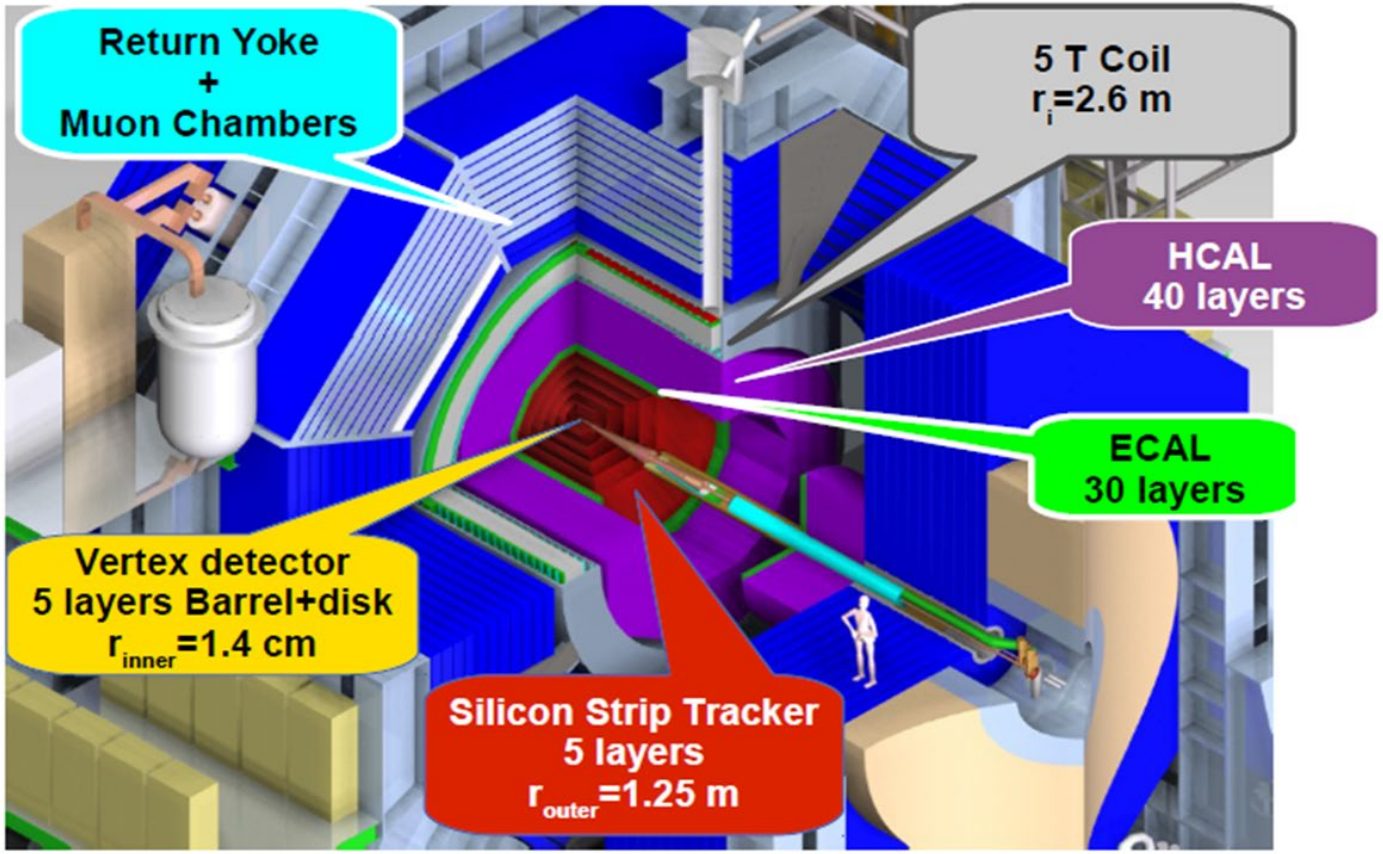
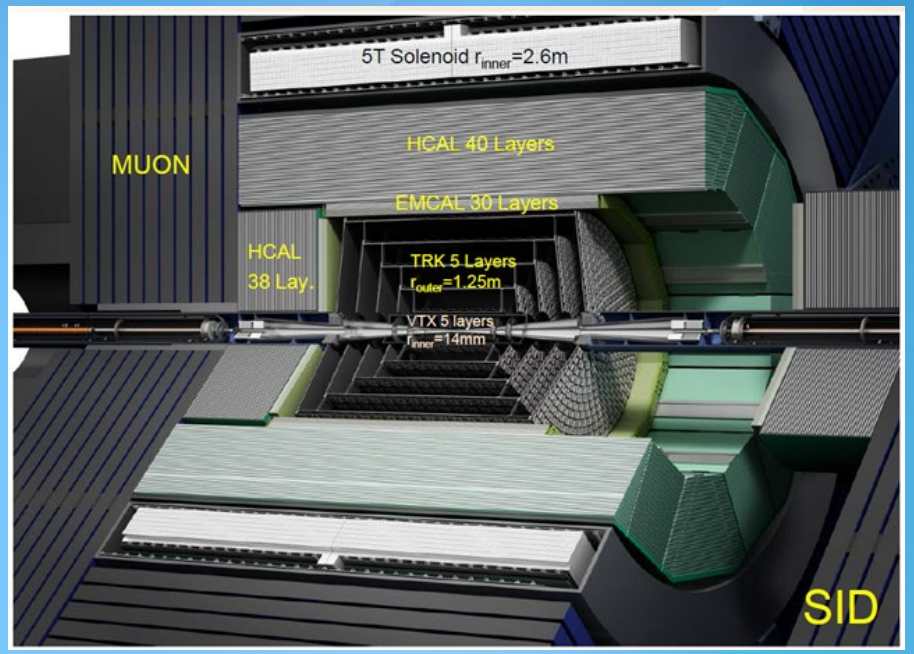
SiD Hadron Calorimeter

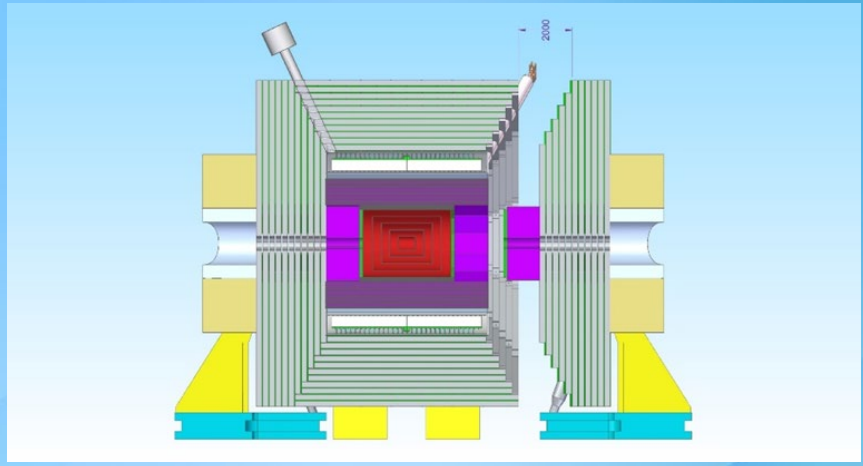
Andy White, Andrew Myers

UNIVERSITY OF TEXAS ARLINGTON

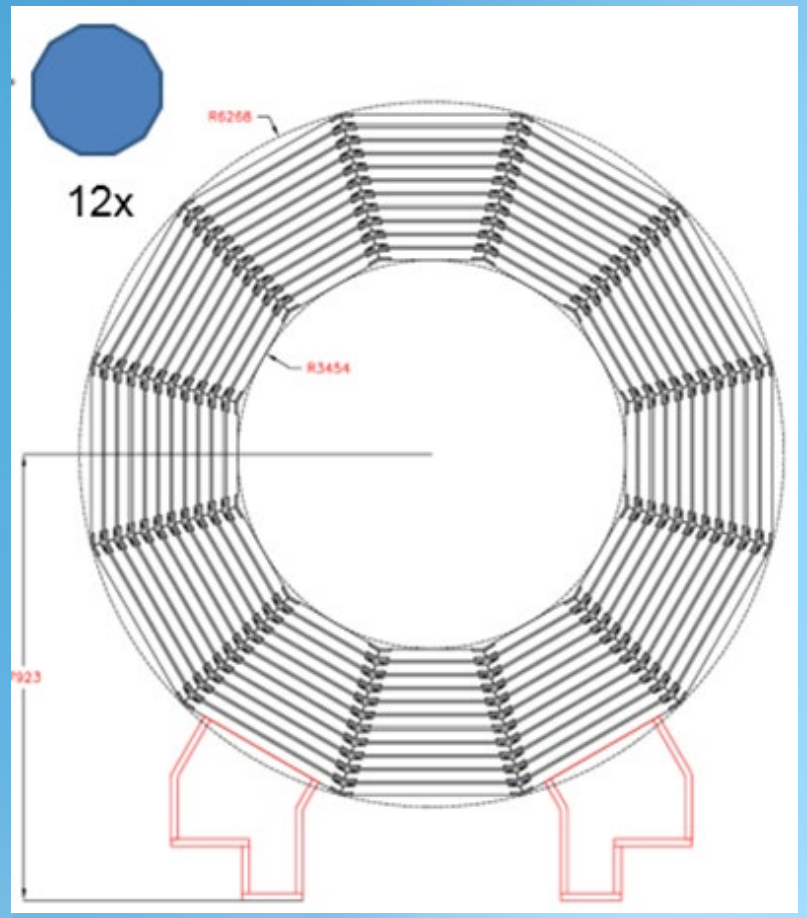
SiD Detector Baseline

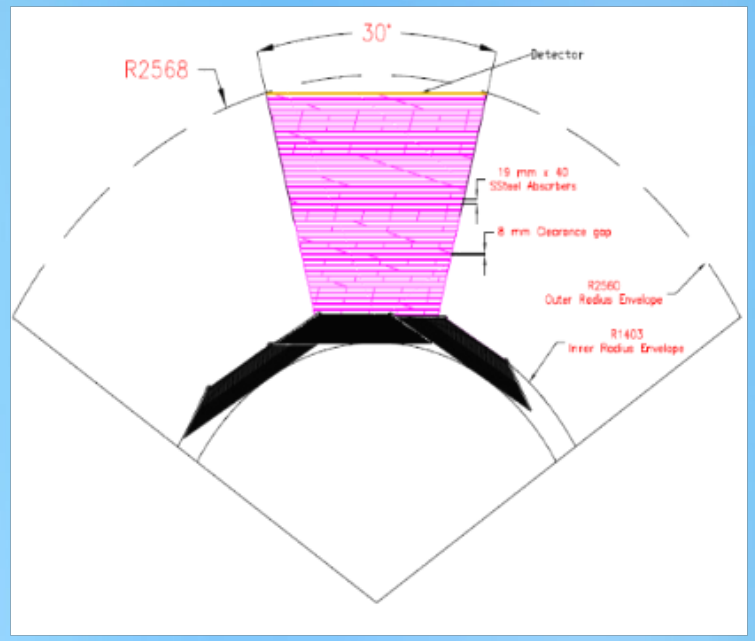




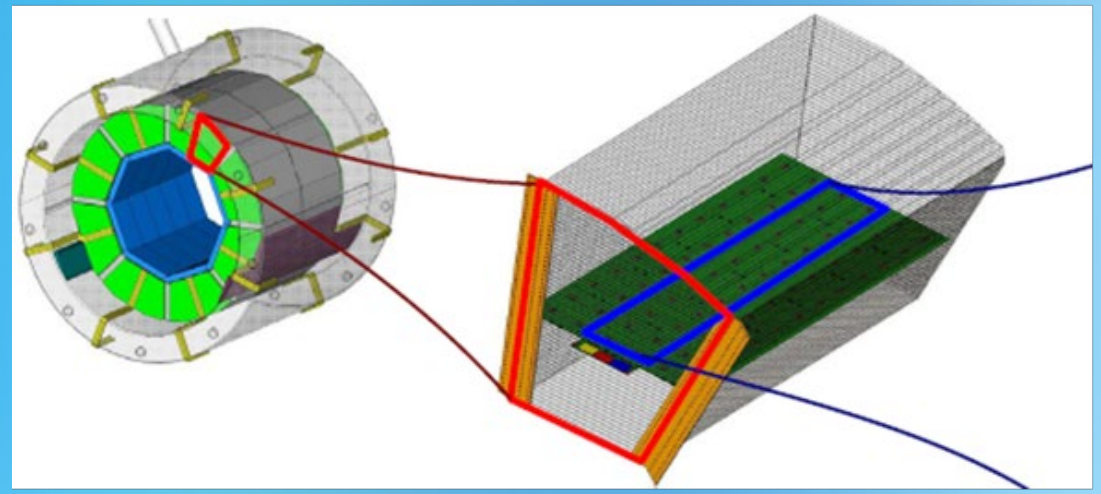


SiD Hadron Calorimeter

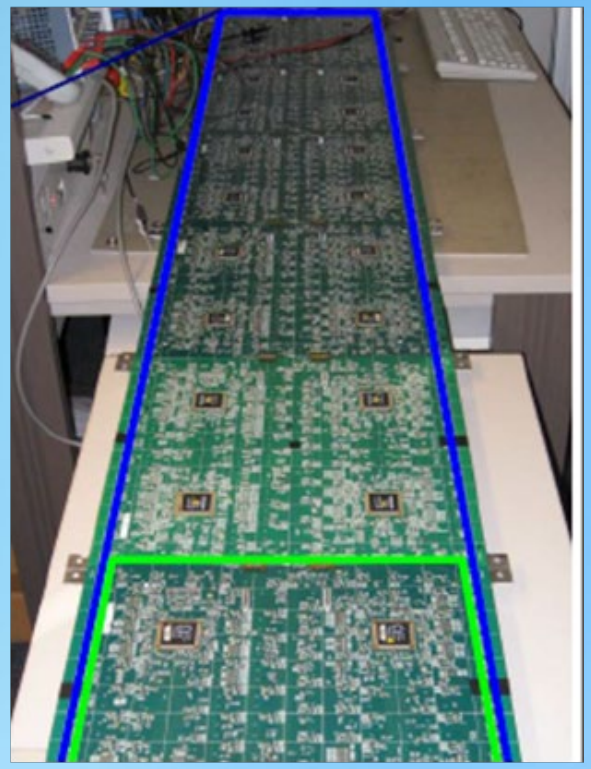


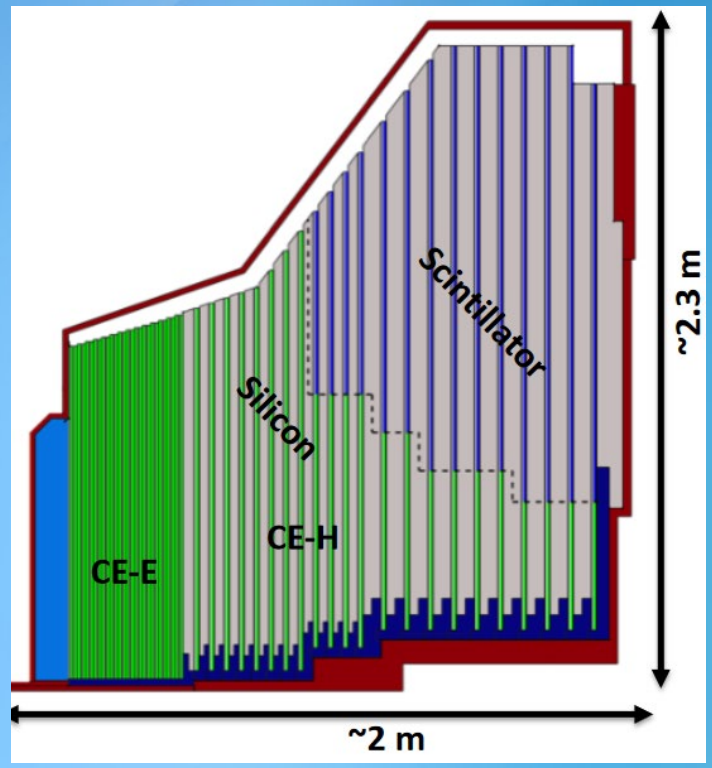


SiD Hadron Calorimeter



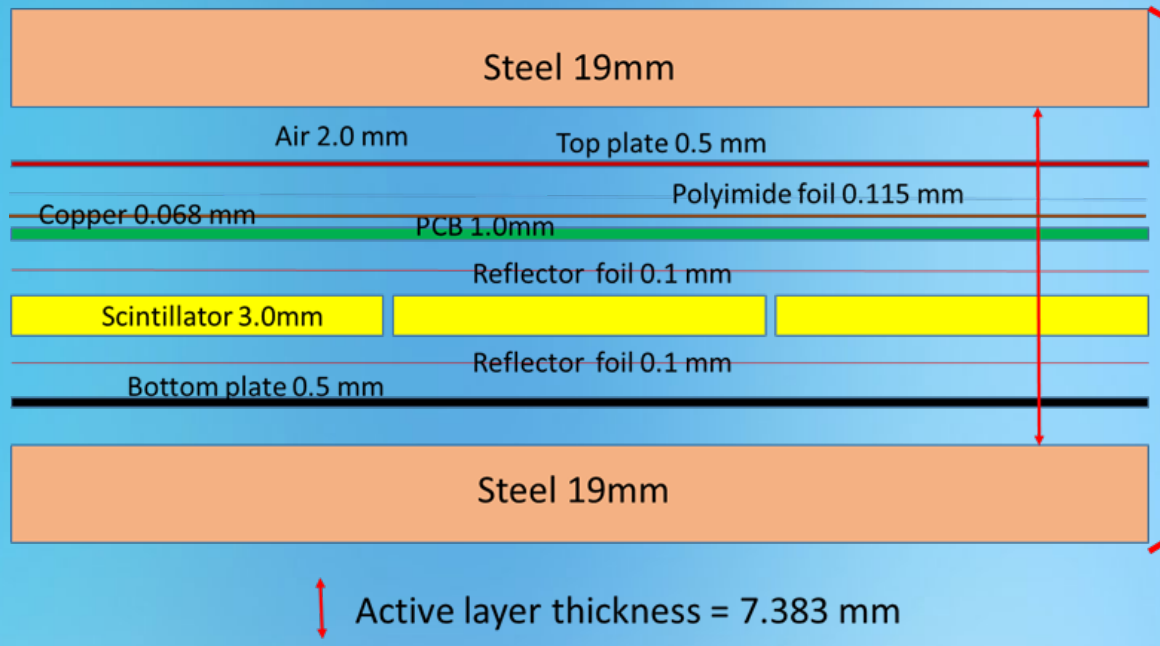
CALICE design





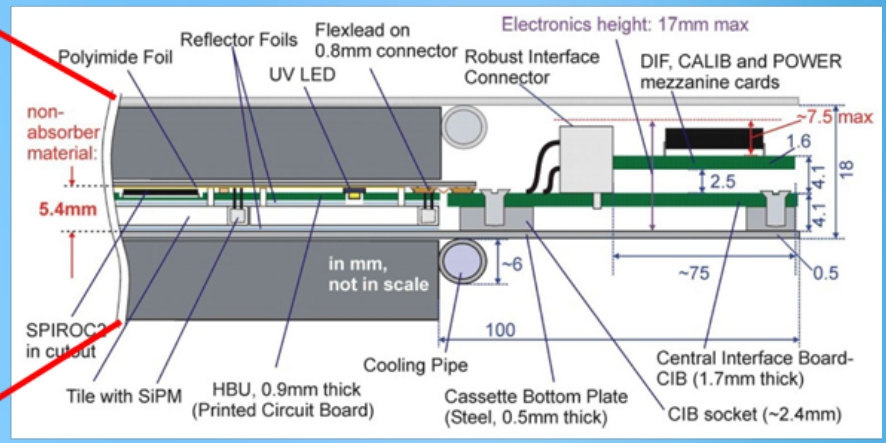
Similarities with CMS HGCAL

SiD Hadron Calorimeter

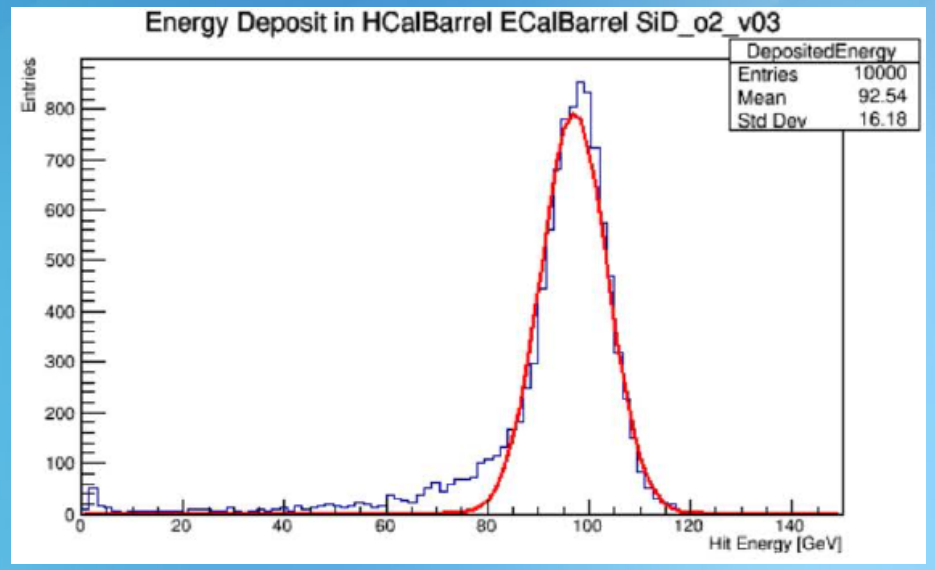


Active layer thickness = 7.383 mm

CALICE design



SiD Hadron Calorimeter

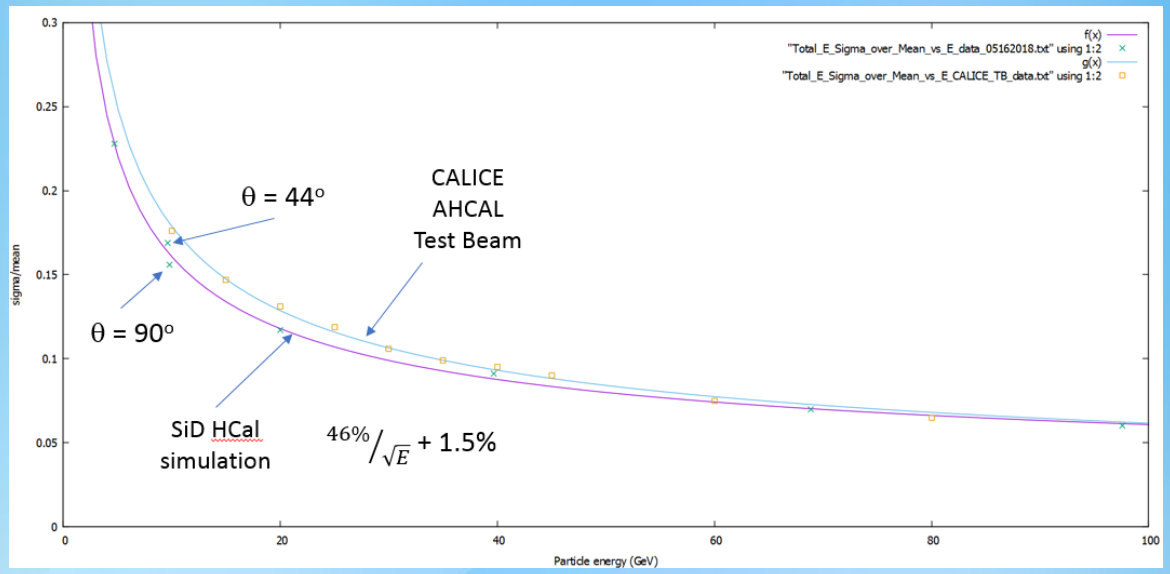


10,000 100 GeV charged pions

Sum of energies in the ECal + HCal.

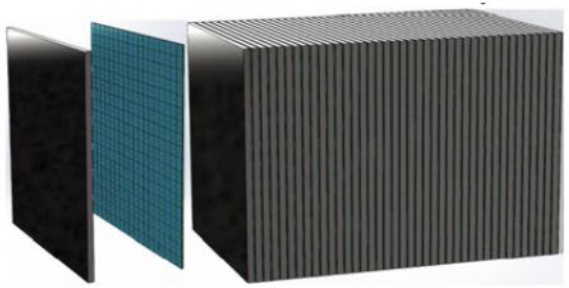
Checking new SiD simulation: compare simulated single particle energy resolution with actual CALICE test beam results

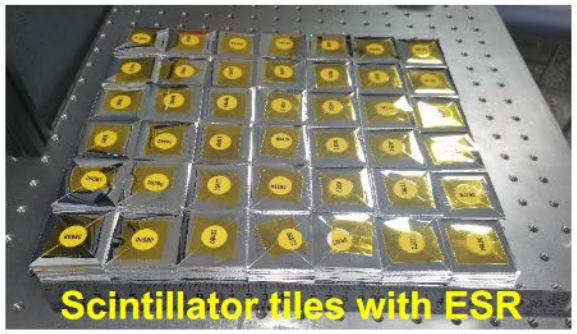
A. Myers, AW - UTA



CALICE Test Beam

Scintillator-iron HCAL prototype: recap



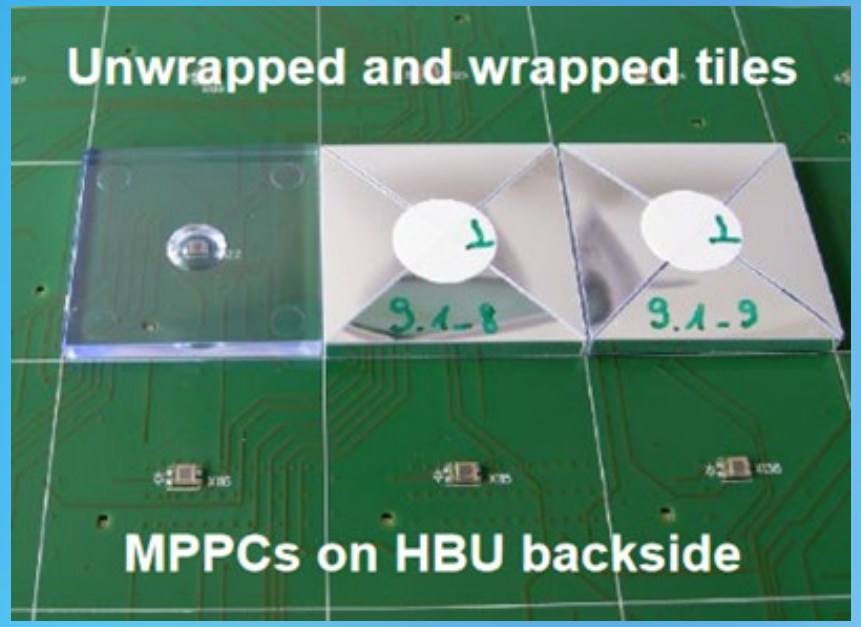


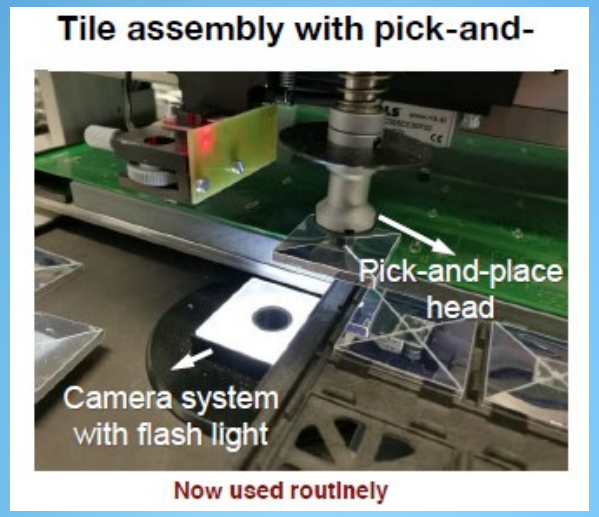
1 full layer: 3 HBUs + cassette

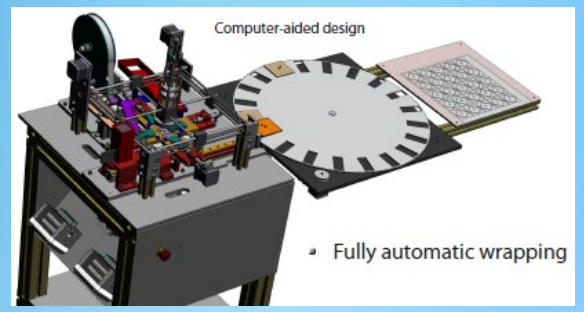
Mechanics Integration

- AHCAL prototype: "SiPM-on-Tile" design
  - Transverse size 72×72 cm^2, 40 longitudinal layers ($\sim4.6\lambda_I$)
  - 12960 readout channels, ~5 ton in weight
  - Developed during 2018 – 2022
  - HBU assembly and commissioning (cosmic muons) at USTC

SiD Hadron Calorimeter

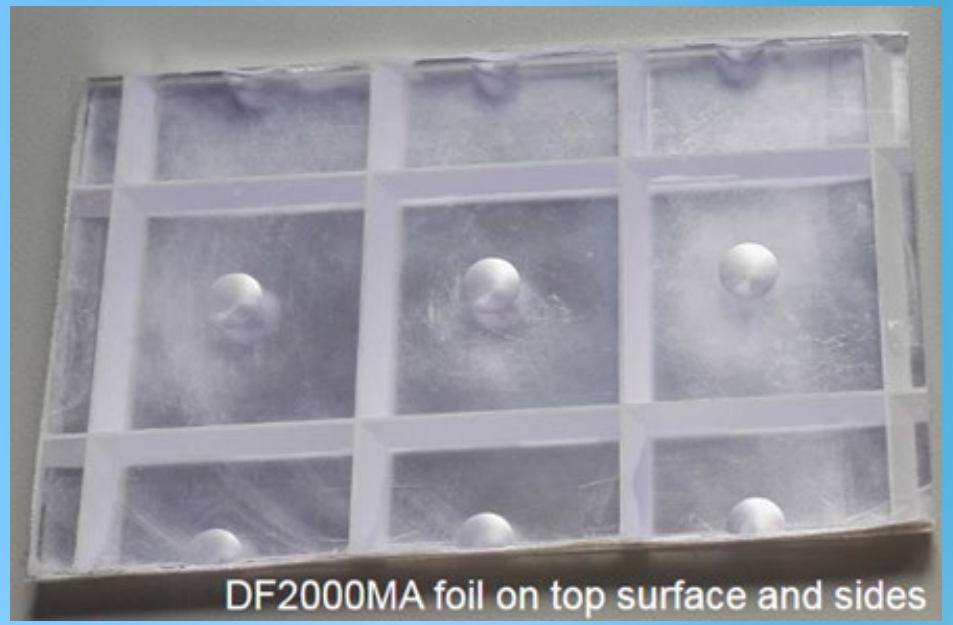






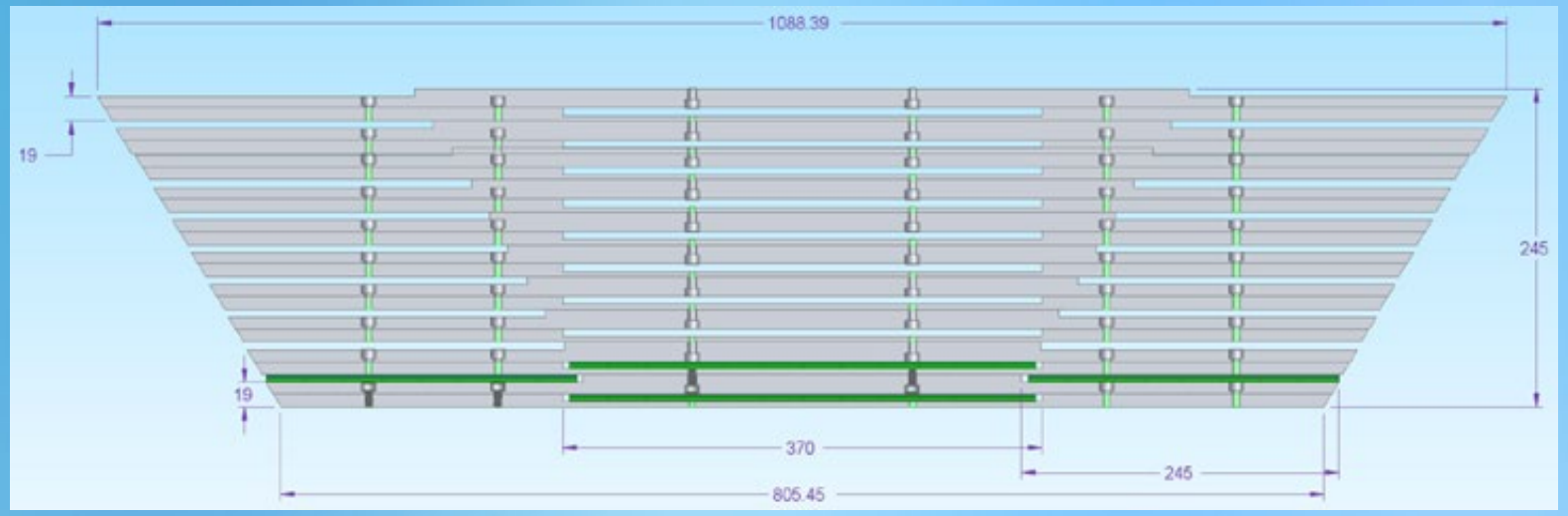
Robotic tile wrapping/placement

Alternative “megatile” approach

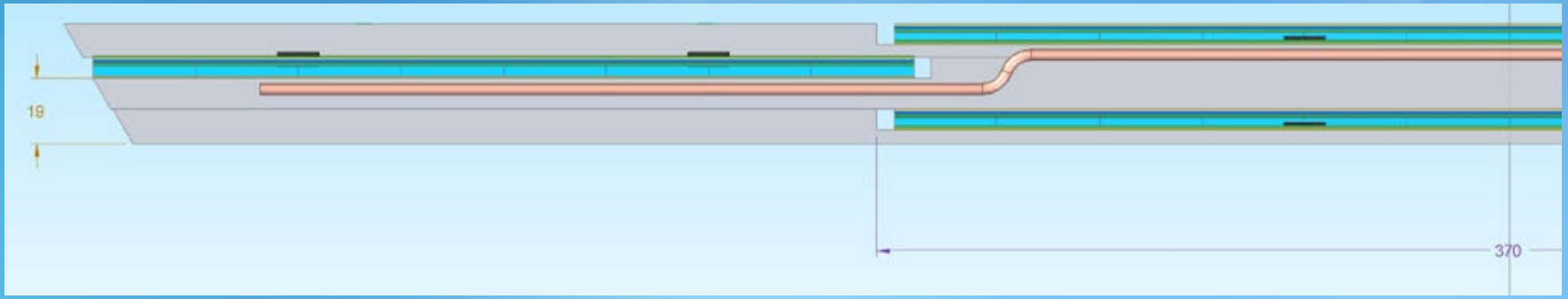


SiD Hadron Calorimeter

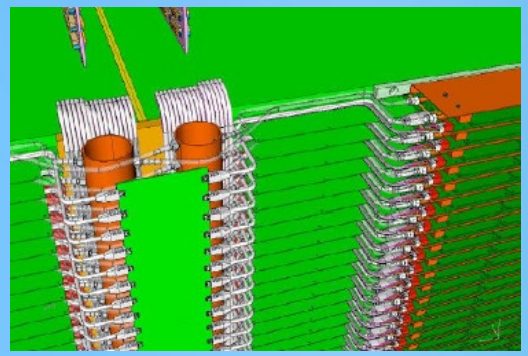
Initial mechanical design ideas – Marco Uriunno (SLAC)



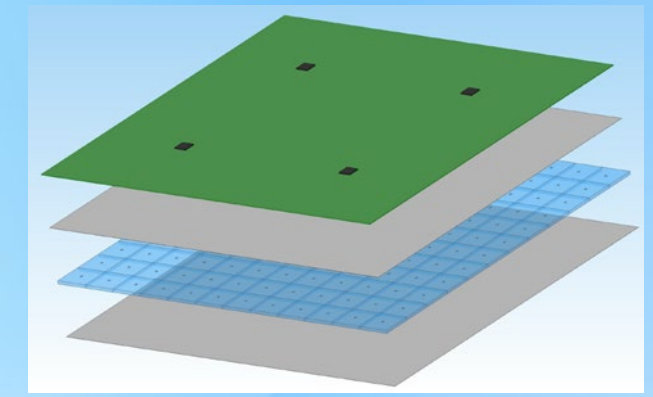
SiD Hadron Calorimeter



- Explored possible cooling schemes
- Heat load/extraction



Marco Uriunno (SLAC)

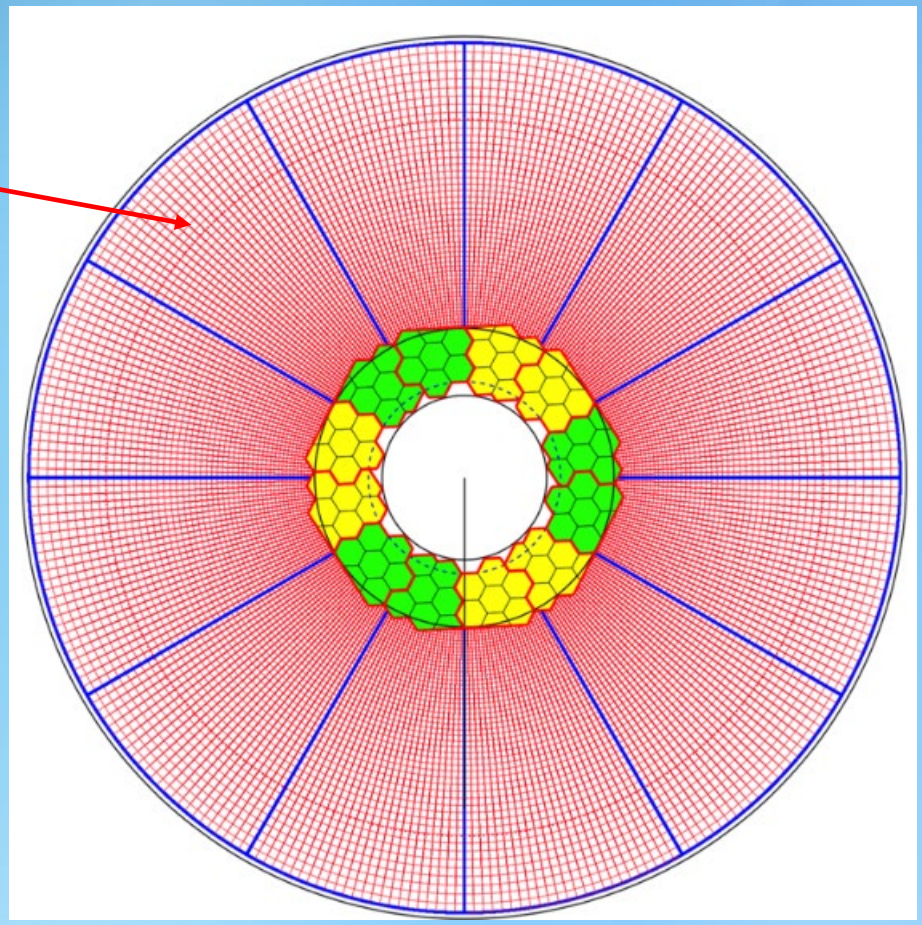


SiD Hadron Calorimeter Endcaps

Similar issues as for CMS HGCAL

- Tile shape(s)
- Tile sizes vs. radius
- Depth (for ECM to 1 TeV)
- Module size(s)
- Aim to minimize complexity

For ILC/C3/SiD there may be a rate issues in forward part of endcaps.



US LC/FCC group White Paper for P5

https://arxiv.org/abs/2306.13567

4.4. Optical Calorimeters: Scintillator tiles with SiPM Readout

- **Title:** Hadron Calorimeter Development
- **Description:** The hadron calorimeter is an essential component of the Particle Flow Algorithm approach to achieving the required jet energy resolution for e+e- physics goals. The hadron calorimeter technology must support individual charged particle tracking through the calorimeter, allow detailed imaging of energy depositions for track-shower association and separation of close-by showers, while providing good energy resolution for the direct measurement of the energies of neutral particles. Recently there has also been discussion of the benefits of providing precise timing in calorimeter layers to facilitate the separation of shower components.
- **Duration:**

  - FY24-26, Simulation and optimization of design, including timing
  - FY26-29, Specification of prototype layers, readout, services; beam tests of prototype
  - FY29-31, Mechanical and electrical design of barrel and endcap modules

  R&D Milestones:

  - FY26 - Completion of simulation studies, active layer specification
  - FY28 - Prototype assembled
  - FY29 - Prototype tested
  - FY31 - Barrel and end-cap module designs complete
- **Priority:** High
- **Justification:** The assembly and testing of a large prototype scintillator-based hadron calorimeter module by CALICE has provided many valuable results for hadron calorimetery at a linear collider detector. This technology is also being used for a major upgrade of the CMS end-cap calorimetry - the HGCAL. However, much R&D remains to be carried out in order to be able to specify the technical details for the use of this technology in an e+e- detector.
- **Institutes:** University of Texas at Arlington,Florida State University, Northern Illinois University, University of Maryland, University of Minnesota, SLAC.