LAr calo project for FCC-ee

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Reaching 10× ATLAS granularity

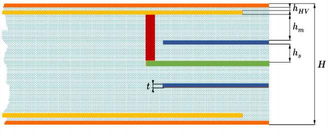
- 200000 cells → few million cells
- Readout in ATLAS uses simple copper/kapton electrodes
- Issue: traces to route signals to front or back of electrode take space !
- For 10× more granular: go to multilayer PCB to route signals in a deep layer

Basic design

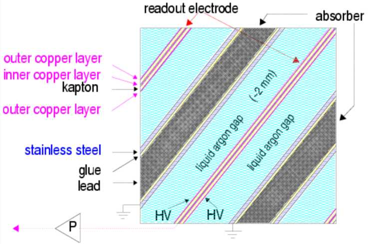
- Cannot use accordion shape for PCBs

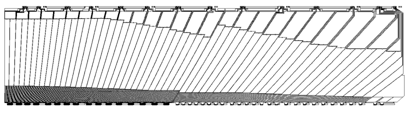
⇒ Straight planes inclined around the barrel

- Simulation in a specific IDEA-LAr setup



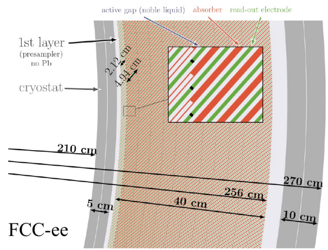
Side view

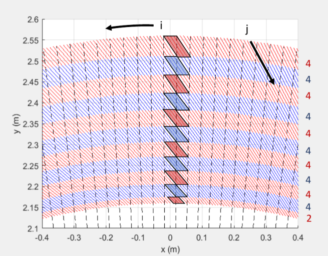




Design of ATLAS electrodes

- Enveloppe from IDEA tracker
- Aim for 20–22 X^0
- Initial proposal: 1536 electrodes around ϕ
  - 2 mm Pb absorber, 1.2 mm PCB, 2 $\times$ 1.24 mm LAr. Sampling fraction $\sim$ 20%
  - Angle 50^o
- Segmentation in θ: $\Delta\theta \sim 0.56^o$
- 11 segments in depth, first one without any Pb (presampler)
  - Projective cells in θ and ϕ
- All parameters still subject to optimisation





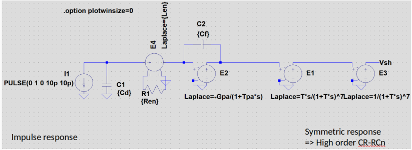
Parallelepipedic cells in $r - \phi$

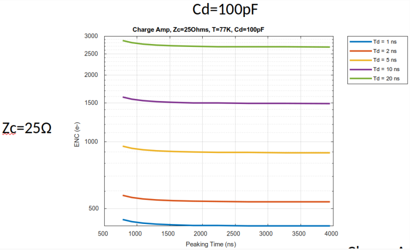
Cold or Warm ?

- Low radiation levels allow to put frontend electronics inside cryostat
- Big advantages
  - Lower noise, higher signal from low T
  - Lower noise from shorter transmission lines
  - Simpler feedthroughs
- Some concerns
  - Reliability
  - Heat dissipation in LAr

Ongoing studies

- Basic simulations are already good enough
- Understand impact of transmission cables
- Understand impact of type of preamp (charge vs current) on noise
- Understand impact of shaping times
- Can compare for instance with BNL preamp for Dune





Necessary R&D

Some items can be blockers to be able to build such a calorimeter

- Thin cryostats: R&D ongoing at CERN
- High density feedthrough: R&D ongoing at CERN
- Cold electronics (IJCLab, Omega)
  - Challenging but very interesting project
- PCB electrodes (CERN and IJCLab)
  - Will define the maximum granularity achievable
- No thoughts put into mechanics yet
- Design of endcaps missing

Physics performance

- Simulation and integration into FCC software (CERN, Prague)
- Electroweak physics performance vs detector geometry, choice of absorber (Edinburgh)
- Tau physics studies and π^0/γ identification (Copenhagen)
- A lot of work to do on these simulation / performance aspects
  - In particular, interesting work to do on the reconstruction / clustering
  - See what we can achieve in terms of jet energy resolution, e/γ identification, in the full energy range, and in the context of a global PFlow reconstruction !

Very open to new contributions !