Report from 4th BTTB workshop in Orsay

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CLICdp Vertex Meeting
12. 02. 2016

BTTB Workshop

3rd to 5th February 2016, LAL, Orsay

- Beam telescopes
- Irradiation facilities
- Testbeam facilities
- Data analysis
- Tools
- Tutorials on Allpix and Eutelescope
- Common DAQ meeting in parallel

Agenda: `https://indico.desy.de/conferenceDisplay.py?ovw=True&confId=13620`

Telescopes + Testbeam facilities + Irradiation facilities

- Timepix3 telescope (LHCb)
- CLIC Timepix3 telescope
- MuPix telescope
- Geneva FE-I4 telescope
- CMS High-rate pixel telescope
- Eudet telescopes
- KarTel - Ljubljana M26 telescope

- Desy-II
- PSI
- Fermilab
- SLAC (+Caladium telescope)
- CERN

- Irradiation: JSI, CERN, KIT

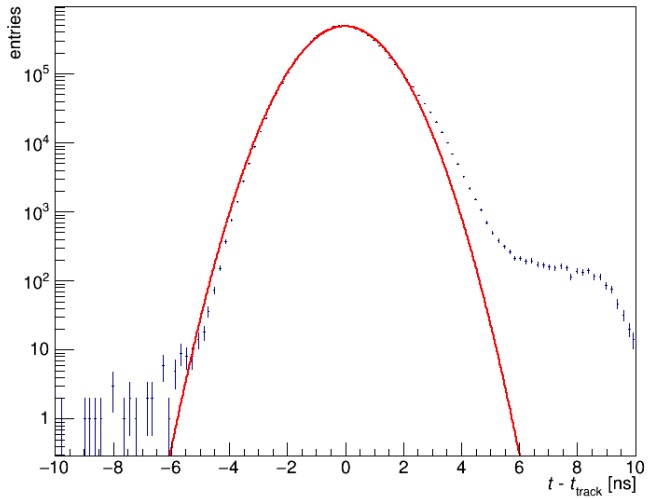
Tools

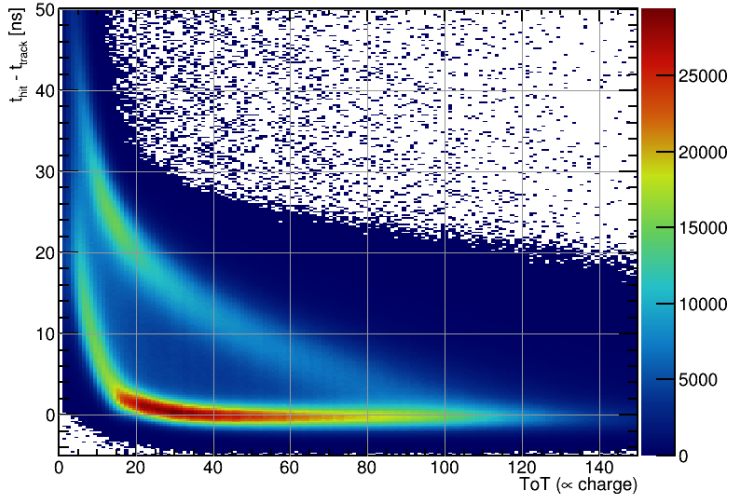
- Re-Timing testbeam data
- Allpix
- EUDAQ Generic online monitoring system
- DQM4HEP, Monitoring Framework - SDHCAL based
- EUTelescope framework
- GBL in Eutelescope
- Status of the miniTLU

Data analysis

- ATLAS ITk UK Pixel Sensors
- Beam tests of pixel-detector prototypes for the CLIC vertex detector
- Test beam studies on n-in-p planar pixel sensors
- Test Beam Measurements for the Upgrade of the CMS Phase I Pixel Detector
- Beam test of 3D pixel detectors up to fluences of 9e15 neq/cm2
- Beam tests for the ATLAS ITk strip upgrade
- DAFNE Beam Test Facility and Performances Assessments of Larger Pixels CMOS sensors
- A comparative sensor testbeam using micro-focused X-rays
- Intrinsic resolution studies with the DATURA telescope
- Beam tests of the ATLAS Forward Proton (AFP) Detector
- Characterization of thin irradiated epitaxial silicon sensors for the CMS phase II pixel upgrade
- Sensor Developments for the LHCb VELO Upgrade

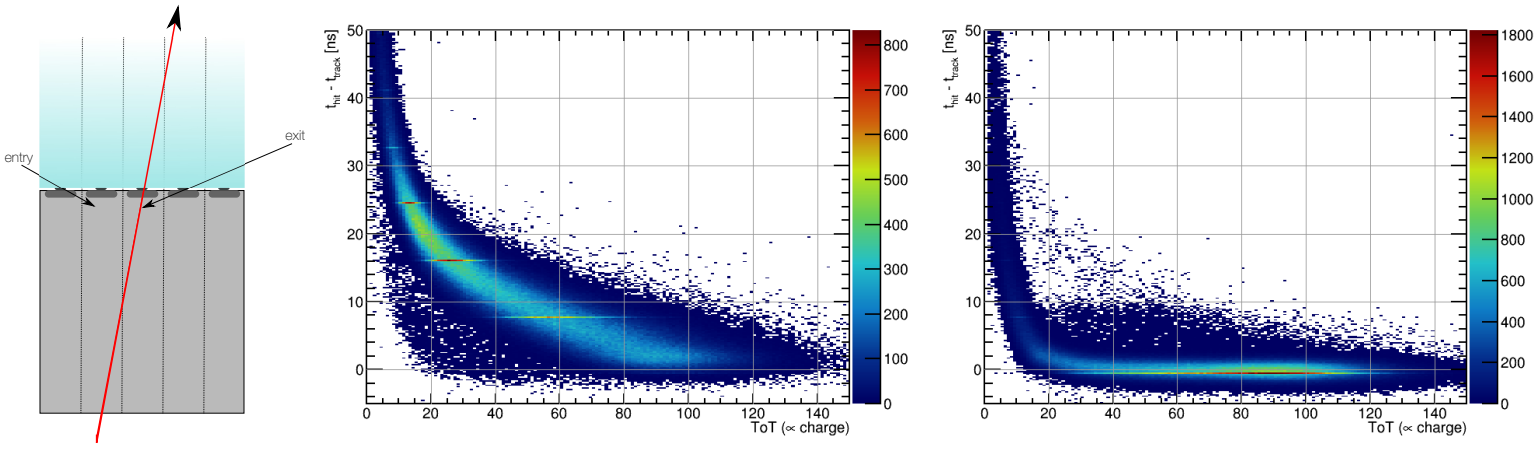
Time Residuals





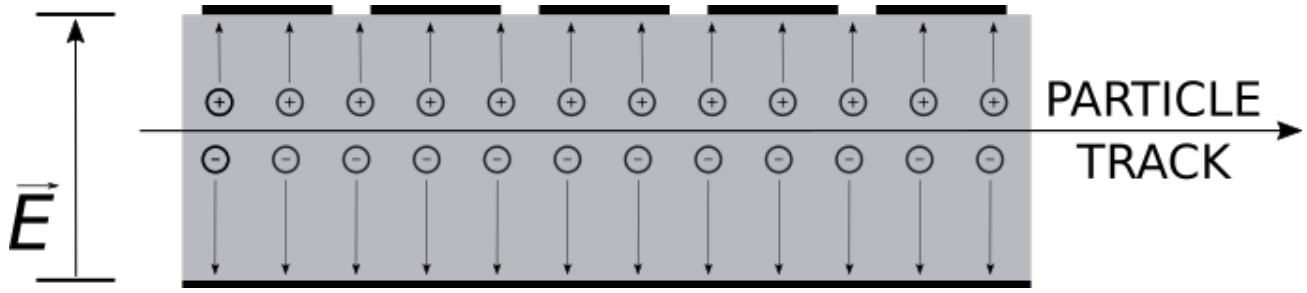
- Left : Biased time residual of a telescope plane.
- The most boring plot we have? It's a Gaussian of $\sigma = 1.12\,\mathrm{ns}$, $\mu = -21\,\mathrm{ps}$.
- Use to esimate the Time pointing resolution of the telescope $\approx 0.4\,\mathrm{ns}$ and of each plane $1\,\mathrm{ns}$.
- It might be expected that the resolution is $1.56\,\mathrm{ns}/\sqrt{12}$ - why so much broader?
- The time of the cluster is defined by the fastest time stamp in the cluster, the track by the average of the cluster times.
- Right : Time residual as a function of ToT (i.e, the Timewalk curve) for all hits in a cluster.

Entry and Exit Pixel



- Left: Diagram showing the definition of entry and exit pixel.
- Center: Charge vs Time-To-Threshold in the pixel where the particle enters the sensor,
- Right: Charge vs Time-To-Threshold in the pixel where the particle exits the sensor. This changes the average depth at which charge is deposited, hence the time to induce charge on the collection. [Still working on the binning for this plot]

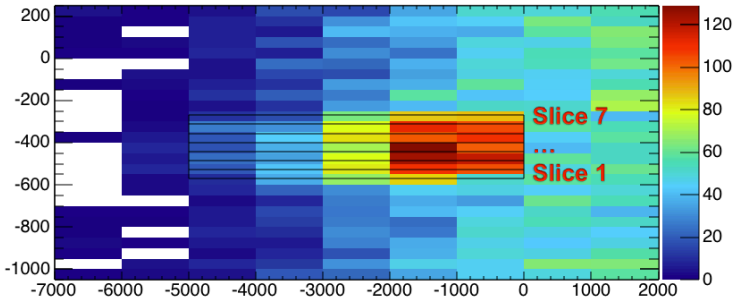
E-TCT with Beam

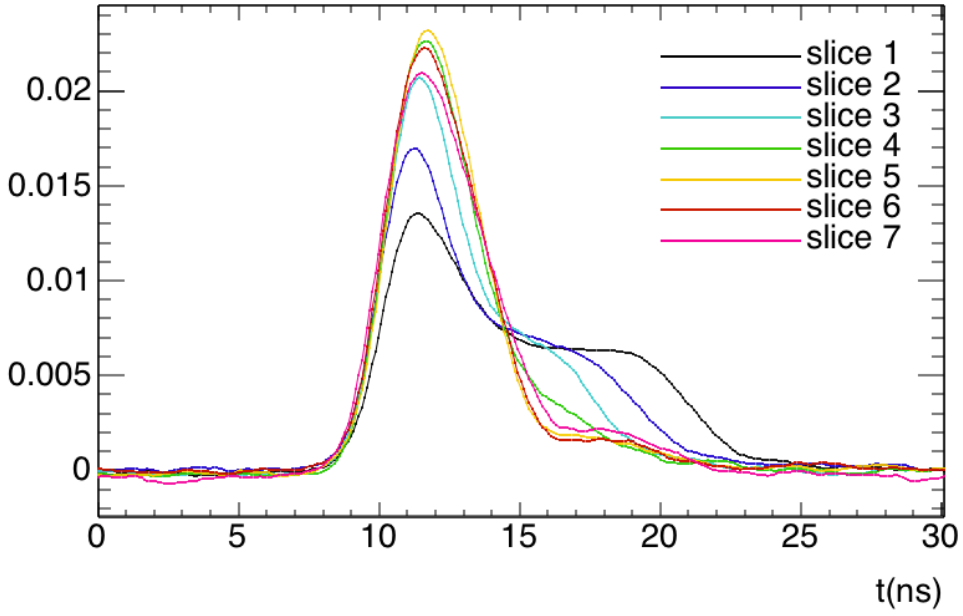


- Incidence points of tracks can be binned in desired manner, waveforms of events with tracks inside one bin can be averaged

Results

- Slices
  - Slice 1 (just under +contact) mostly signal from drift of the holes
  - …
  - Slice 7 (just under –contact) mostly signal from electron drift
  - In all the time e– signal is super-imposed on h+ signal

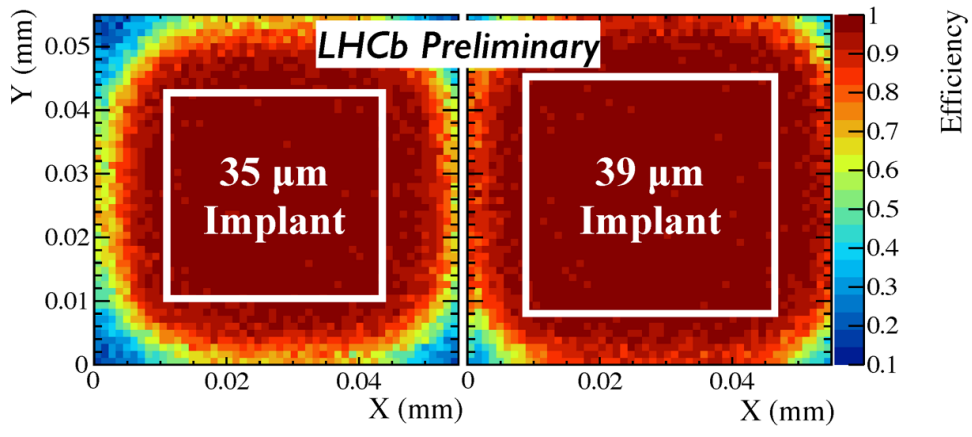




Efficiency

- Irradiated assemblies show slightly lower efficiency
- Larger implants improve the efficiency at the corners

HPK 300 V



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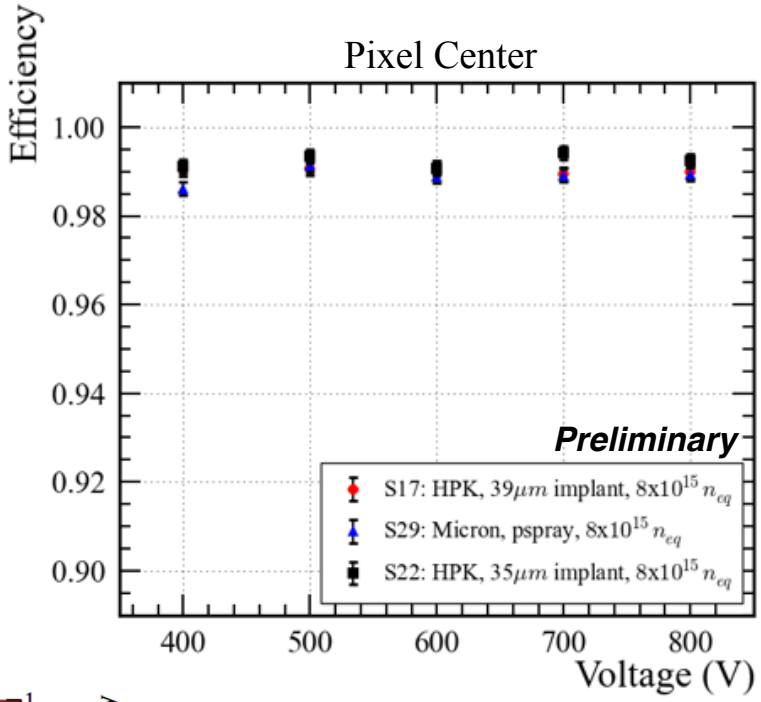

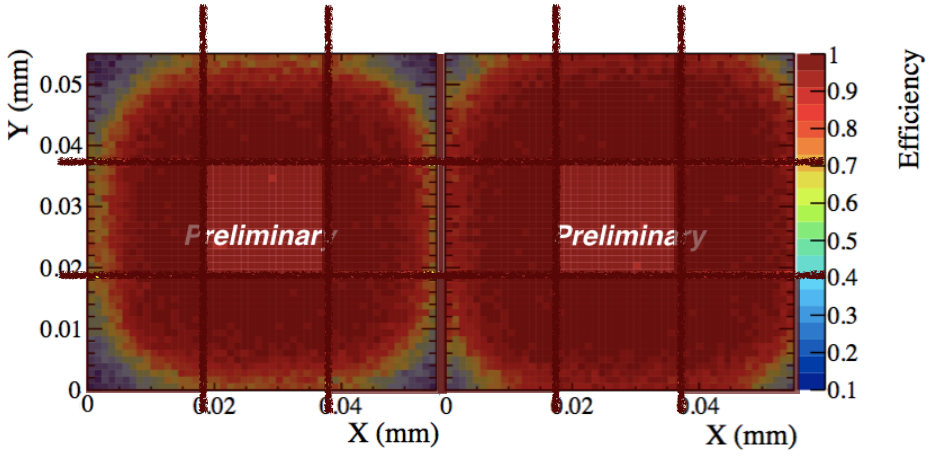

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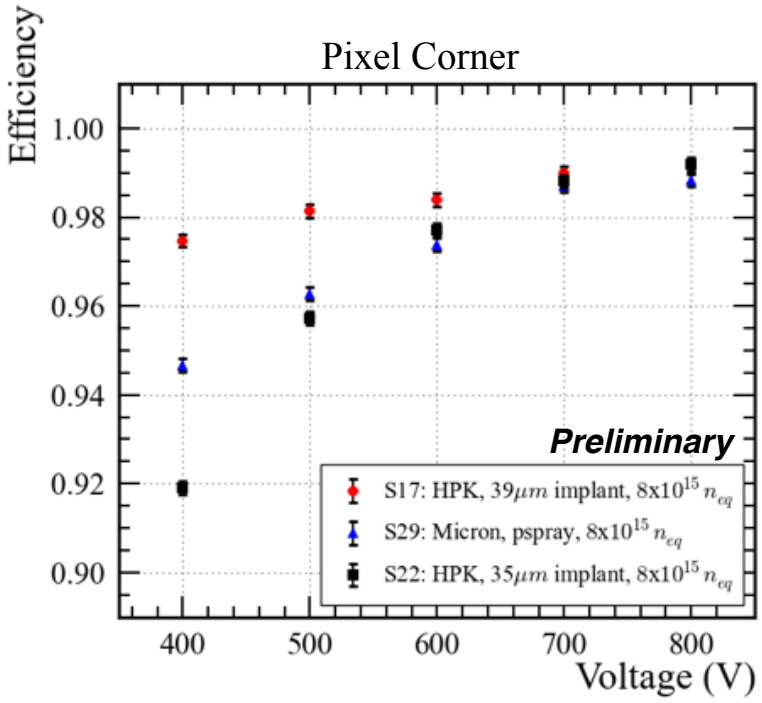
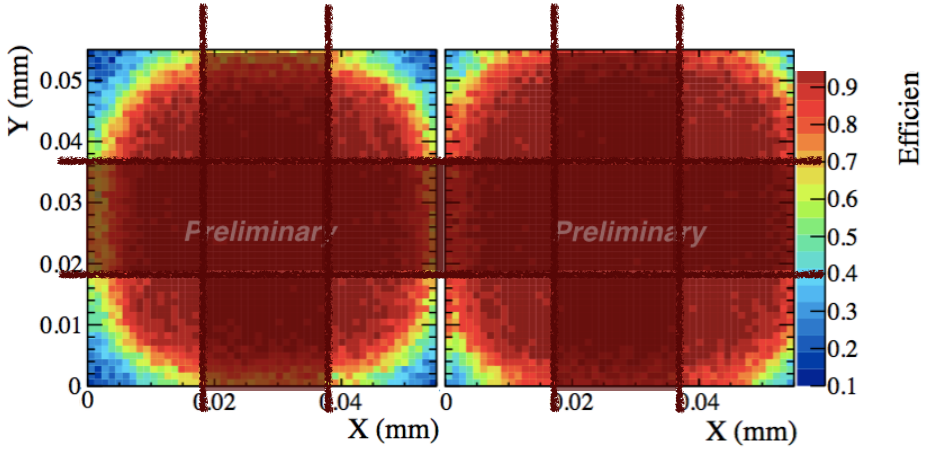
- The inefficiencies appear at pixel corners going to lower V, but fully efficient at 1000 V

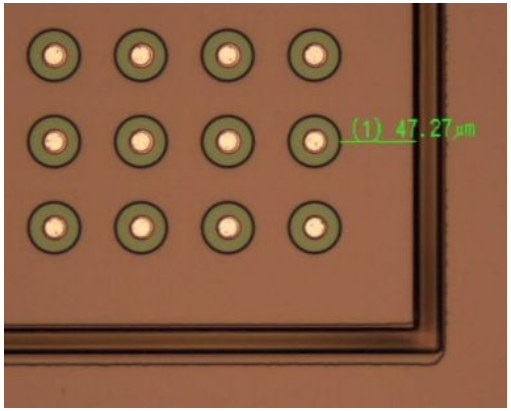




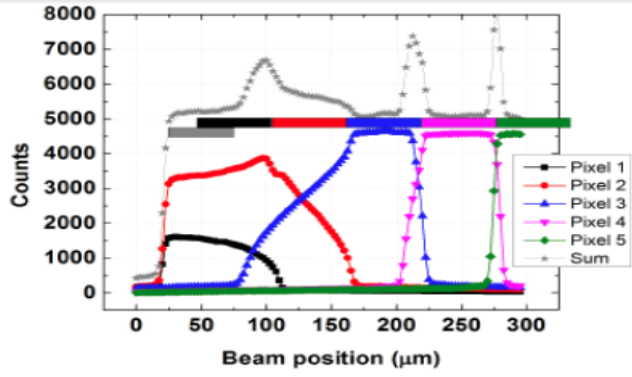
Active Edge devices

Device	Implant	Bulk	Thickness (mm)	Pixel to Edge (mm)	Calculated Full depletion voltage (V)
NN-200-50	N	N	200	50	28
NP-100-100	N	P	100	100	10
NP-100-50	N	P	100	50	10

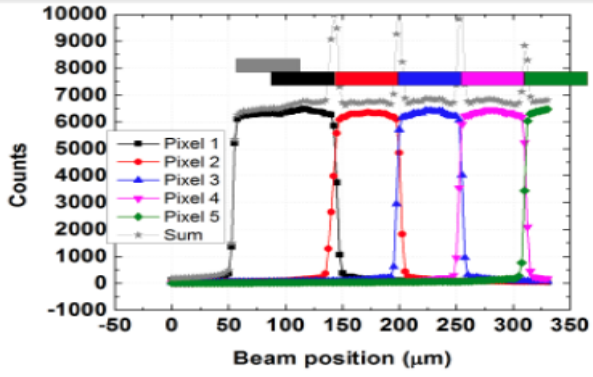
- VTT/Advacam Active Edge sensors
- Sensors flip-chip bonded to Timepix
- 55μm x 55μm pixels
- Measurements taken in pixel counting mode



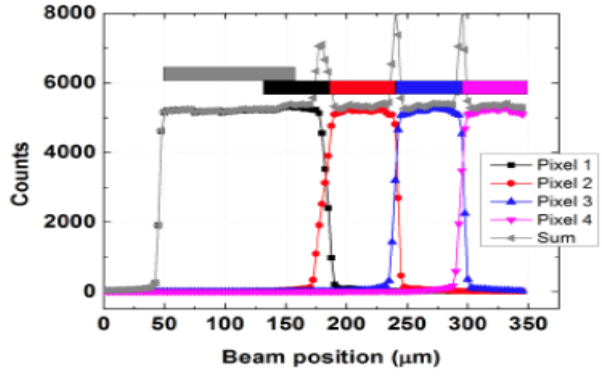
Over Edge Scans - Active Edge/Timepix



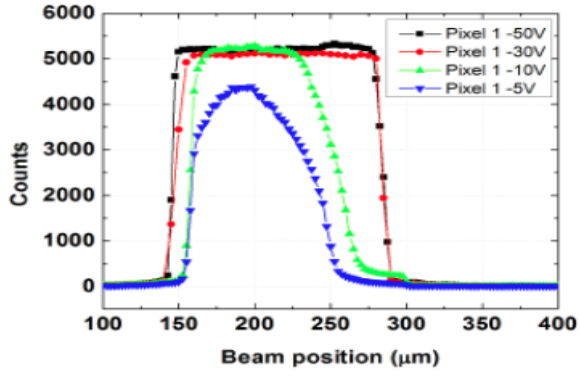
(a) F08-NN-200-50



(b) J08-NP-100-50



(c) C07-NP-100-100



(d) C07-NP-100-100

Input from coffee discussions

- Mupix class in Eutelescope already stores 64-bit timestamps. Can/should we use their class?
- For telescope time resolution, constant time offset of telescope planes should be corrected