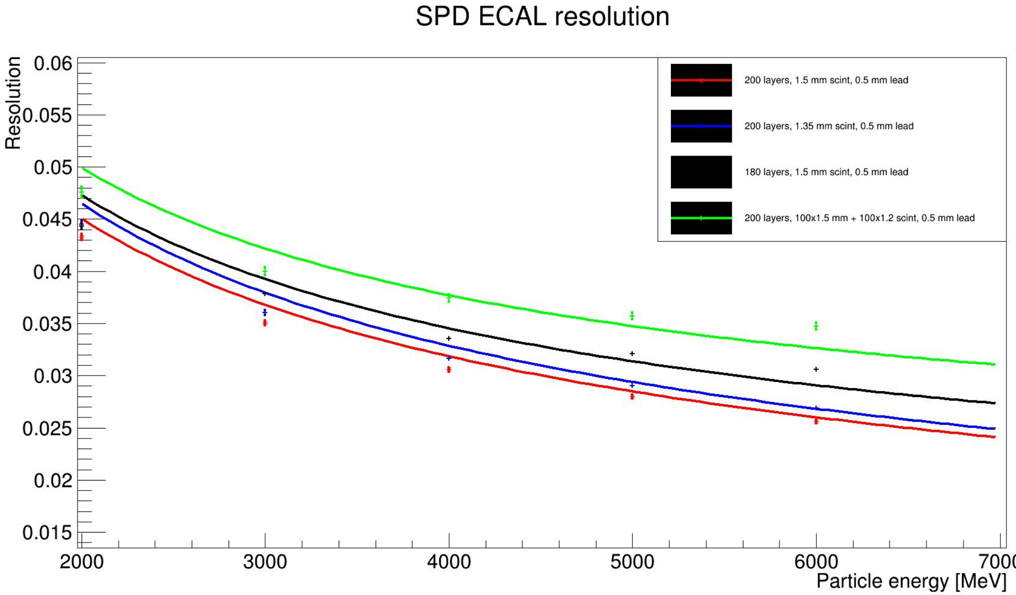


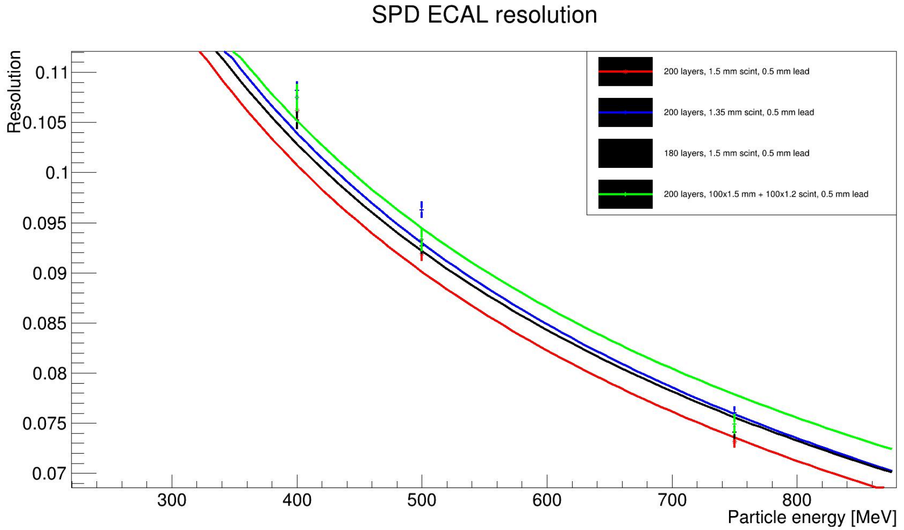
For future references:
https://git.jinr.ru/AndreiMaltsev/ecal_geant4

ECAL energy resolution for photons

Which option is better?



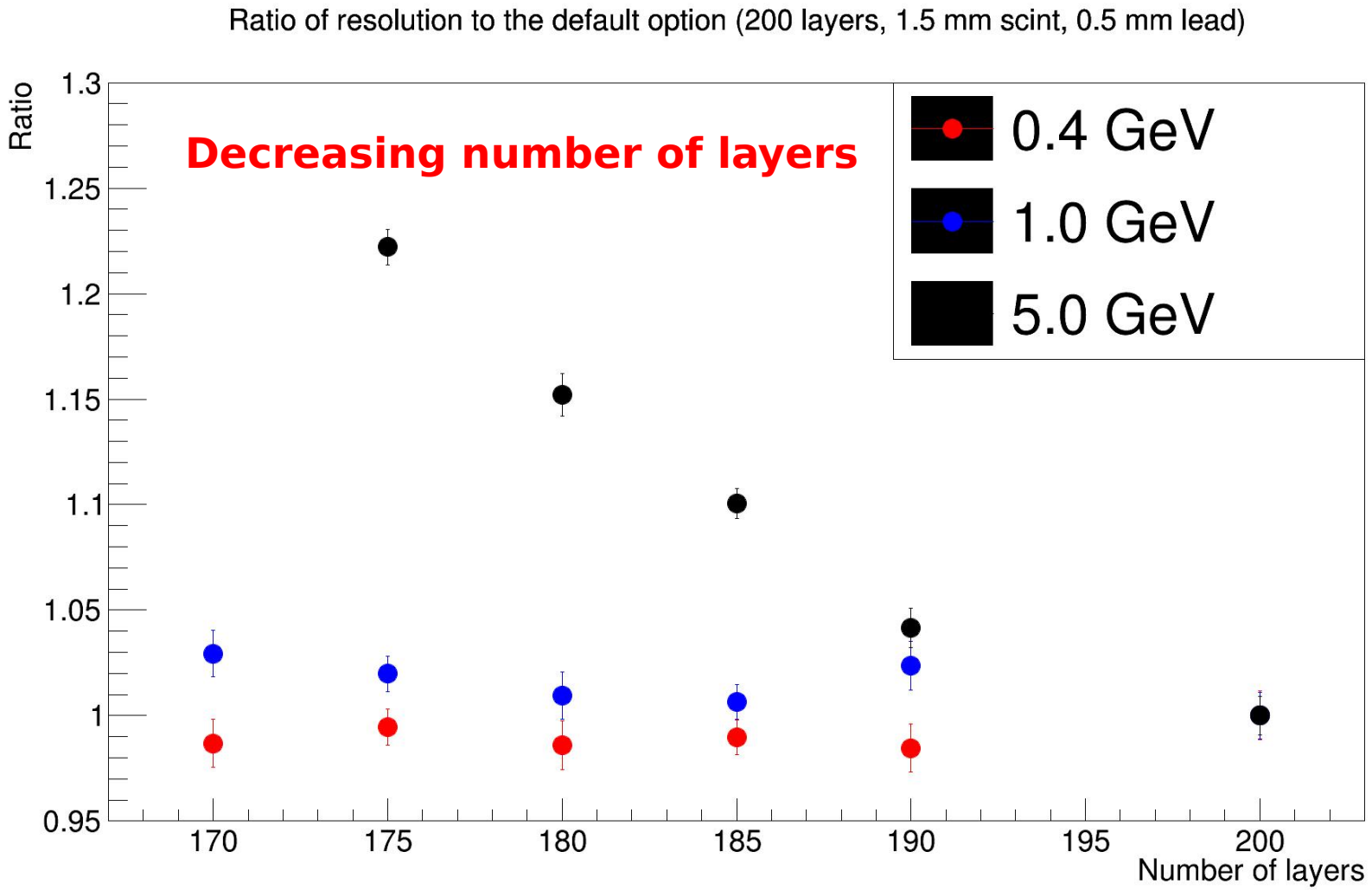




200×(1.5 + 0.5) - old geometry
180×(1.5 + 0.5)
200×(1.35 + 0.5)
100×(1.5 + 0.5) + 100x(1.2 + 0.5)

taking into account: cell energy threshold, p.e. statistics

Scans of resolution for different parameters



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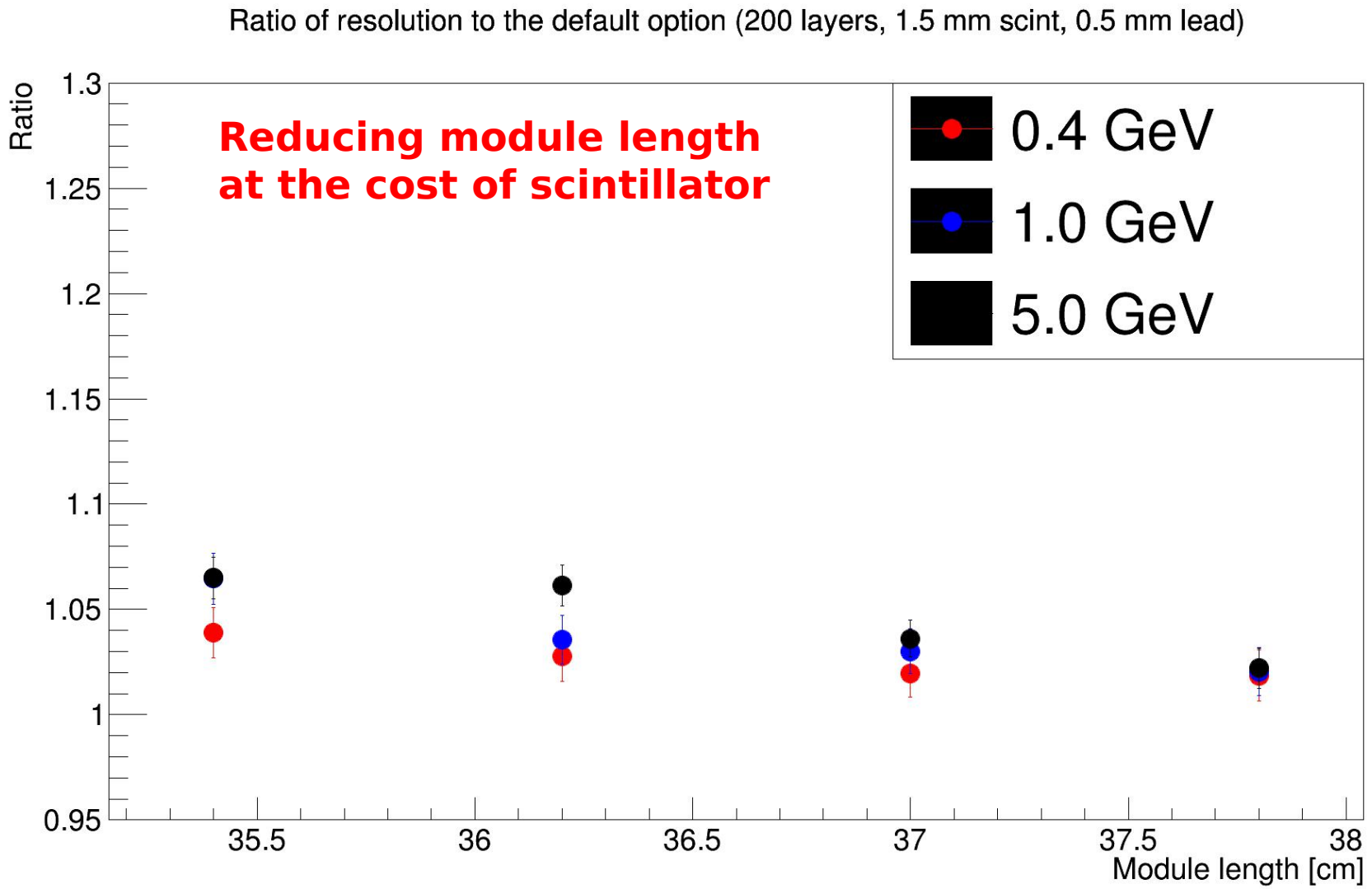

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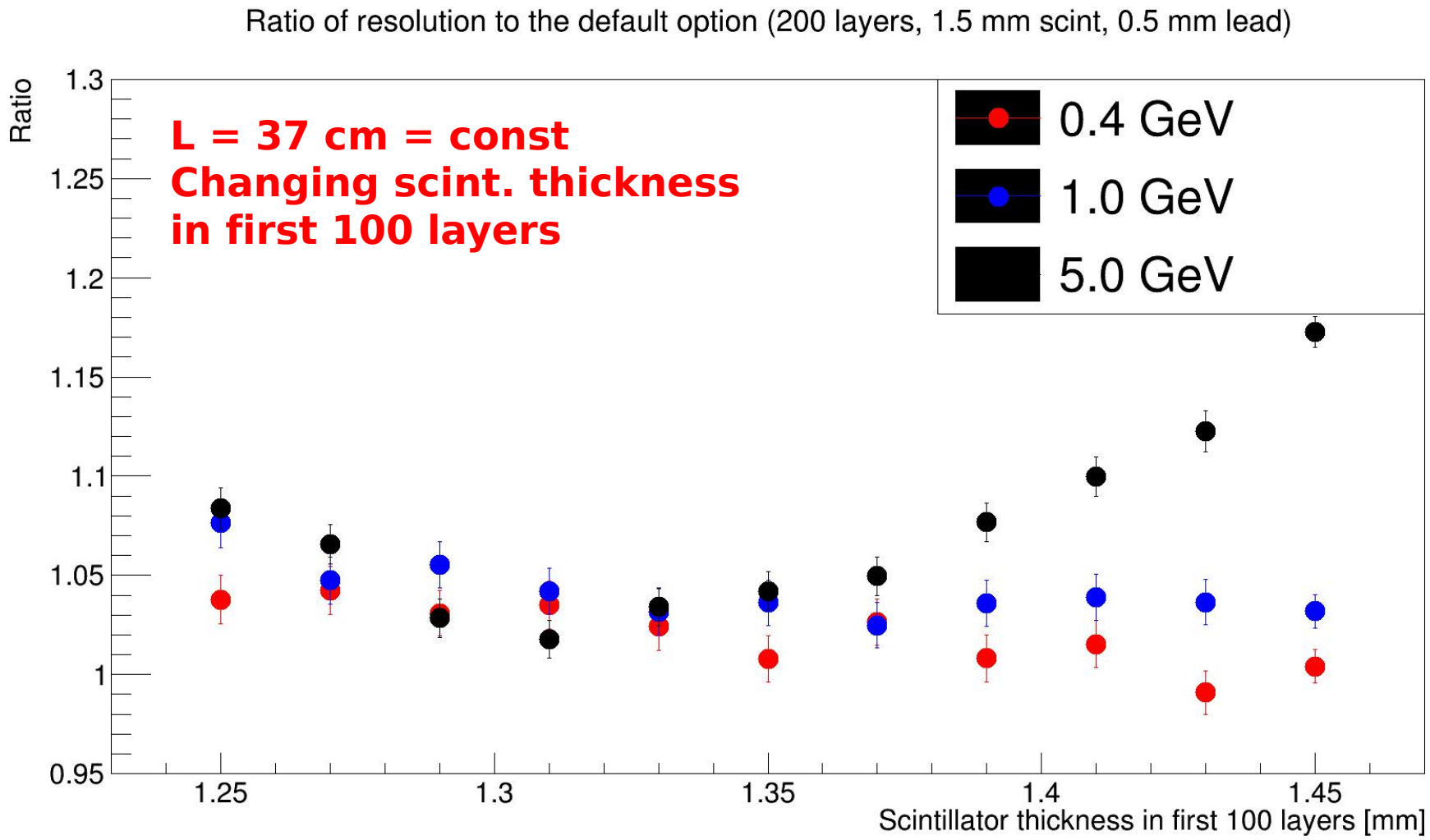

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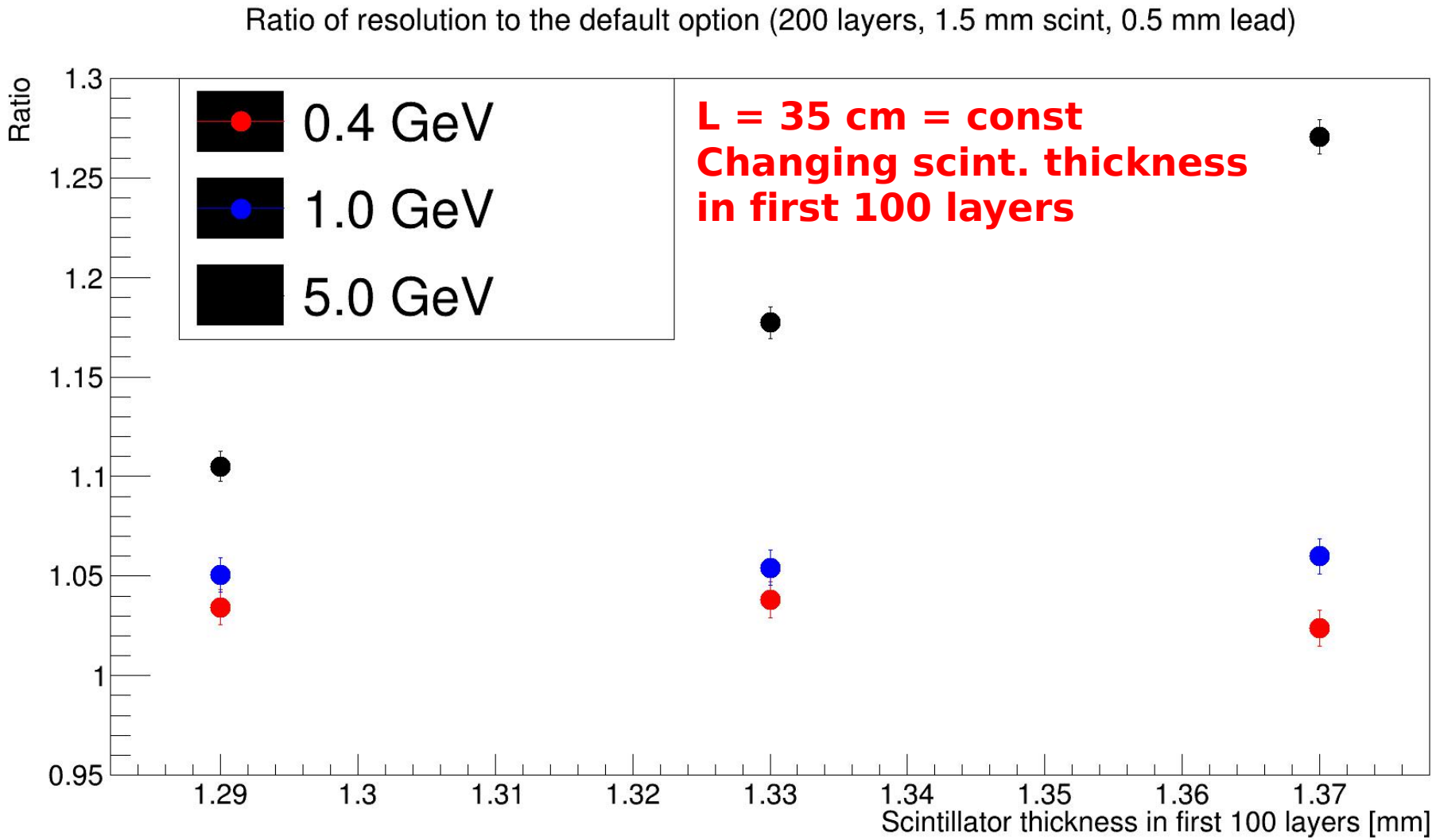

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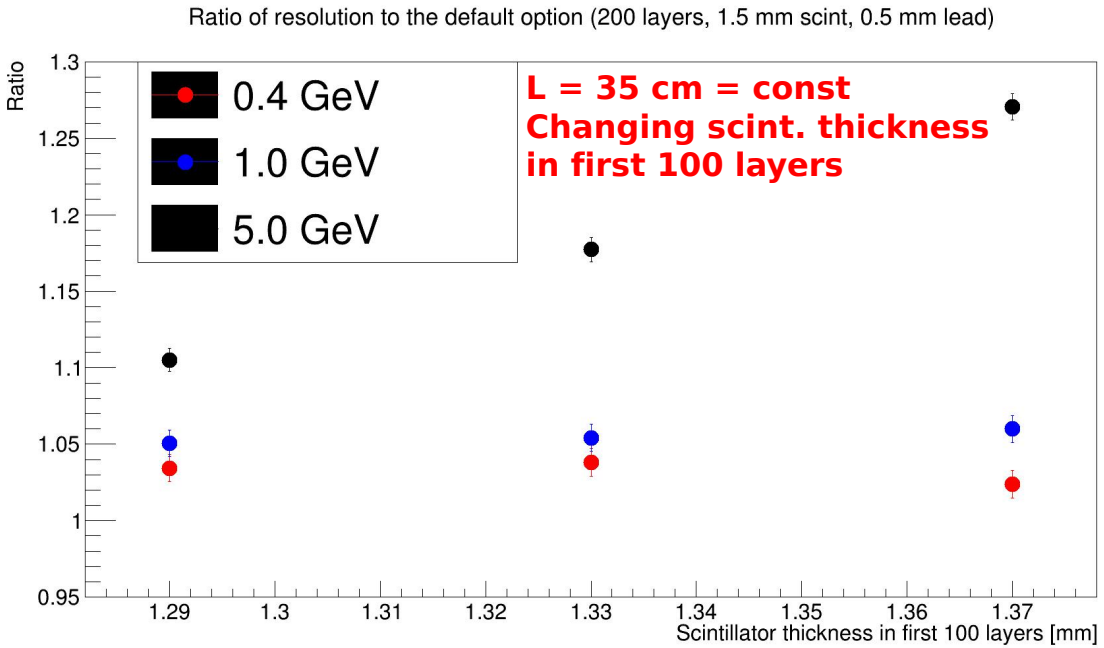

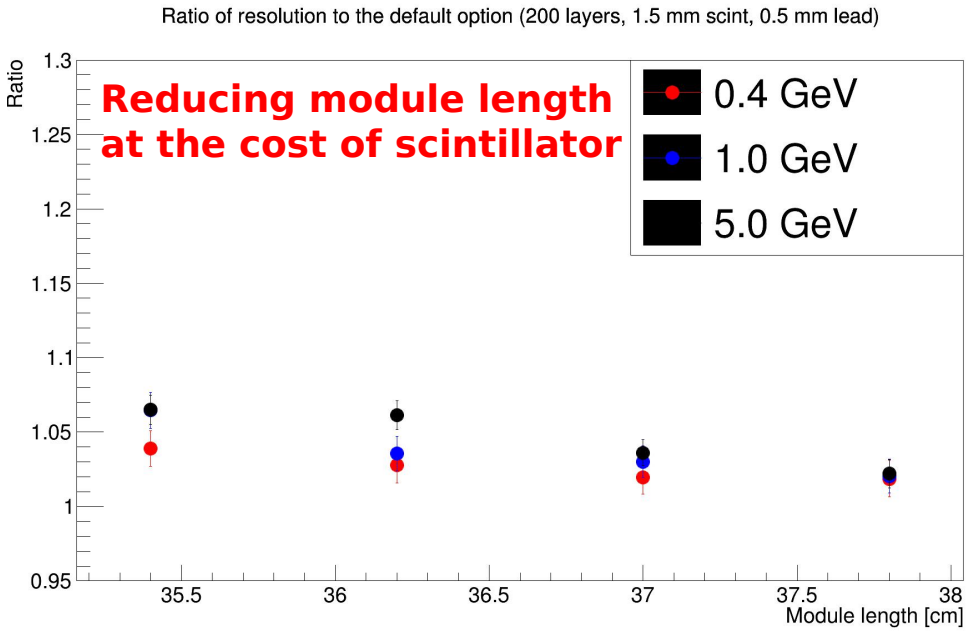

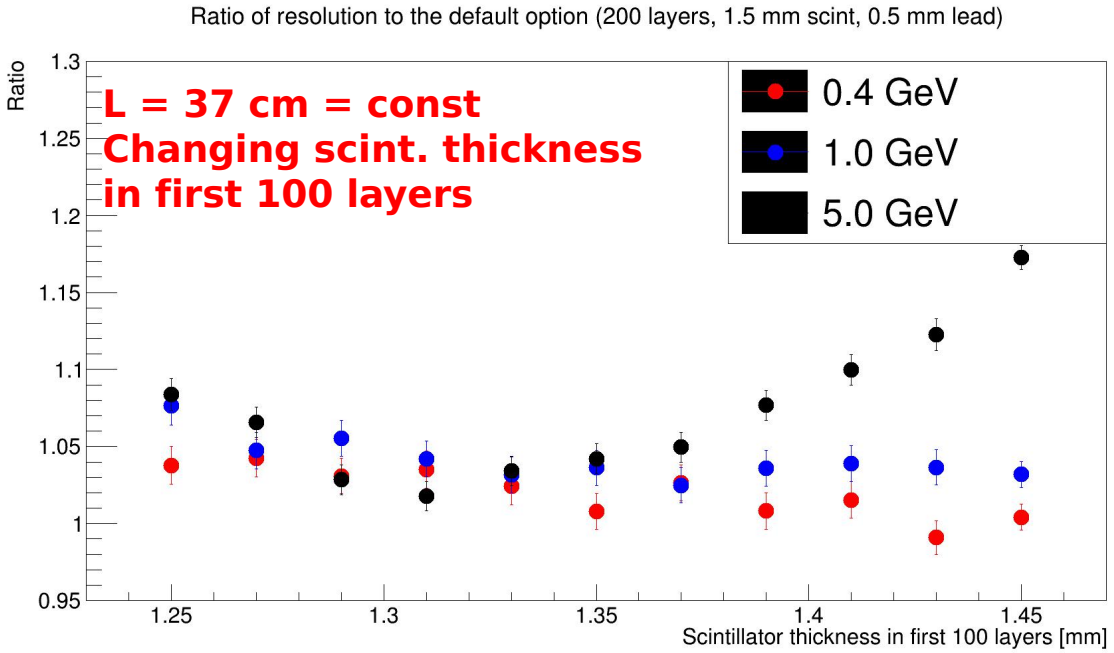

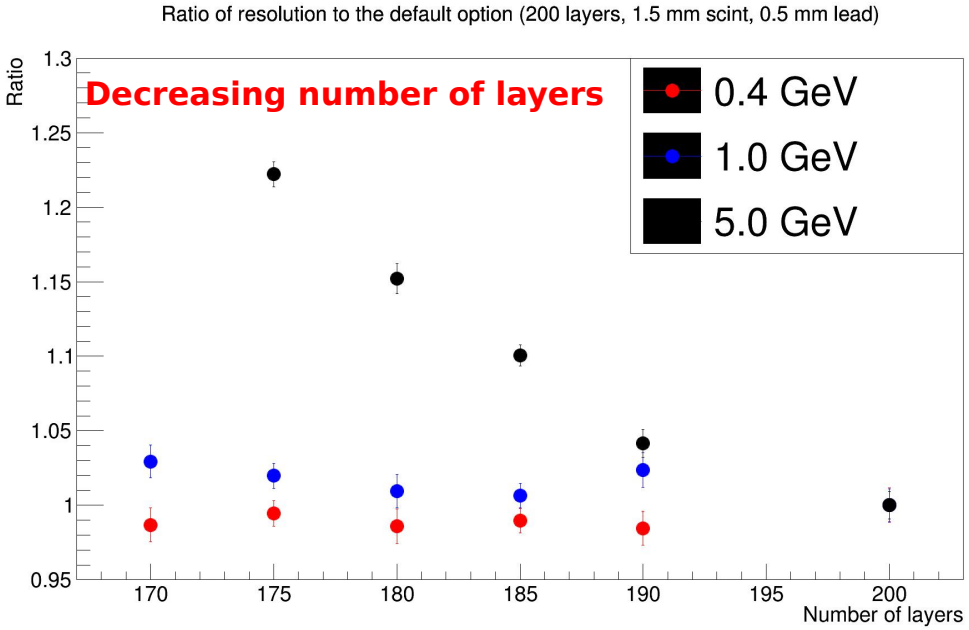

Conclusions (first part of the talk)

- Depending on resolution goals for different energies, different options could be considered
- Assuming resolution at 400 MeV is much more important than at 4-10 GeV, decreasing number of layers seems to be a reasonable choice
- Otherwise, if one has to maintain the old resolution in the entire energy range, decreasing module size at the cost of scintillator is better

ECAL reconstruction in the new release of SPDROOT

The algorithm:

1) collect interaction points at the level of simulation

2) for each cell, combine points → get deposited energy

3) find clusters of neighboring cells above certain threshold

4) determine reconstructed particle energy/position as center of gravity with log.weighting +

+ apply empirical corrections

ECAL reconstruction in the new release of SPDROOT

Data classes:

Class name	Meaning	What it contains
SpdEcalTB2Point SpdEcalTEC2Point	Interaction point inside ECAL (simulation level)	Position/energy/time
SpdEcalMCHit	ECAL cell information	Cell index (position), deposited energy in cell, time
SpdEcalRCCluster **“Reco”**	Cluster (set) of neighboring cells	Indices of cells in cluster, indices of reconstructed particles from this cluster
SpdEcalRCParticle	Reconstructed particle	Physical information: position, energy, PID (in the future)

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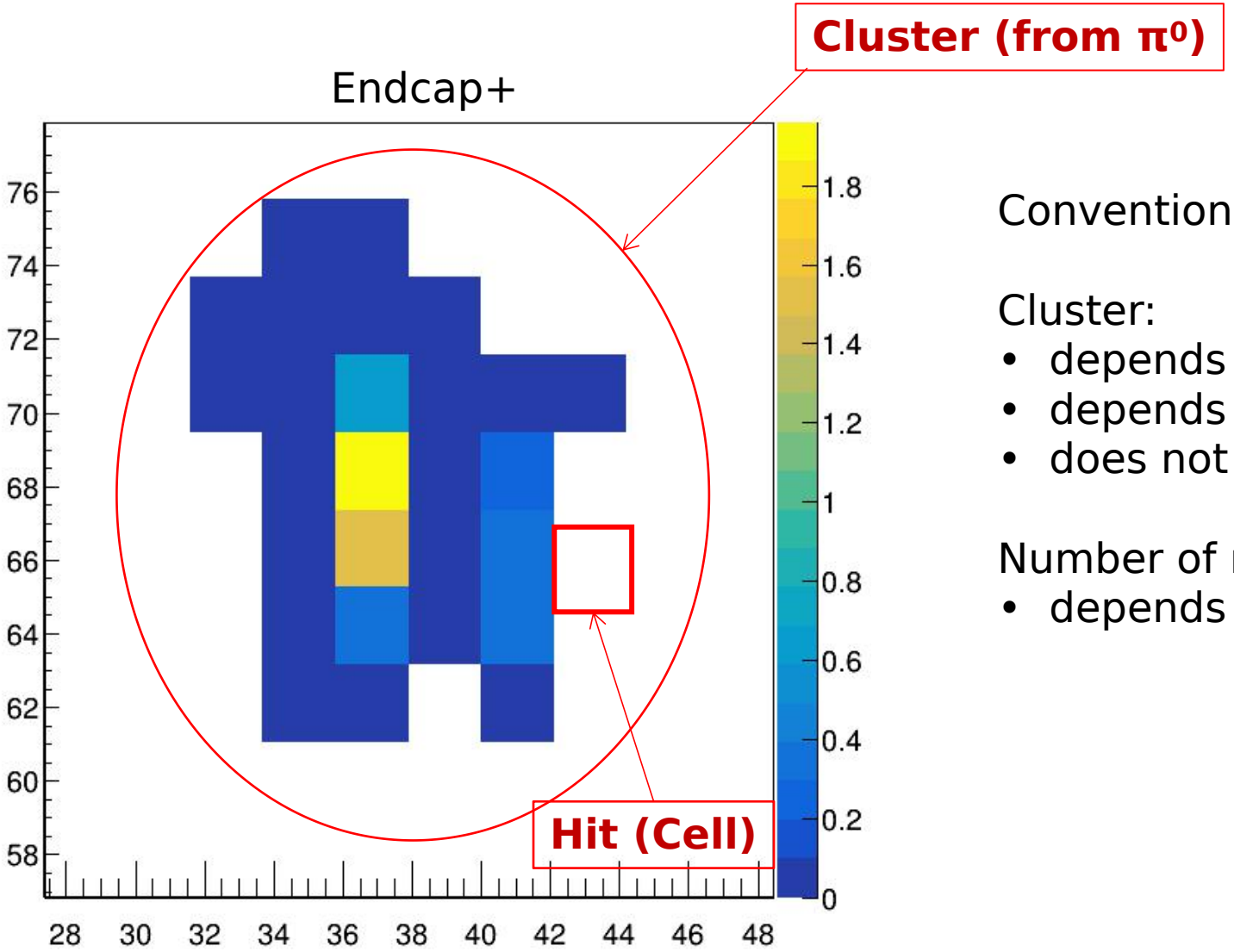
SpdEcalRCParticle **Main class for analysis**	Reconstructed particle	Physical information: position, energy, PID (in the future)

Cluster visualized



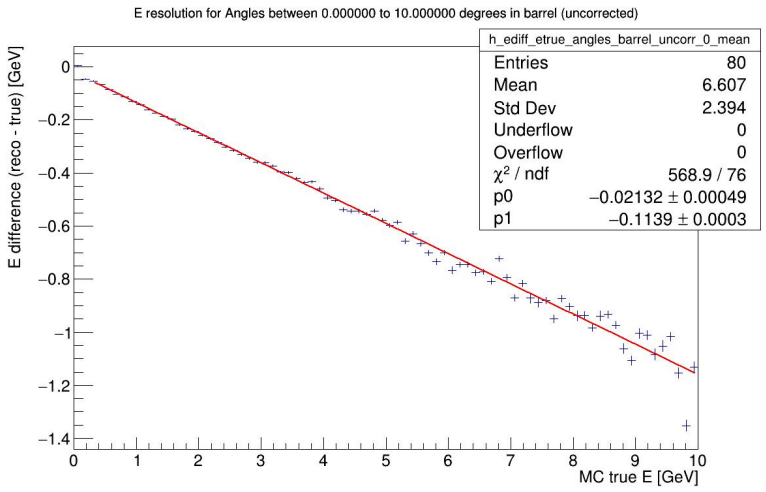
Conventions:

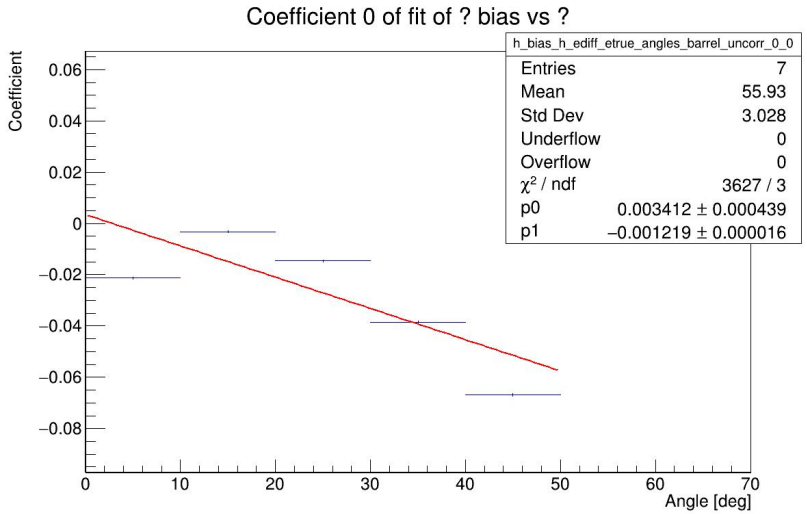
Cluster:
- depends on cell energy threshold
- depends on clustering distance (e.g. cellSize*sqrt(2))
- does not depend on reconstruction algorithm

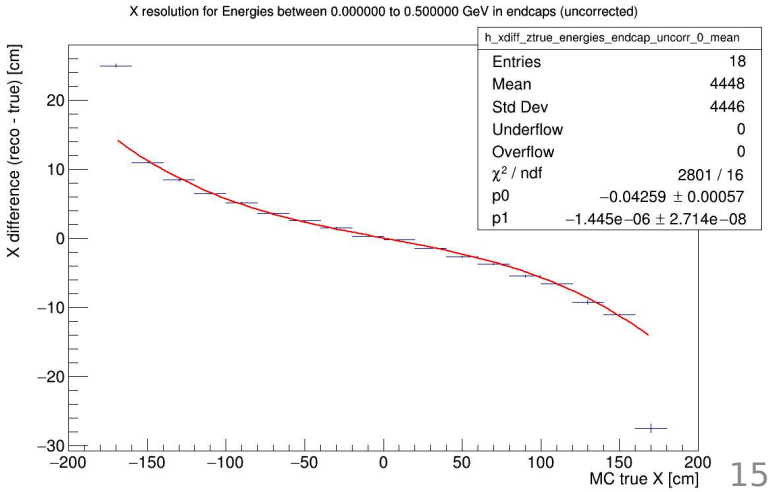
Number of reconstructed particles for each cluster:
- depends on the reconstruction algorithm

Some details

- Clusters in barrel/endcaps are not merged yet
- Empirical corrections:
  - Energy corrections:
    - Fitted residuals in bins of the incidence angle (line)
    - Slopes/intersections fitted with a line
  - Position corrections:
    - Fitted residuals in energy bins (3rd degree polynomial, 2 free parameters)
    - 2 parameters fitted with a line







Example

→ macro/examples/ecal/CheckEtaSimple.C

```
IT = new SpdMCDataIterator();
IT->AddSourceFile("reco_full.root"); //several ways to add source files, see examples
IT->ActivateBranch("RCEcalParticles"); //!
EcalParticlesRC_ = IT->GetEcalParticlesRC();


while (IT->NextEvent()) { //main loop
      //obtain particle info
      for (Int_t ip = 0; ip < EcalParticlesRC_->GetEntriesFast(); ++ip) {
            SpdEcalRCParticle* part = (SpdEcalRCParticle*)EcalParticlesRC_->At(ip);
            TVector3 pos = part->GetPosition();
            Double_t en = part->GetEnergy();
       }
}
```

Outlook

Future steps:

- correspondence of RC-MC particles
- MC clusters produced by a single MC particle as opposed to “blind” clustering of neighboring cells

Waiting for your feedback/questions/recommendations!

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Also check https://git.jinr.ru/nica/spdroot/-/wikis/ECAL for more information