Enhanced lateral drift sensors: simulation and production.

Third MT student retreat

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DESY

30.01.2017
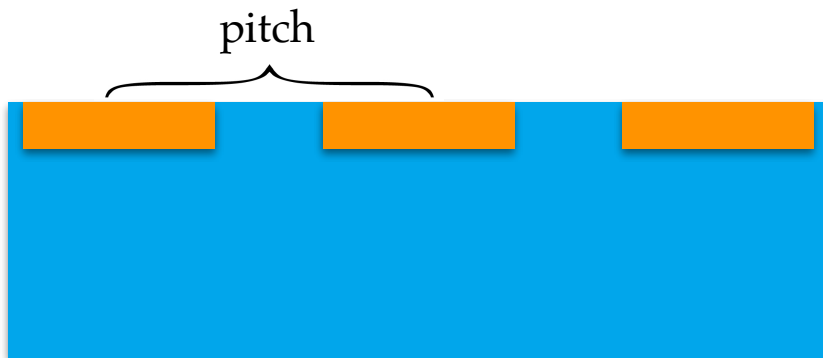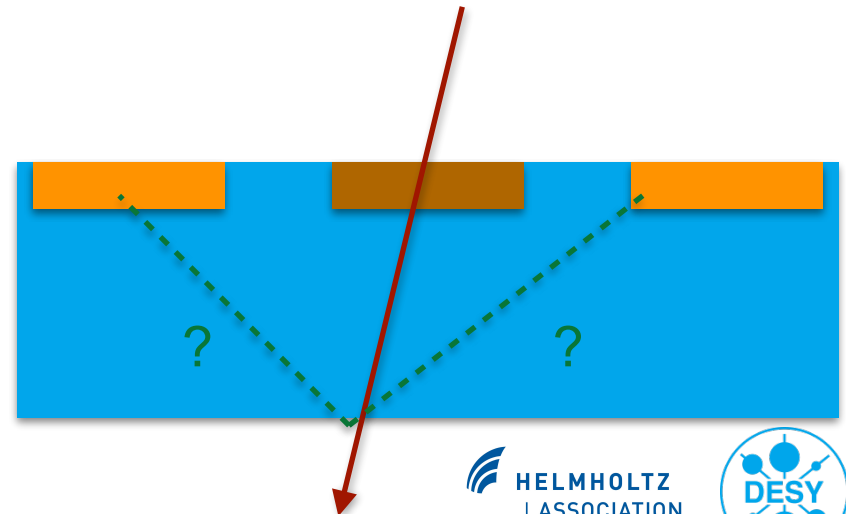
High position resolution

> Decrease the size of the read-out cell, i.e. to decrease the pixel or strip pitch

> Increase the lateral size of the charge distribution already during the drift in the sensor material

> The number of channels increases

> Less space on-chip per channel
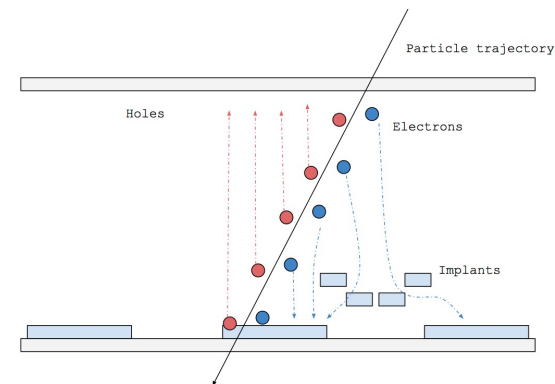
> Higher power dissipation

pitch

Main Goal

> **Main Goal** - Improve the position resolution of tracking sensors by local manipulation of the electric field.

> **Idea** - Improved position resolution rendered possible by increasing the lateral size of the charge distribution during the drift.
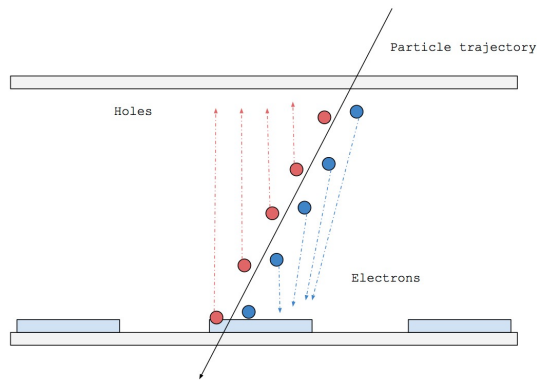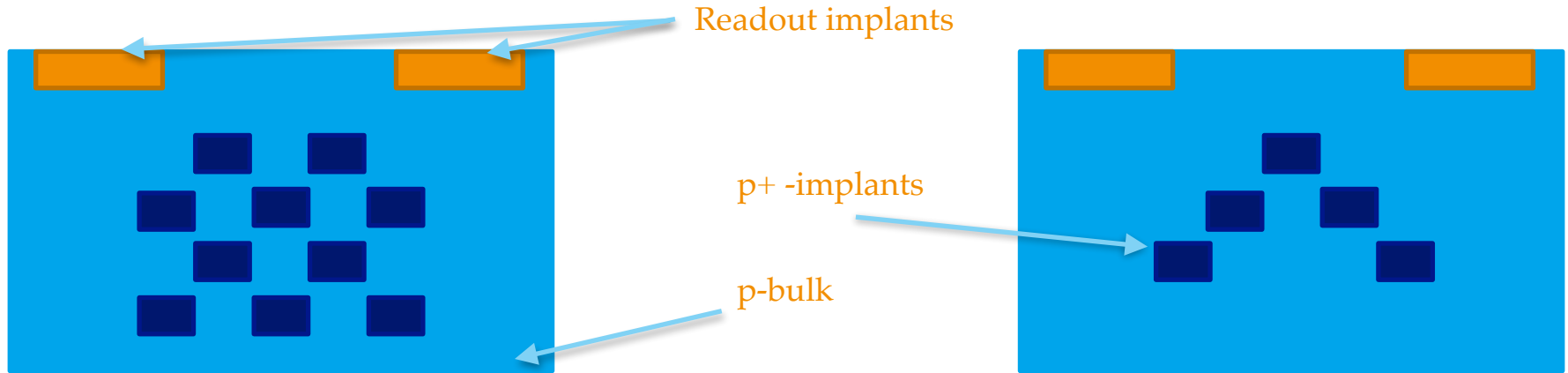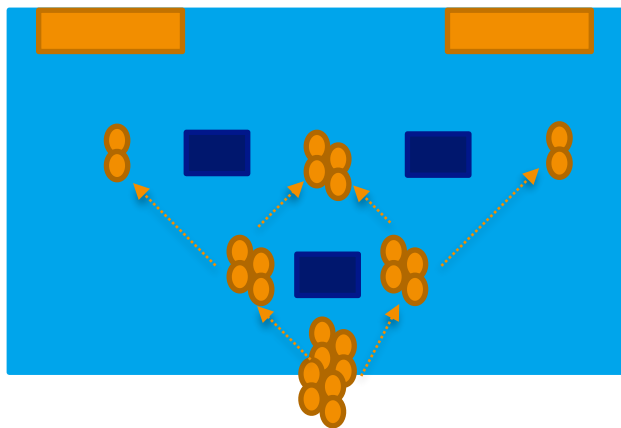

Usual design

New design

New design

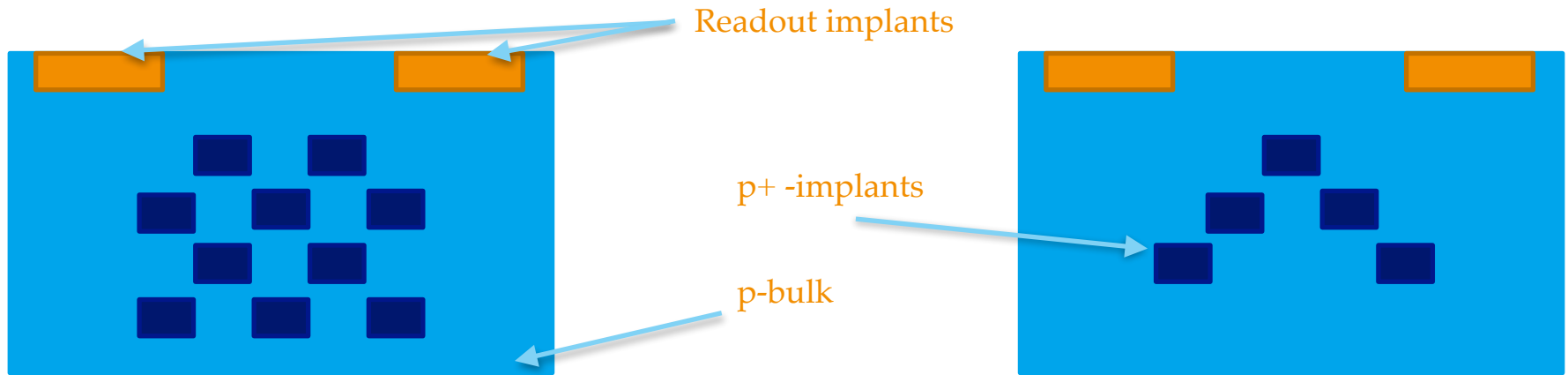Readout implants

p+ -implants

p-bulk

Binomial design
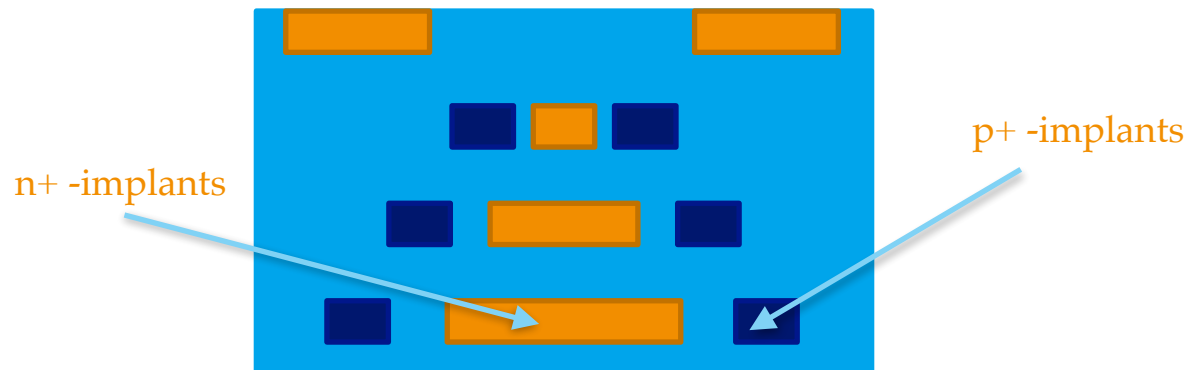
Tweak position of implants

- Repulsive areas split the charge cloud 50-50. Apply this layer-wise.
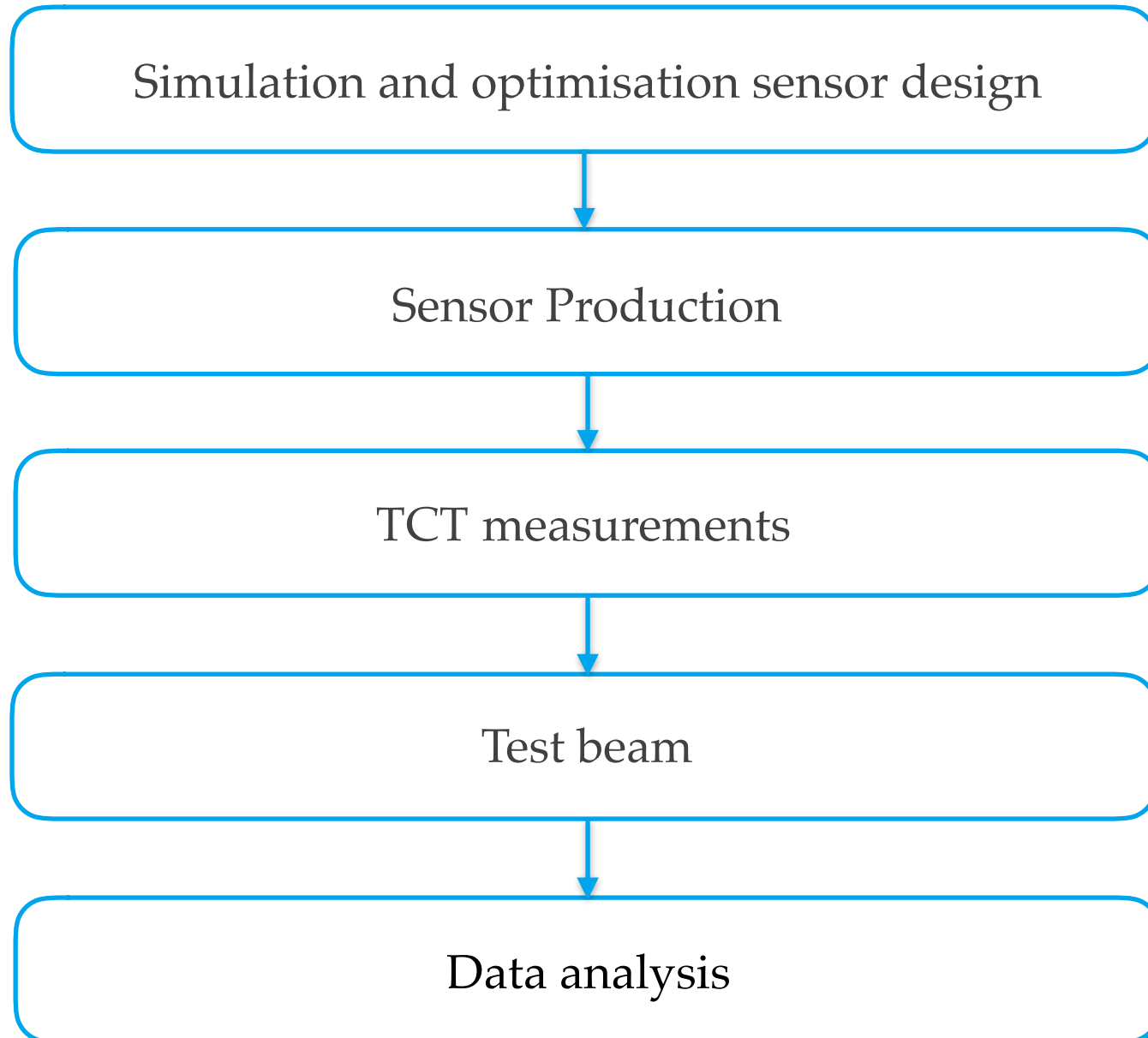- Achieve lateral enlargement of charge cloud independent of the incident position

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New design

Readout implants

p+ -implants

p-bulk

Binomial design
- not enough charge sharing

Tweak position of implants
- hight value of N_{eff}

n+ -implants

p+ -implants

ELAD design
+ enough charge sharing
+ controlled value of N_{eff}

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Stages of development

Simulation and optimisation sensor design

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Sensor Production

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TCT measurements

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Test beam

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Data analysis

Readout electrode

P-spray
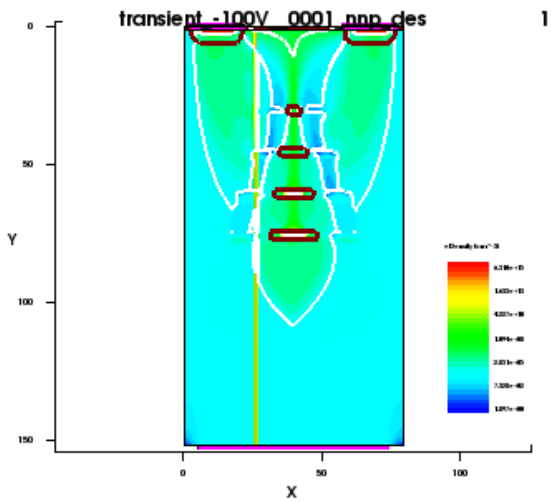
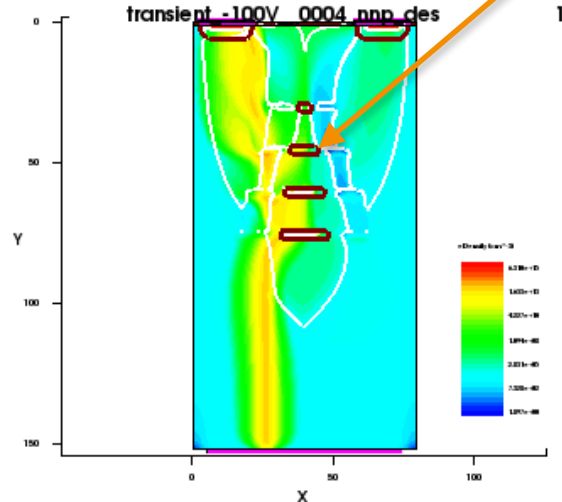Readout implants

Epi-zone

n-implants

p-implants

p-bulk

Backplane
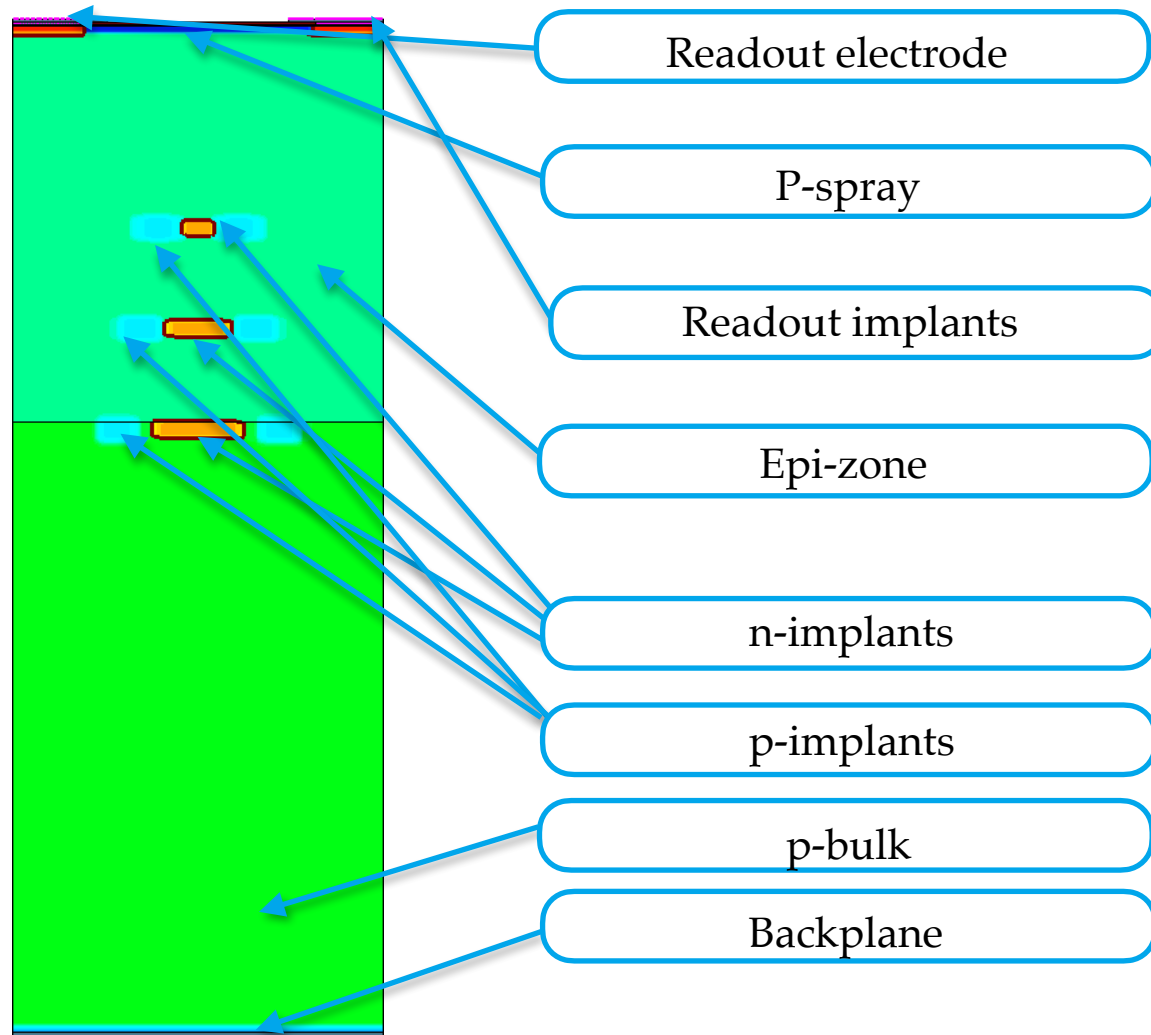
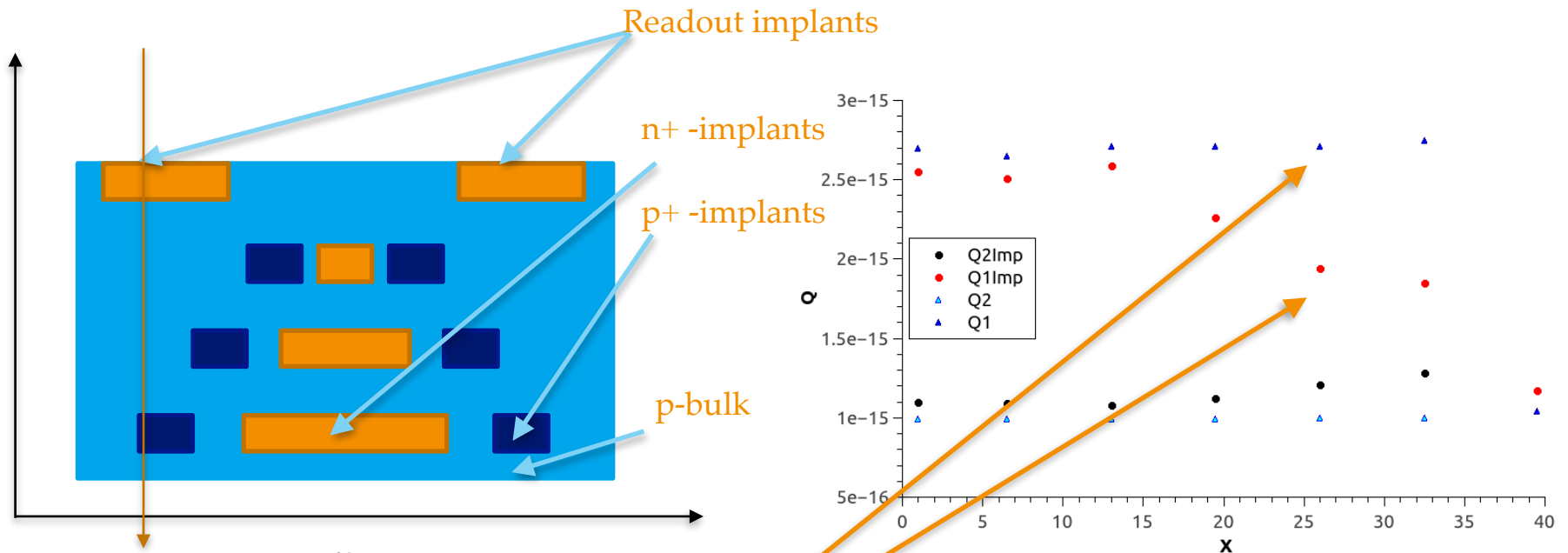## Drift simulations in TCAD SYNOPSYS

Charge sharing
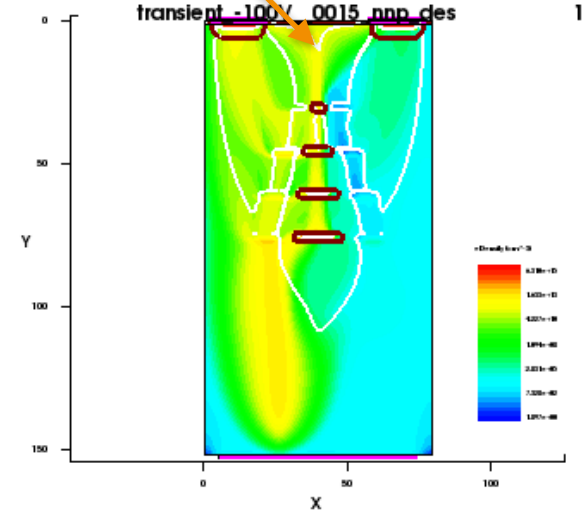
t=1e-12s
t=1e-10s
t=1,2e-9s

> Number of collected charge carriers for each strip

Readout implants

n+ -implants

p+ -implants

p-bulk

MIP position

x

Charge sharing

Q1 - collected charge at 1st strip in usual sensor;
Q2 - collected charge at 2nd strip in usual sensor;
Q1Imp - collected charge at 1st strip in ELAD;
Q2Imp - collected charge at 2nd strip in ELAD;
V=100V.

Surface implantation

Epi layer and
surface implantation

p+ -implants

p-bulk

Readout implants

n+ -implants

Backplane

Epi layer and
surface implantation

Epi layer, surface
and backside
implantation

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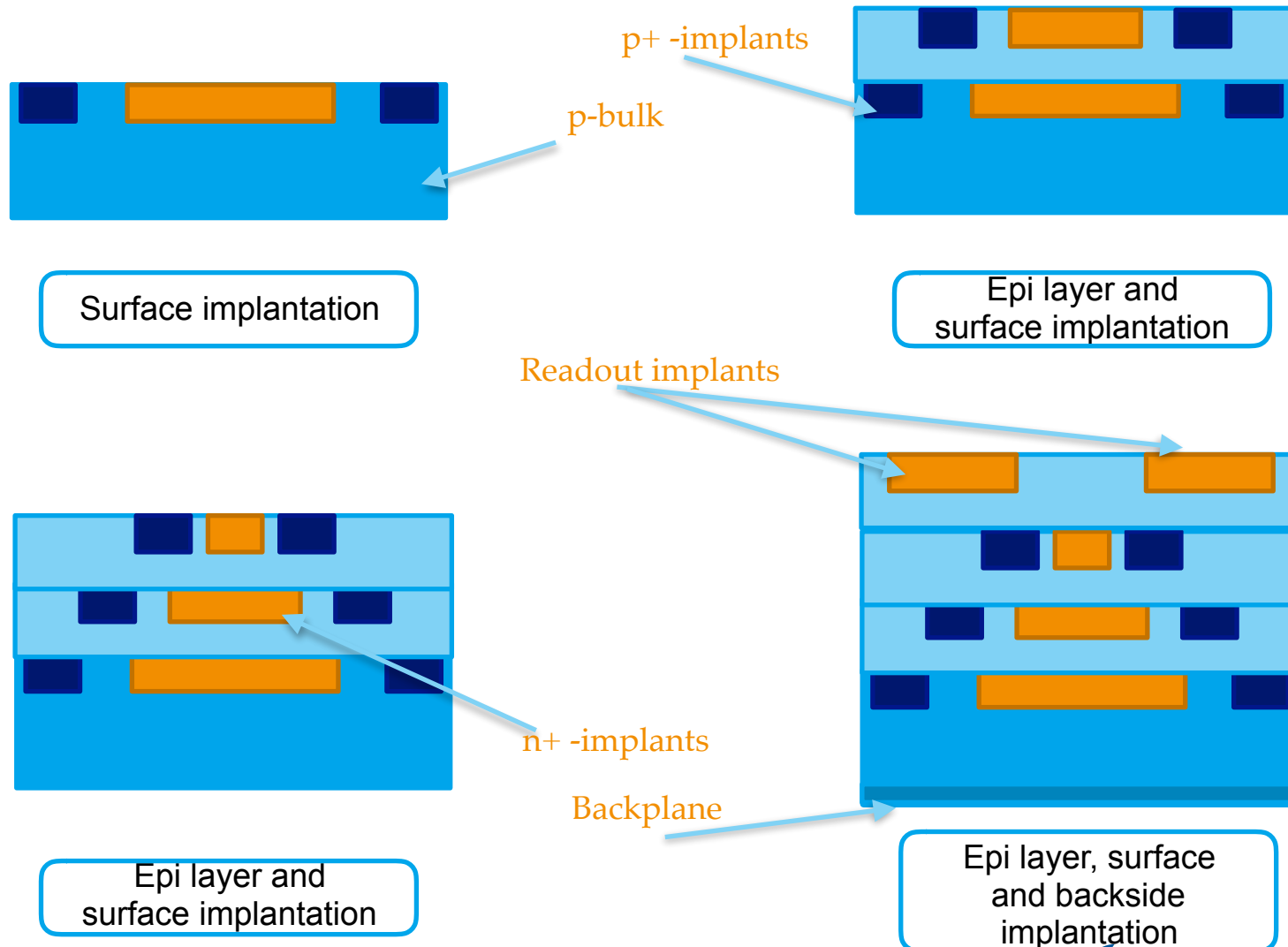
Next steps:

- Make simulations using different voltage in TCAD;

- Make simulations using different MIP positions in TCAD;

- Optimise design;

- Pick the better design;

- Production!

- Lab test (TCT);

- Test beam;

- Data analysis.

Thank you for attention!