LAr Calorimetry for FCC-ee – First Performance Studies

FCC-hh Calorimetry Group; Martin Aleksa, Jana Faltova, Valentin Volkl, Clement Helsens, Ana Henriques Correia, Coralie Neubuser, Anna Zaborowska

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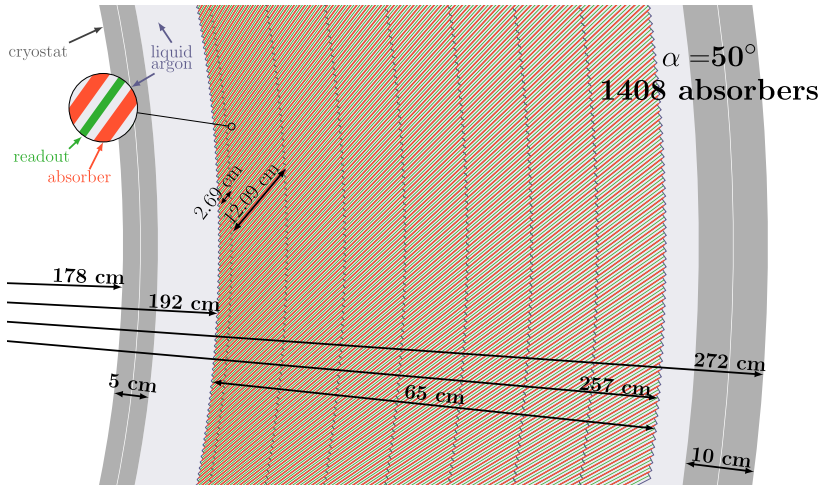
CERN / University Innsbruck

Recap: Requirements for Calorimetry for FCCee

Recap:

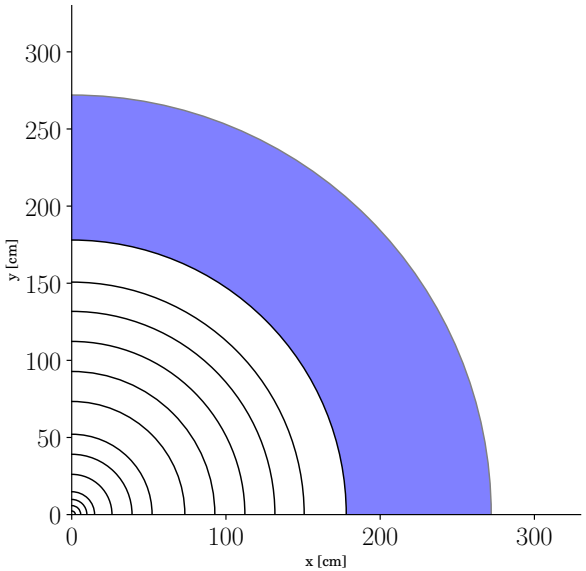
- All particles under 182.5 GeV: 22 X_0 and 5-7 λ sufficient
  - but low momentum range down to 300 MeV
    - light tracker, low noise
- Jet resolution of $30\%/\sqrt{E}$
  - $\rightarrow$ most likely requires Particle Flow
- EM resolution as good as possible ($a \leq 15\%/\sqrt{E}$)
- Position resolution of photons: $\sigma_x = \sigma_y = (6GeV/E \oplus 2)$ mm
- Particle ID
  - $e^{\pm}$ $\pi^{\pm}$ separation
  - τ decays with collimated final states, separate different decay modes with minimal overlap (e.g. π_0 close to $\pi^{\pm}$)



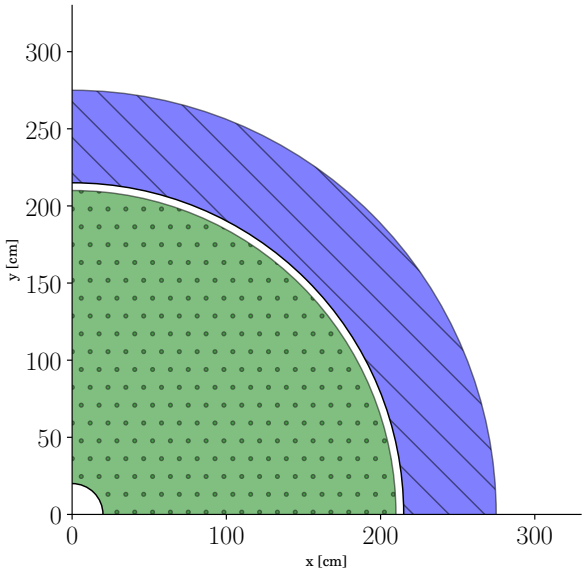
- we have **adapted** Inclined-Absorber LAr electromagnetic calorimeter designed for FCC-hh

Reference FCC-hh Dimensions – FCC-ee option

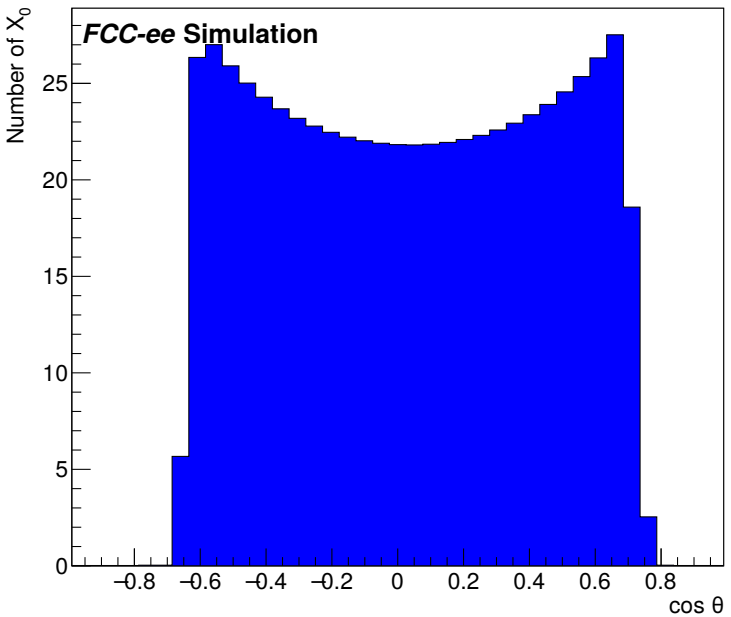
FCC-hh



FCC-ee IDEA-LAr

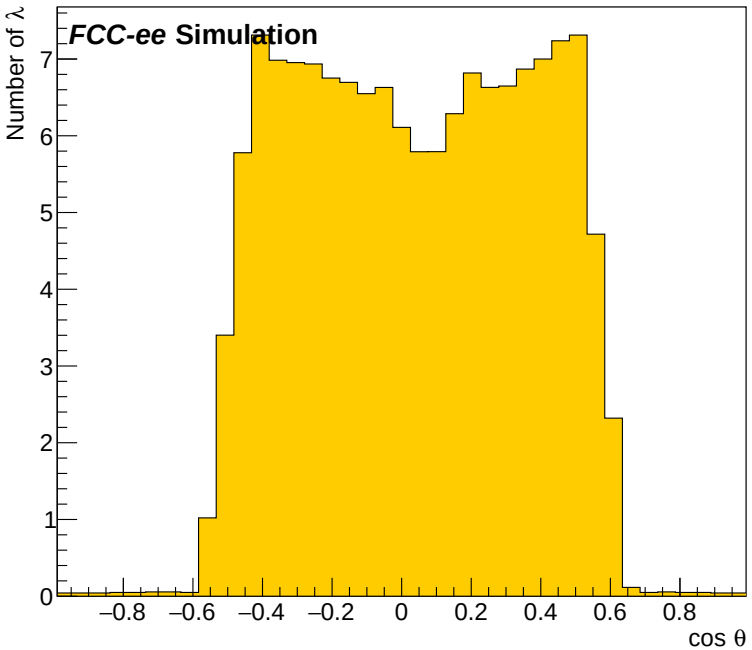


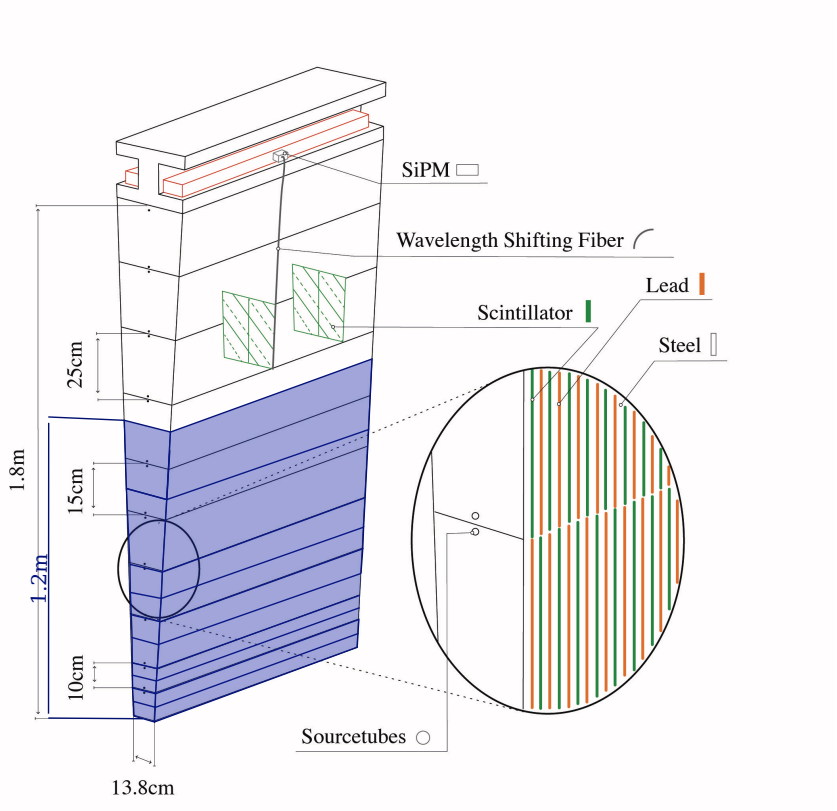
For, FCC-ee, ECal can be scaled to 60cm, adapting LAr-gap but keeping layer structure the same



TileCal adapted dimensions

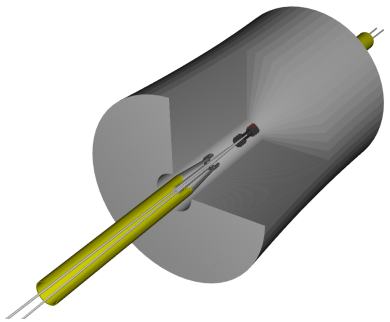
Hadronic Tile-Calorimeter can be scaled to 1.2m, keeping the number of layers (10).

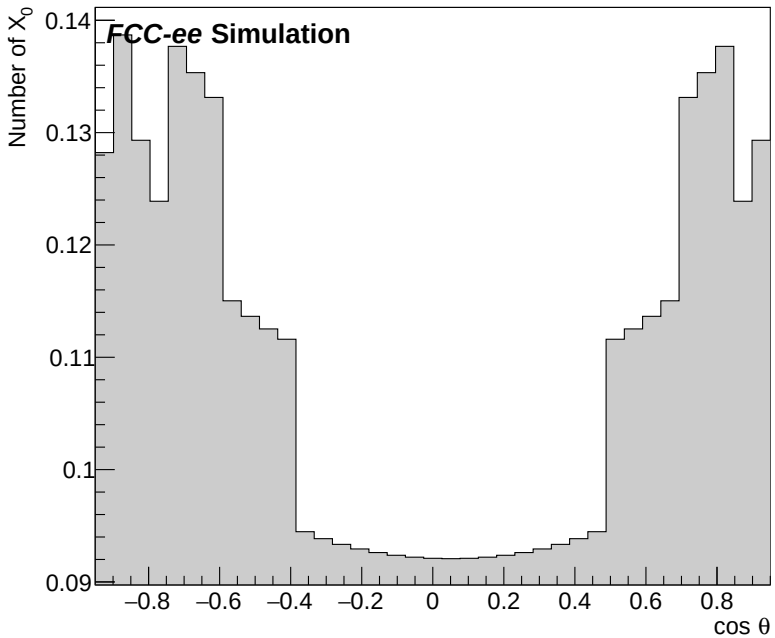




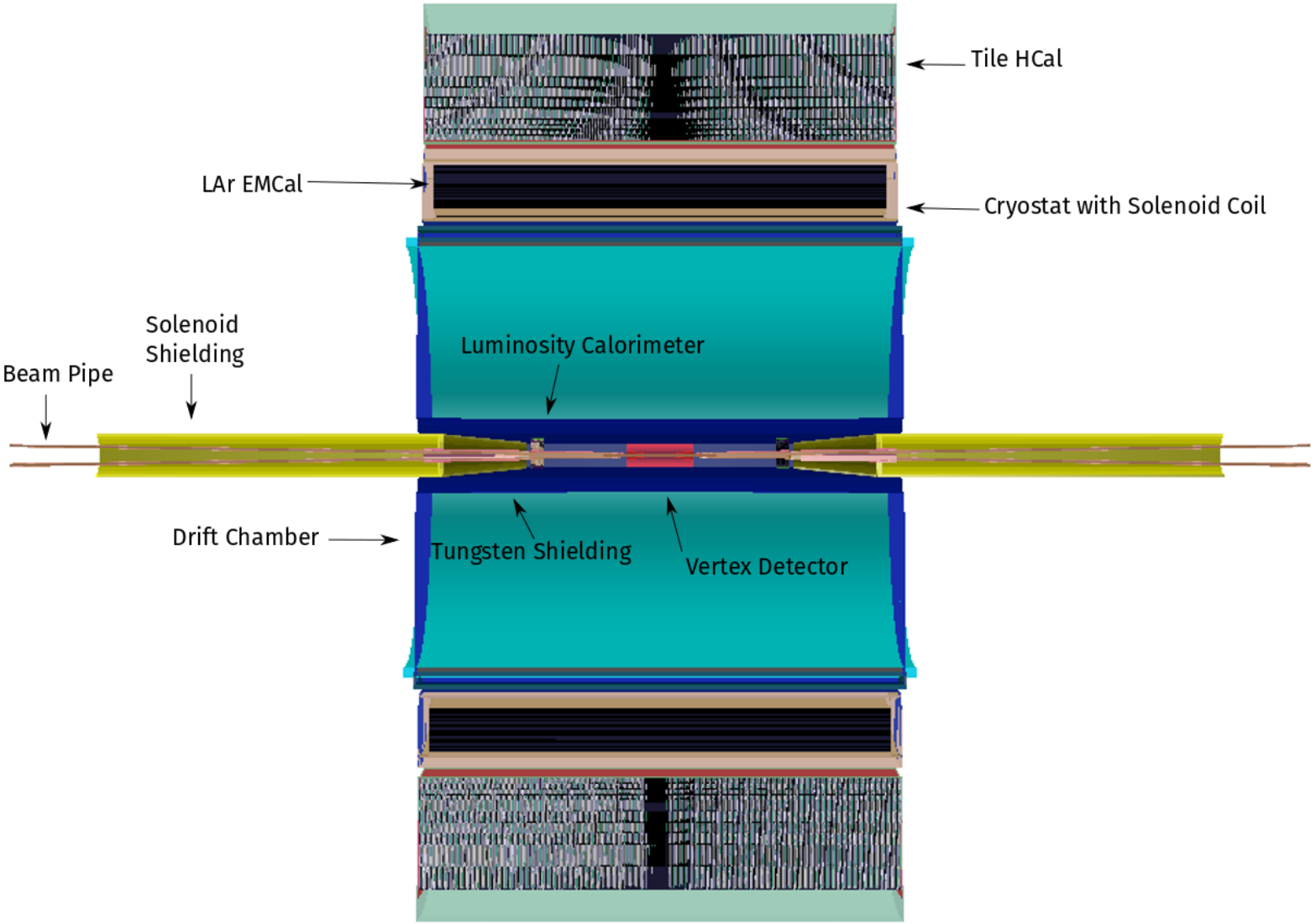
Material Scan

IDEA upstream material

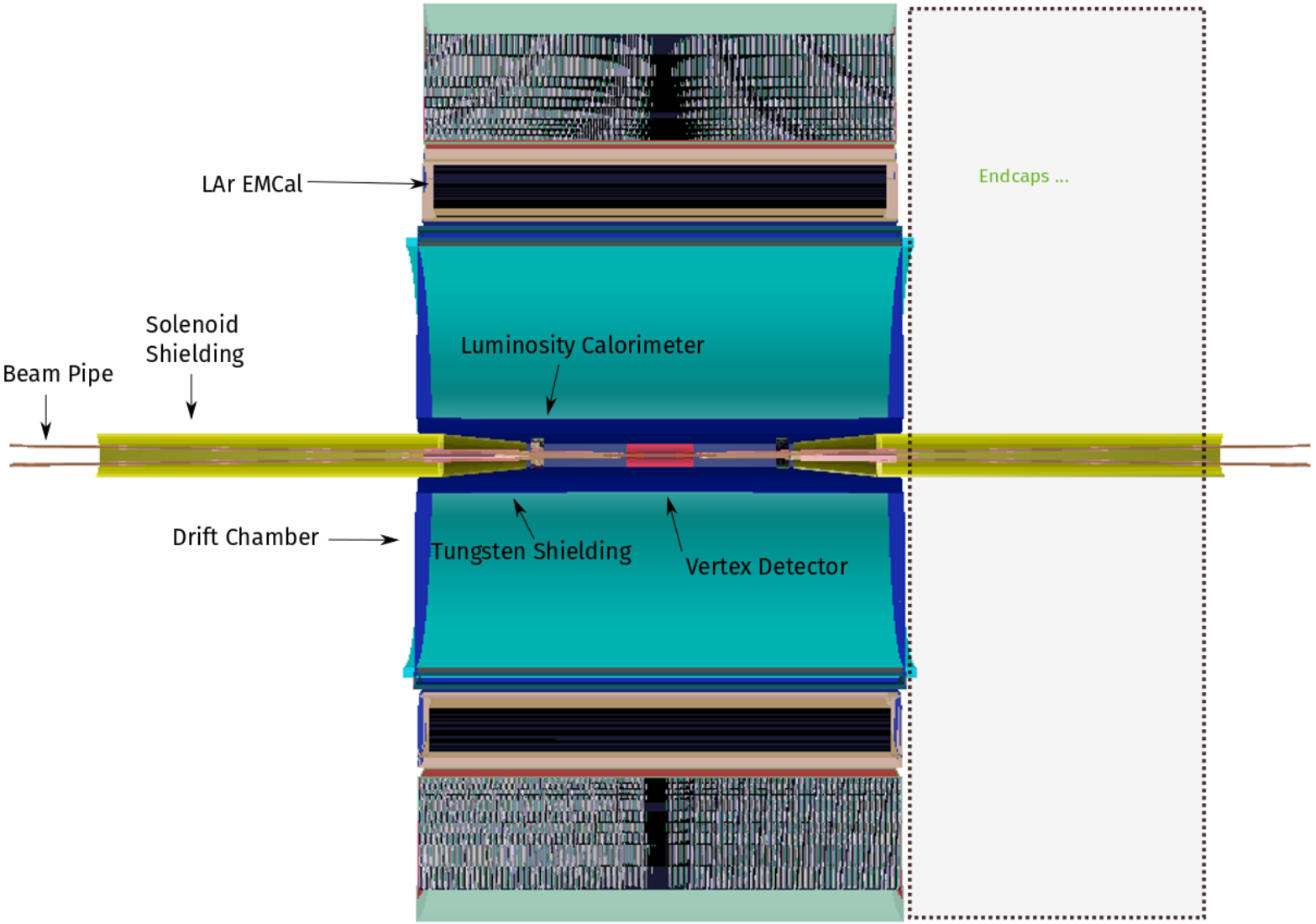




DD4hep Detector Implementation Display



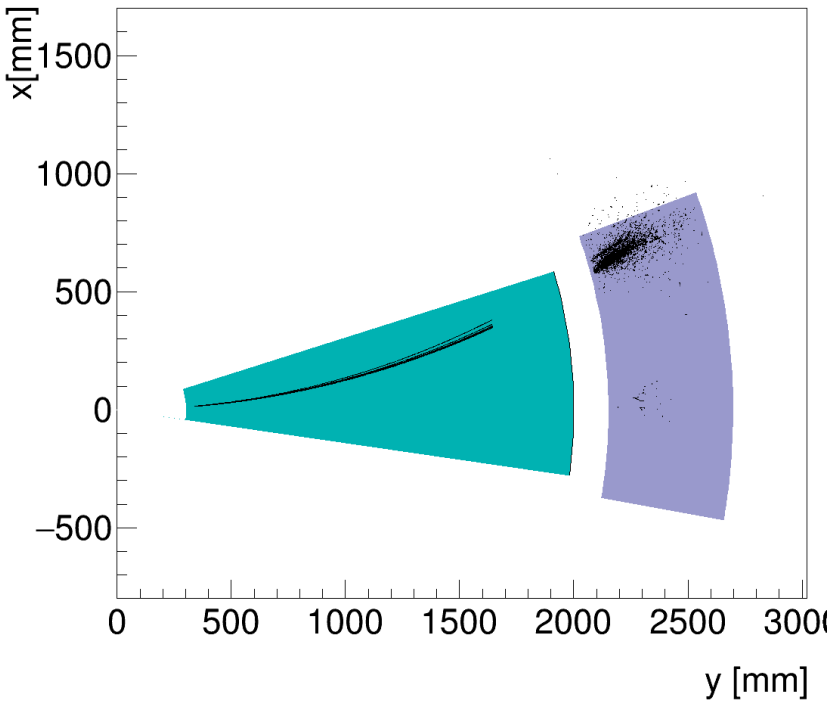
DD4hep Detector Implementation Display



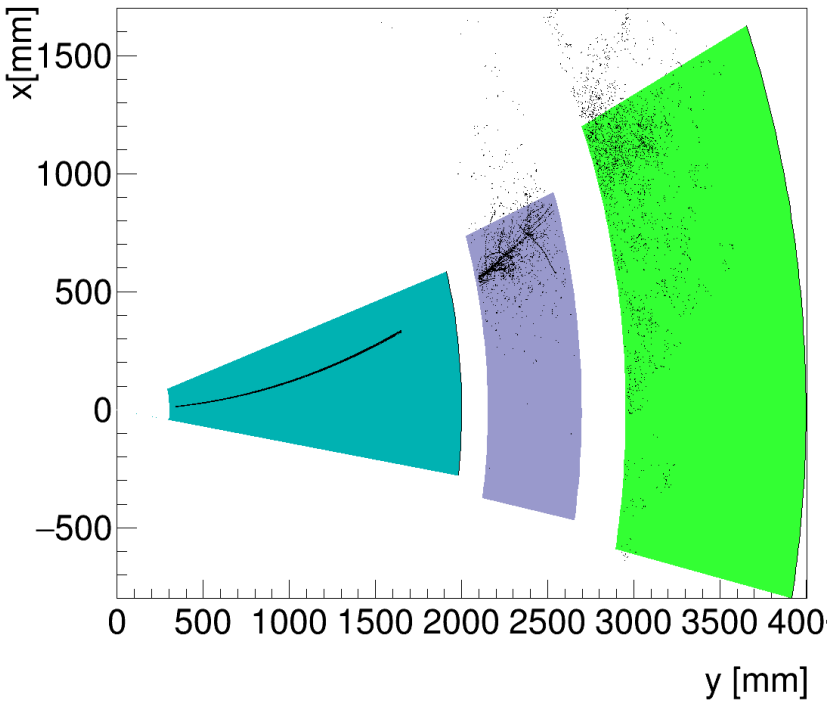
Event Displays

Simulated Energy Deposits in Drift Chamber and Calorimeters

2.4 Gev e^-



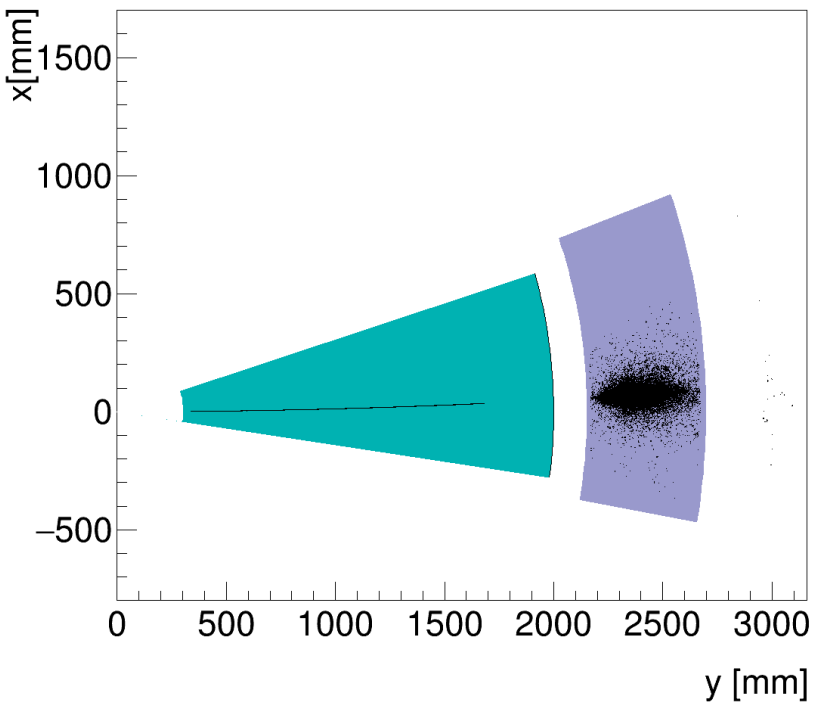
2.4 Gev π^-



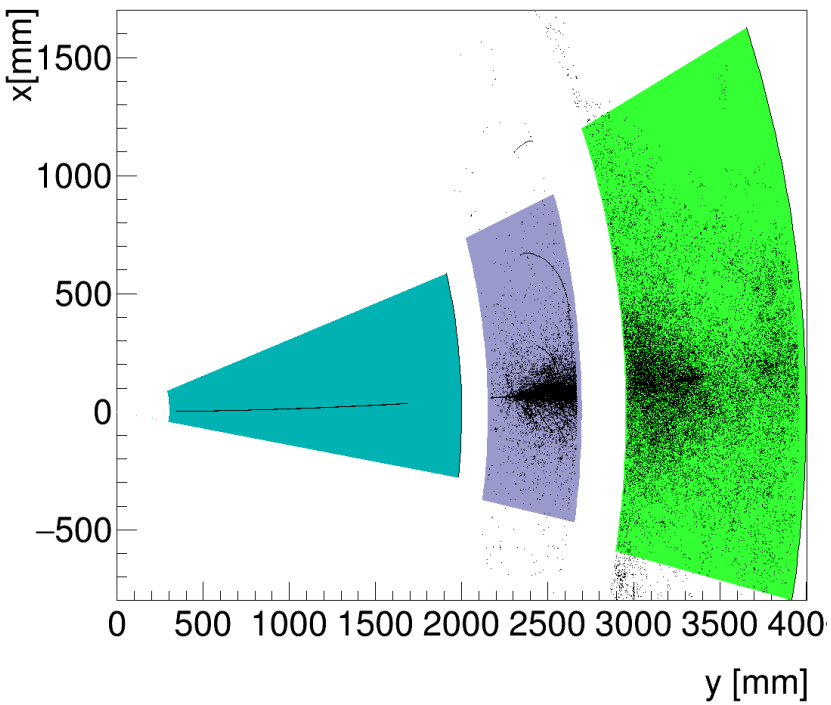
Event Displays

Simulated Energy Deposits in Drift Chamber and Calorimeters

24 Gev e^-

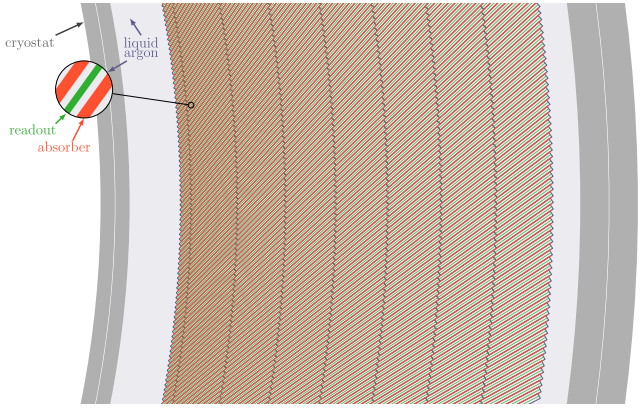


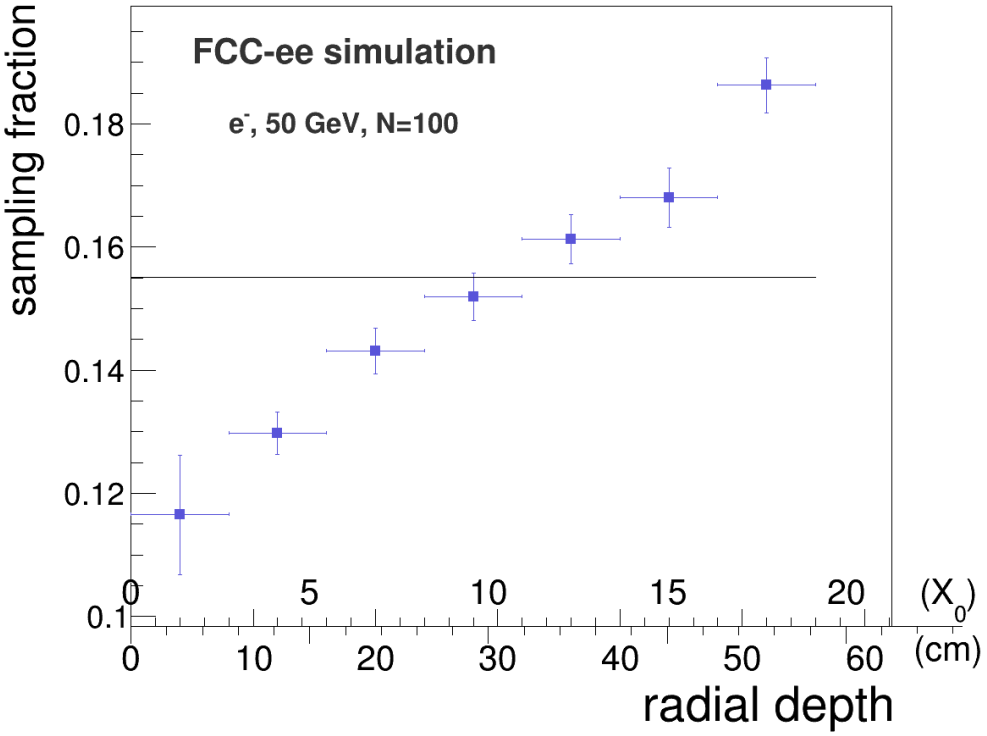
24 Gev π^-



Sampling Fraction (50 GeV e-)

- Sampling fractions for each layer obtained from Full Simulation



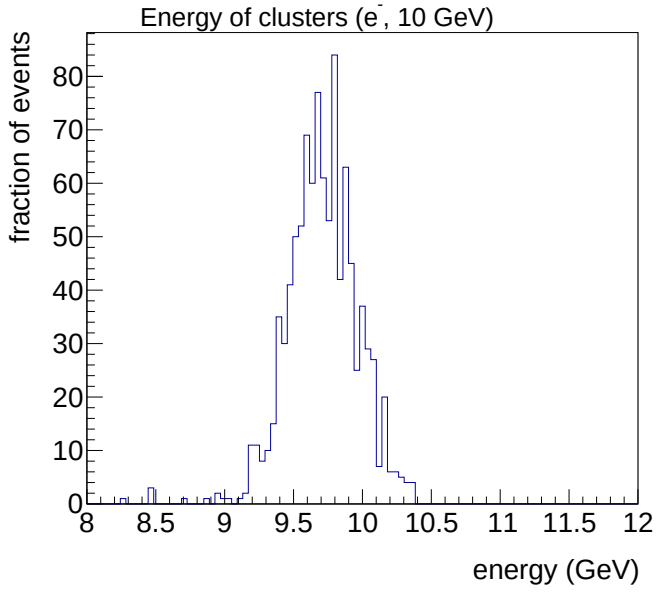


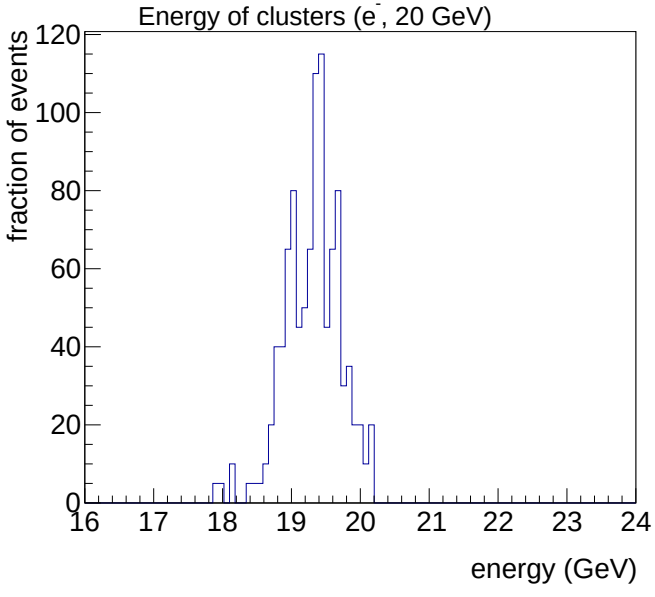
Thicknesses:

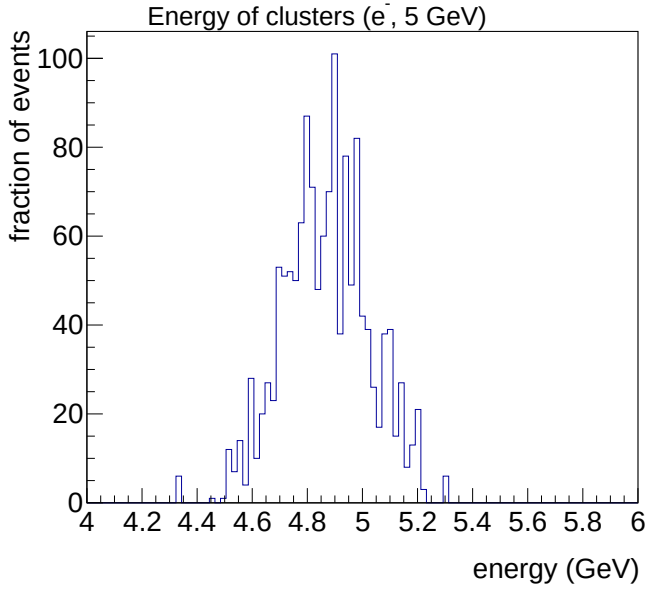
- LAr gap: 1.8 mm (inner radius) - 3.8 mm (outer radius)
- Pb absorber: 2mm
- read-out electrode PCB: 1.2mm

Energy Distributions

- Single e^-, reconstructed with Sliding Window Algorithm
- No correction yet for energy deposited in upstream material



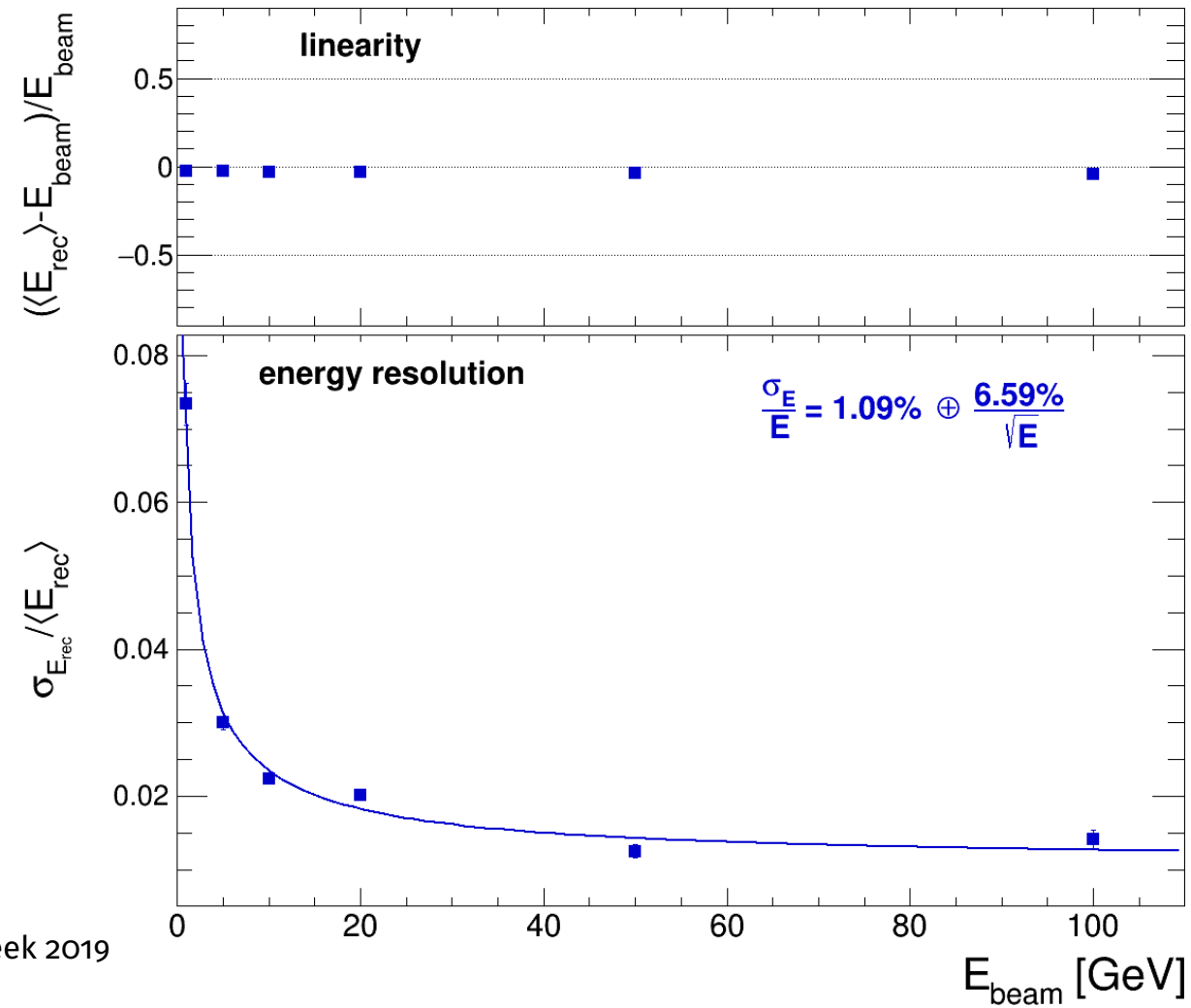




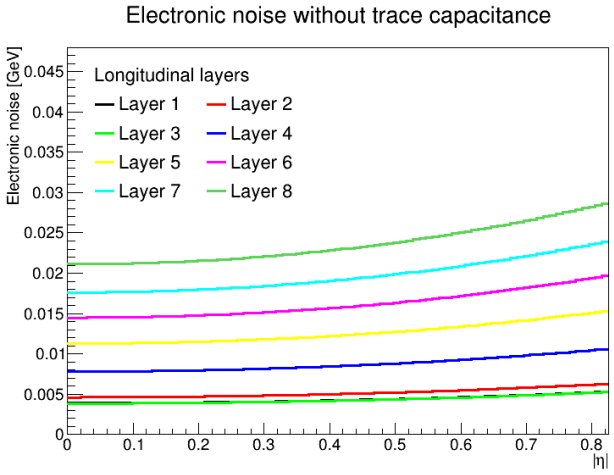
Energy resolution

FCC-ee Preliminary

- ECal single electron resolution
  - without noise or background
  - no magnetic field



Electronics Noise

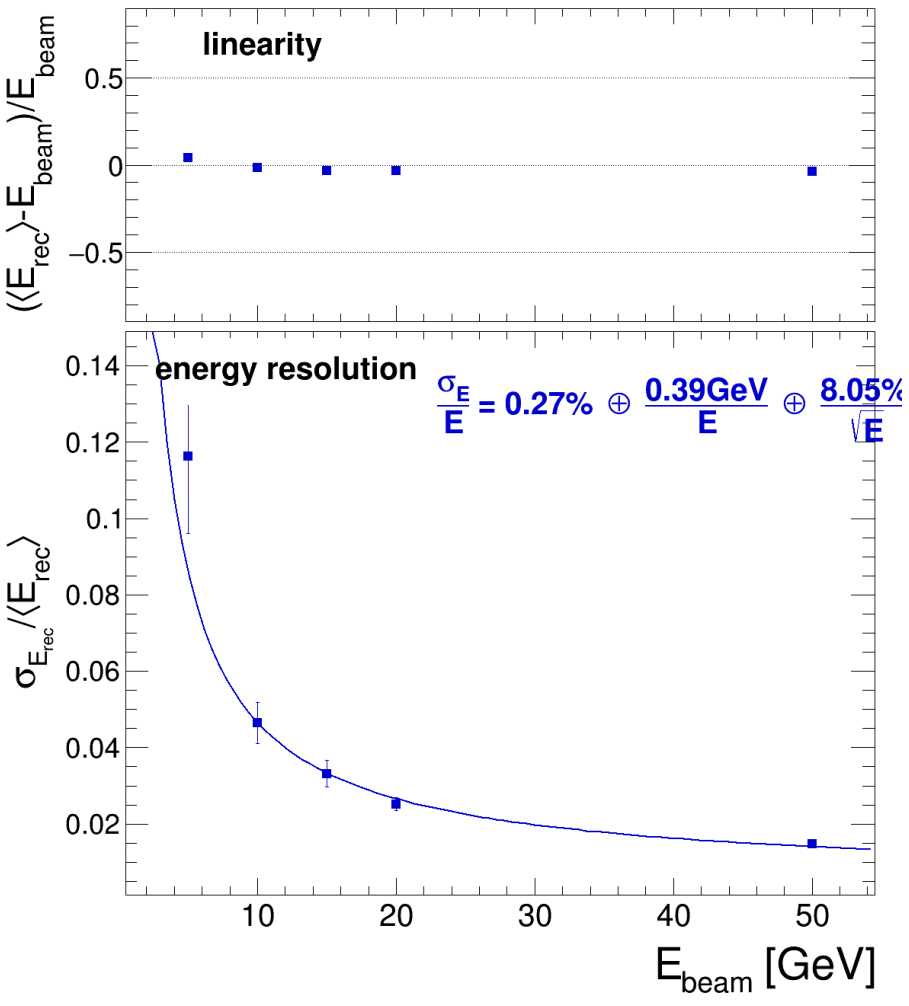


J. Faltova

- Noise term to be optimised
  - Sliding Window Cluster sizes taken from FCC-hh, need to be adapted

FCC-ee preliminary

- single electron energy resolution
  - with electronics noise
  - no backgounds
  - no magnetic field



Conclusion

- First Full Simulation Study of LAr Calorimetry for FCC-ee
- Variables still to be investigated:
  - other subdetectors
  - solenoid coil position
  - beam backgrounds
- Jet Reconstruction, Particle Flow studies still to be done