

CERN-PH-LCD
pixel-detector R&D activities
and plans for AIDA 2020 WP 7

AIDA 2020 WP 7 kickoff-meeting
June 4th, 2015

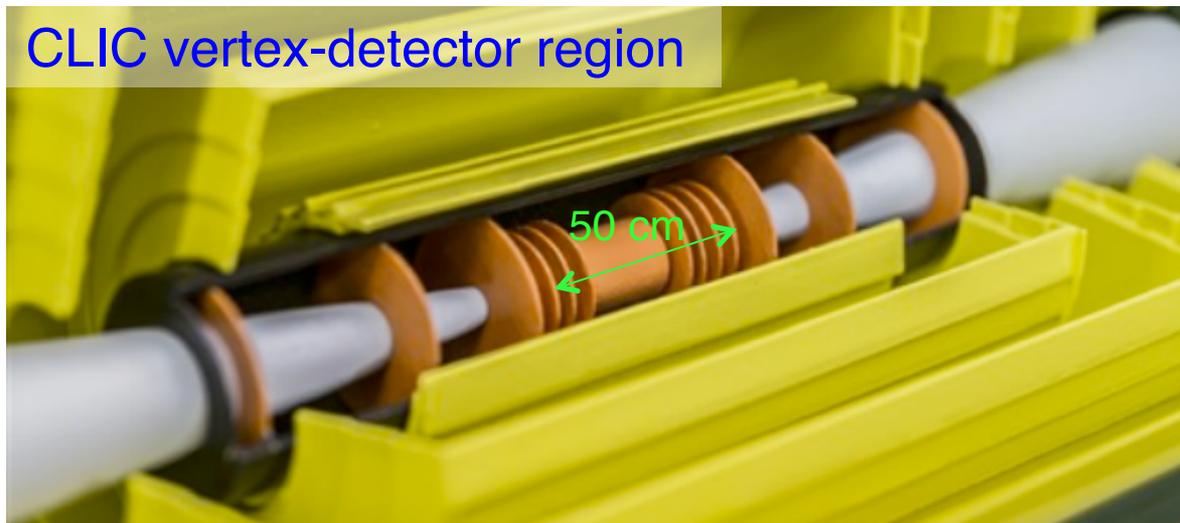
Dominik Dannheim (CERN)

CLIC vertex-detector R&D

- CLIC (Compact Linear Collider): linear e^+e^- collider concept for post HL-LHC phase
- \sqrt{s} from few hundred GeV up to 3 TeV
- CLIC detector R&D at CERN: Linear Collider Detector group (PH-LCD), CERN is host lab for world-wide CLIC detector and physics (CLICdp) collaboration

CLIC vertex-detector requirements:

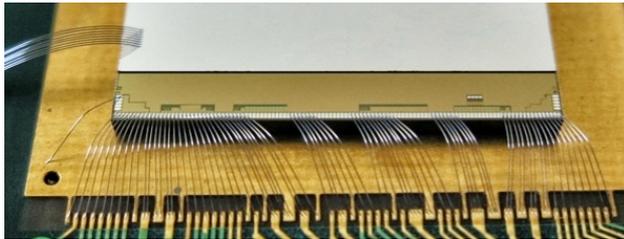
- high precision: small pixels $< \sim 25 \times 25 \mu\text{m}^2$, analog readout
- low material budget: $X \sim 0.2\% X_0$ / layer
- high background occupancies: fast time stamping ~ 10 ns
- very small duty cycle: trigger-less readout, power pulsing with 20 ms gaps
- low radiation levels compared to LHC: NIEL $< 10^{11} n_{\text{eq}}/\text{cm}^2/\text{y}$, TID $< 1\text{kGy}/\text{y}$
- multi-layer barrel + end-cap detector system, $\sim 1 \text{ m}^2$ detector surface



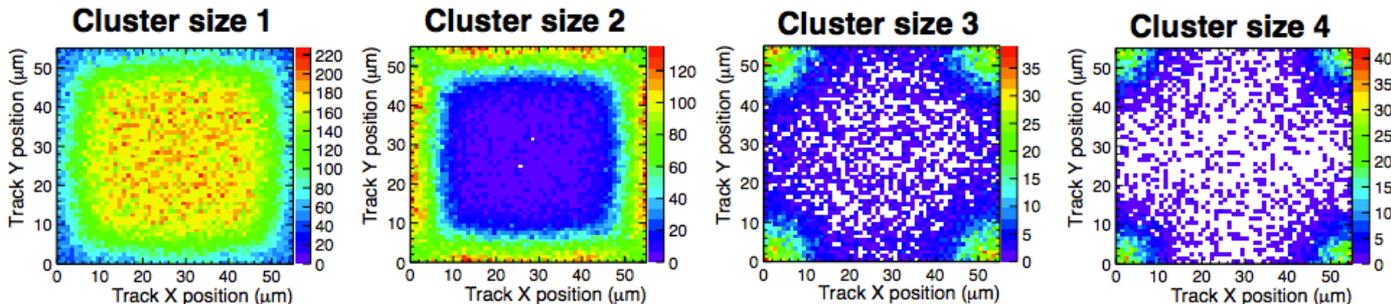
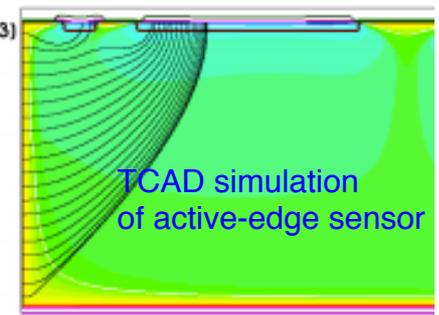
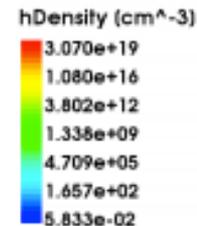
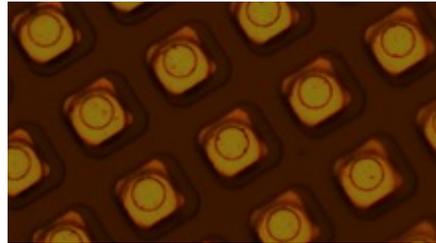
CERN LCD pixel-sensor activities

- PH-LCD sensor R&D:
 - ultra-thin **hybrid pixel** assemblies:
 - **Timepix** ASICs (55 μm pitch) with 50-300 μm Micron and Advacam sensors: test beams in 2013/14, data analysis ongoing
 - **CLICpix** ASICs (25 μm pitch) with 50-300 μm Micron and Advacam sensors: ongoing bump-bonding trials (with SLAC)
 - **TSV** project with CEA-LETI: 50 μm Timepix3 on 50-100 μm sensors, ongoing
 - **active HV-CMOS sensors** with capacitive coupling: \rightarrow AIDA 2020 WP 6
 - TCAD + Geant4 **simulations**: design optimization, extrapolation to smaller pitch

Timepix assembly with 50 μm thick sensor



CLICpix sensor with 25 μm pitch



Charge sharing
in 50 μm thin
Timepix sensor

Planned AIDA 2020 WP 7 activities



- Agreed WP 7 effort: 26 person months
- Main focus: **thin planar active-edge sensors** (50 μm) with small pitch (25 μm), matching next-generation CLICpix prototype ASICs (128 x 128 pixels)
 - Contribute to CLICpix parts of **MPWR** planar-sensor submissions: design, hybridization, testing, data analysis
- Try also **LGAD** for enhanced signal in very thin sensors?
- Task 7.2: TCAD simulation
 - focus on simulation and optimization of **small-pitch** planar active-edge sensors
 - **optimize charge sharing** to improve position resolution
 - **minimize inactive region** for seamless tiling
 - **Deliverable 7.2** (month 18): report on optimized designs and simulation results