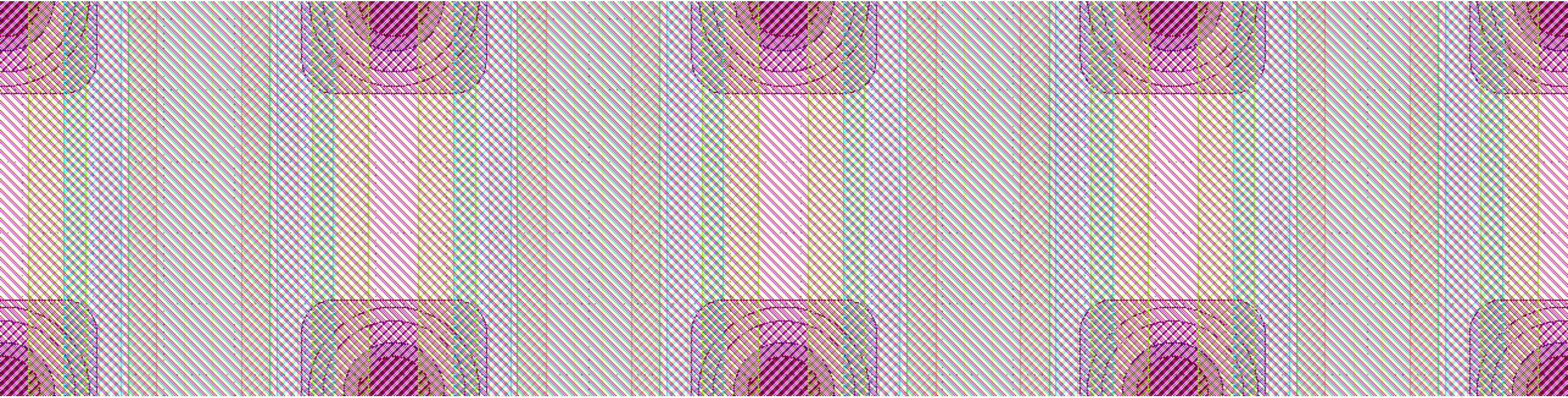


Enhanced Lateral Drift Sensors

Status and sensor characterisation plans

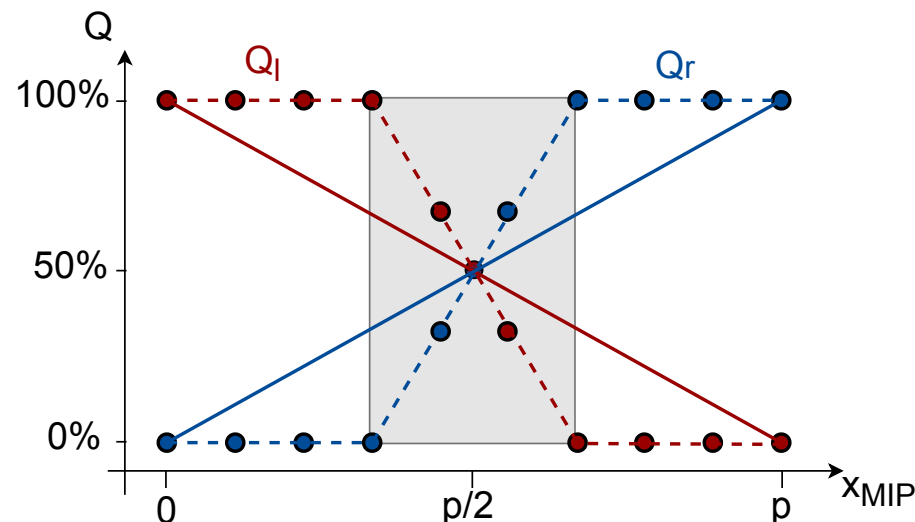
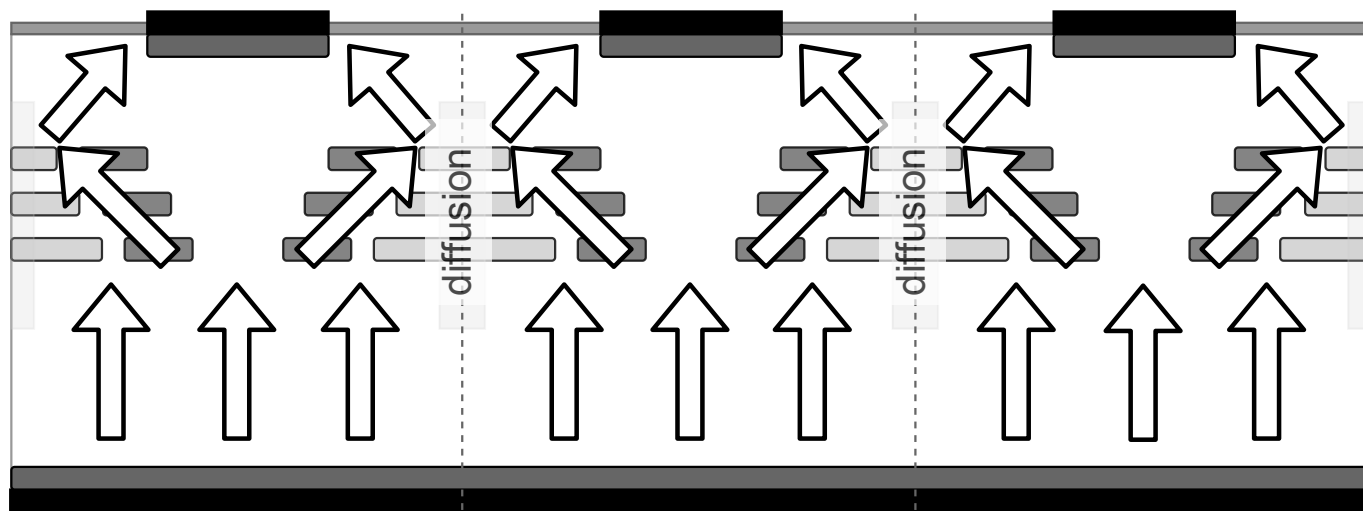


Anastasiia Velyka, Simon Spannagel, Doris Eckstein
19 Jan 2024 | Detector R&D retreat - DESY

Concept of an Enhanced Lateral Drift Sensor

Manipulating the electric field

- Buried implants → regions of additional doping

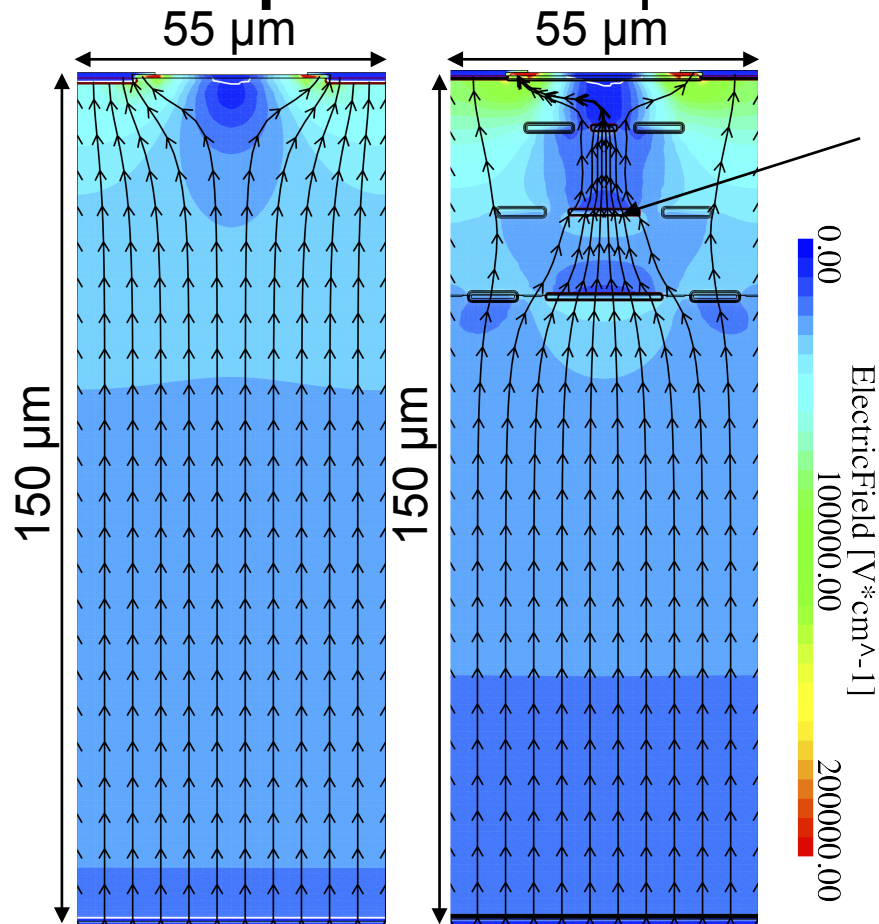


- Lateral electric field → repulsive/attractive areas inside the bulk
- **Modified drift path of the charge carriers**
- charge distribution between 1st and 2nd strip is **linear** → best charge sharing

Simulations of the ELAD Sensors

TCAD Electric Field & Transient Simulations

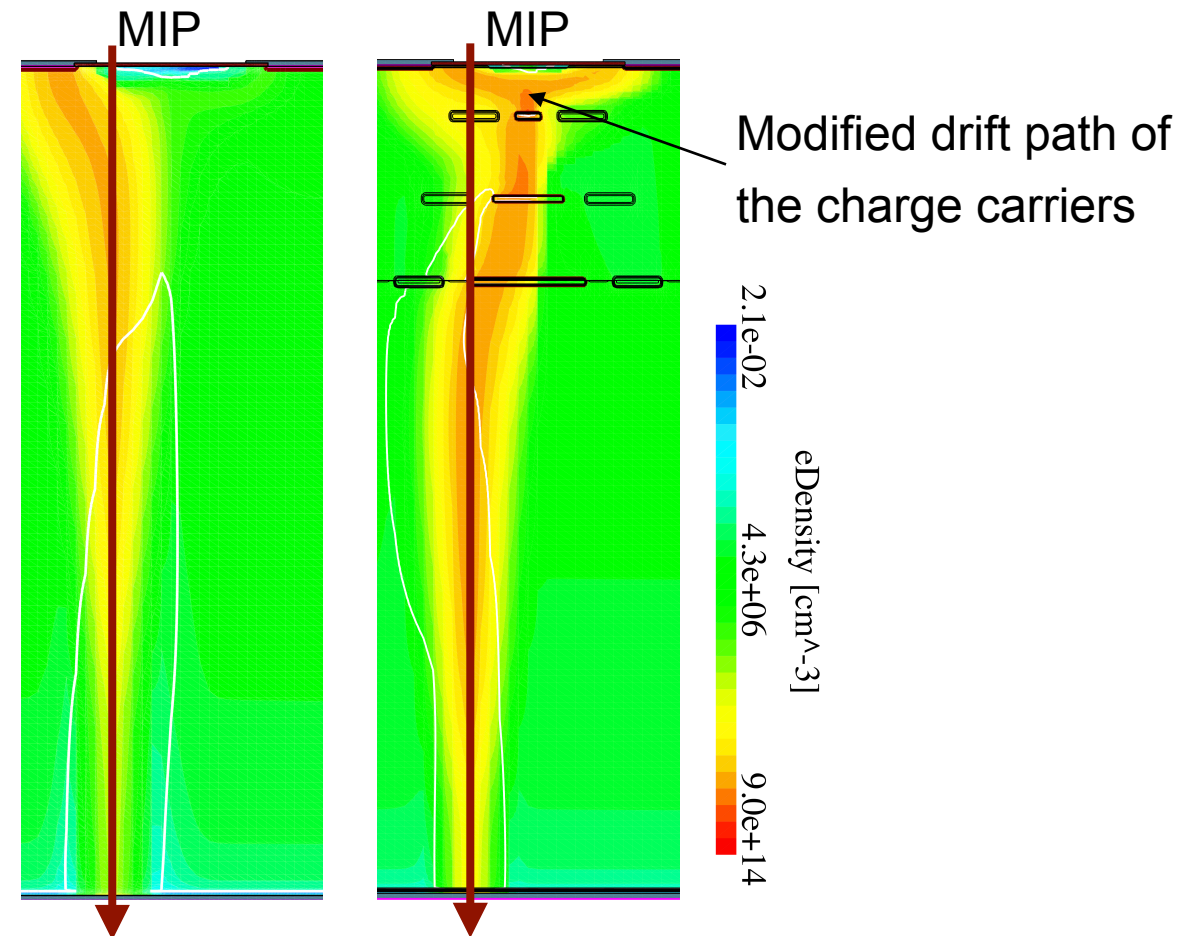
- Buried p^+ - and n^+ -implants create the lateral electric field in the bulk.



Electric field lines move to the centre

Planar sensor *p-ELAD*

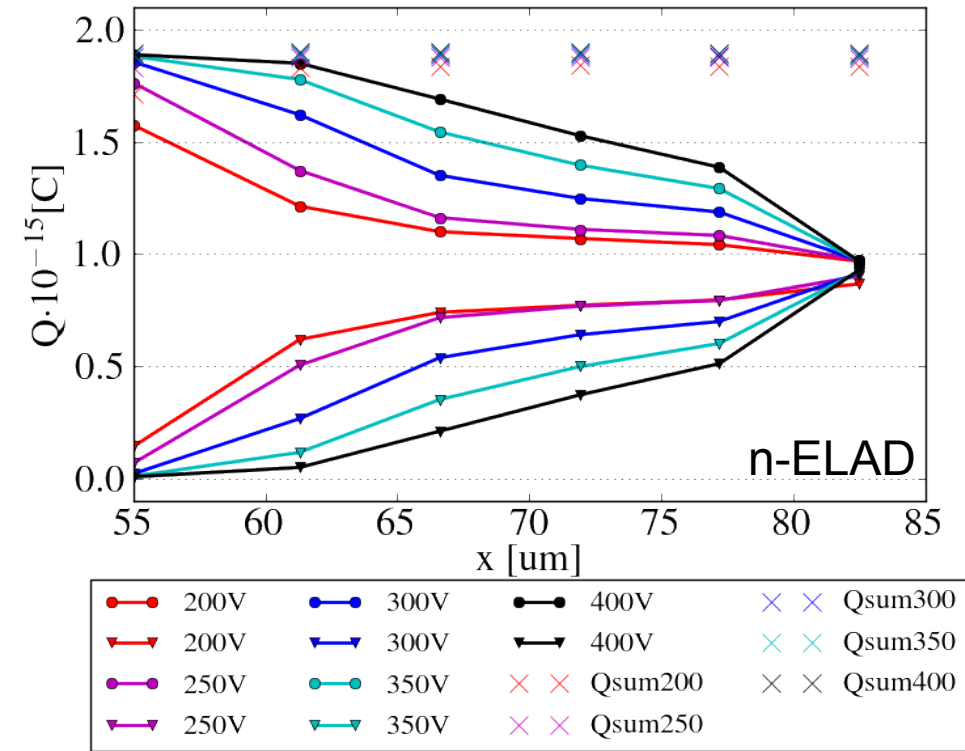
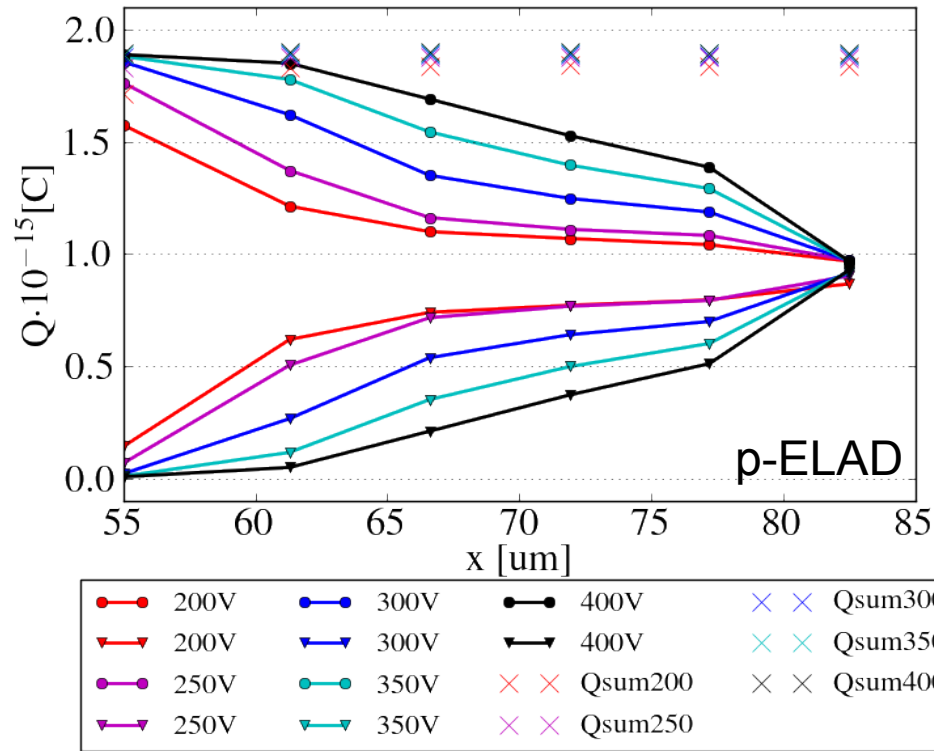
DESY.



Planar sensor *p-ELAD*

Simulations of the ELAD Sensors

TCAD η - function 150 μm ELAD $n_{\text{di}} = 3 \times 10^{15} \text{ cm}^{-3}$

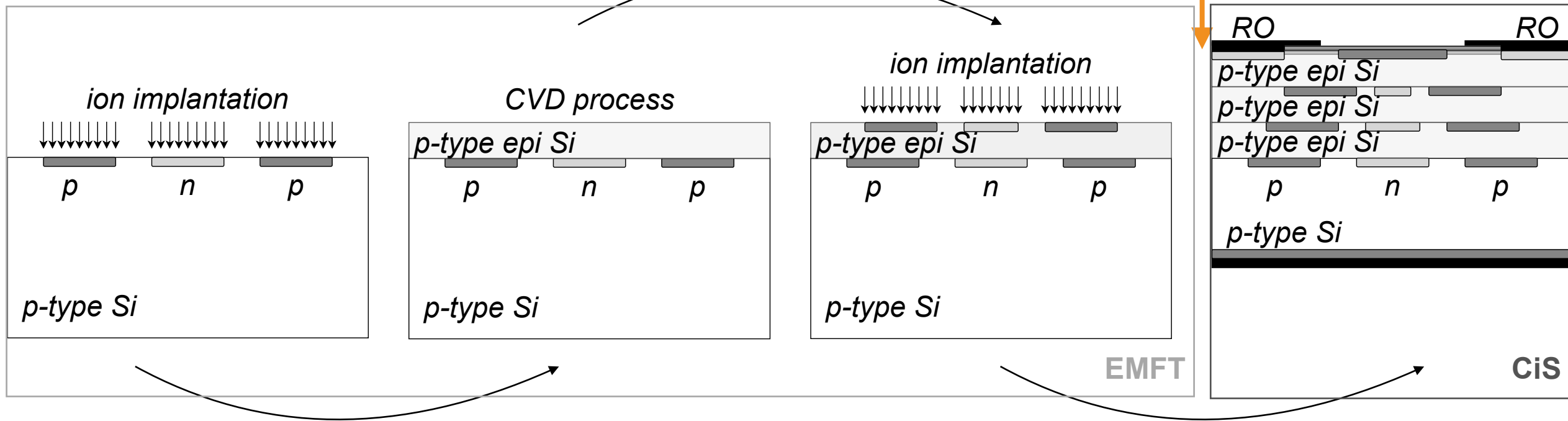


- p-ELAD: optimal voltage $\rightarrow$ 300V and 350V
- n-ELAD: optimal voltage $\rightarrow$ 250V and 300V
- **tuning** of the **lateral** and **longitudinal** components of the electric field

Production

New method

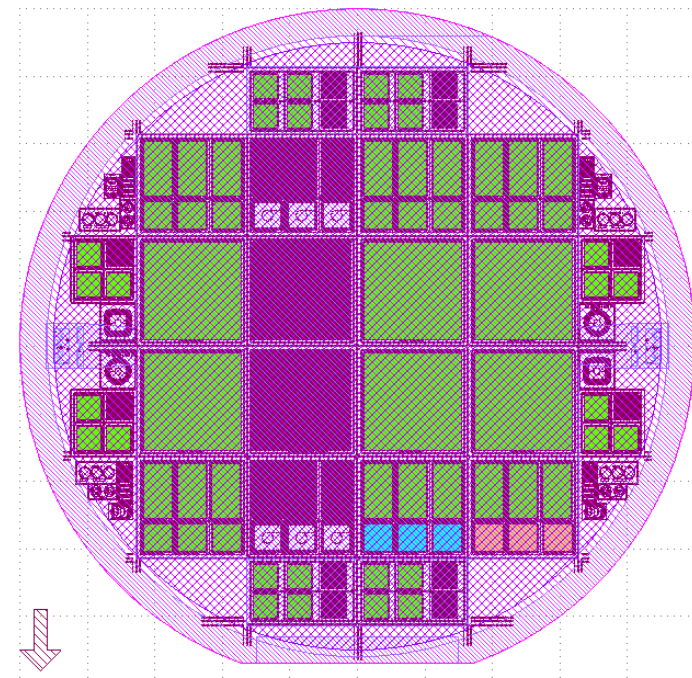
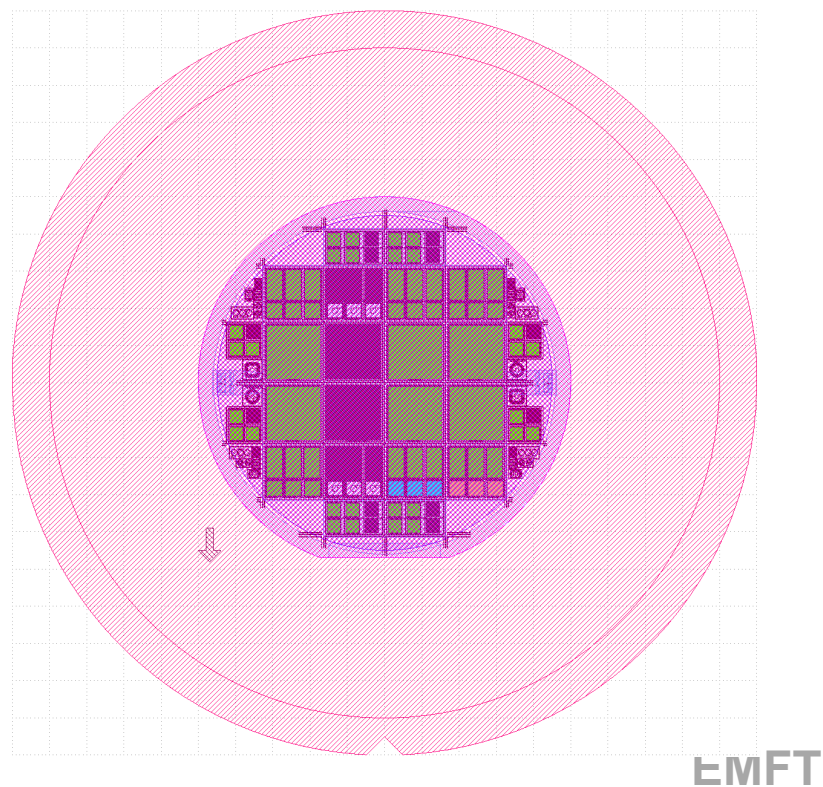
We are here



- Read-out implantation
- Wafer thinning to 150 μm
- Backside implantation
- Metallisation

Production

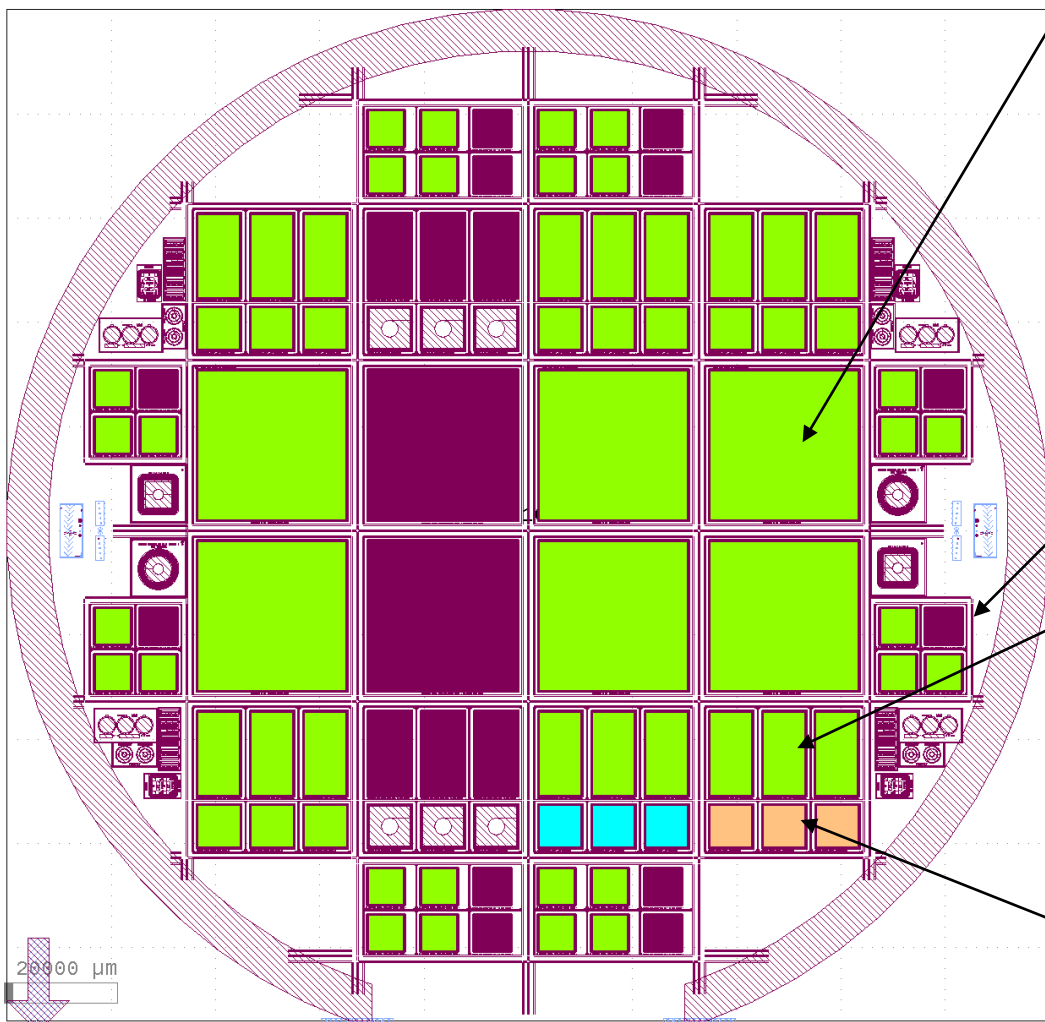
Wafer resizing



- EMFT production line wafer size -> 8 inch
- CiS production line wafer size -> 4 inch

Production

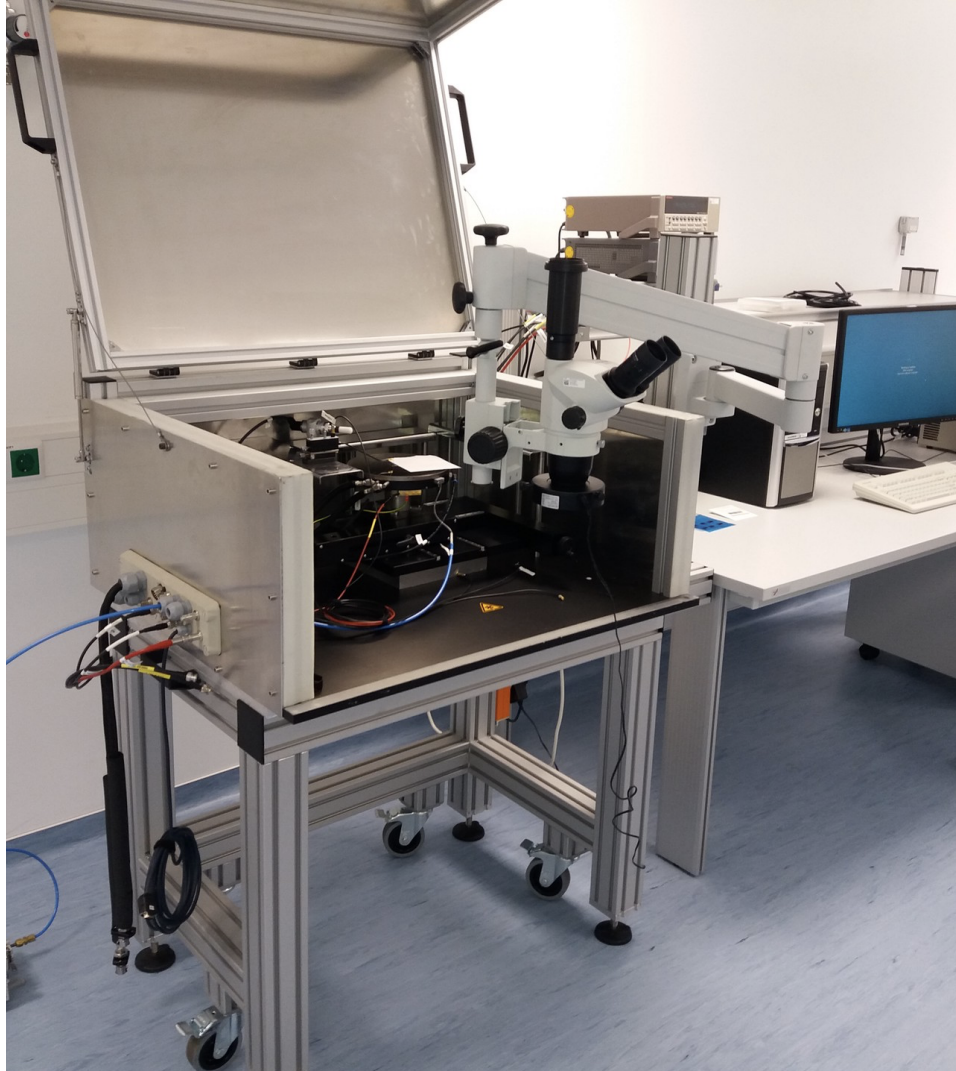
Wafer layout



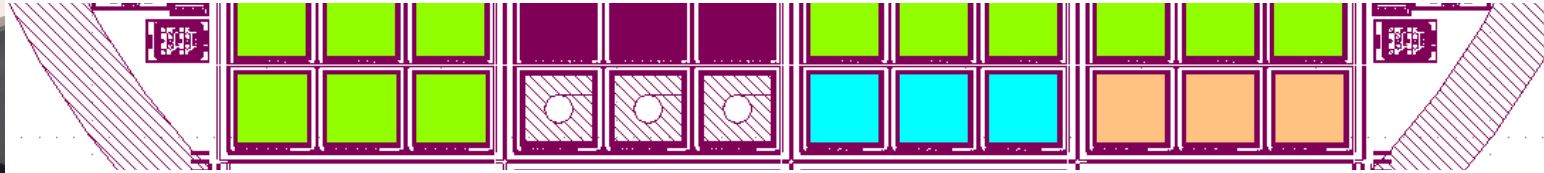
- Three types of sensors:
 - Timepix3 pixel sensor (test beam)
 - CP2 pixel sensor (test beam)
 - strip sensor (test beam & TCT)
 - diode (lab)
- Sensors with and without the buried implants
- Diodes with 1 and 2 buried implants layers
- SRP and SIMS for production quality control

Sensor characterisation

Probe station



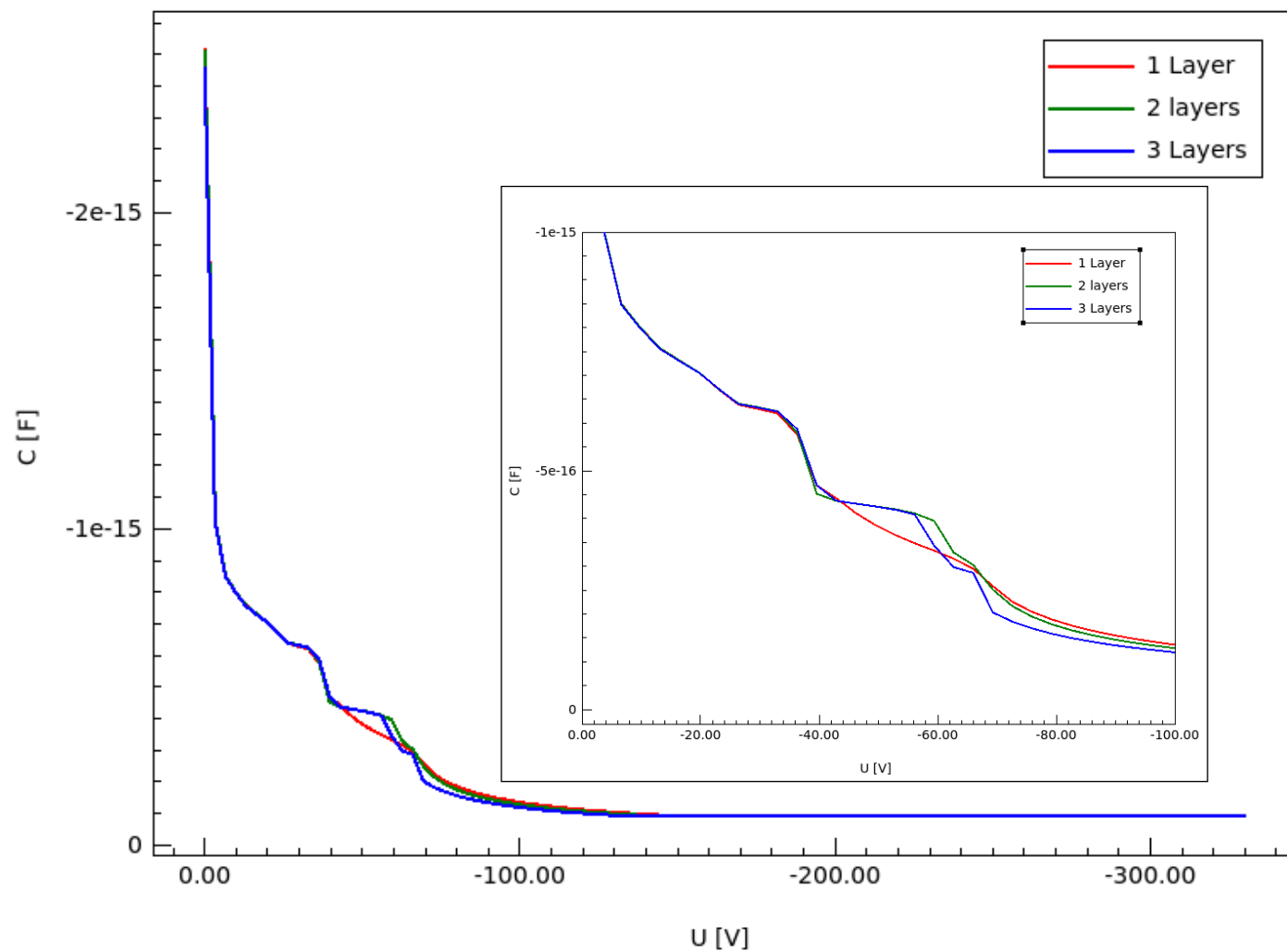
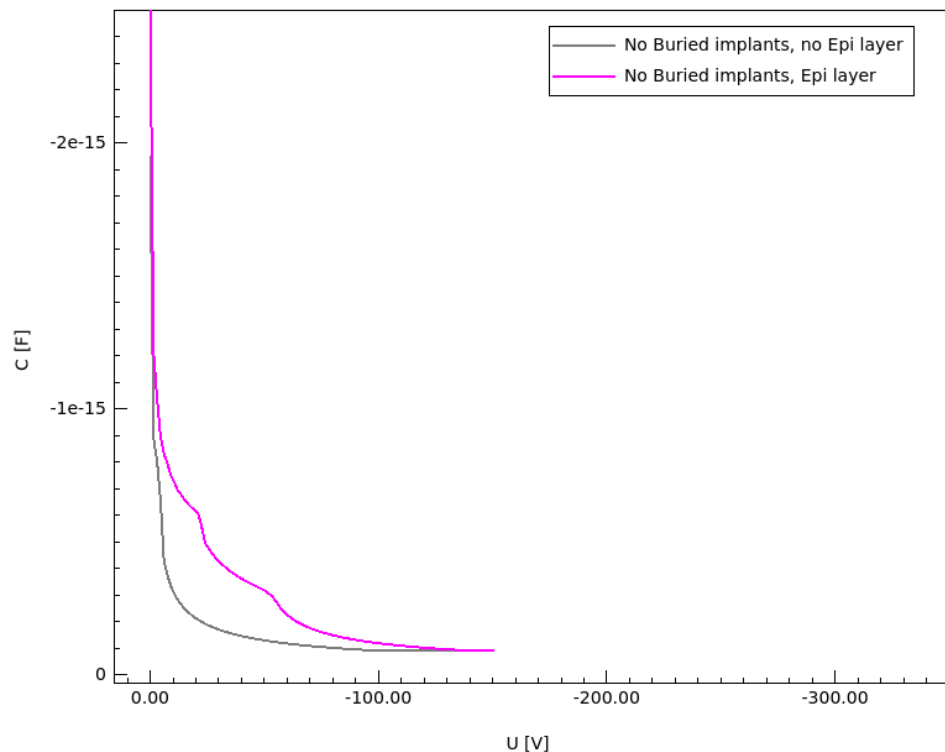
- Types of diodes:
 - with 1 buried implants layer
 - with 2 buried implants layer
 - with 3 buried implants layer
 - with 0 buried implants layer



- Measurements:
 - IV
 - CV

Sensor characterisation

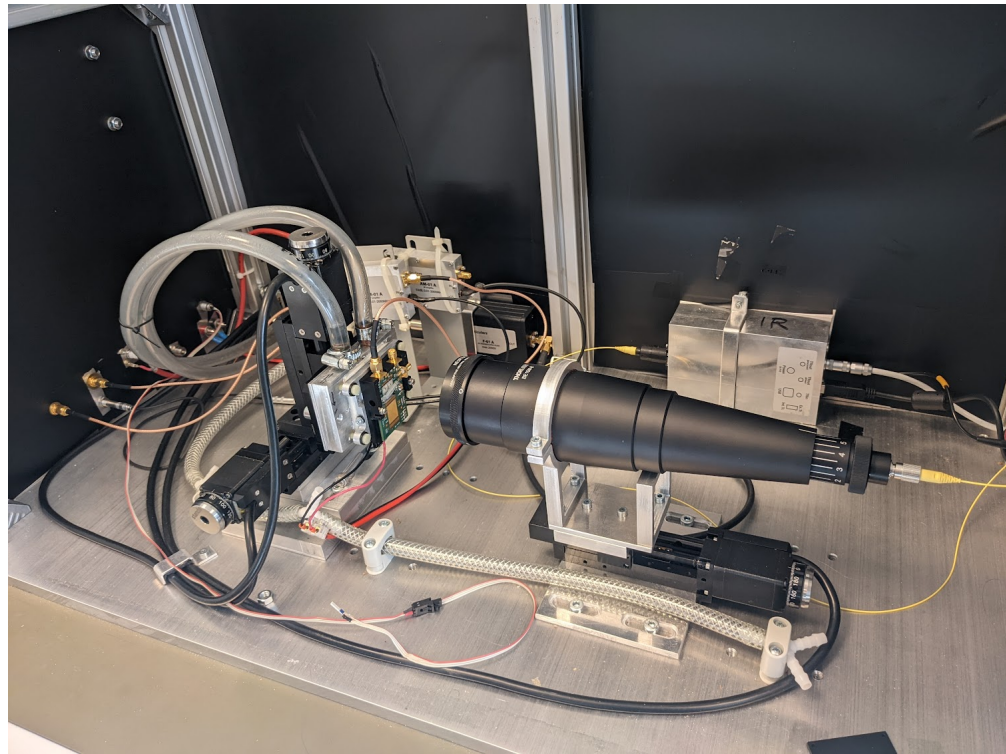
IV & CV Measurements



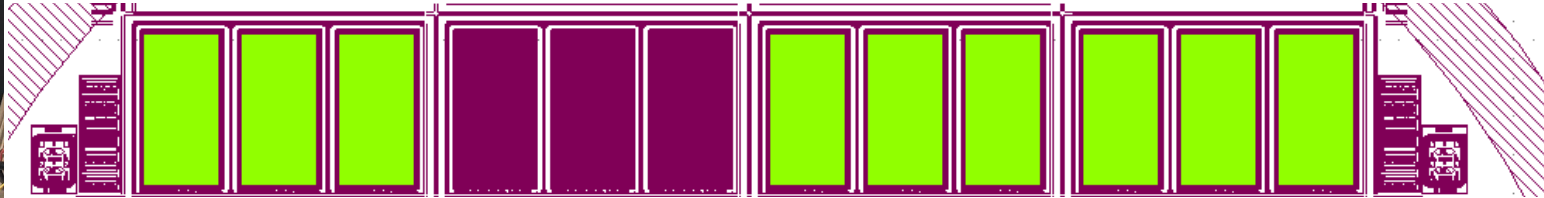
- CV measurement -> production process
- IV measurement -> expect no breakdown up 1000V

Sensor characterisation

Transient Current Technique (TCT) Setup



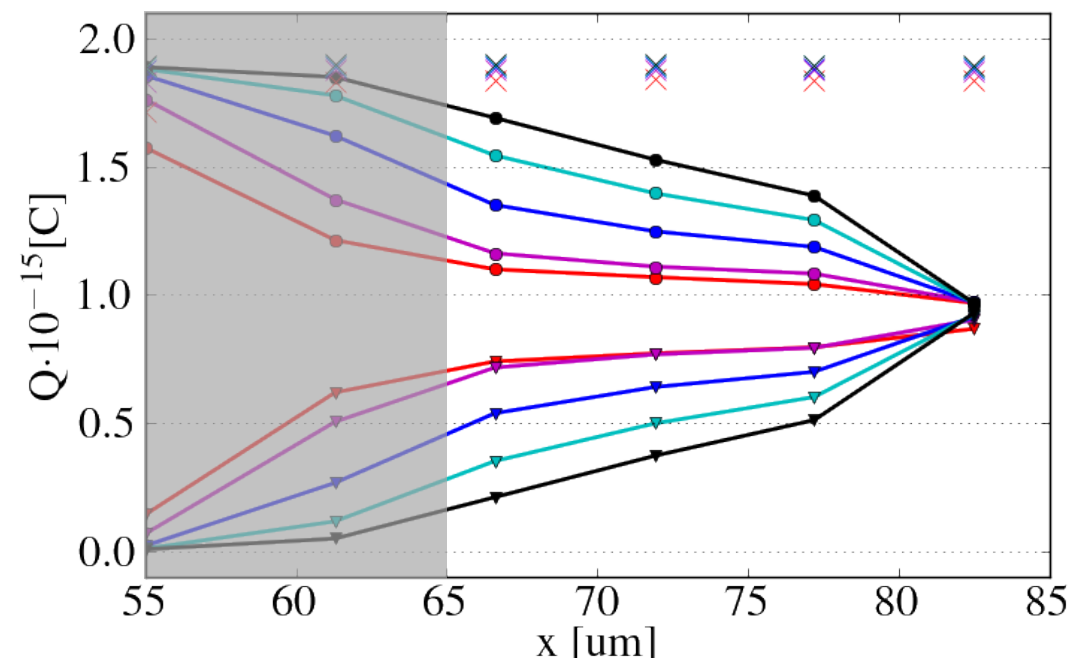
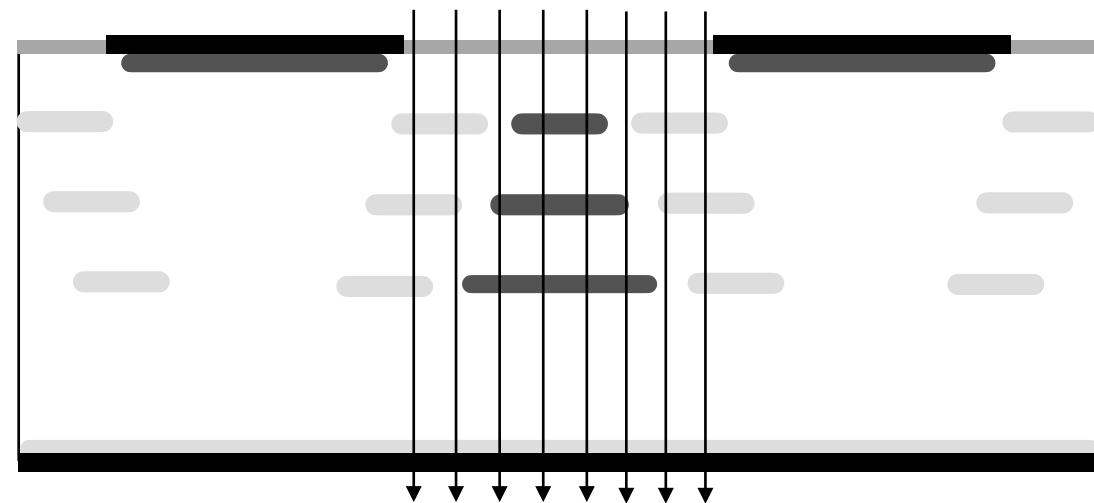
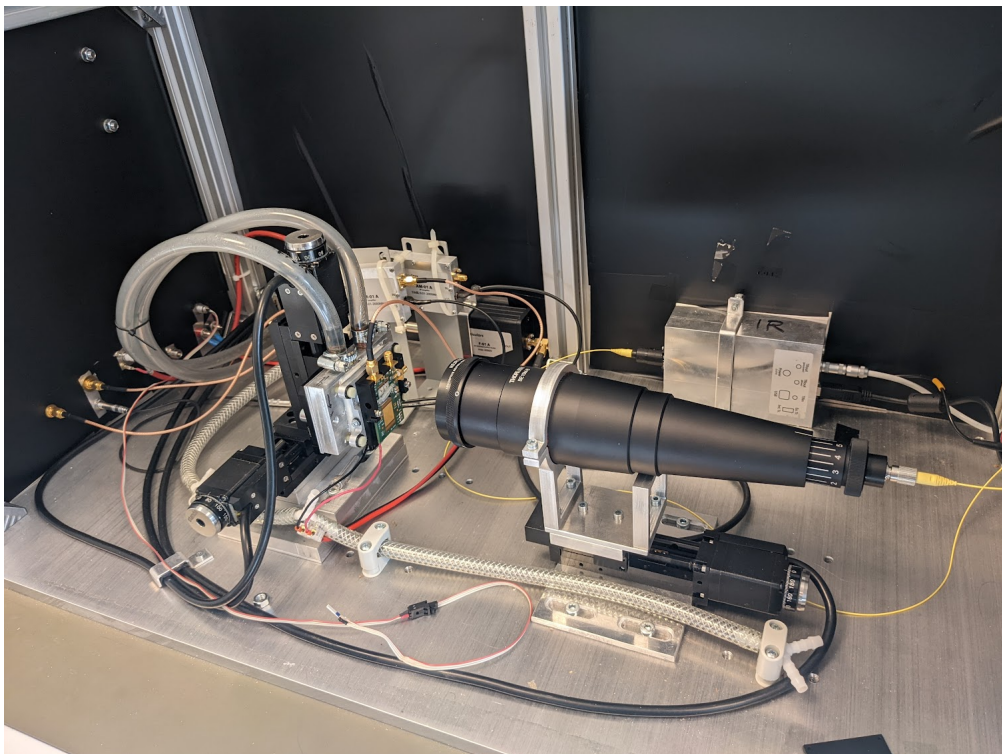
- Strip sensors
 - with 3 buried implants layer
 - with 0 buried implants layer



- DAQ:
 - TCT setup
 - Alibava
- Measurements:
 - η -function

Sensor characterisation

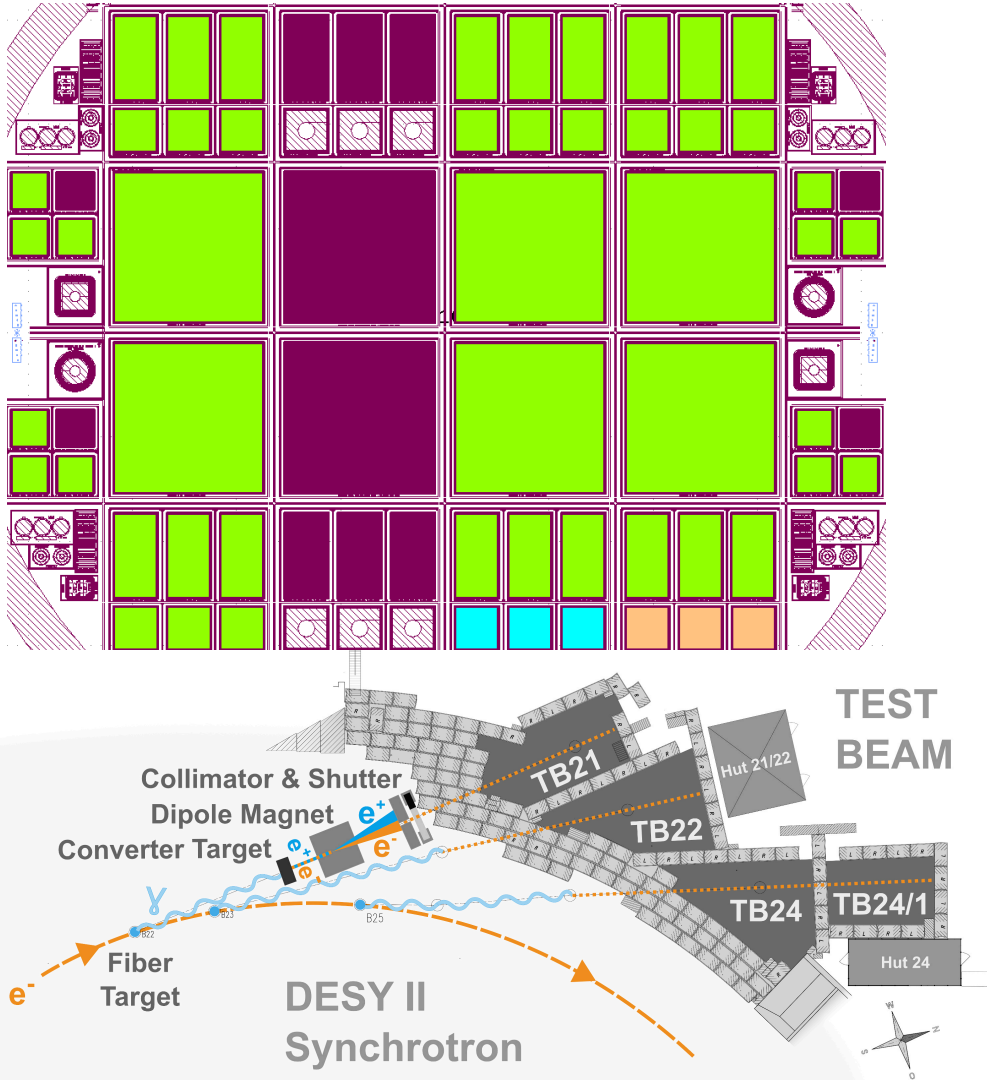
Transient Current Technique Setup



- The region beneath the read-out metallisation can not be measured

Sensor characterisation

Test beam

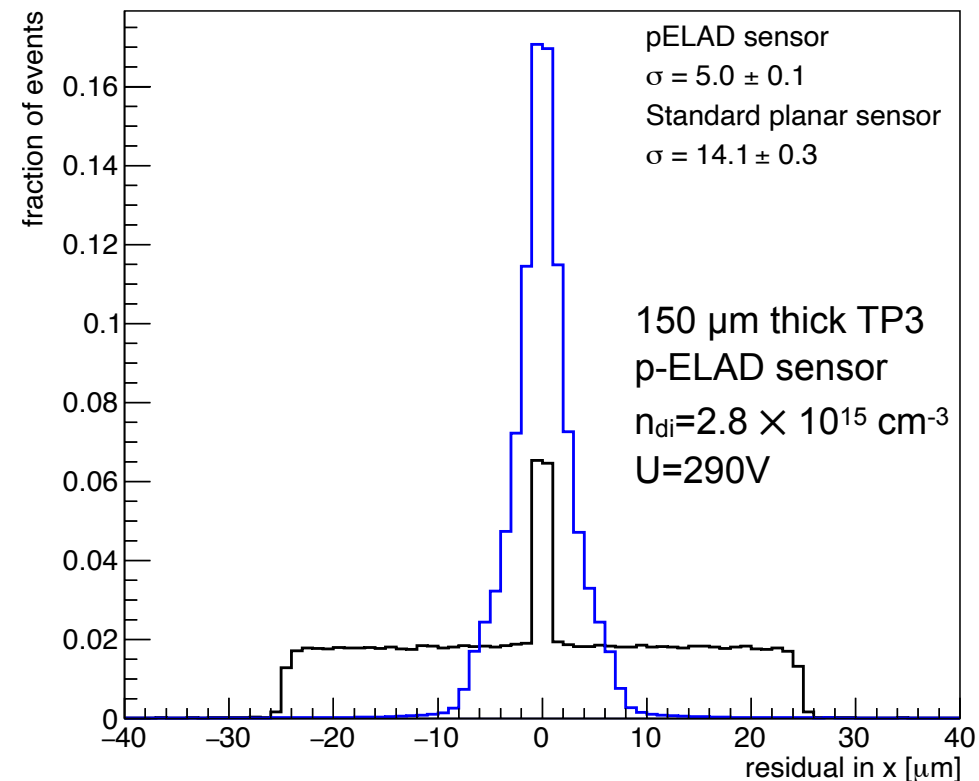
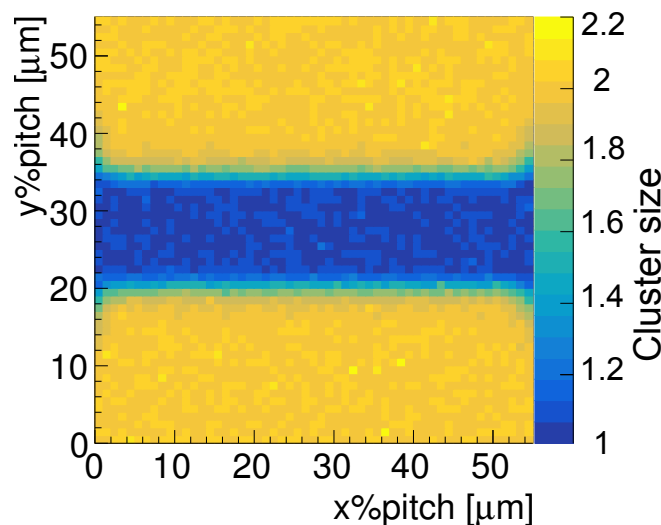


- Strip sensors (Alibava DAQ)
 - with 3 buried implants layer
 - with 0 buried implants layer
- Pixel sensors
- Timepix3
 - with 3 buried implants layer
 - with 0 buried implants layer
- CP2
 - with 3 buried implants layer
 - with 0 buried implants layer

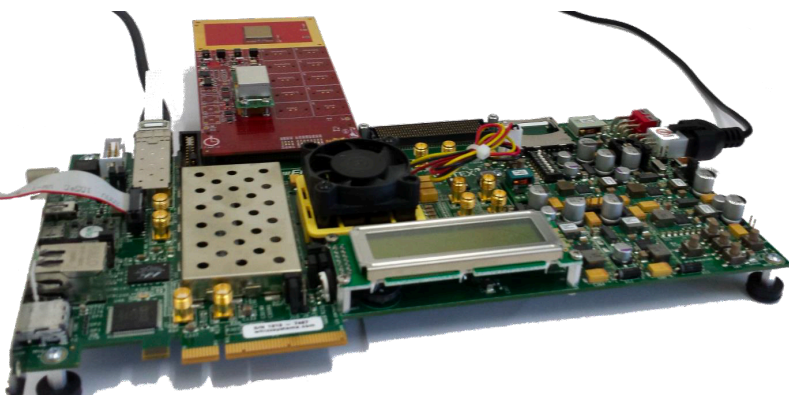
Sensor characterisation

Test beam 55x55 μm

- TimePix 3 ROC
- SPIDR DAQ



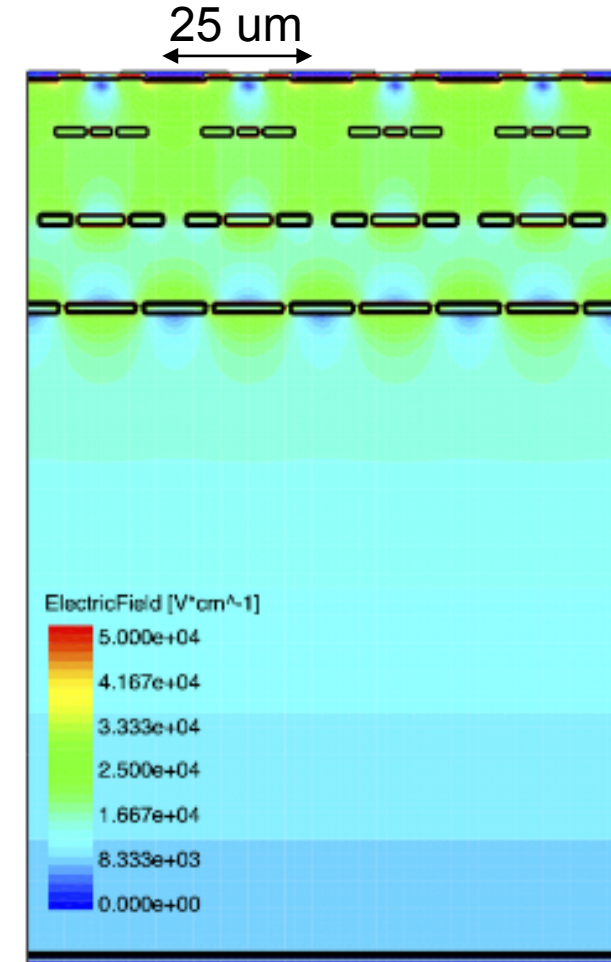
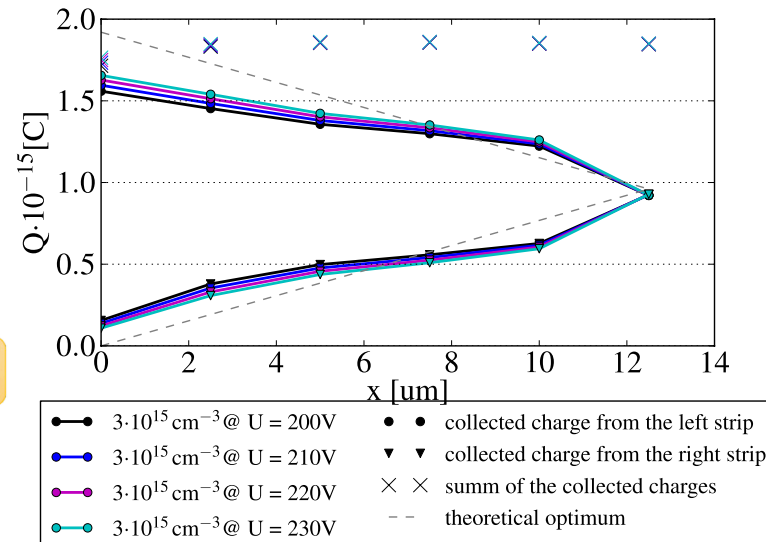
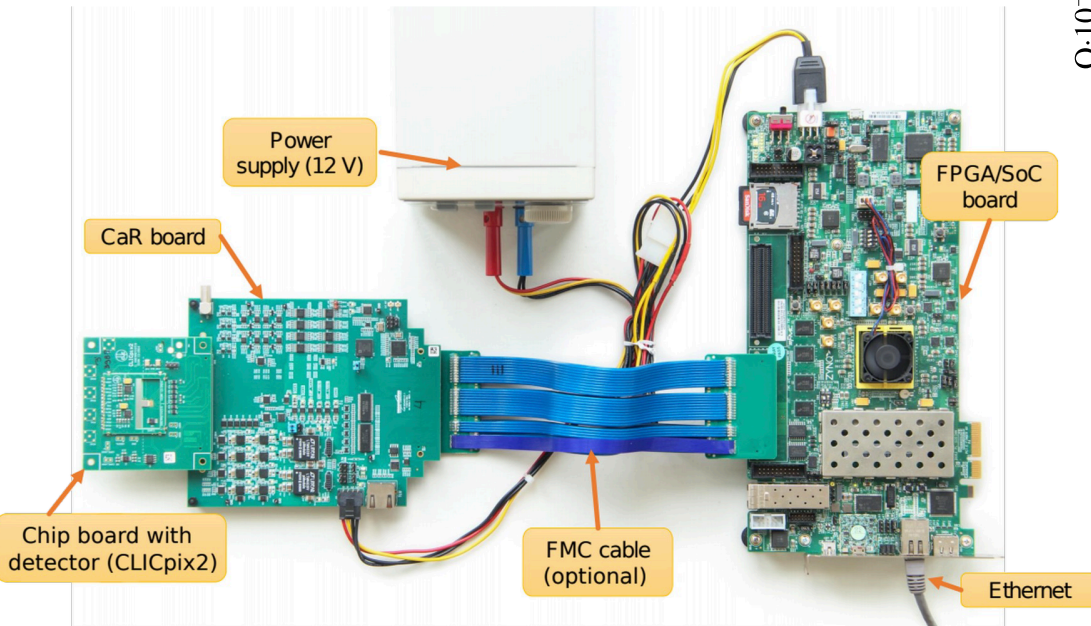
- Cluster size in y ~ 2
- $\sigma = 5.0 \pm 0.1 \text{ } \mu\text{m}$



Sensor characterisation

Test beam 55x55 μm

- CLICpix2 ROC
- Caribou DAQ



- Distances in depth are not optimised for 25x25 μm design

Summary & Outlook

Summary:

- The first stage of production is finished
- The wafers should be ready this year
- The characterisation of the sensors is planned at DESY

Outlook:

- Looking forward to receiving the wafers
- Probe station, TCT, test beam measurements
- Comparing the measurement results with the simulations

