

Development and construction of InGrid based gaseous detectors

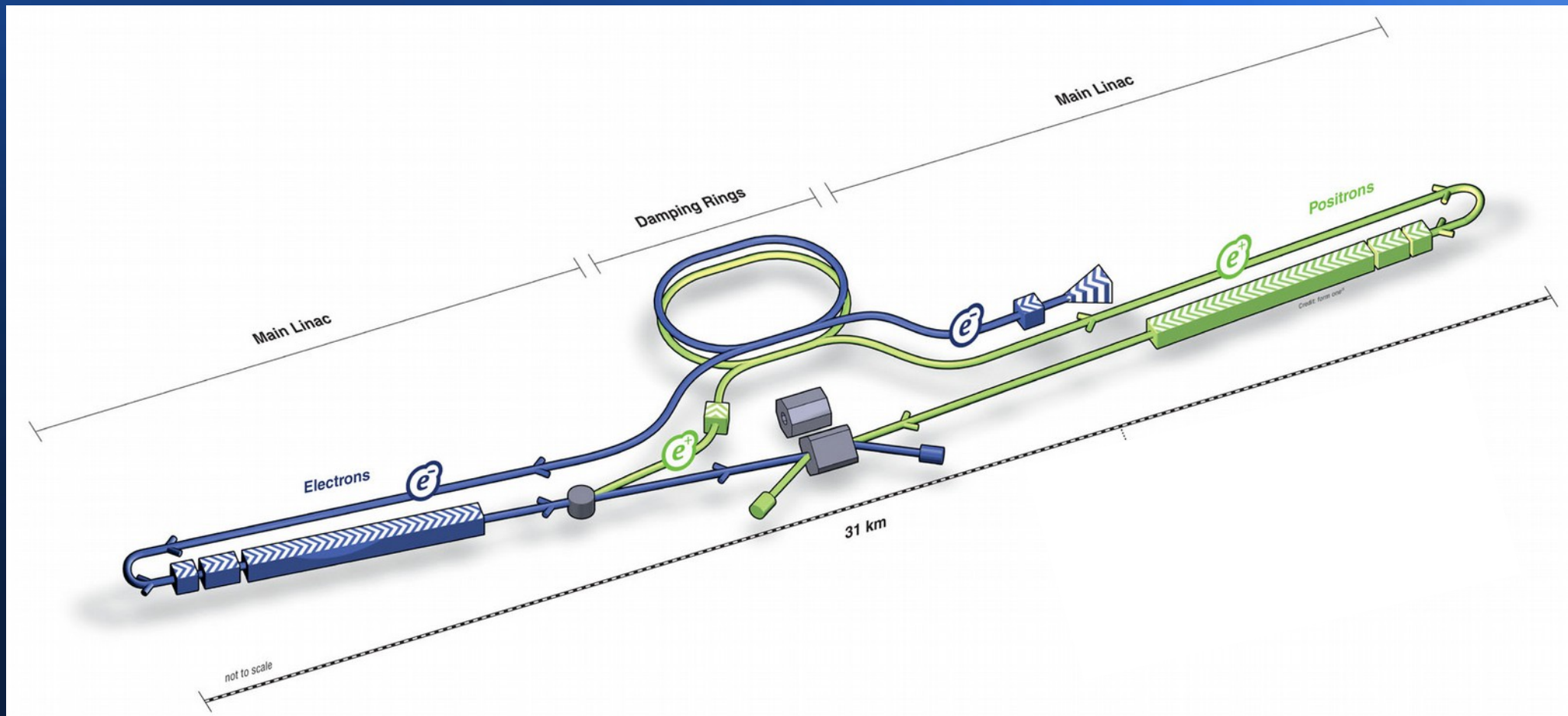
DPG Frühjahrstagung
Münster 2017

HK 8.3

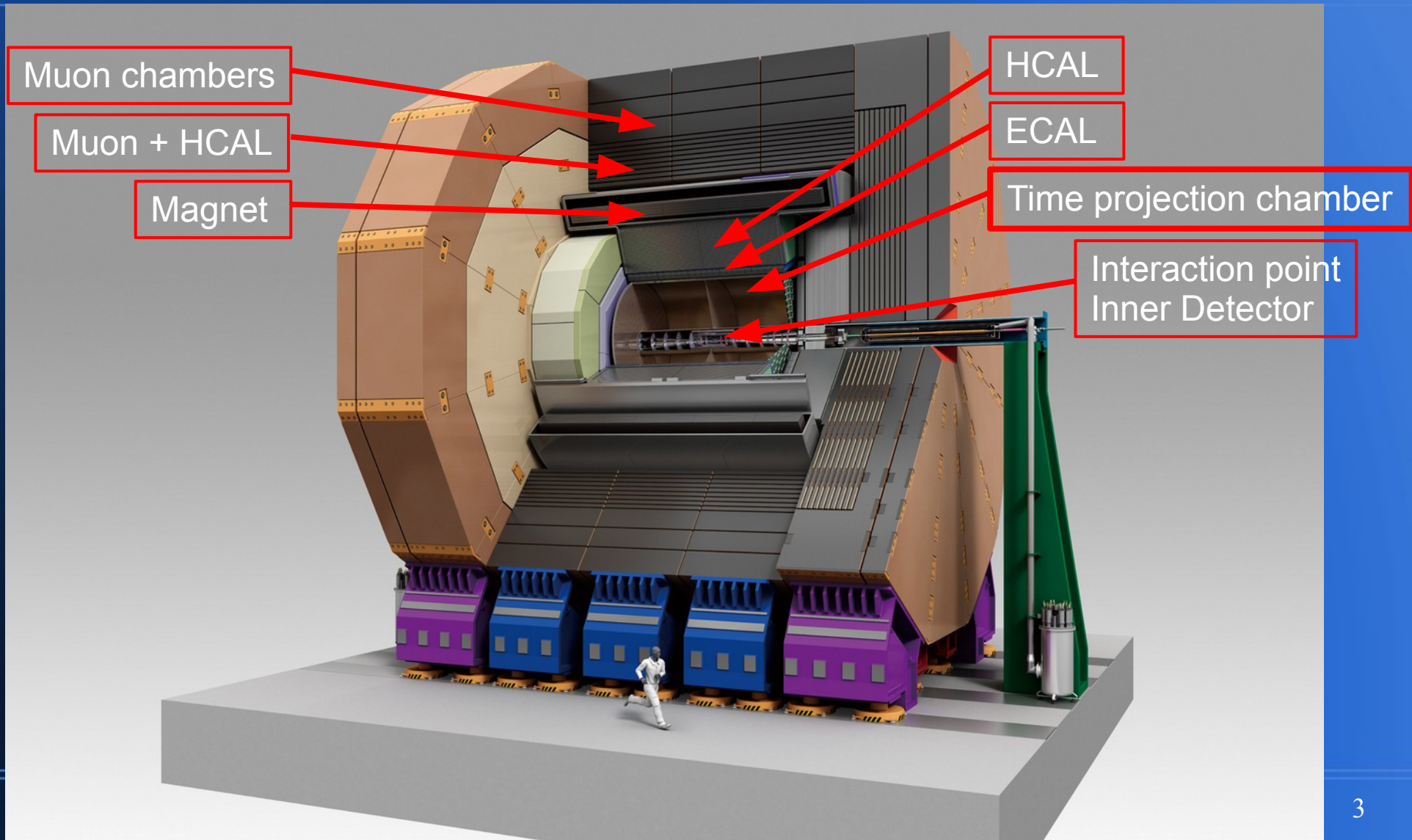
Tobias Schiffer
Universität Bonn



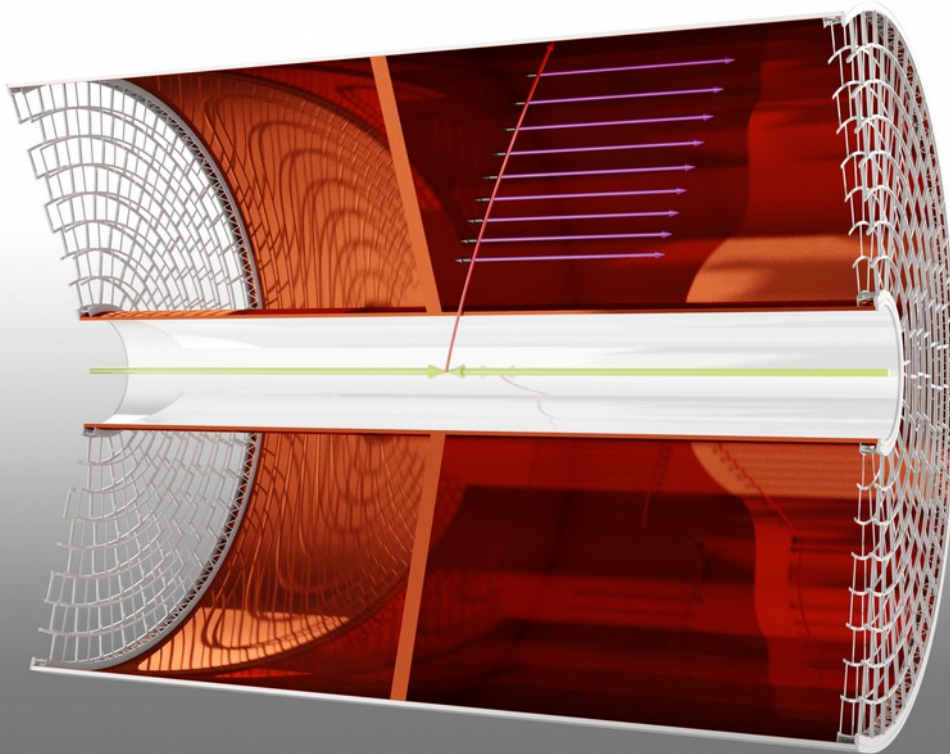
International Linear Collider



International Large Detector



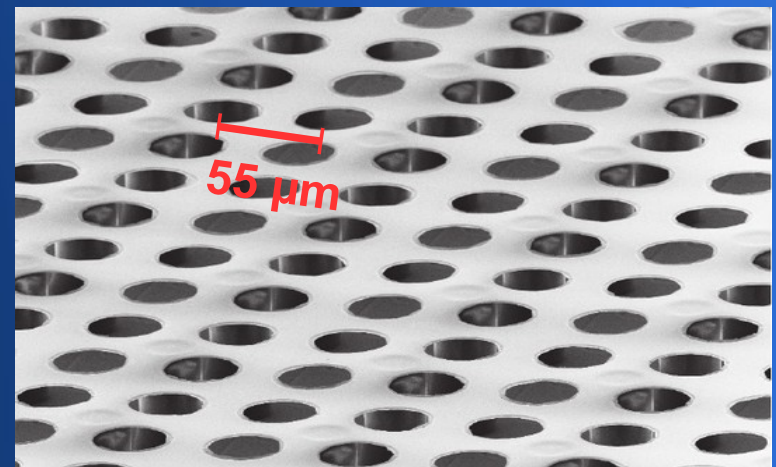
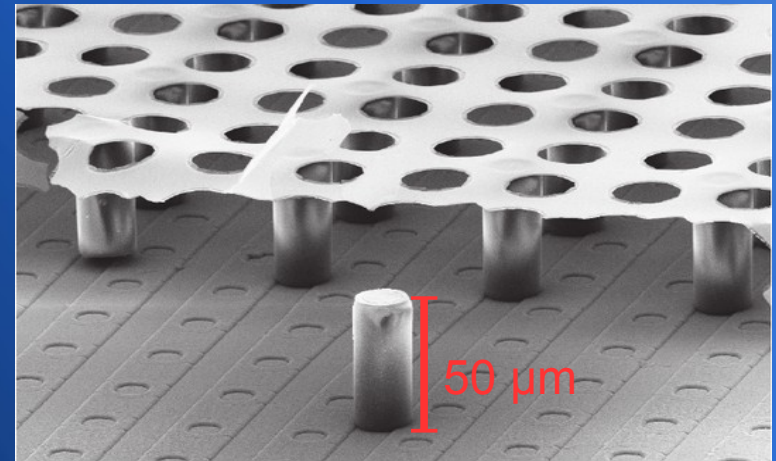
Time Projection Chamber



- Main tracker
- 4.3 m long
- 3.6 m diameter
- 10 m² endplates per side

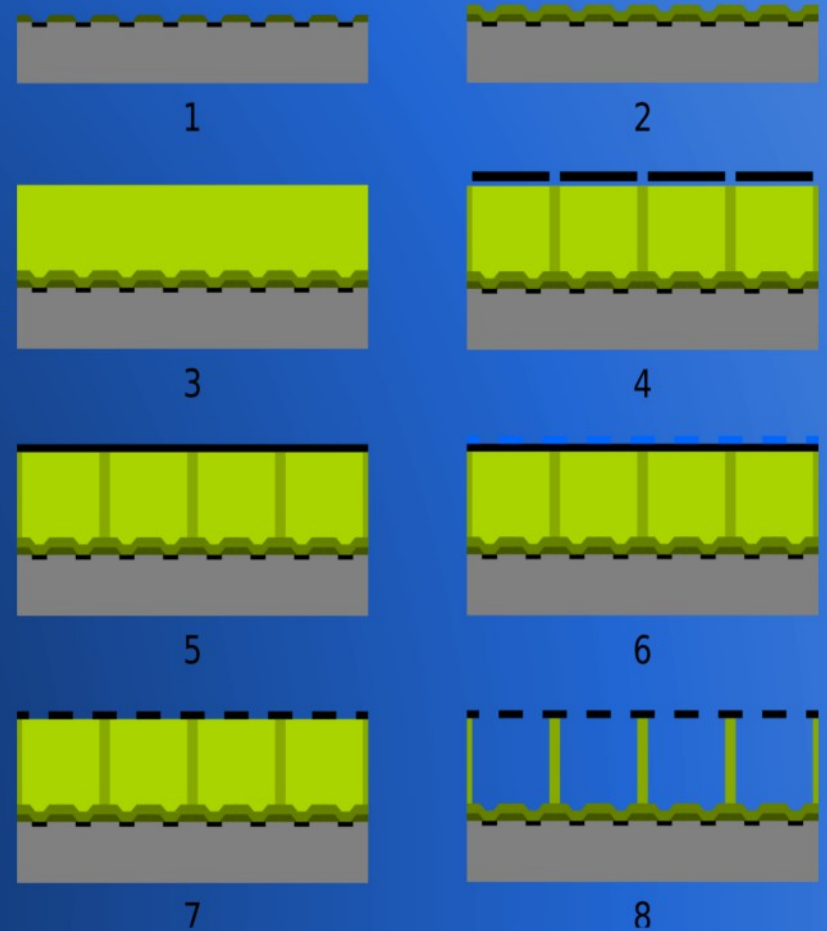
InGrid (Integrated Micromegas)

- Micromegas structure
- Aluminium grid of $1\mu\text{m}$ thickness
- One hole above each pixel
- $55\mu\text{m}$ spacing between the holes



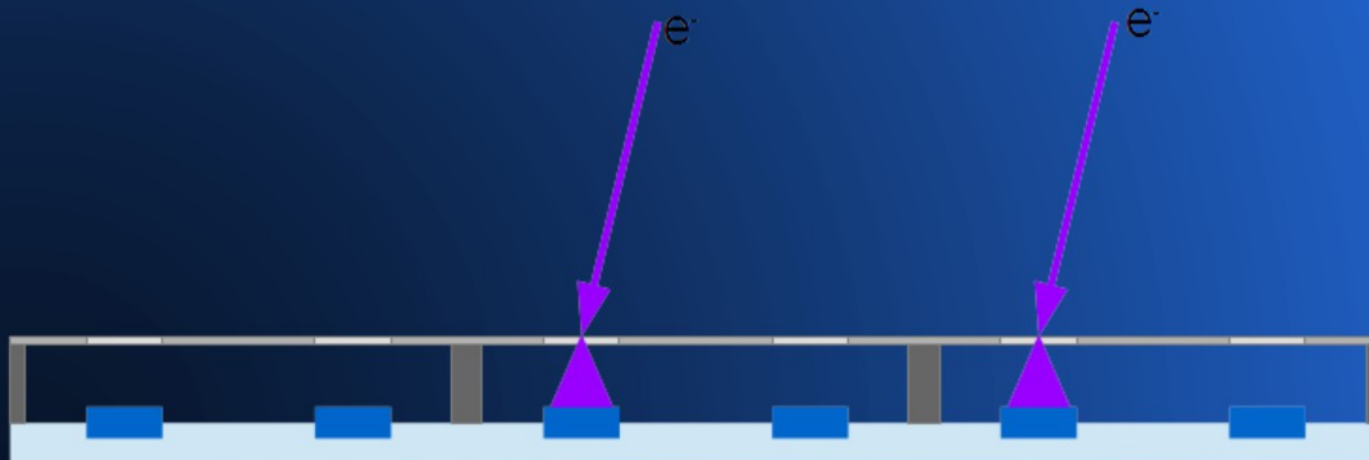
Production of InGrids

1. Timepix ASIC
2. Formation of the resistive layer
(4 μm to 8 μm Si_xN_y)
3. Deposition of SU-8 negative photoresist
4. Exposure of the photoresist
5. Aluminium sputtering (1 μm)
6. Putting the mask on the aluminium
(photoresist)
7. Etching the aluminium holes
8. Wash out of the SU-8



Amplification with an InGrid

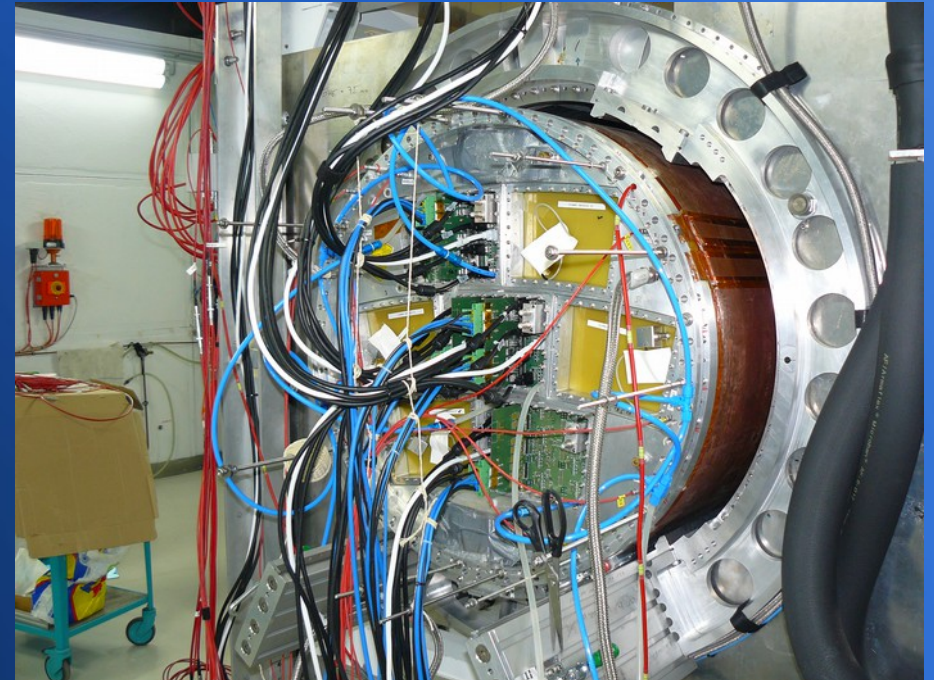
- Below the grid the field is stronger causing an avalanche effect
- Charge is measured in our case with a pixel chip



Usage of GridPix

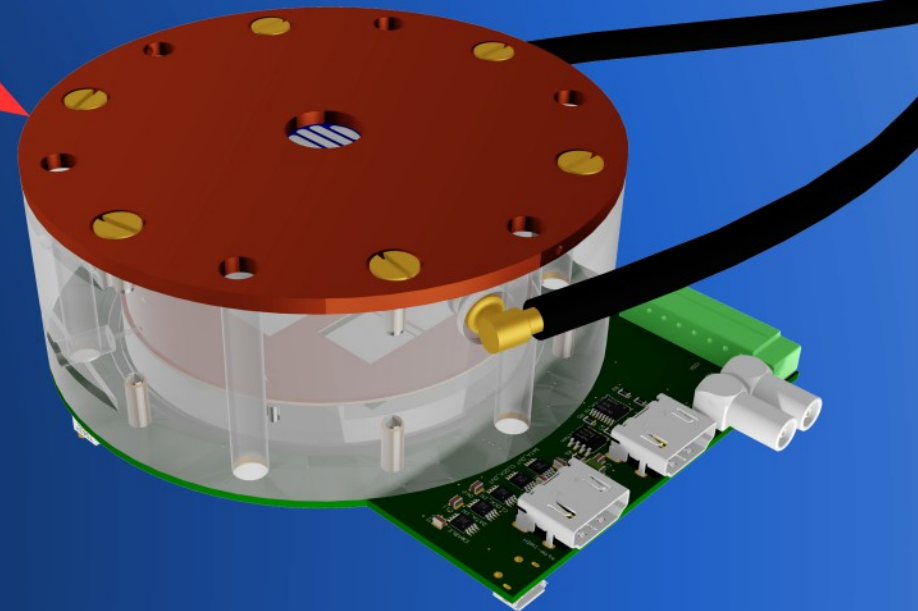
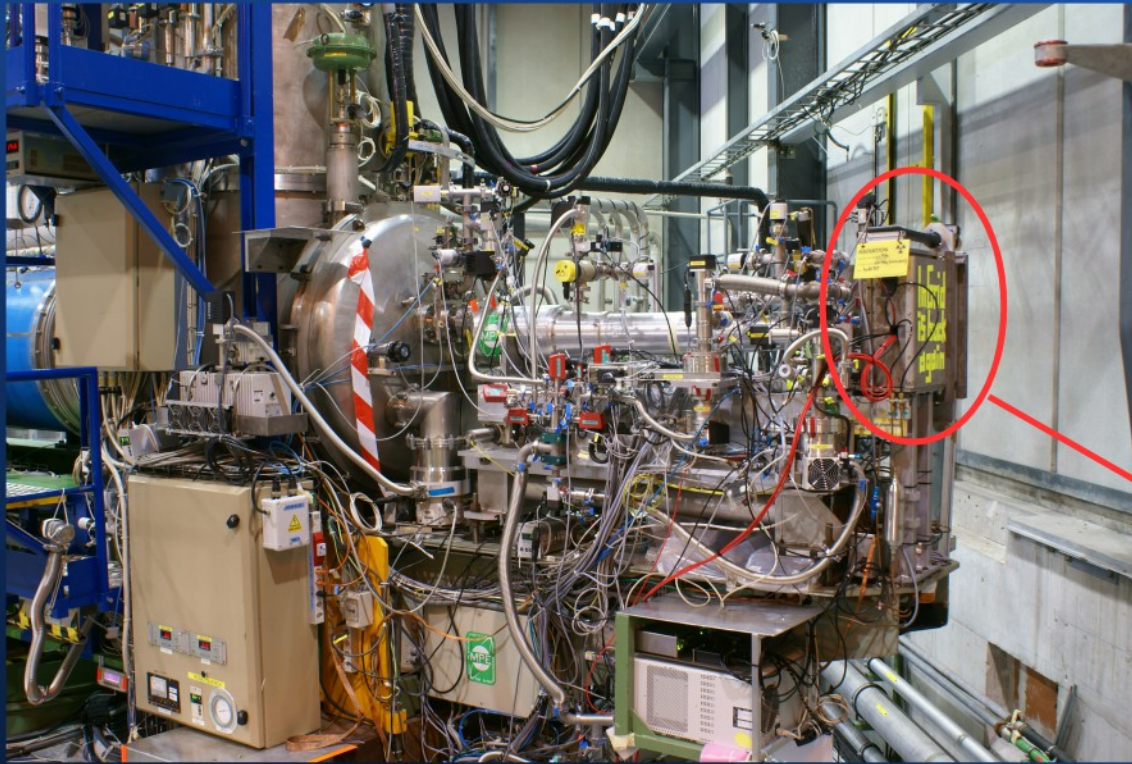


- The CAST experiment at CERN

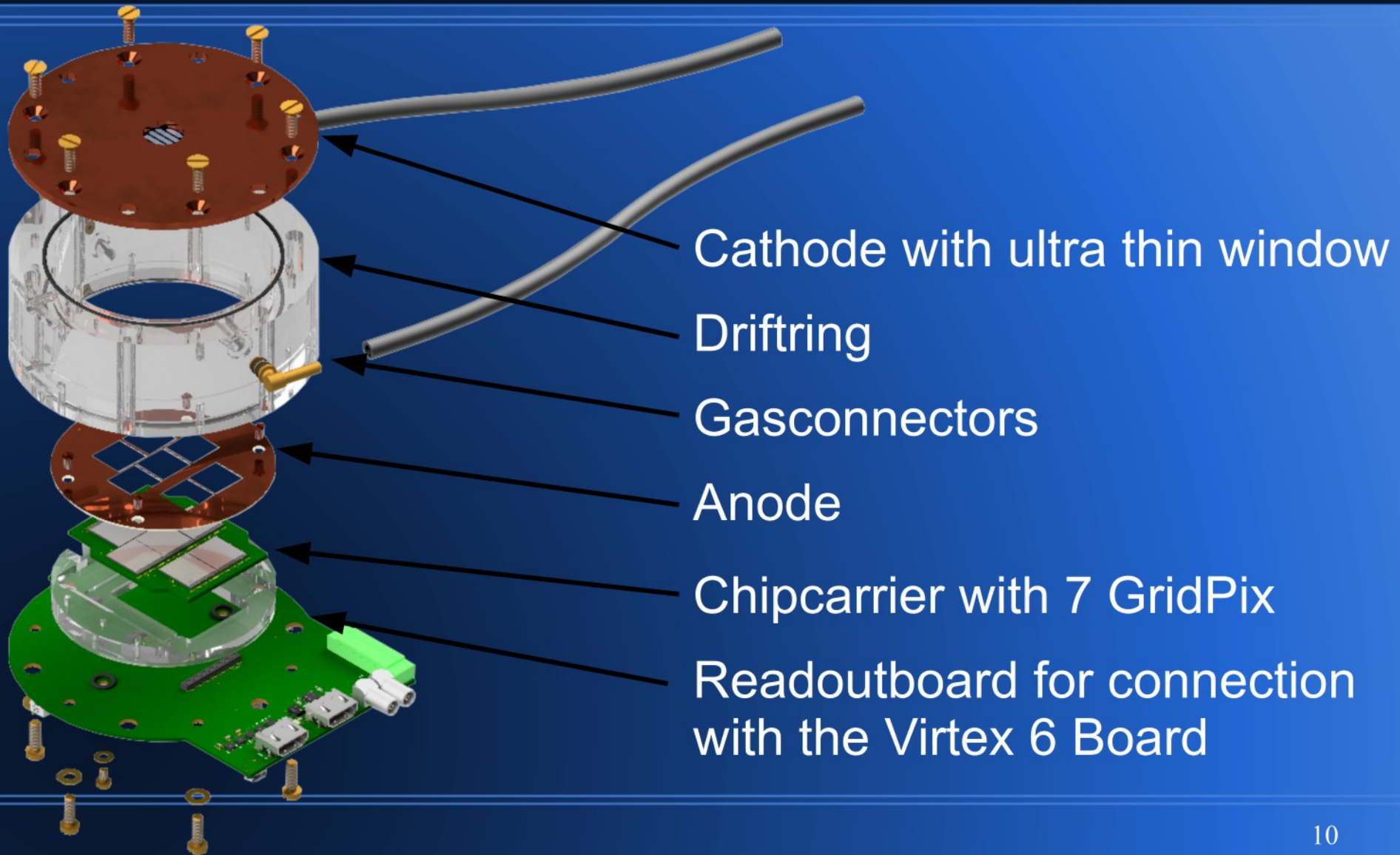


- TPC Demonstrator at the Large Prototype

InGrid Detector at CAST



Detector in detail



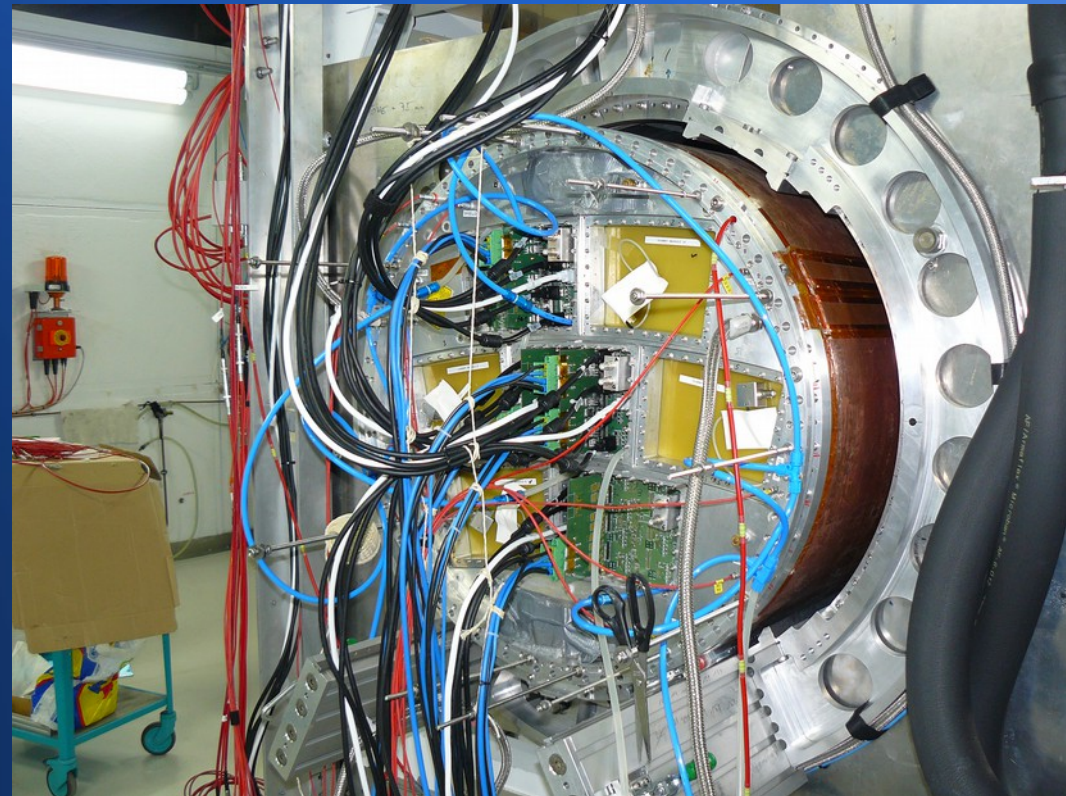
Ultra thin windows

- 4 different designs in a variety of thicknesses tested
- 300 nm thick windows survived several tests up to 1.5 bar pressure difference and are vacuum tight
- leak rate below 8×10^{-8} mbar l/s

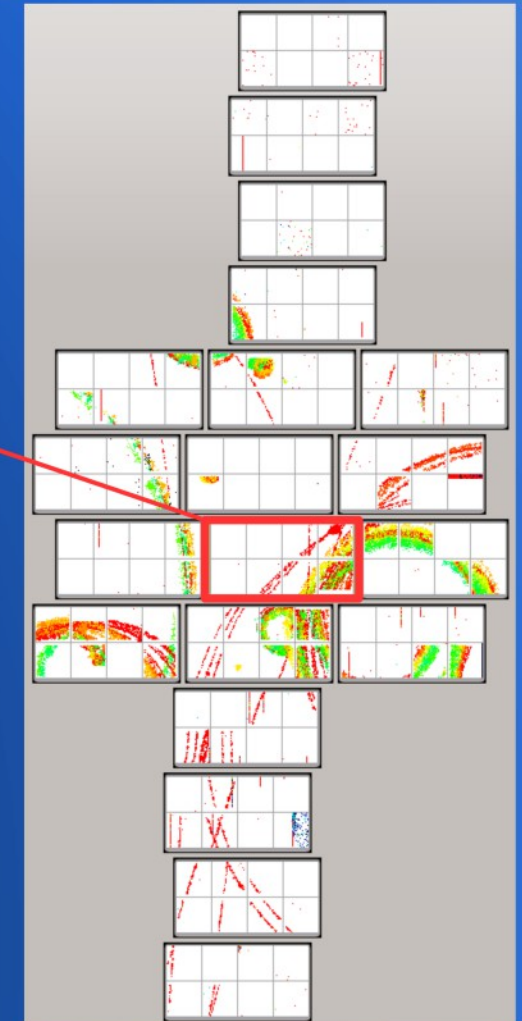
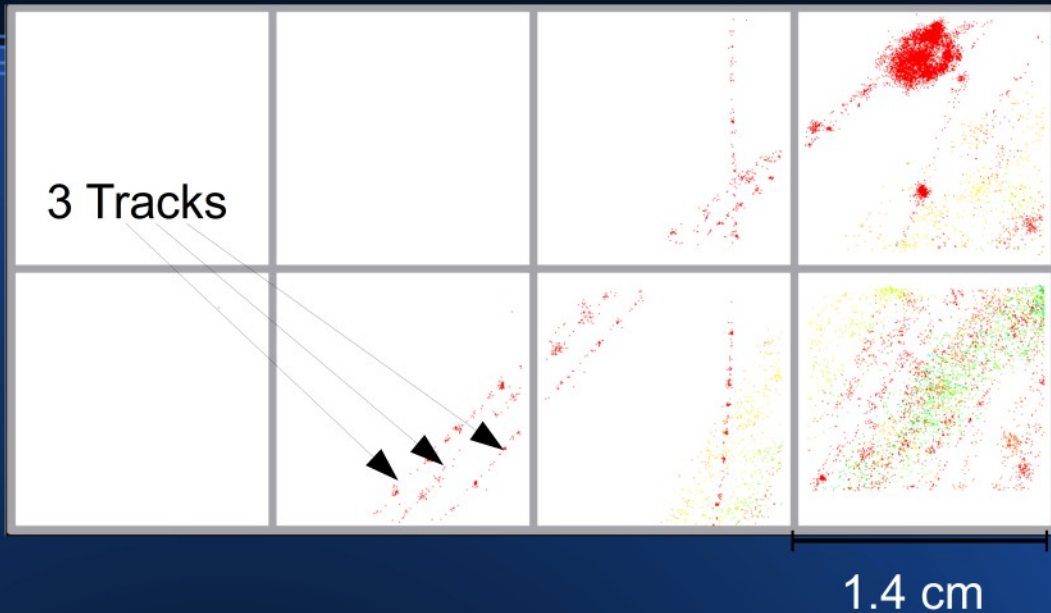


The first TPC test setup

- Readout of 160 GridPixes in parallel
- Test in the large prototype at DESY



Measurements with the GridPixes



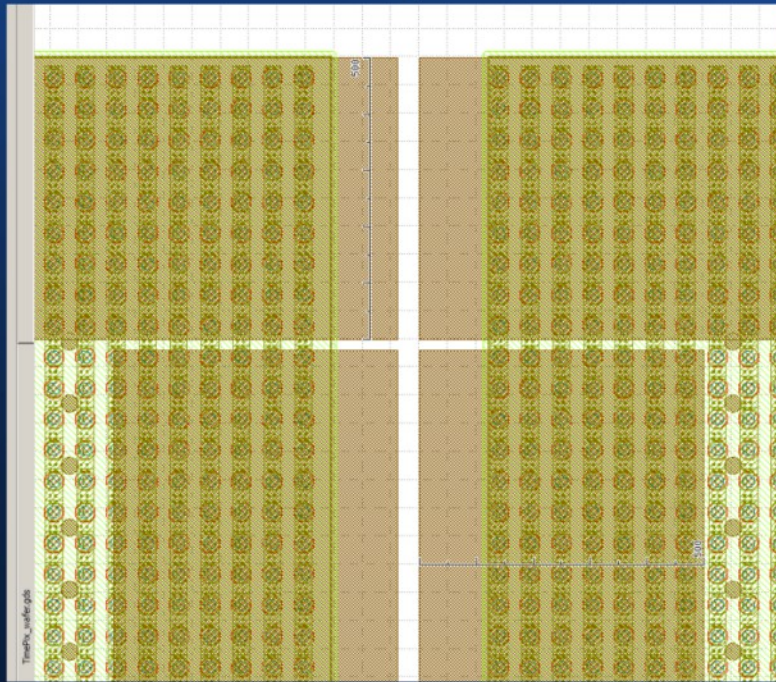
- Every single primary electron visible
- Good separation of close by tracks

Timepix3

| Timepix | Timepix3 |
|------------------------------------|------------------------------------|
| ToT (charge) or ToA (time) | ToT and ToA at the same time |
| Frame based output | Data driven or frame based output |
| No zero suppression | Zero suppression |
| Noise threshold 750 e ⁻ | Noise threshold 500 e ⁻ |
| Time resolution 10 ns | Time resolution 1.5 ns |

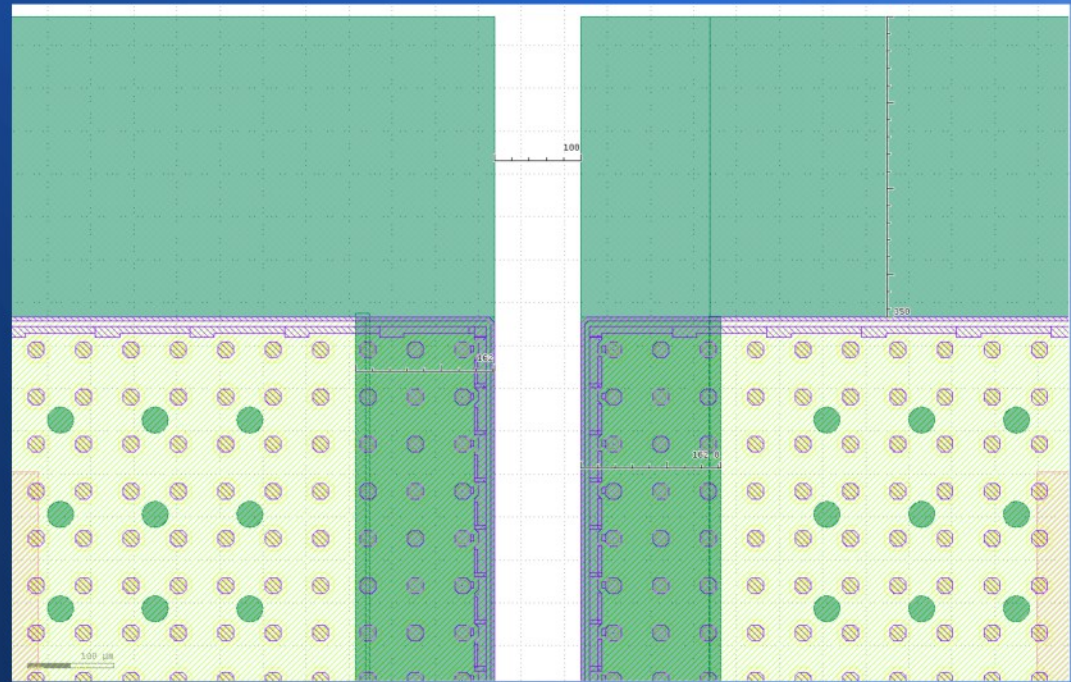
Different Grid designs

Timepix



9 rows and 14 columns covered (8.7%)

Timepix3

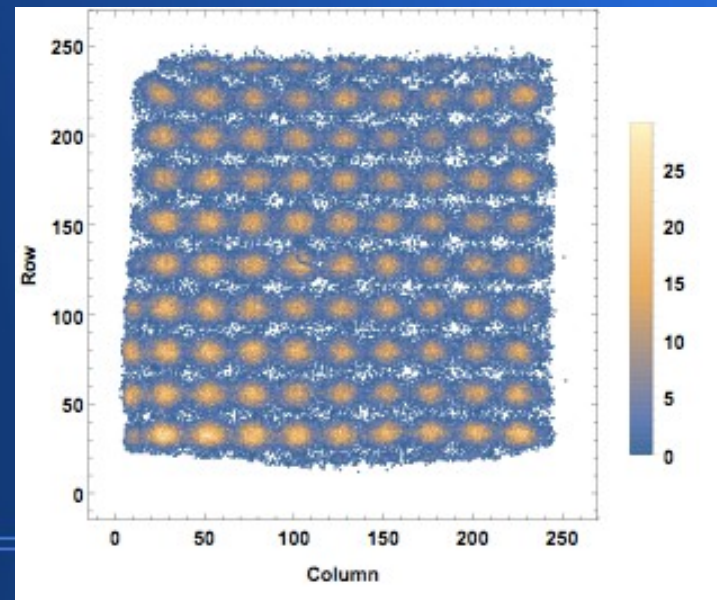
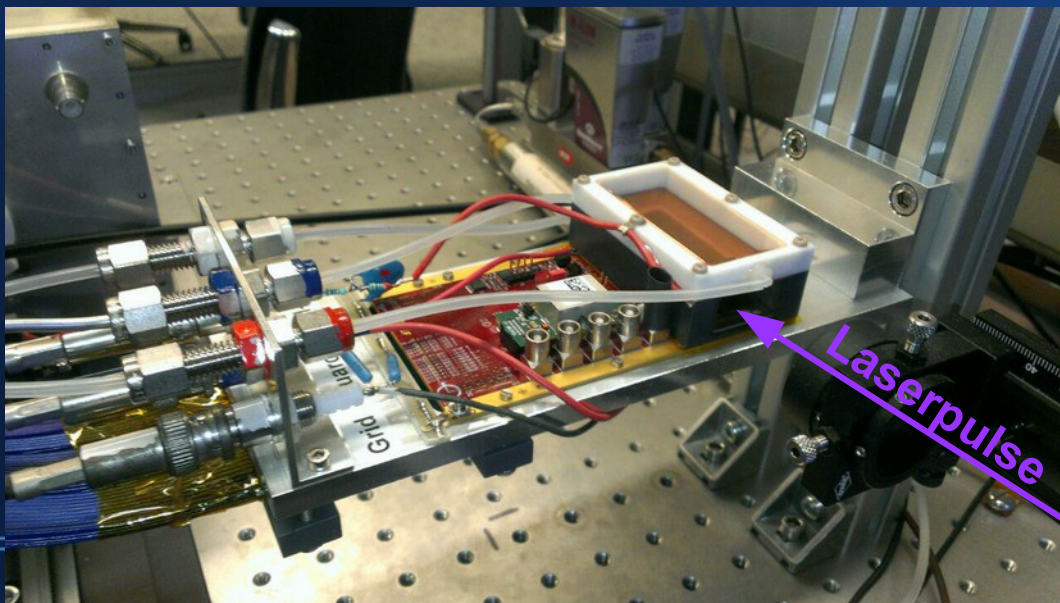


6 columns covered (2.3%)

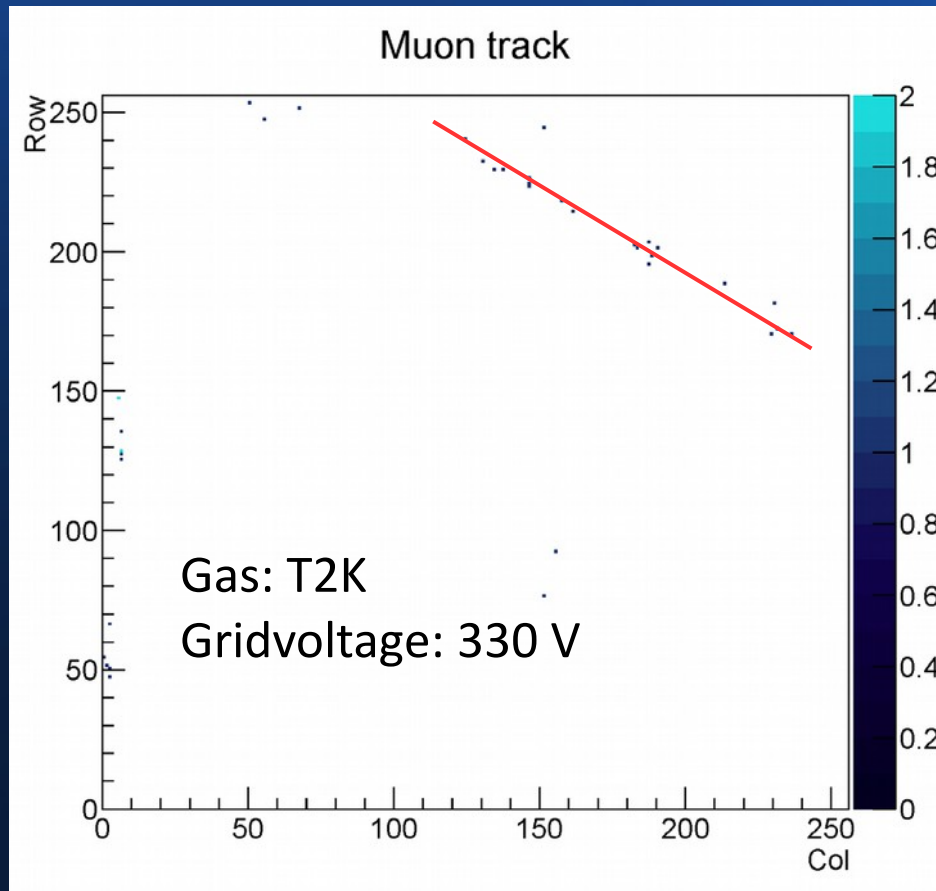
GridPix3 Now available!

In collaboration with Nikhef
LEPCOL group:
F. Hartjes, K. Heijhof, P. Kluit,
G. Raven, J. Timmermans,
S. Tsigaridas, H. van der Graaf

- First bonded and tested GridPix3 at a setup at Nikhef
- Laser setup for testing

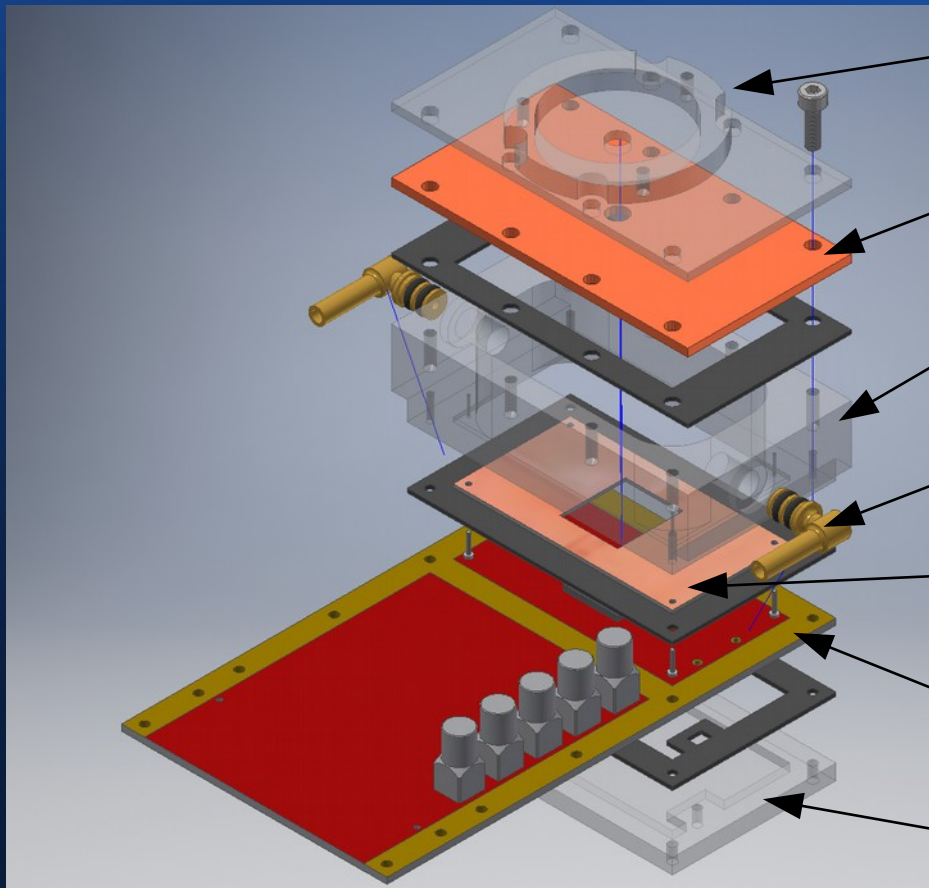


First test results



- First measurement of cosmics with the GridPix3
- Only few primary electrons are detected

Detector details



- Top lid
- Cathode
- Driftring
- Gasconnector
- Anode
- SPIDR Chipcarrier
- Bottem lid

Thank you
for your attention