

Suggestions for contributions by the collaboration: Vertex/tracker R&D

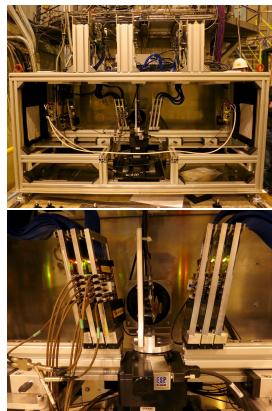
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CLICdp Collaboration Workshop
CERN
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Test-beam infrastructure for CLICdp studies

- ▶ CERN Timepix3 telescope
 - ▶ Permanent installation at end of SPS H6 beamline
 - ▶ 2 μm spatial, 1 ns timing resolution
 - ▶ high rate
 - ▶ Automated motion stage
- ▶ CERN provides support for integration, operation and analysis (on best-effort basis) for developments aiming at CLIC requirements
- ▶ Needs close collaboration with CERN group

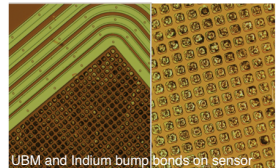
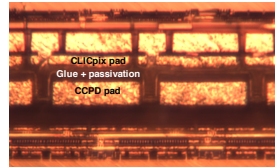


Analysis of test-beam data

- ▶ Participation in analysis of test-beam data taken with novel prototype detectors
- ▶ There will be active-edge sensors from AIDA 2020 FBK production available soon
- ▶ There are new HV-CMOS sensor to come, new engineering run foreseen by the end of the year.
- ▶ Other sensor concepts (segmented SiPMs, monolithic sensors,...)
- ▶ Single-layer tracking using drift-time information

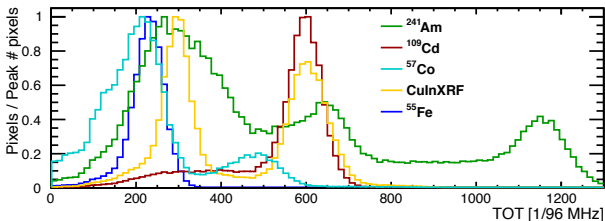
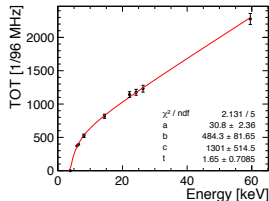
Hybridisation of pixel detectors

- ▶ Capacitively coupled devices
 - ▶ Any institute with flip-chip machine could contribute
 - ▶ Already ongoing project within AIDA 2020 with Geneva, Milano, Liverpool, Barcelona for test structures with segmented capacitors
 - ▶ Possibly new production of test chips with large-area bumps for electrical interconnects
 - ▶ ⇒ CERN can provide support for cross sections, SEM pictures, etc.. Mechanical tests
- ▶ Fine-pitch bump bonding, investigate possible alternatives to Indium process
 - ▶ Gold-stud bonding
 - ▶ Copper pillar



Assembly calibration with xray and/or sources

- ▶ Energy calibration of sensor assemblies using photons
- ▶ X-Ray fluorescence or radioactive source
- ▶ At CERN or at an institute

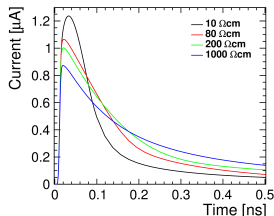
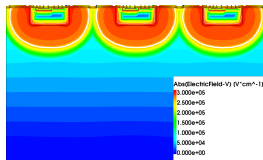


Readout/DAQ

- ▶ Ongoing Caribou development with BNL, Uni Geneva, Cracow
- ▶ Generic readout system based on Xilinx ZC706 FPGA development board
- ▶ Project would benefit from a wider user basis
 - ▶ sharing developments (firmware, software,...)
 - ▶ sharing spare components
 - ▶ easier integration in existing test setups like beam telescopes

Simulation/Digitisation

- ▶ Aim: realistic digitizer for planar and HV-CMOS sensors in full simulation for tracker and vertex
 - ▶ TCAD simulations
 - ▶ Allpix/Geant4 simulations
 - ▶ Parametric/analytic models
- ▶ dd4hep validation
- ▶ \Rightarrow CERN can provide some support and access to TCAD licenses

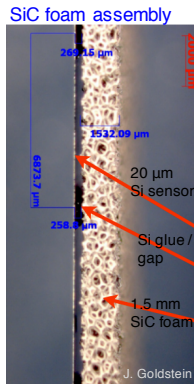
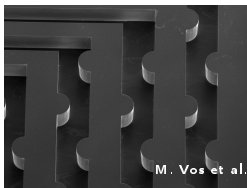
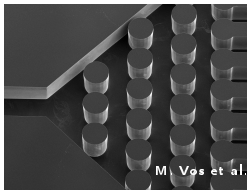


Software oriented tasks

- ▶ Flavour tagging performance
- ▶ Benefit from dE/dx measurement in the tracker for physics analysis?
- ▶ Applicability of single-layer tracking in CLIC tracker? Possible benefits for track reconstruction or background rejection? Implications on the detector layout?
- ▶ See → Philipp's talk

Mechanics, support structures, cooling

- ▶ Investigate alternative cooling concepts (e.g. micro-channels)
- ▶ CERN can provide wind-channel setup for cooling and vibration studies
- ▶ Investigate alternative materials for support structures (SiC foams, ...)



Engineering

- ▶ Engineering and production techniques for a thin beryllium beam pipe coupled to thick steel cones
- ▶ Cavern design for a single CLIC detector with QD0 in the tunnel
- ▶ More detailed drawings of the CLICdp detector and its sub-detectors for better overall understanding (and to improve the quality of our presentations)

Summary

- ▶ (Non-exhaustive) list of possible contributions to the vertex and tracker R&D activities
 - ▶ Sensor design, test-beam, calibration, hybridization
 - ▶ Data acquisition systems
 - ▶ Simulation, detector performance
- ▶ Engineering tasks
- ▶ Interested? Contact the working group convenors