UNIVERSITY OF TEXAS ARLINGTON

SLAC: SiD AHCAL

Status and Update

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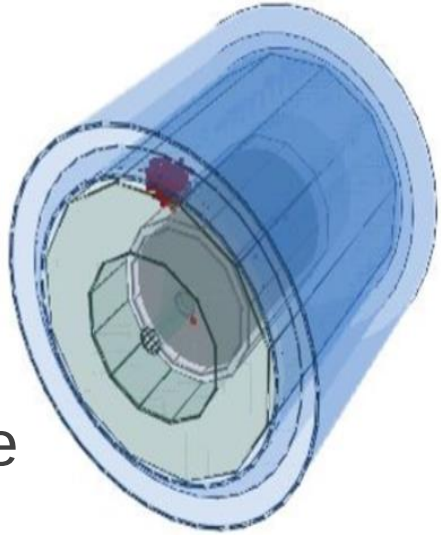
Introduction

- The University of Texas at Arlington has joined the SiD optimization in plans to design and calibrate the AHCal
- Initial calibration effort performed using single particle studies

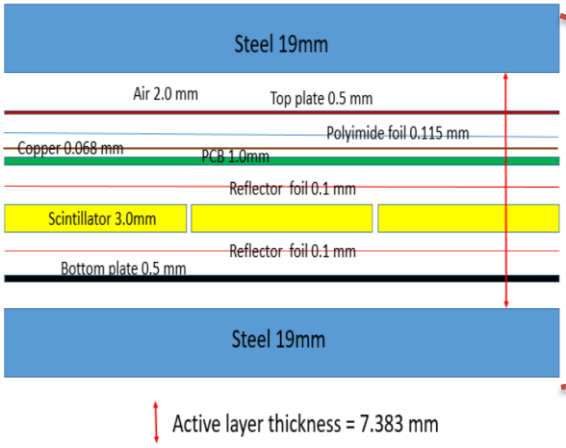


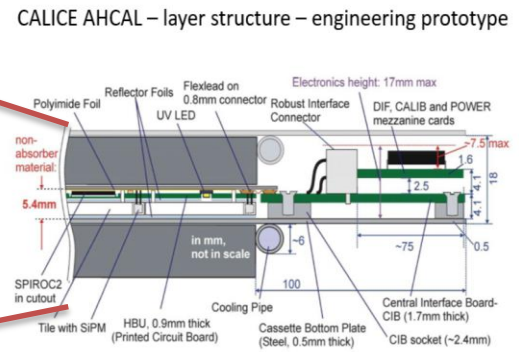
Graphic generated from ced2go event display

SiD AHCAL DD4HEP Migration

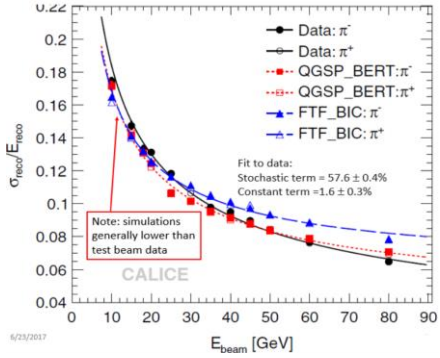
- Previous simulation and reconstruction process was based on ILCSoft with multiple tools needed for each step
- Many of these tools were outdated or no longer supported, necessitating move to new software
- DD4HEP offers simplified and standardized approach to simulation and reconstruction with fewer tools needed, reducing potential points of failure in software
- First AHCAL geometry in DD4HEP based on sidloi3 model, using RPC gas detectors in active layer, then redesigned to use scintillator
- Current AHCAL geometry (SiD_o2_v02) accurately reflects July 2016 engineering model, with active layer based on CALICE test beam design

Adapting AHCAL Design for SiD





(courtesy Oskar Hartbrich/DESY/CALICE)



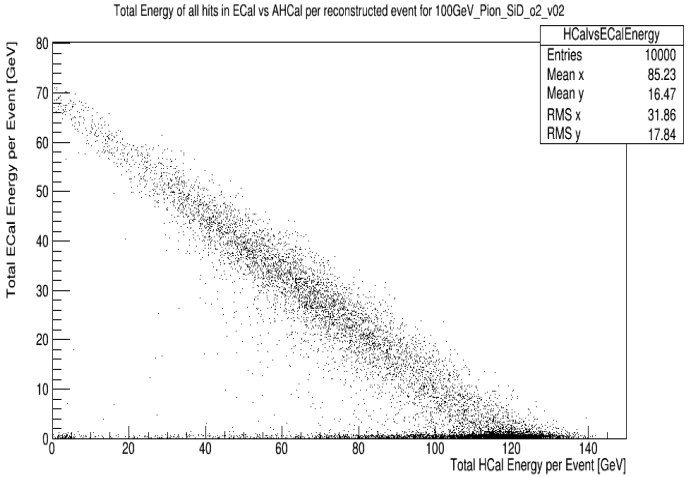
Initial goal: compare simulated single particle energy resolution with actual CALICE test beam results

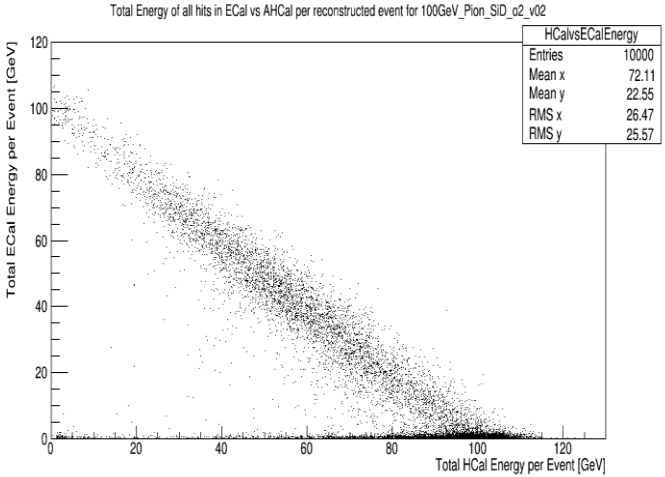
Data File Specifics

- Detector Version: SiD_o2_v02
- Physics list: FTFP_BERT
- Particles: Pions and Photons
- Sample Size: 10,000 events
- All events were run with full simulation and reconstruction process unless otherwise noted
- Analysis performed using C++, Python, and Modular Analysis and Reconstruction for the Linear Collider (MARLIN)

SiD AHCAL Calibration

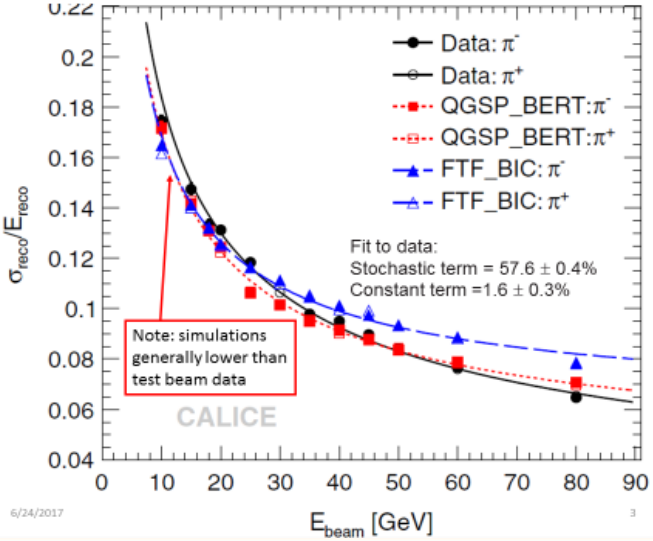
- Analysis of 5-100 GeV pion data post-reconstruction revealed existing calibration values for ECal and HCal were incorrect (Left image, only 100 GeV data shown)
- Manual adjustment of calibration factors (Right image) for ECal and HCal show good agreement with initial input particle energy

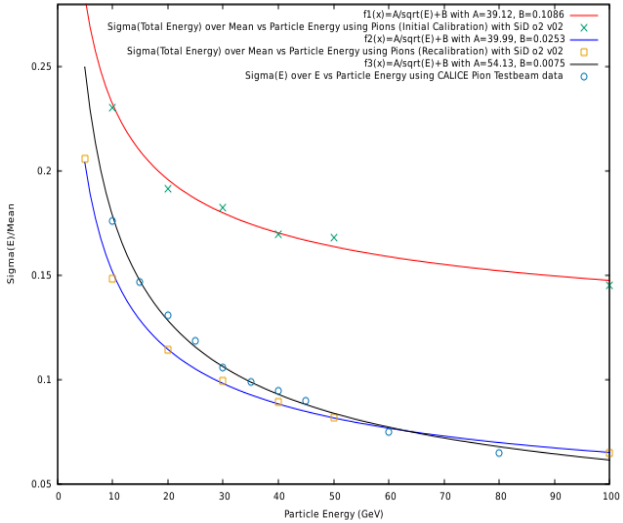




SiD AHCAL Calibration

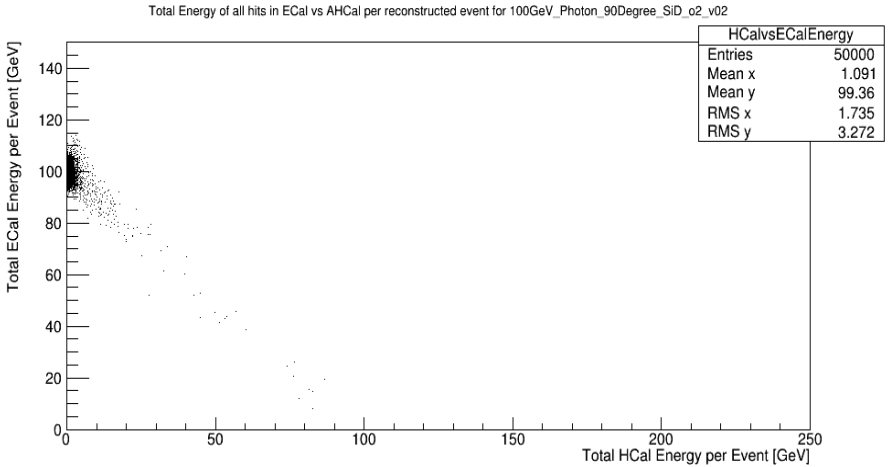
- After manual calibration, energy resolution shows better agreement with CALICE Pion test beam results
- As expected, results from simulation are lower than actual test beam data



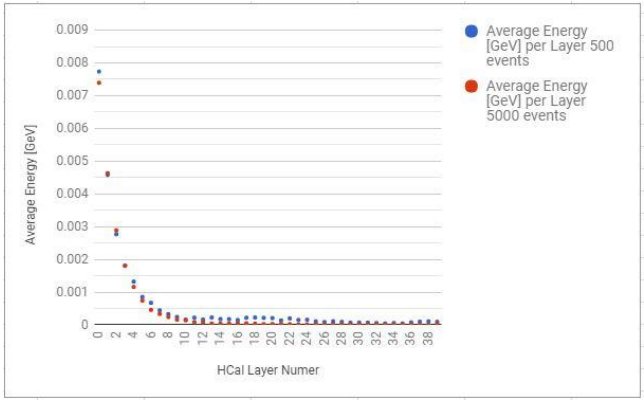


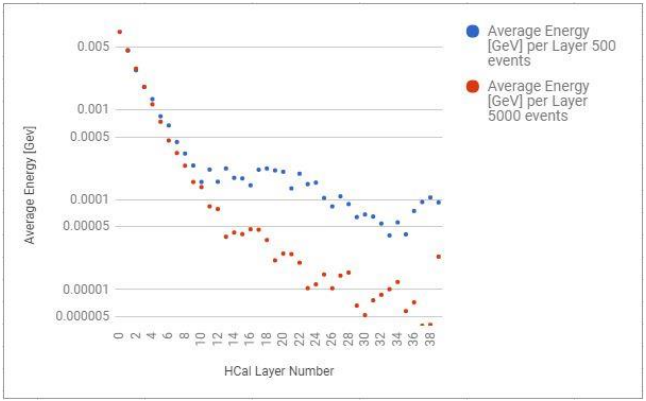
SiD AHCAL Calibration

- Initial attempt at manual recalibration for ECal and AHCal shows good results, however, further research is needed into effects of electromagnetic component of energy deposition
- More sophisticated calibration software development needed
- Current studies are ongoing into measuring leakage from EM showers inside ECal and comparing with expected energy deposition in AHCal



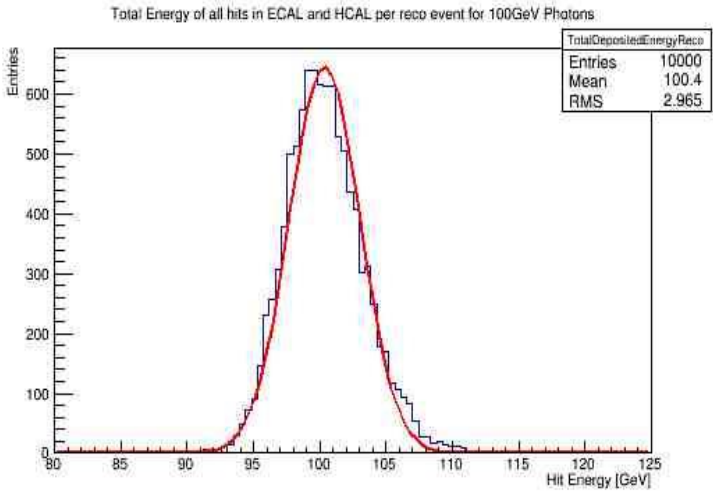
SiD AHCAL Calibration

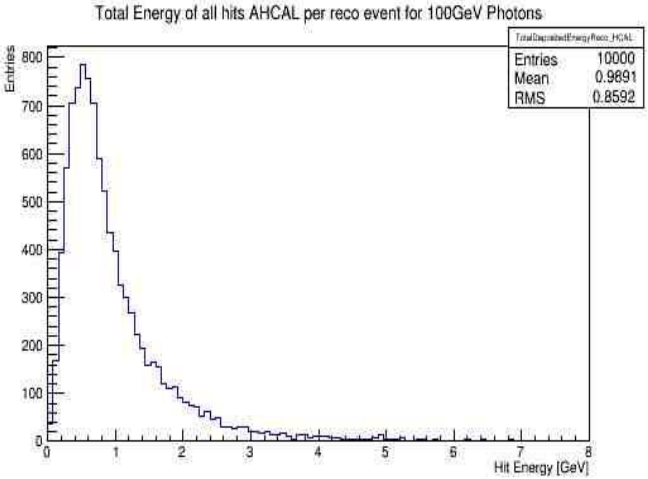




- Above photon data courtesy of A. Steinhebel (U.Oregon)
- Plots are pre-reconstruction

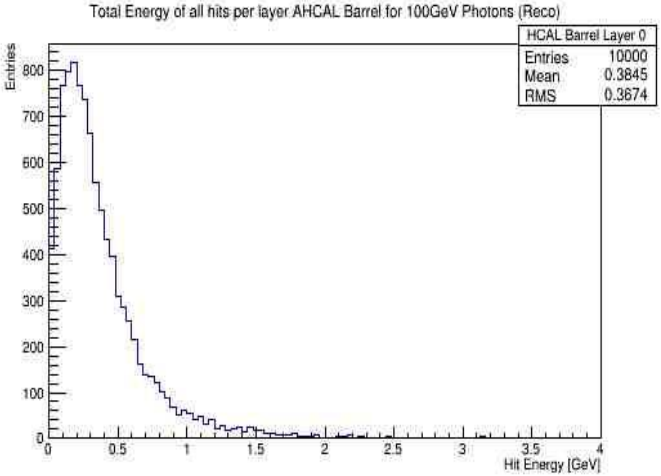
SiD AHCAL Calibration

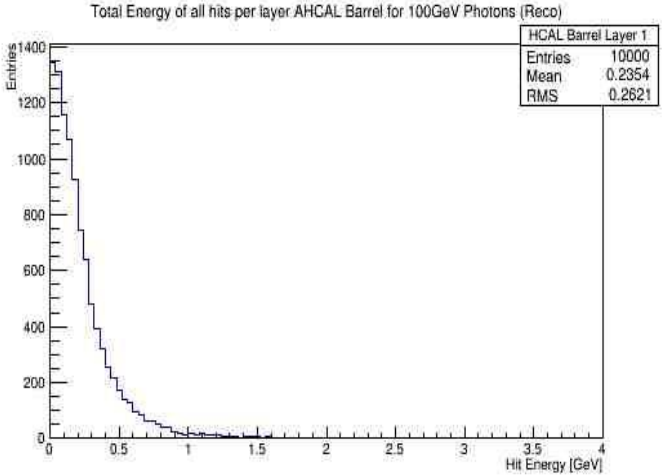




- Results generated using UTA's manual calibration factors
- We observe approximately 1% leakage from ECal into AHCal

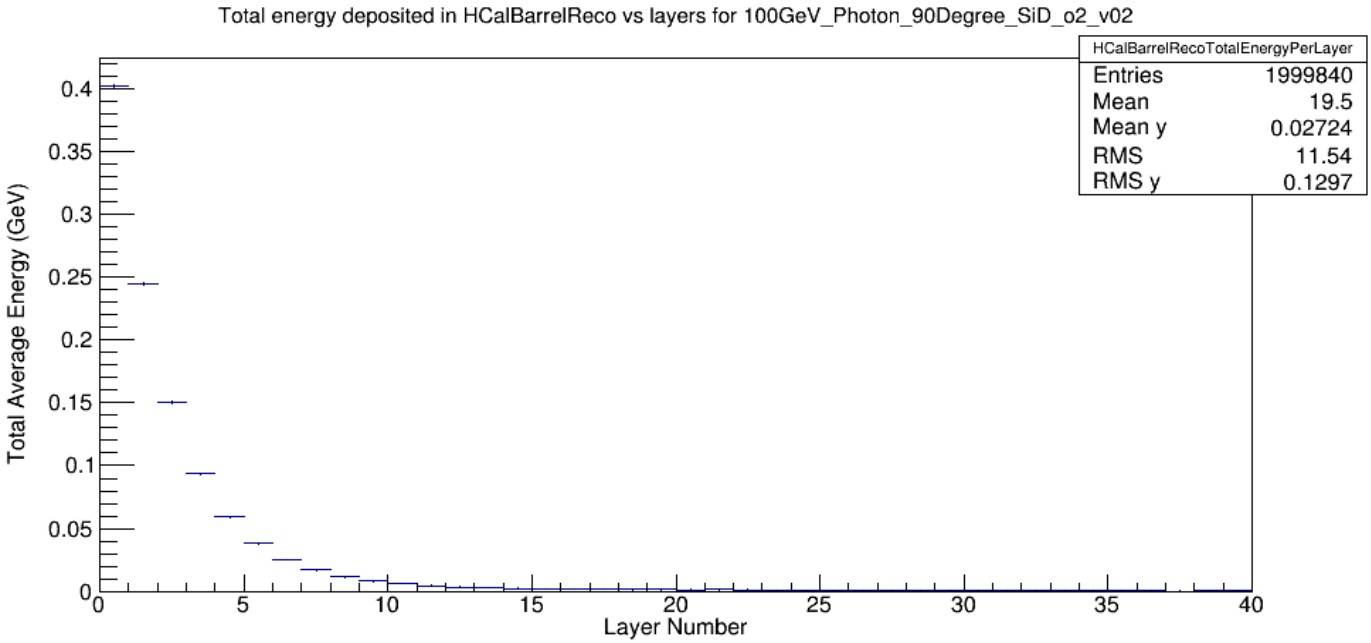
SiD AHCAL Calibration





- ~65% of energy deposited into first two layers of AHCal from a 100 GeV photon

SiD AHCAL Calibration



- Reconstructed average total energy per layer deposited in HCAL Barrel for 100 GeV photons for 50,000 events

UTA SiD AHCAL Future Plans

- Continue to run single particle studies if any major changes in geometry
- Continue photon calibration studies in preparation for jet studies
- Adapt and implement Jan's JULIA calibration code instead of using manual calibration
- Adapt and implement Pandora particle flow algorithm in DD4HEP
- Begin jet energy resolution studies
- Discussing steps towards realization of SiD-specific HCAL – opportunity afforded by U.S. – Japan funding
- Need engineering support (through SLAC)
- Continue to work with SLAC on refining the module design and include the results in the simulation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Relevant Information

- All particles used were pions, fired using single particle gun at θ=65°, for a run of 10000 events
- Geometry used was SiD_o2_v02
- Full simulation, including digitization and reconstruction, performed as usual
- ECal: calibration_factorsMipGev increased from **6.58e-3** and **13.16e-3** to **9.212e-3** and **18.424e-3**
- HCal: calibration_factorsMipGev decreased from **3.0e-2** to **2.5e-2**