FCC-hh HCAL software goals

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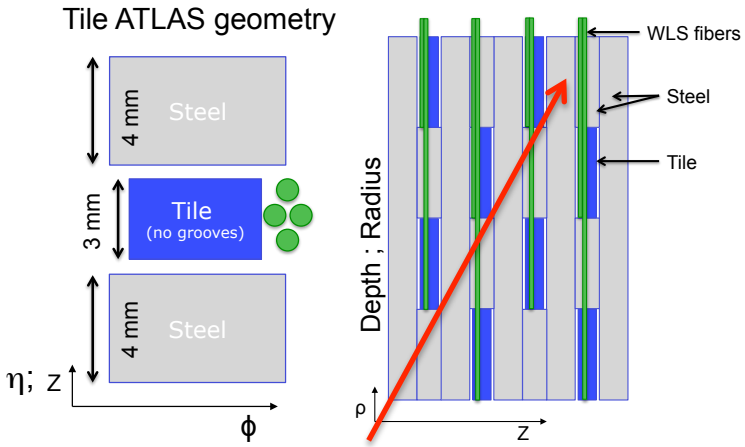
(thanks for Clement Helsens, Carlos Solans input)

FCC-hh HCAL software goals

- Follow the FCC-hh SW recommendations (short term)
  - DD4Hep for the detector description
  - Gaudi modules for the simulation jobs
  - Podio for event data model / analysis interface
- Aim for FCC week in April 2016
  - Implement stand-alone simulation (that already exists)
  - Repeat single particle performance studies (e, π,…)
  - Converge on jet performance studies
- Longer term
  - Contribute to global detector description in parametric Geant4

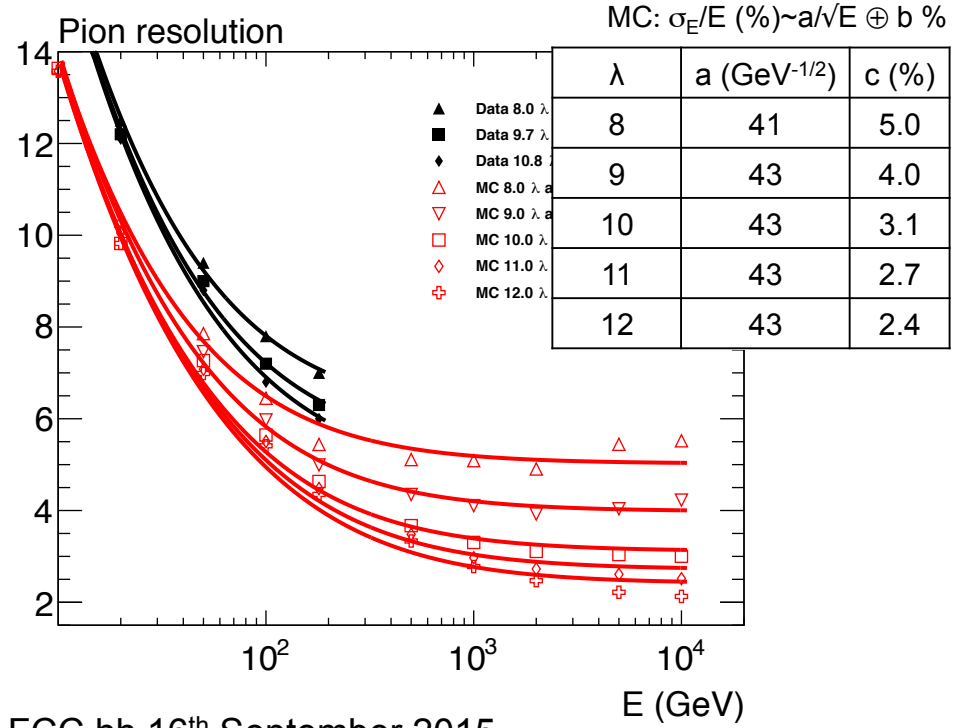


Challenges/needed actions

- Implementation for the central barrel HCAL is basically settled
  - ATLAS-Tilecal based with better η,ϕ,depth granularity; 10λ active cells (assuming 2λ in the emcalo+tracker). **Can extend to extended barrel (if R_{in} is kept constant and end-cap ? (radiation levels considerations)**
- No ongoing efforts for the end-cap and forwards detectors (yet…)
  - More complex (radiation levels and pile-up). Not clear what the best technology choices are (Lar; Si/W;…). **For simplicity could implement Lar as in the em calo as a starting point?**
- Need software, detector and physics inputs/experts to start/continue the development
- Detector calibration
- Jet reconstruction and resolution in extremely high pileup
- Jet reconstruction in forward regions
- Jet substructure
- Low pT jet reconstruction with high B
- Include particle flow calibration
- **New fellow neeed….**

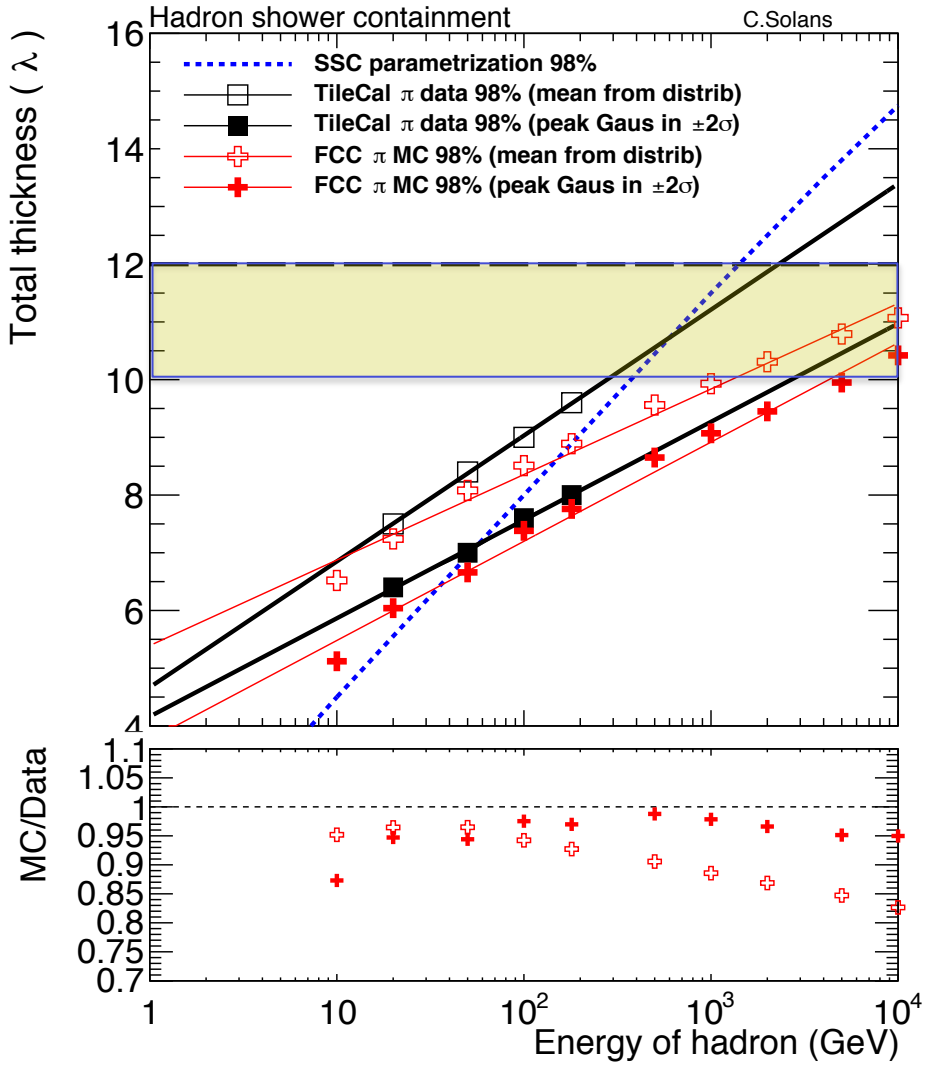
Stand-alone simulation

- Geant4 + Tile ATLAS model for single hadron and jet simulation
- Focused on calo depth; σ_E/E
  - ~12 λ for few TeV single hadron
  - Jet simulations to be concluded



MC: σ_E/E (%)~a/√E ⊕ b %

λ	a (GeV$^{-1/2}$)	c (%)
8	41	5.0
9	43	4.0
10	43	3.1
11	43	2.7
12	43	2.4

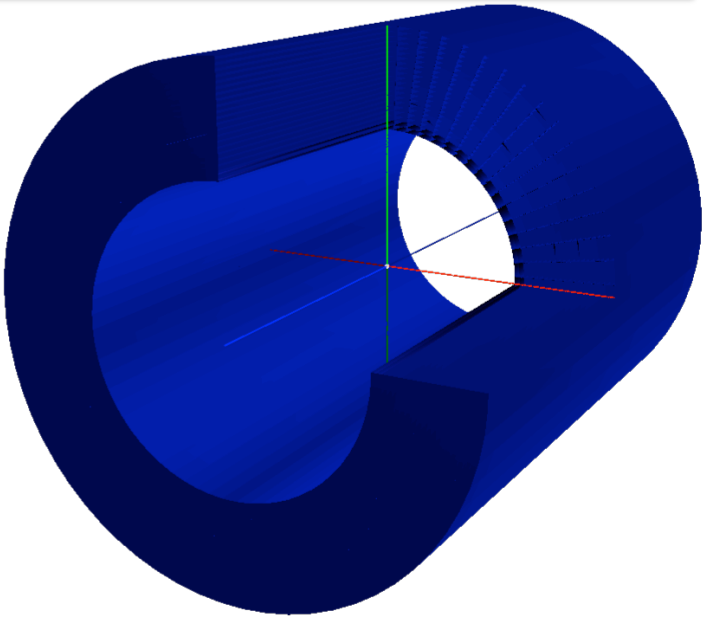


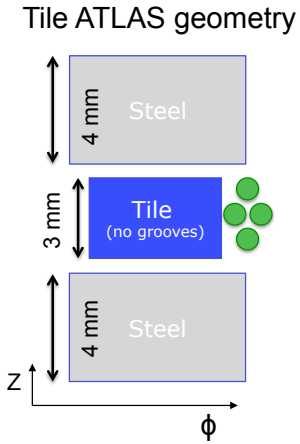
FCC hh 16th September 2015
https://indico.cern.ch/event/443015/

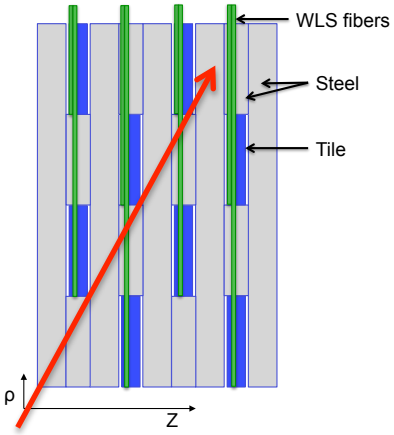
Simulation ~ compatible with ATLAS test-beam

A tile scintillating sampling calorimeter for FCC-hh

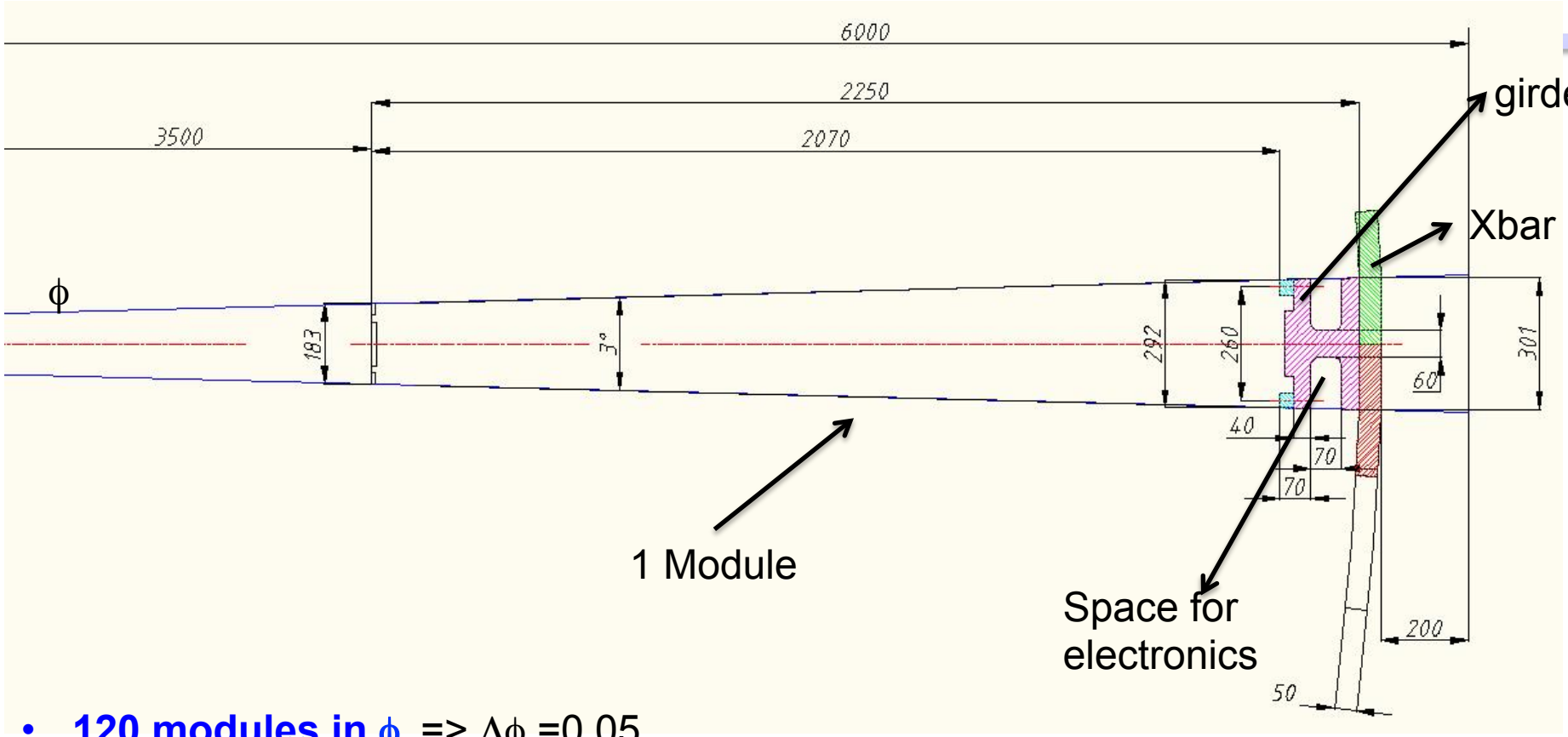
- Simulated a tile scintillating sampling calorimeter made with plates perpendicular to the beam pipe (inspired in TileCal)
  - Iron master plates Δz = 5 mm
  - Iron spacer plates Δz = 4 mm
  - Scintillating tiles Δz = 3 mm
  - Air gap Δz = 0.5 mm
  - Sampling period 18 mm
  - Sampling ratio 4.6/1
- Double azimuthal granularity (Δϕ) wrt ATLAS
  - 128 **(-> 120)** wedges in ϕ: Δϕ = 0.05
  - Same size of tiles as in ATLAS due to larger distance from i.p. $\Delta\phi' = \Delta\phi \frac{r}{r'}$
- Radial depth of 15 λ to fully contain multi-TeV particle showers **(→10λ in global detector)**
  - 30 layers in ρ: Δρ = 10 cm
- Run simulation with cylindrical configuration
  - Two alternating patterns along depth (ρ)







FCC Tile Had. Calo module Dimensions (version 120 modules in a cylinder)



- **120 modules in ϕ** => Δϕ =0.05
- **Rmin=3.5m** (OR 3.4m IF em calo+tracker <2λ). Need to keep 12λ in total…
- **Rout =5.8m** (with supports and Xbars). Need 20cm for supports/rails at least…
- Depth active cells = 207 cm = 10λ (;1λ=20.7cm).
- **Depth Outer Supports=20cm** (15cm girder+5cm Xbars)