# Summary of Calorimetry/Muon Sessions

Burak Bilki

University of Iowa
Argonne National Laboratory

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# Calorimetry Requirements

- Jet energy resolution $\sigma/E$ ) ≤ 3.5 – 5 % for jet energies ~ 1 TeV – 50 GeV
- Excellent e/γ ID
- Low noise, fit inside the coil, radiation hard (for forward calorimeters)
- Precision timing (~1 ns) needed for CLIC
- Conventional → Novel

## Two major methods

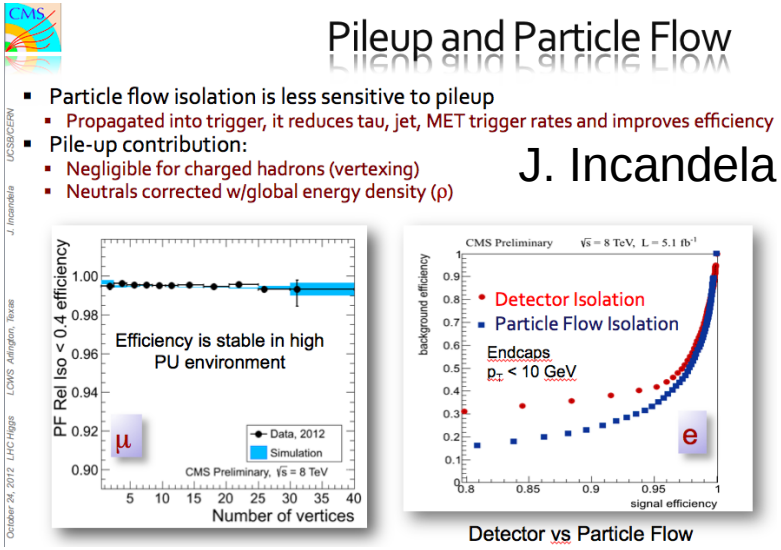
Dual Readout Calorimetry:

Different hardware concepts under beam test

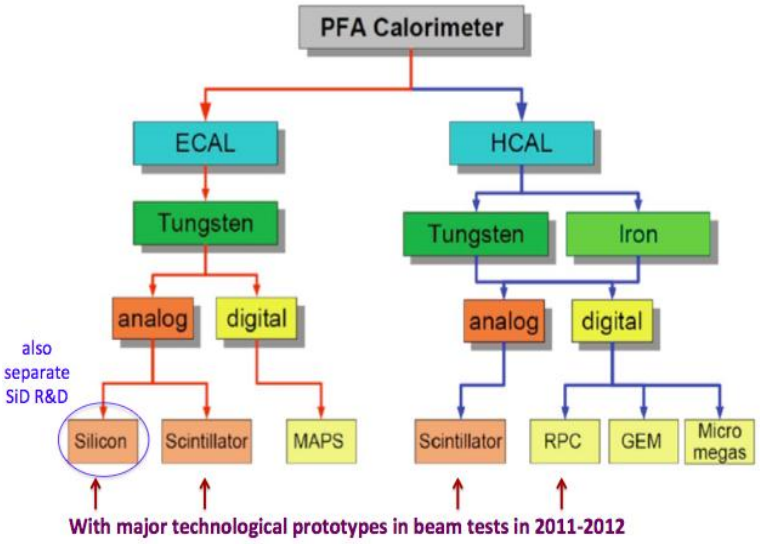

C. Gatto

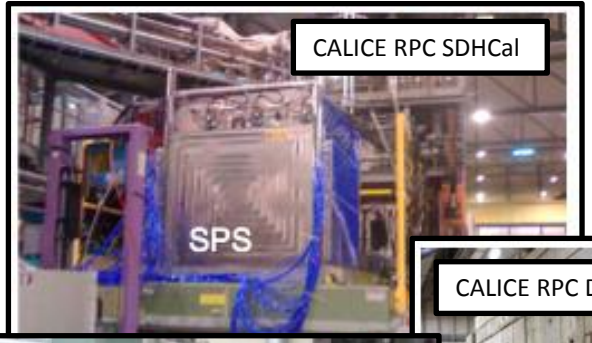
Imaging/PFA Calorimetry:

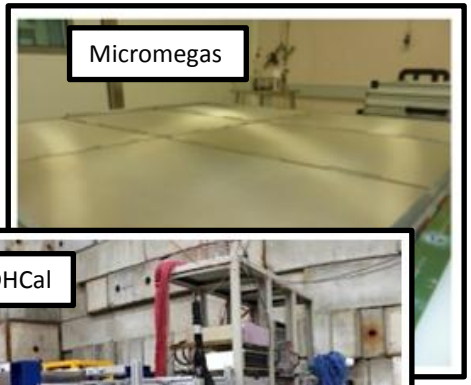
Has large scale prototypes with ~ established principles



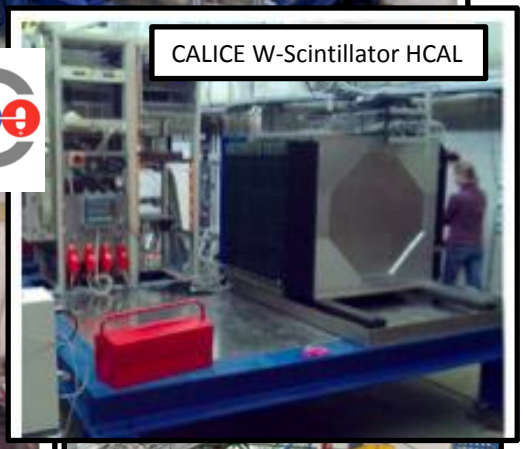
# Experiments:



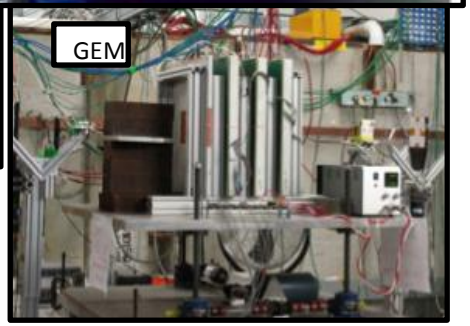



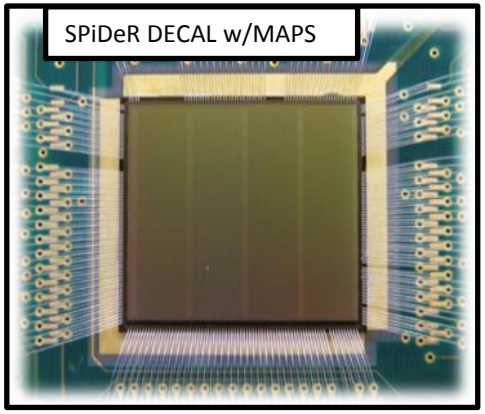



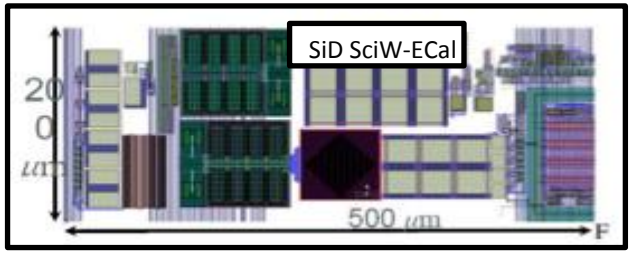






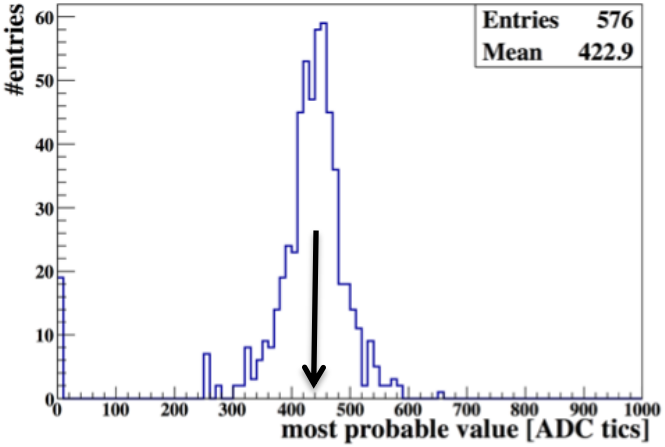

## Common Features:

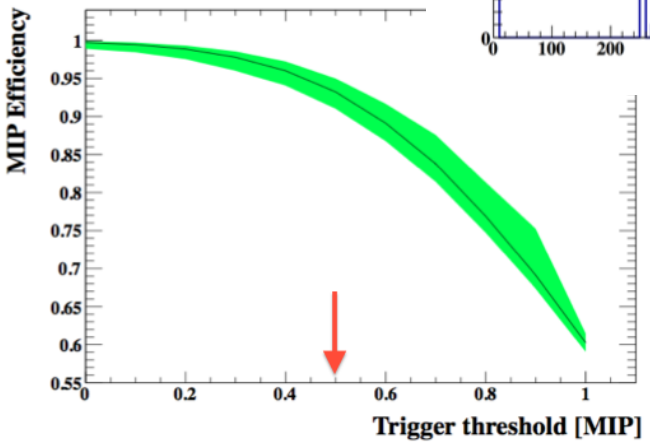
- ✓ Fine granularity
- ✓ Embedded front-end

# 2nd Generation Prototypes:

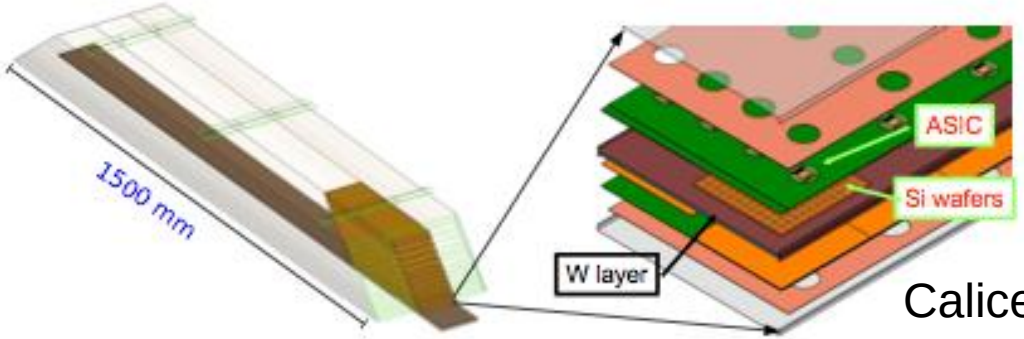
~ Realistic dimensions (partly equipped)
Technological solutions for the final detector

Calice AHCAL



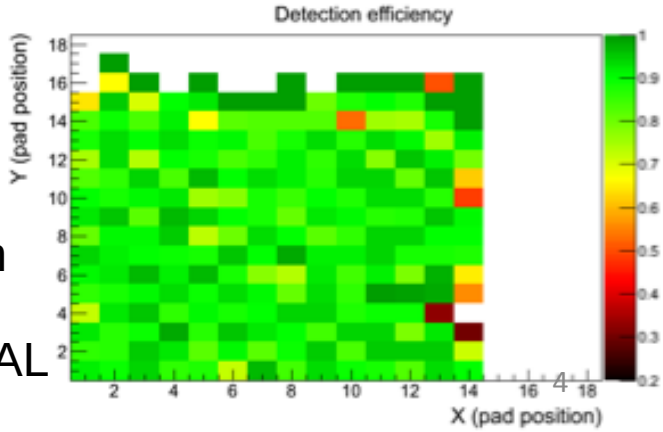




K. Kruger



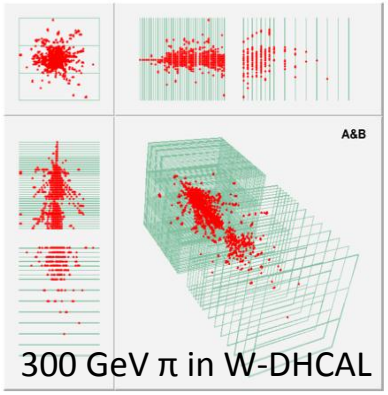

T. Frisson

Calice SiW ECAL

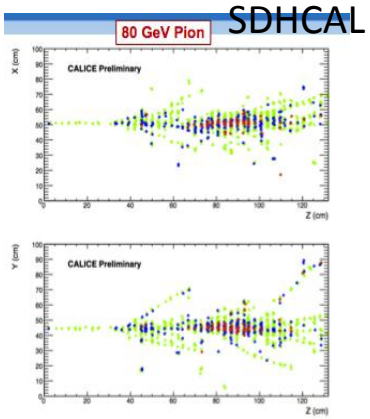


# Overall Achievements

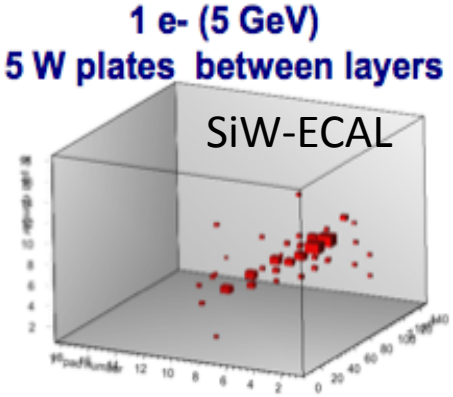
- **A lot of data – Successful test beams at FNAL, CERN and DESY; 100Ms of events**
- **Very beautiful images.**




J. Repond



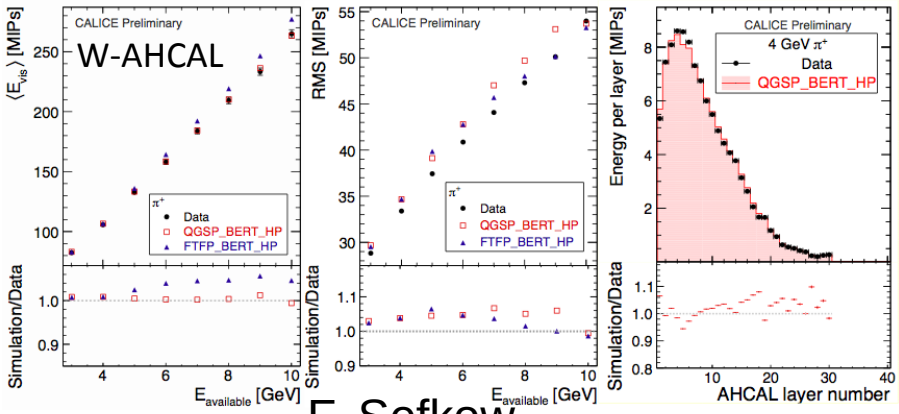

V. Boudry



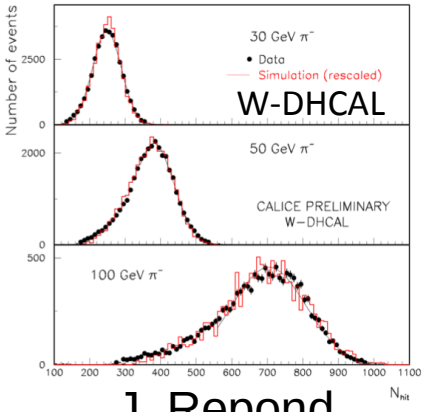

T. Frisson

- **Comparison with MC and testing the reliability of detector simulations.**

Immediately accessible after/during test beam → Excellent understanding of the calorimeters!

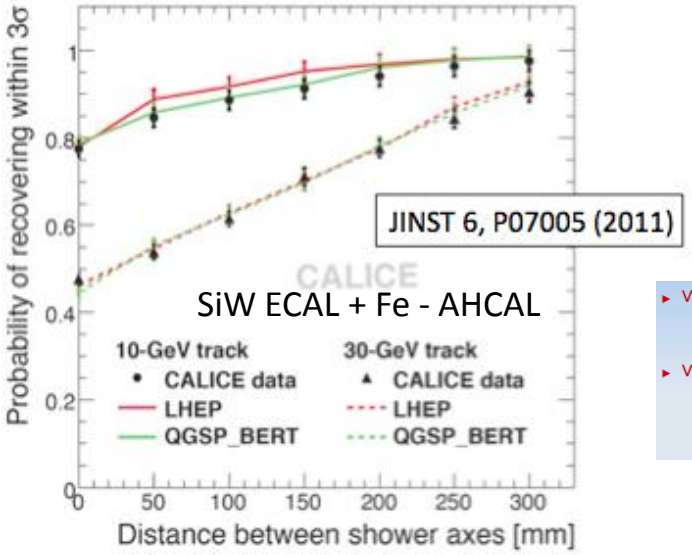


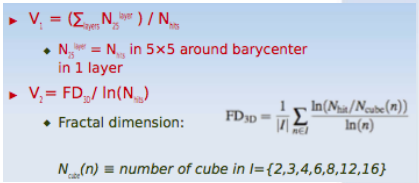

F. Sefkow

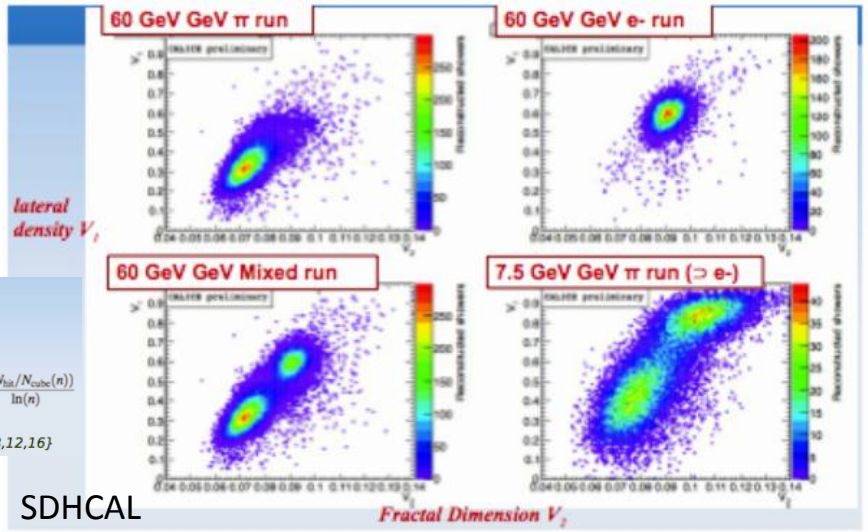



J. Repond

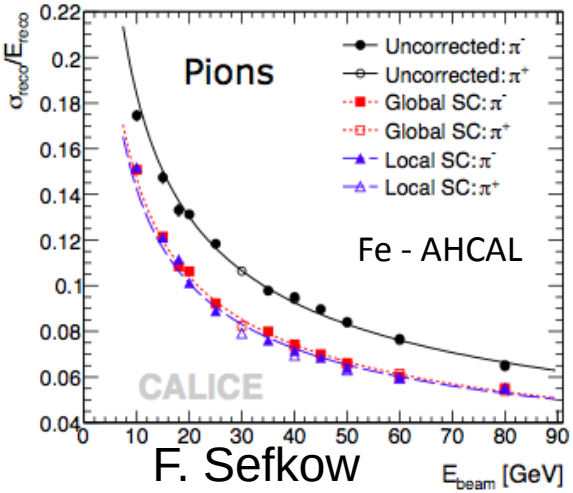
- **Particle ID and separation**




- **In addition to PFA, software compensation is also possible**



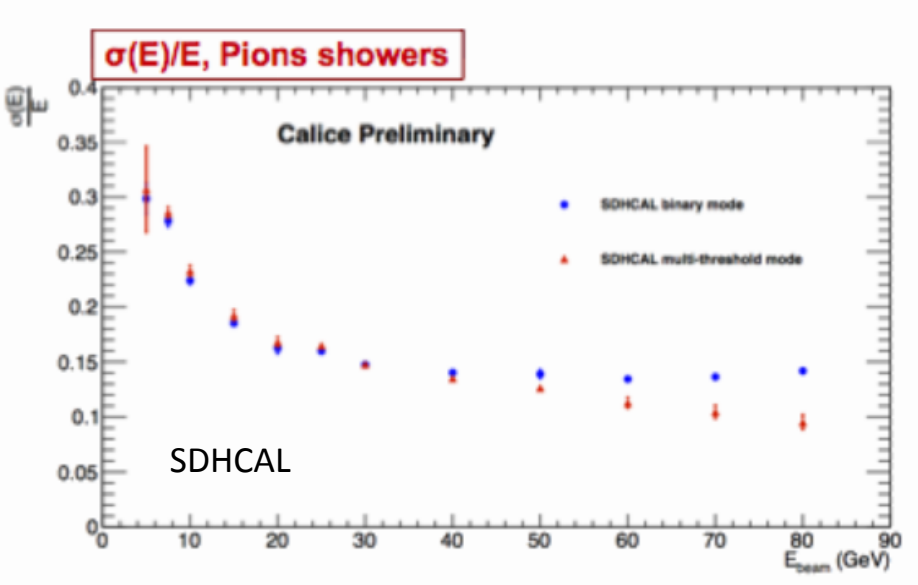

F. Sefkow

Local compensation: re-weighting based on single cell energy density

Global compensation: correction factor calculated on event-by-event basis

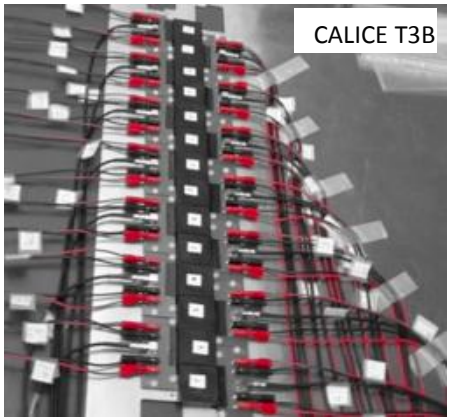
- **Utilization of multiple thresholds (very preliminary)**

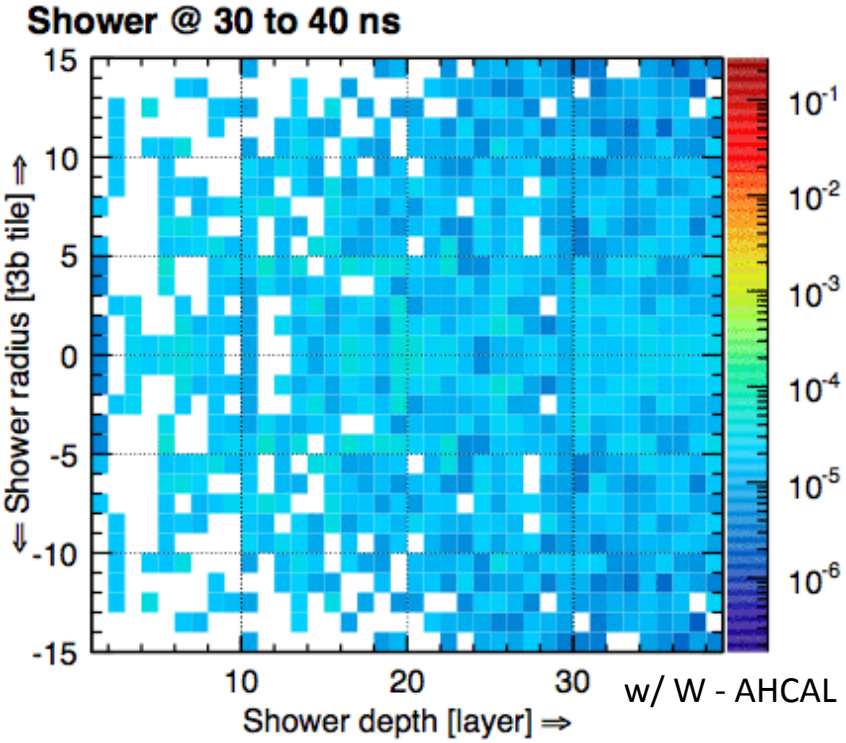
V. Boudry



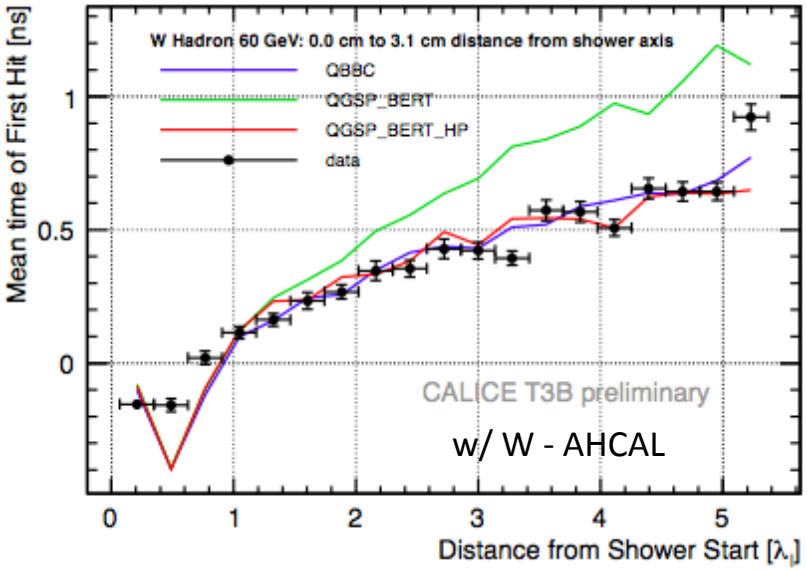
# Precision Timing for CLIC

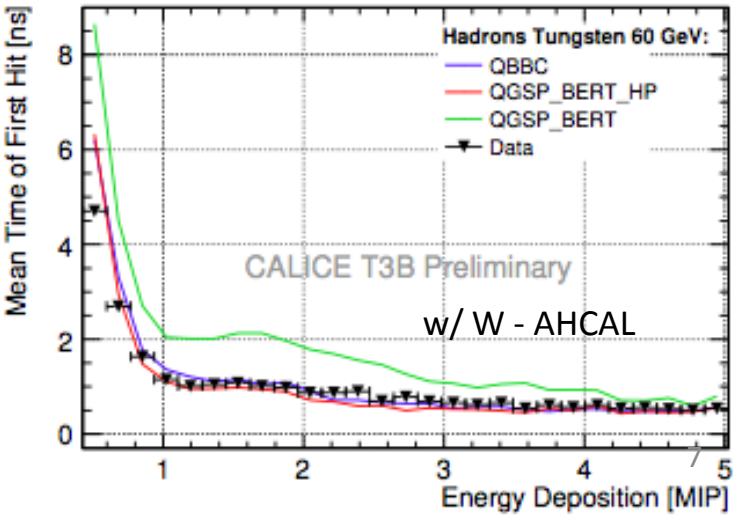
Measure the time structure of the signal within hadron showers



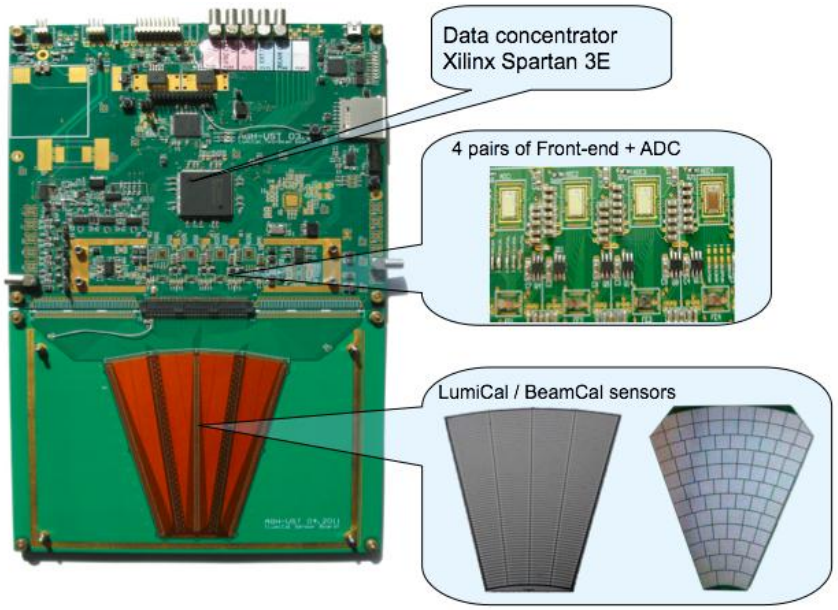



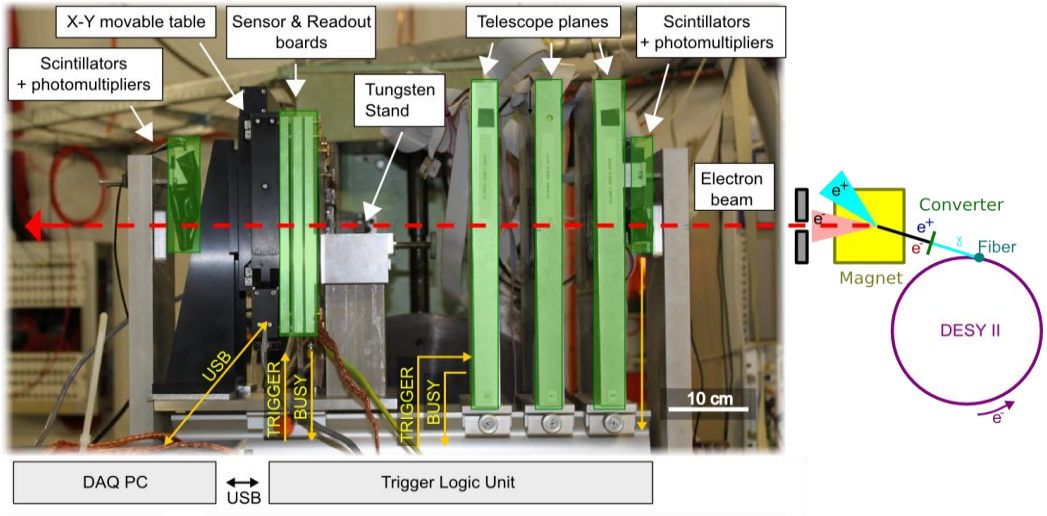

F. Simon



# Forward Calorimetry




W. Lohmann

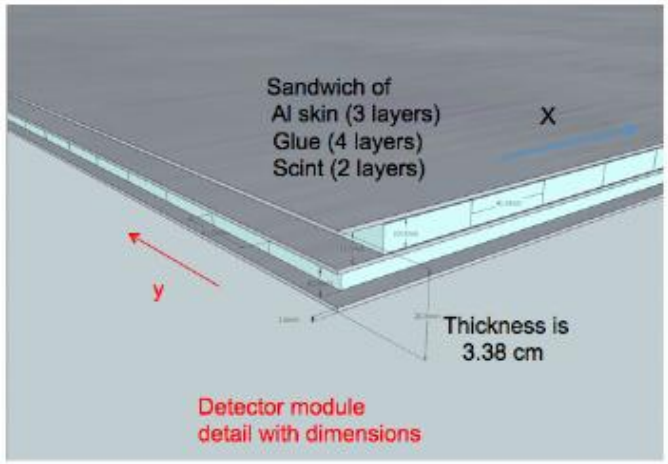
Radiation damage studies underway.

# SiD Muon Detector

## SiD Muon Detector Baseline Design

- Large planar modules ~ 5.54m X 3.8m ~ 21m$^2$.
- Si avalanche photo-diodes-pixelated photon det.
- Common electronics: KPiX.

E. Fisk



# Conclusions and Outlook

- Several projects at different stages of prototyping.
- Full scale beam test series completed for all major technologies.
- First test beam results from 2nd generation prototypes addressing integration issues available.
- Viability of PFAs and imaging calorimetry not questioned anymore.
- No expectation of breakthrough in basic principles and technology in the near future.
- BUT, the calorimeters already started to produce unprecedented physics results well before collider detector integration.