Testbeam Overview & Look into data.

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- Testbeam Overview
  - CERN PS
  - DESY February
  - DESY April
- First look into the data
- Conclusion & Outlook
Testbeam Overview

- Several TB Campaigns during last year and beginning of this year: CERN PS, DESY (February and April)

- EBU:
  - bottom readout (10k MPPC)
  - longitudinal (10k MPPC)
  - old transverse (1600 px)

- HBU:
  - SMD Megatile (2 types MPPC)
  - old ITEP (800 px)
  - new ITEP (Ketek 12k px)
  - individually wrapped SiPM (Ketek 2300 px, SensL 1300 px)
  - SMD Mainz (1600 px MPPC)
Motivation

> Electronics:
  - Demonstrating scalability to a full ILD → towards 1m$^3$ prototype
  - DAQ Development → towards ILD DAQ
  - Testing different types of SiPMs (number of pixels, packaging...) and designs (SMD, tiles...)
  - Flexibility → Common running with others detectors

> Software tools
  - Reconstruction, Monitoring

> Mechanics:
  - Absorber stack (Iron/Tungsten), Cooling, Power distribution

> Physics program:
  - Calibration, EM scale, Hadron showers → time development
> 2 periods:
  - 13\textsuperscript{th} October to 22\textsuperscript{nd} October + 28\textsuperscript{th} November to 8\textsuperscript{th} December

> Configuration:
  - EUDET Steel Stack Absorber
  - 15 Layers: **EBUs (3 in front)**, 5 Old ITEP, SMD Megatile, 2 new ITEP, 4 big layers (2 Ketek UHH (one repaired, one new), 2 SensL UHH/UHD)
Goals:

- MIP Calibration of Innermost tiles (6x6) due to small muon beam size (~ 10cm in diameter)
- Electrons to check calibration on EM scale, Timing correlation of Hadronic showers
- First Large scale system → first step toward a full barrel module!!!
- First DAQ Test via HDMI
- First ILD Cooling prototype

Summary:

First Period:

- Problem with DAQ (kernel driver not stable) – fallback on USB+HDMI DAQ – limited amount of data taken
- Instabilities in large layers: Stuck TDCs, sudden noisy/dead chips after switch on/off
  → Learned a lot about the system!

Second Period:

- New DAQ fully working and stable (2 mini-xLDAs – hardware problem of the wing-LDA)
- Continuously taking data in common with EUDAQ & SiECAL – Run smooth and stable
- Instabilities in big layers
- Running LED Calibration daily
- Development of Online Reconstruction/Monitoring

Big layer instabilities:

- Temperature related – better with improvement of the cooling

Overall:

- ~ 350 runs taken
Look into Data

- First Muon data → getting MIP constant for innermost channels
- First Light Yield results (first check Gain stability)
- Data Selection: TrackFinder (cut on number of track hits) + First fit (ML/Chi2 to reject outliers) + Refit cut single amplitude hit cut
- 612 channels fitted → ~ 85% of 6x6 innermost channels + EBU's
- MIP Spread between 10 – 20% → checks ongoing
2 Periods at DESY
  - 23\textsuperscript{rd} Feb to 1\textsuperscript{st} March
  - 7\textsuperscript{th} April to 12\textsuperscript{th} April
  - 3 GeV Electrons

Configuration in Airstack February (5 Layers):
  - 2 new ITEP boards + new SMD Mainz board
  - UHH Ketek “repaired”
  - UHH new Ketek
  - UHH/UHD SensL
DESY Testbeams

- Goals:
  - MIP calibration / cross-check between CERN and DESY
  - First test of the new SMD Mainz board → **fast commissioning (very good uniformity)!**

- Movable stage:
  - → Allowed for channel-wise MIP Calibration
  - ~ 600 runs in total
  - Daily LED runs + Pedestal

- Summary:
  - Very stable running
  - Still stuck TDCs in big layers → improvement with cooling and power board modifications, but still not fully understood.
  - Gain fluctuations for new ITEP Layers → investigation on software / check if problem specific to configuration (power board delivering 2 very different HV)
  - Ketek Layers: Light yield lower than expected (~10 instead of 13 px) → **understood!!!**
Look in the data

- MIP Calibration for all channels
- Reconstruction of the data to make use of the x,y position → Track Finder
- Track selection + Maximum Likelihood fitting
- Comparison with CERN Data ongoing
Configuration in Airstack April (5 Layers):

- UHH Ketek “repaired”
- UHH new Ketek
- UHH/UHD SensL
- 2 new ITEP boards
- SMD Mainz board
DESY Testbeams

> Goals:

- MIP calibration / cross-check between CERN and DESY Feb / DESY April
- Recalibration of Mainz board (IDAC=0)
- Resettings of SiPMs HV for 2 Ketek layers → higher Light yield and SiPM gain → Target gain ~ 20 ADC
- Run with EUDAQ + Wing-LDA → Major Milestone!!

> Summary

- ~ 600 runs in total
- 1 absorber run to have a first look into TDC Calibration
- Daily LED runs + Pedestal
- Very stable running
- Still stuck TDCs in one layer → still investigations ongoing
- Calibration / gain ongoing

After recommissioning:
Spread < 4%

Gain [ADC]

Preamplifier recalculation after SiPM bias changed
Looking into data

- MIP Calibration ongoing
- Gain stability checks → very stable gain along the days
- Correlation Feb/April ongoing
  - Few scaling factor needed due to change in LY/Gain
Conclusion & Outlook

> Very busy Testbeam schedule last year and beginning of this year

> CERN PS :
  - Lots of things learned about a large scale system
  - **Major Milestone** : DAQ (mini-LDAs) / EUDAQ in common with SiECAL
  - First Cooling prototype for ILD

> DESY Testbeams :
  - Still learning!
  - Allows to get calibration for many channels
  - Consolidation of DAQ system → faster readout speed!

> *Latest SiPMs generations performs very well!!!* → comparison soon to come.

> Big picture : **full ILD module** almost ready!

> Outlook :
  - DESY Testbeam June : “Dress rehearsal” - Setup in EUDET steel stack – full configuration – DAQ consolidation and final checks before CERN.
  - CERN SPS : July/August → Few Muon runs – Main purpose Hadron showers and time development!
Thanks for your attention!