FCC EMCAL Simulation Plans

Summary of SW Discussions on Nov. 25

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after discussions with

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Some Thoughts on EMCAL for FCC

Barrel (|η|<1.5): EMCAL space:

- R=2.5m to R= 3.6m → ΔR=1.1m

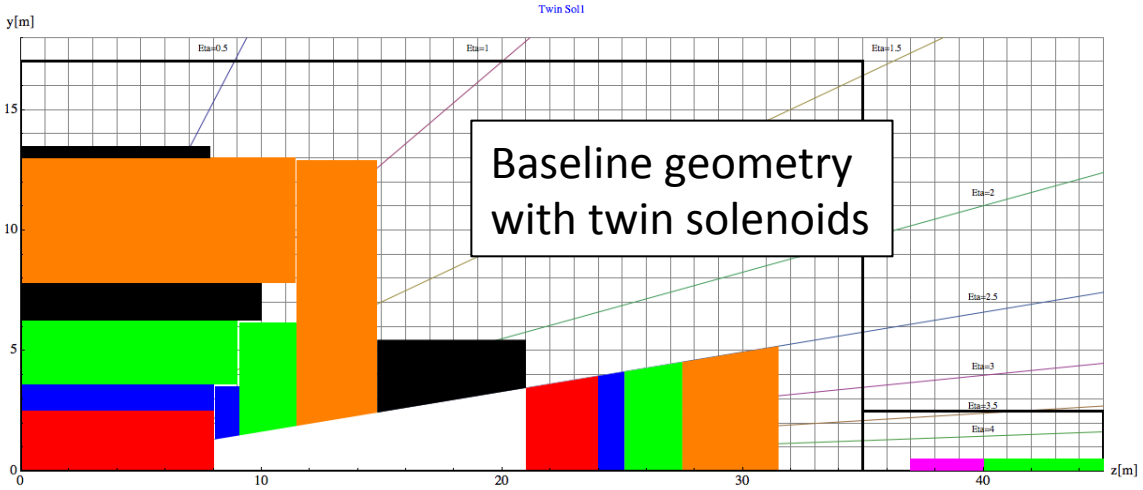
EndCap (1.5<|η|<2.5): EMCAL space:

- z=8m to z= 9.1m → Δz=1.1m

Forward (|η|>2.5): EMCAL space:

- z=24m to z= 25.1m → Δz=1.1m

"Precision" region up to p_T of ≈100GeV and up to |η|≈4 (to be closer defined by physics requirements)



Some introductory thoughts

- EM energy measurement will not be able to rely on the EMCAL only, but will need to heavily rely on tracker measurement as well (of course the jet and E_T^{miss} measurement even more so)
  - High magnetic field and large radius: Bremsstrahlungs photons will end up far away from electron (i.e. will mostly not be contained in the same cluster, e.g. distance of e^- and brem γ is up to ~30cm for 20GeV e^-), similar problem for photon conversions
  - High pile-up: pile-up rejection (e.g. for isolation requirement for EM objects) will also need to rely on tracker information
- → EM energy measurement in FCC will consist in an intelligent combination between tracker measurement and EMCAL measurement
- Track-cluster matching is essential to achieve the above → rather fine (lateral) granularity and position resolution

Plans for EMCAL Software

- Fellow will start on Feb. 2016 + interested people helping
- Start with implementing simple ECAL geometry (barrel) in GEANT4 (sensitive volume information, i.e. including cell boundaries)
- Put GEANT4 model into GAUDI module (preferably via gdml)
- For the cell out-put use official I/O (Benedikt Hegner's event data model)
- In parallel continue developing DD4HEP and integration of EMCAL into DD4HEP.
- Working towards full mock-up

Plans for the next months (preliminary)

- Implement simple geometry into GEANT4 within FCCSW
  - Start standalone: Implement sampling calorimeter, stack of absorbers (e.g. Pb, W) and active material (e.g. LAr, Kr, Si).
    - Energy measurement based on truth energy deposit in active material, (no digitization, no reconstruction, like for HCAL)
    - Validation by comparing obtained performance for single particles to known calorimeter (e.g. ATLAS LAr)
  - Combine with HCAL GEANT4 model – validation
  - Combined studies possible in GAUDI framework
    - Validate EDM, need magnetic field map(!), approx. material of Inner Tracker, approx. material of cryostats (for the case of LAr/Kr).
  - Eventually implement this simple calorimeter into DD4HEP inside baseline FCC detector geometry (towards full mock-up detector)
- Studies:
  - transverse granularity, Pb vs W, position resolution, track matching, π_0 rejection, particle ID (e/γ – jet distinction).
  - sampling fraction (LAr/Kr/Si and Pb/W), EM energy resolution, linearity (important to extrapolate energy scale from Z-peak or use E/p), longitudinal segmentation
  - EM energy resolution with strong magnetic field (Bremsstrahlung!), photon conversions.
  - Jet performance
  - Pile-up ….