Proposal for a production of active edge diodes and pixels at ADVACAM

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for the MPP, LAL, CERN CLIC groups

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Introduction

- New diode and pixel production at ADVACAM with n-on-p technology
  - Designs implemented in the new production for ATLAS pixels
  - Simulation of edgeless devices and pixel sensors for 3D electronics
  - Pixel sensors for the Vertex Detector at CLIC

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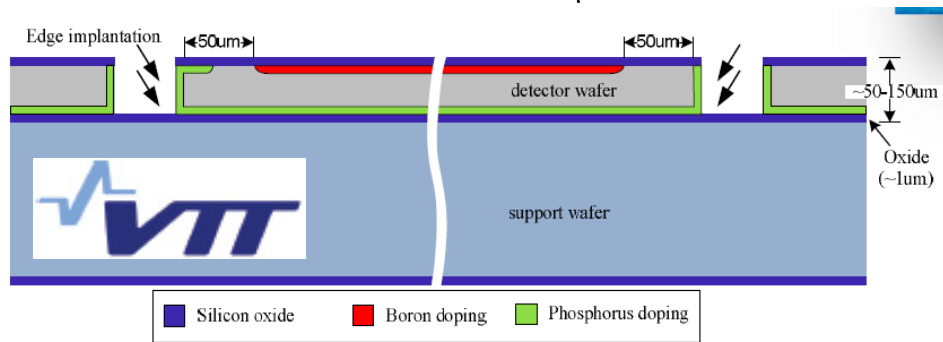
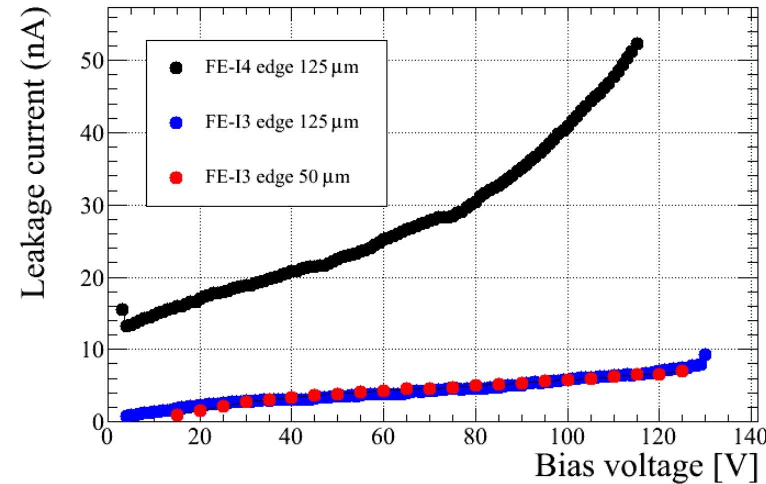
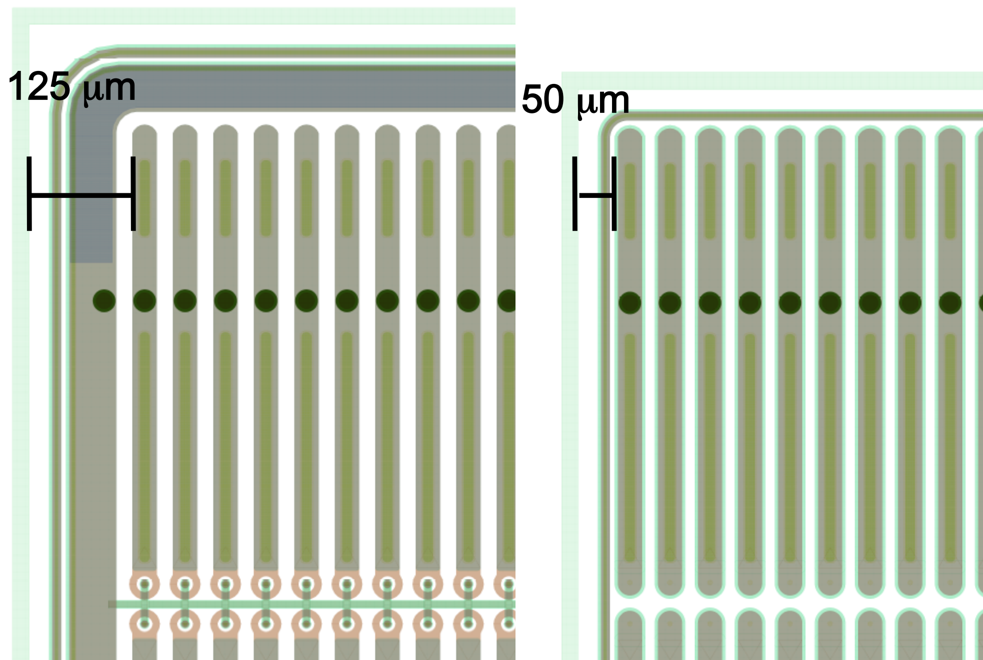
VTT active edge sensors

- Trench doped by four-quadrant implantation
- Sensor thickness 100-200 μm







- 125 μm edge implemented In FE-I3 and FE-I4 sensors
- 50 μm implemented only in FE-I3 sensors

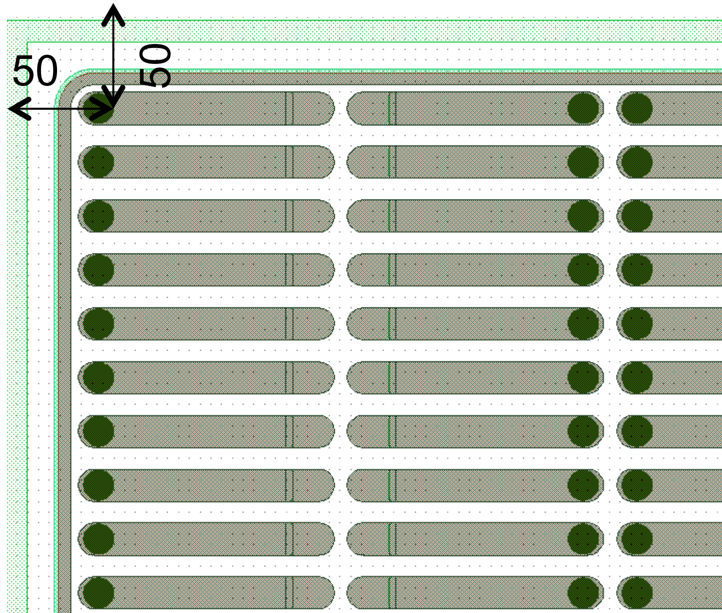
Second production of active edge pixels at ADVACAM

- Plans for a second FE-I4 production at ADVACAM

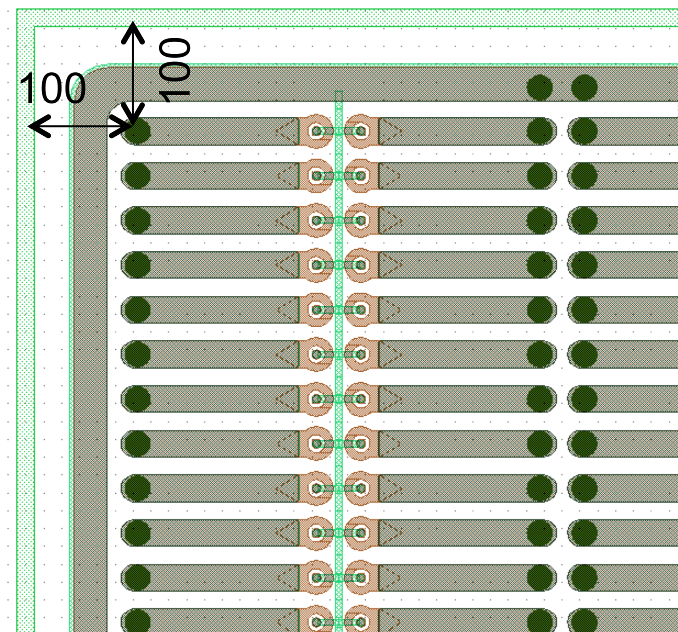
50, 100, 150 μm sensor thickness

- Pixels plus diodes with different edges to investigate post-irradiation breakdown properties

- FE-I4 with 50 μm edge, one GR, no punch-through structures



- FE-I4 with 100 μm edge, Bias Ring, punch-through structures



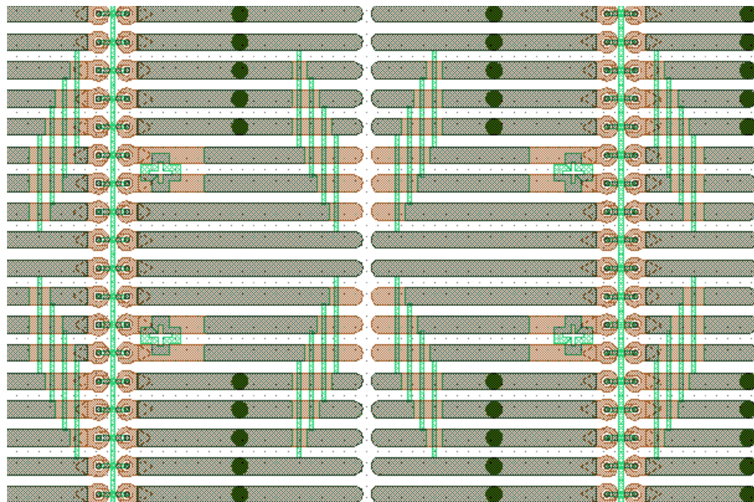
Second production of active edge pixels at ADVACAM

- Plans for a second FE-I4 production at ADVACAM

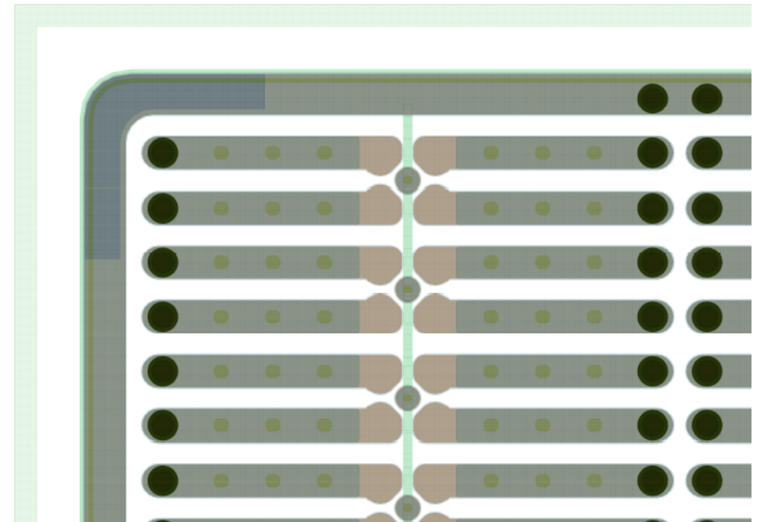
50, 100, 150 μm sensor thickness

- Pixels plus diodes with different edges to investigate post-irradiation breakdown properties

- Quad module with 100 μm edge

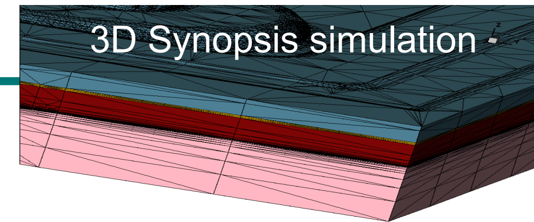


- SCM with new punch-through structure



- + several diodes with different edge configurations

LAL Contribution: Simulation



- **Contribute to active edge sensor designs**

3D TCAD simulation of sensor design and detector layout

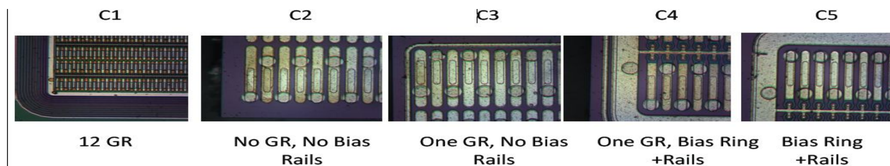
- Predictions of improved pixel designs : Edge reduction, Optimization of Bias dot and Bias rail configurations
  - Irradiations models predictions : Understanding and interpretation of high Charge amplification of heavily irradiated sensors

- **Calibration of TCAD simulations : Depth profiling techniques:**

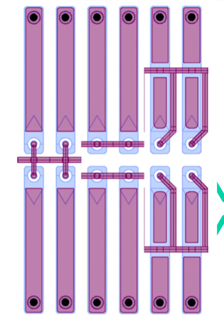
- Secondary Ion Mass Spectrometry (SIMS)
  - total atomic profile (at/cm^3 vs depth)
- Scanning Spreading Resistance Microscopy (SSRM)
  - carrier profile (q/cm^3 vs depth)
  - method under development: LAL – CTU IEF ORSAY

- **Use the data from Depth Profiling techniques for un-irradiated and irradiated samples**

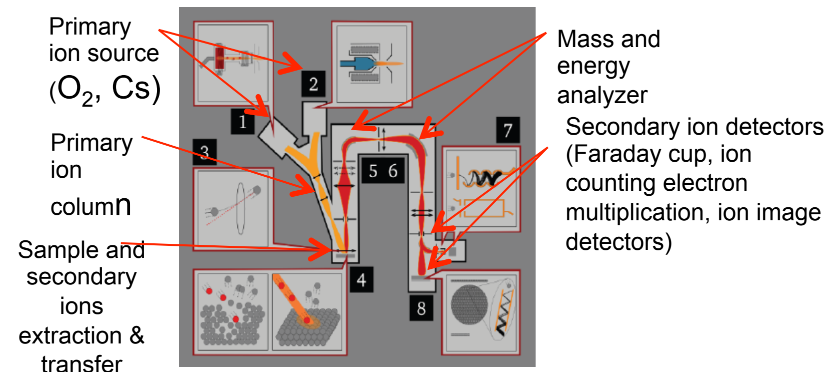
- Edgeless planar pixel sensors



- Optimize Bias Rail, dots configurations



- SIMS facility –CNRS

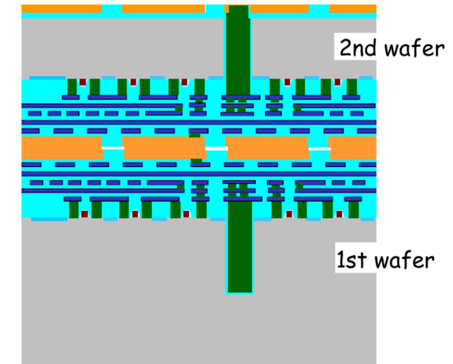


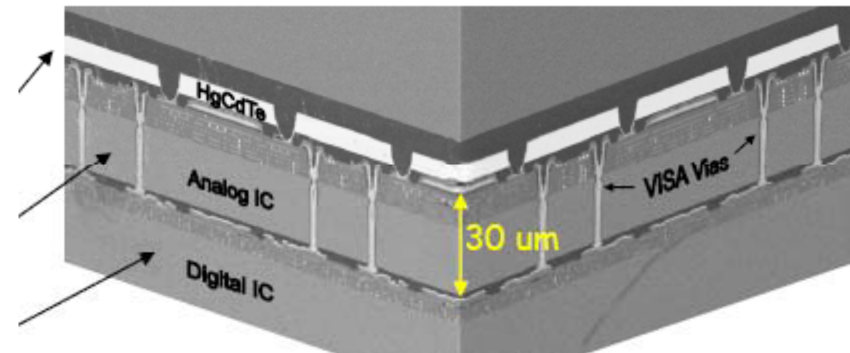
A. Lounis

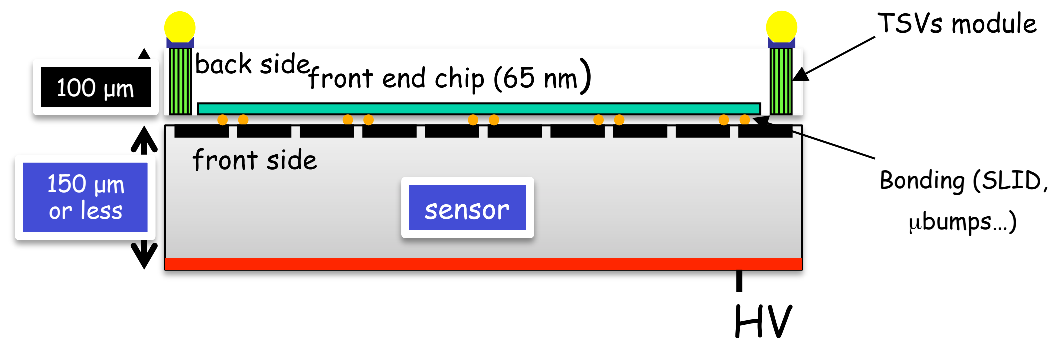
LAL: thin pixel sensor for 3D electronics

- **ASIC development for Planar edgeless sensor**

- A view on the future : design of edgeless pixels and 3D electronics
- 3D pixel electronics from Tezzaron-Chartered: CMOS 130 nm Omegapix
- Pitch 35x200 μm^2
- Framework of AIDA
  - 65 nm electronics (LAL, LPNHE, CERN) and innovative interconnections







Requirements for pixel detectors at CLIC

good single point resolution: σ_{SP}~3 μm

→ small pixels <~25x25 μm^2 (analog readout)

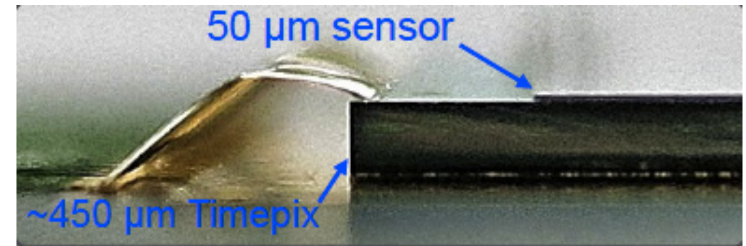
- low material budget: X ≲ 0.2% X0 / layer

(corresponds to ~200 μm Si, including supports, cables, cooling)

→ very thin sensors and ASIC (~50 + 50 μm)

→ gas-flow cooling

→ low-power ASICs (~50 mW/cm^2)



- Maximum occupancy of few % (from beam-induced backgrounds)

→ time stamping ~10 ns (high-resistivity sensors, fast readout)

First ADVACAM production for CLIC pixels

Thin sensor +"normal" Timepix assemblies

→ Feasibility tests of ultra-thin sensors

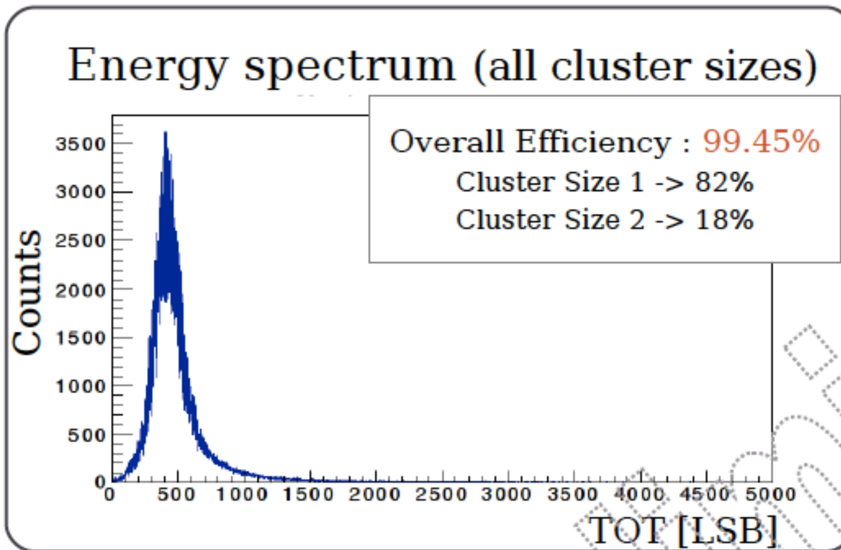
→ Assemblies with 50, 100, 200 μm sensor

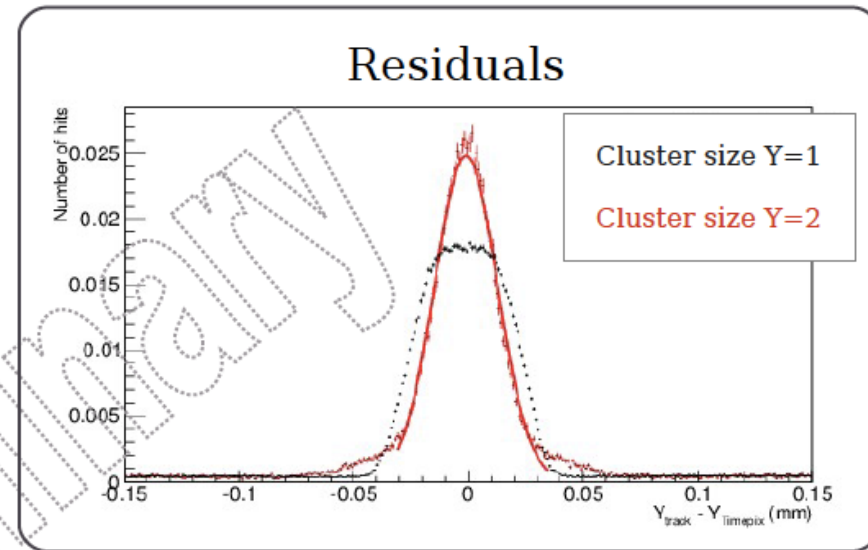
→ Pitch 55 μm x 55 μm

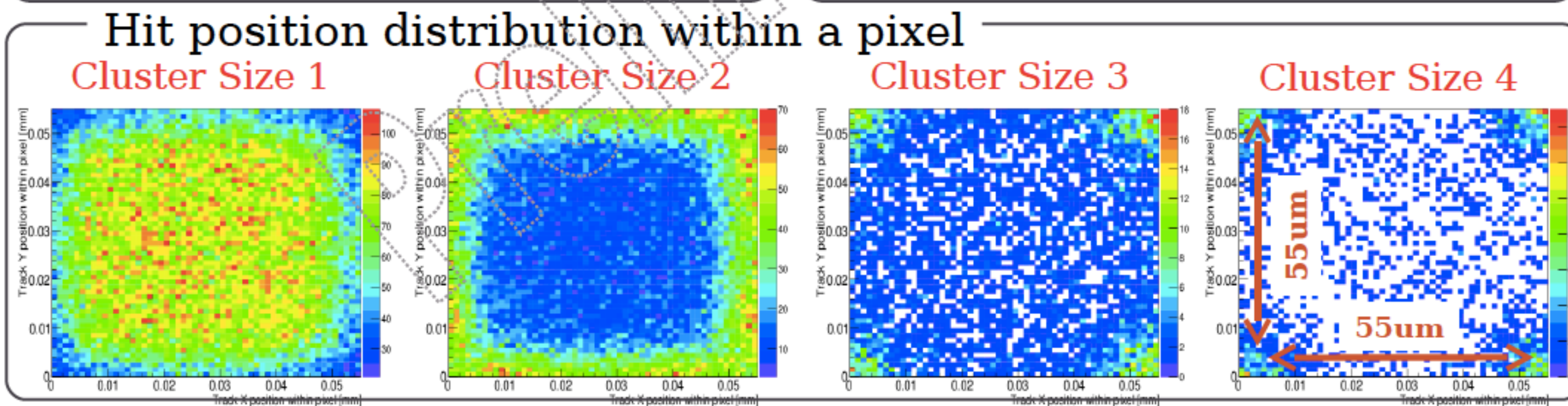
Szymon KULIS, Vertex Detector R&D for CLIC, Vertex 2013

CLIC, test-beam results with first VTT production

50µm sensor thickness (15 V bias), 50 µm active edges (from Advacam)



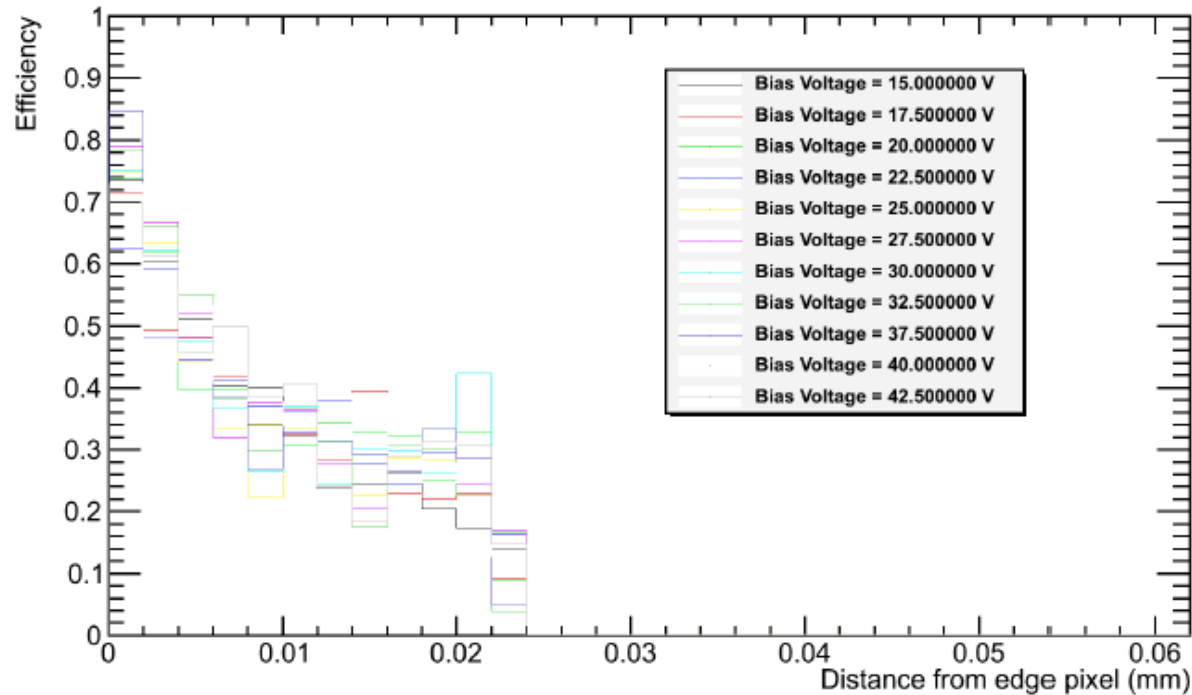




Szymon KULIS, Vertex Detector R&D for CLIC, Vertex 2013

CLIC, Edge efficiency

Advacam p-in-n 50µm thin Timepix Assembly, 20µm edges, leakage ~100nA@15V



Samir Arfaoui, LCWS2013

All RD50 members are welcome to join the production if interested!