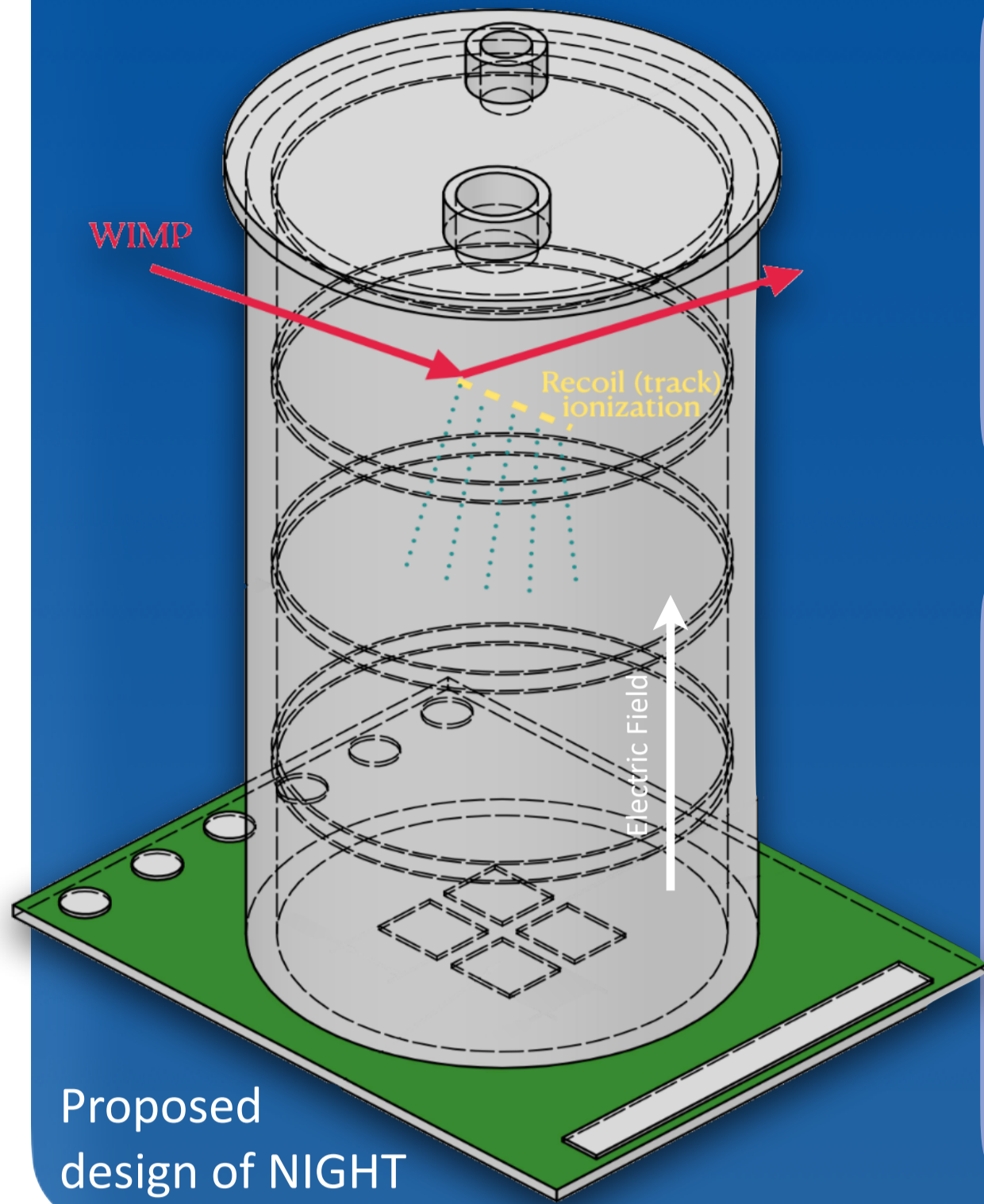


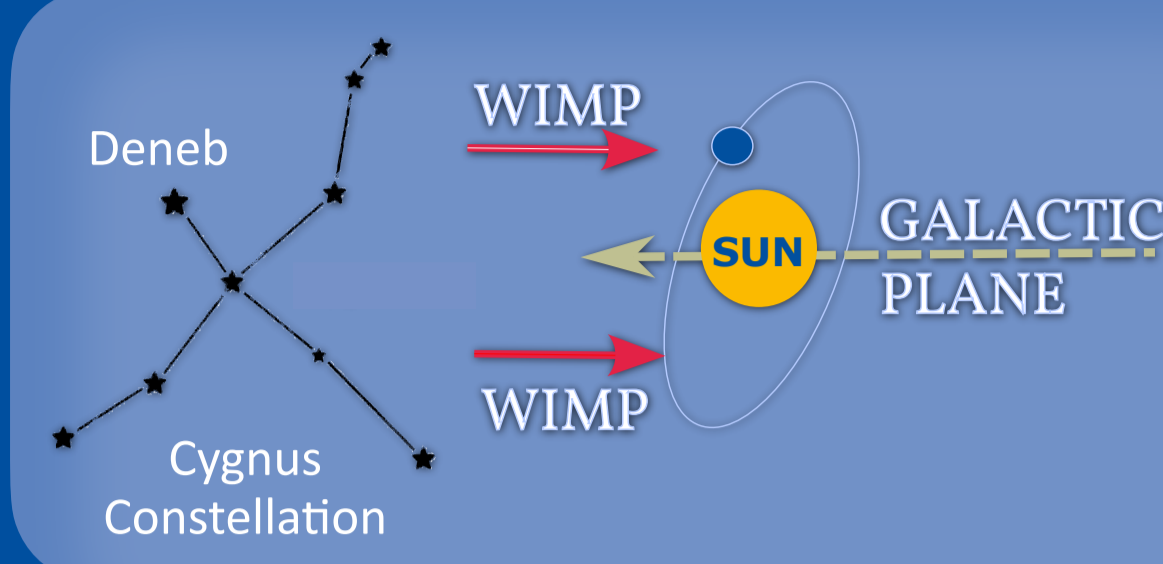
Negative Ion GridPix based High resolution TPC (NIGHT) detector

Saime Gürbüz (gurbuz@uni-bonn.de), Can Cihan Çetinkaya, Klaus Desch, Jan Glowacz, Jochen Kaminski, Michael Vogt (University of Bonn)

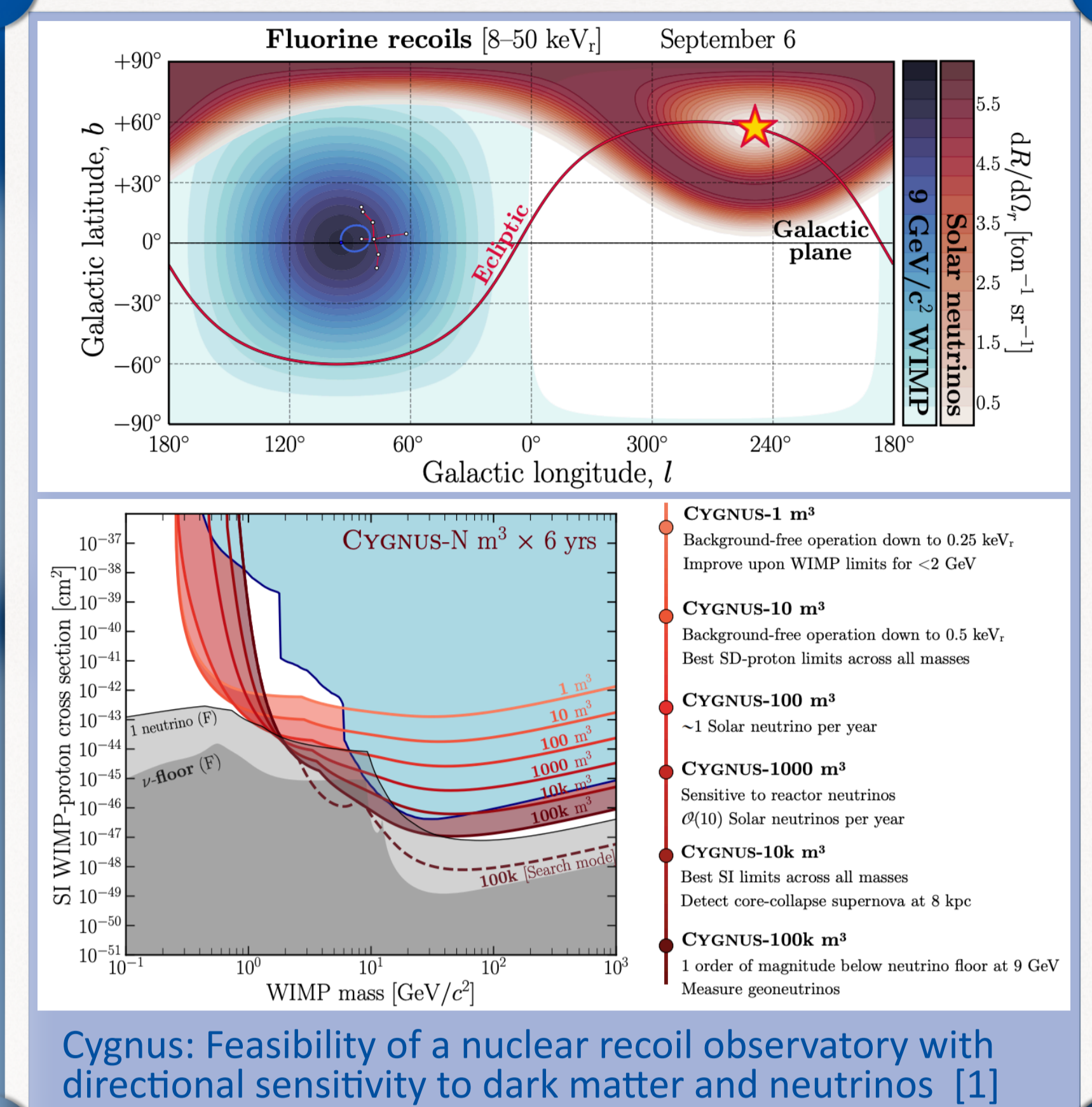
Directional dark matter searches



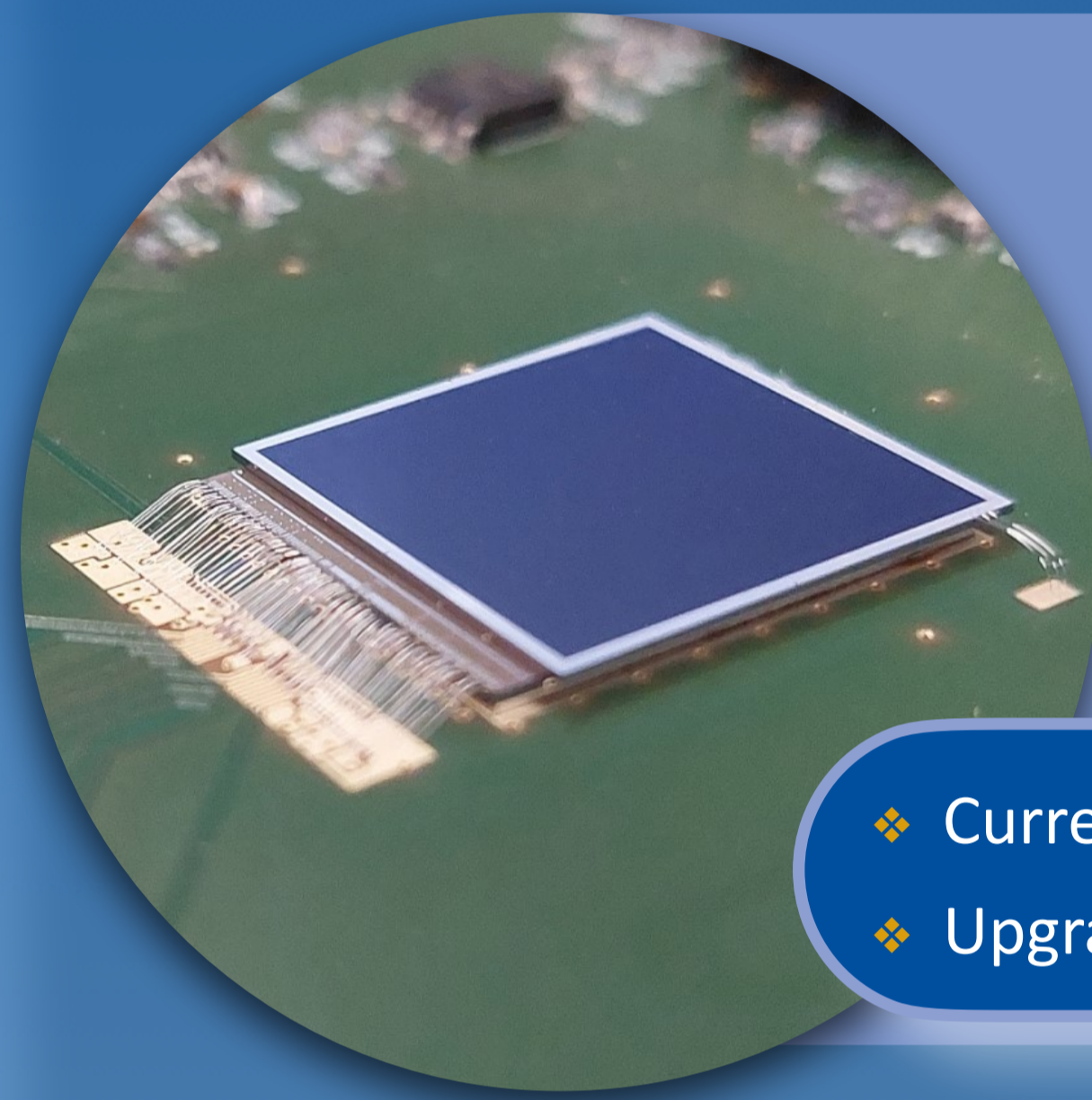
- Dark matter halo in the direction of the Cygnus constellation
- Weakly Interacting Massive Particles (WIMPs)
- Higher cross-section of WIMPs from this direction \rightarrow DM wind



- Time Projection Chamber (TPC) with a pixelated readout called GridPix:
 - High resolution and precision in directional dark matter (DM) searches
 - High performance and cost-effectiveness per area of readout
- Negative ion drift gas SF_6 (He to operate the detector close to atmospheric pressure)
 - Low diffusion
- A proof-of-concept detector soon to be tested



Readout System



Timepix [4]



256 x 256 ASICs
55 μm pixel pitch

- Time or Charge
- Frame readout
- 25msec dead time

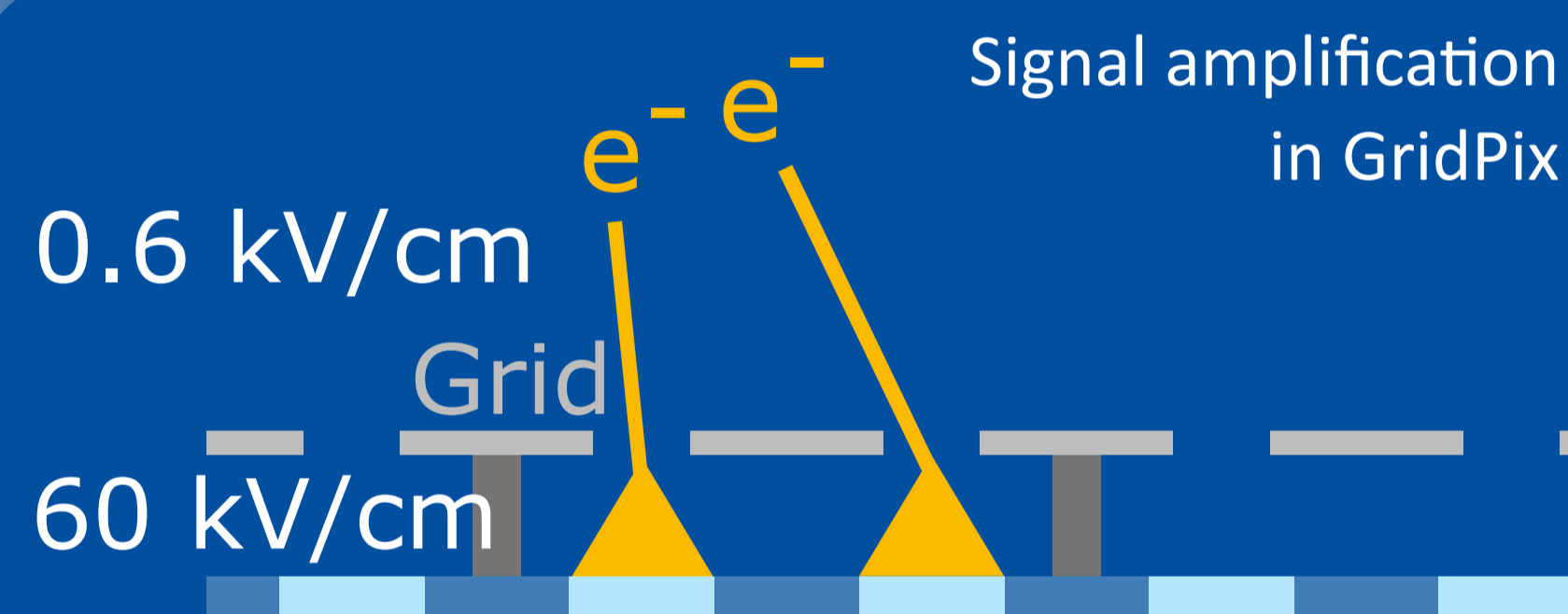
Timepix3 [5]



Time and Charge

- Data driven readout
- Dead time free

- Currently single Timepix chip
- Upgrade to Timepix3 and multi chip tests in the future

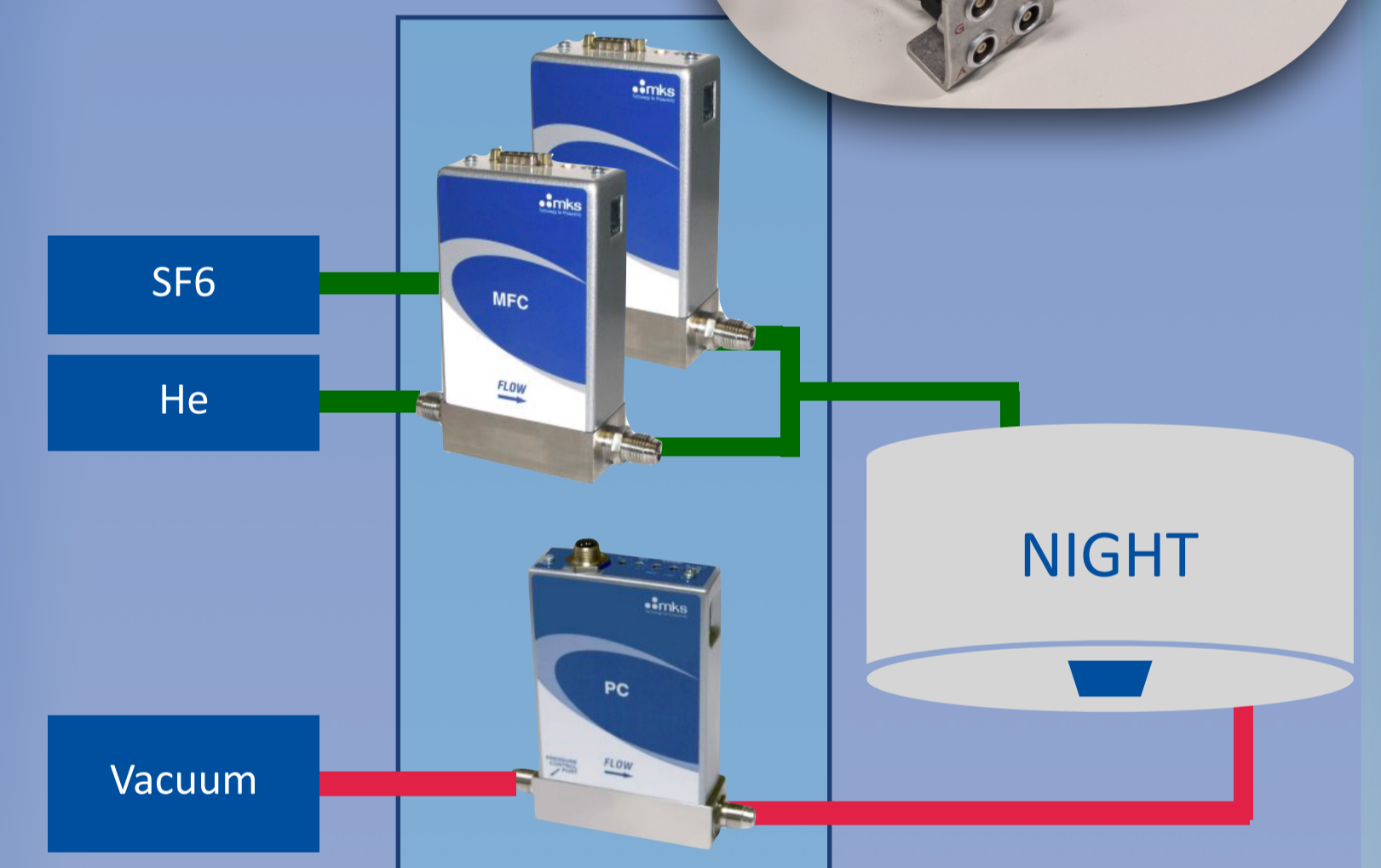
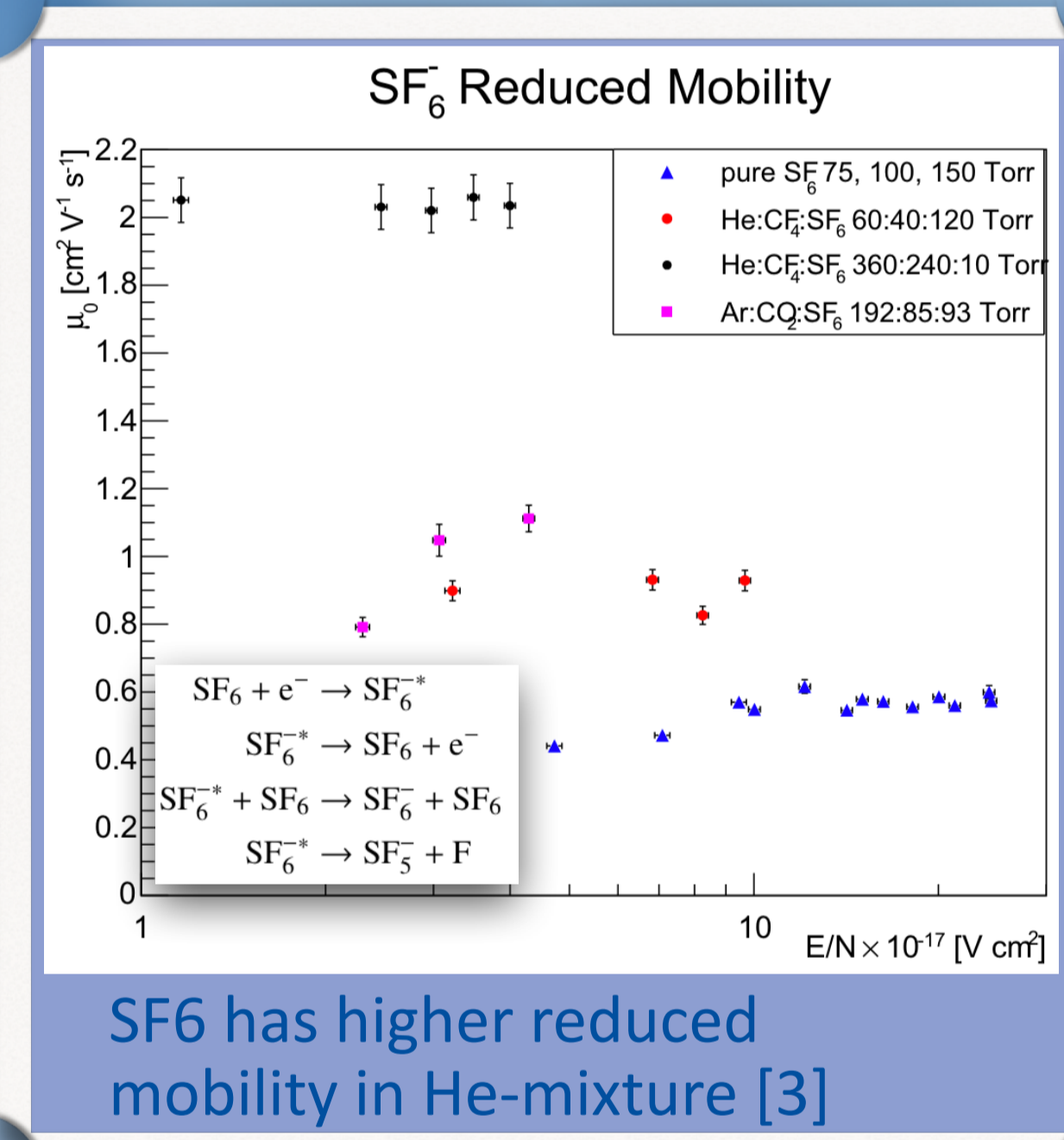


GridPix = Timepix + InGrid

Grids perfectly aligned with pixels by microprocessing [2]

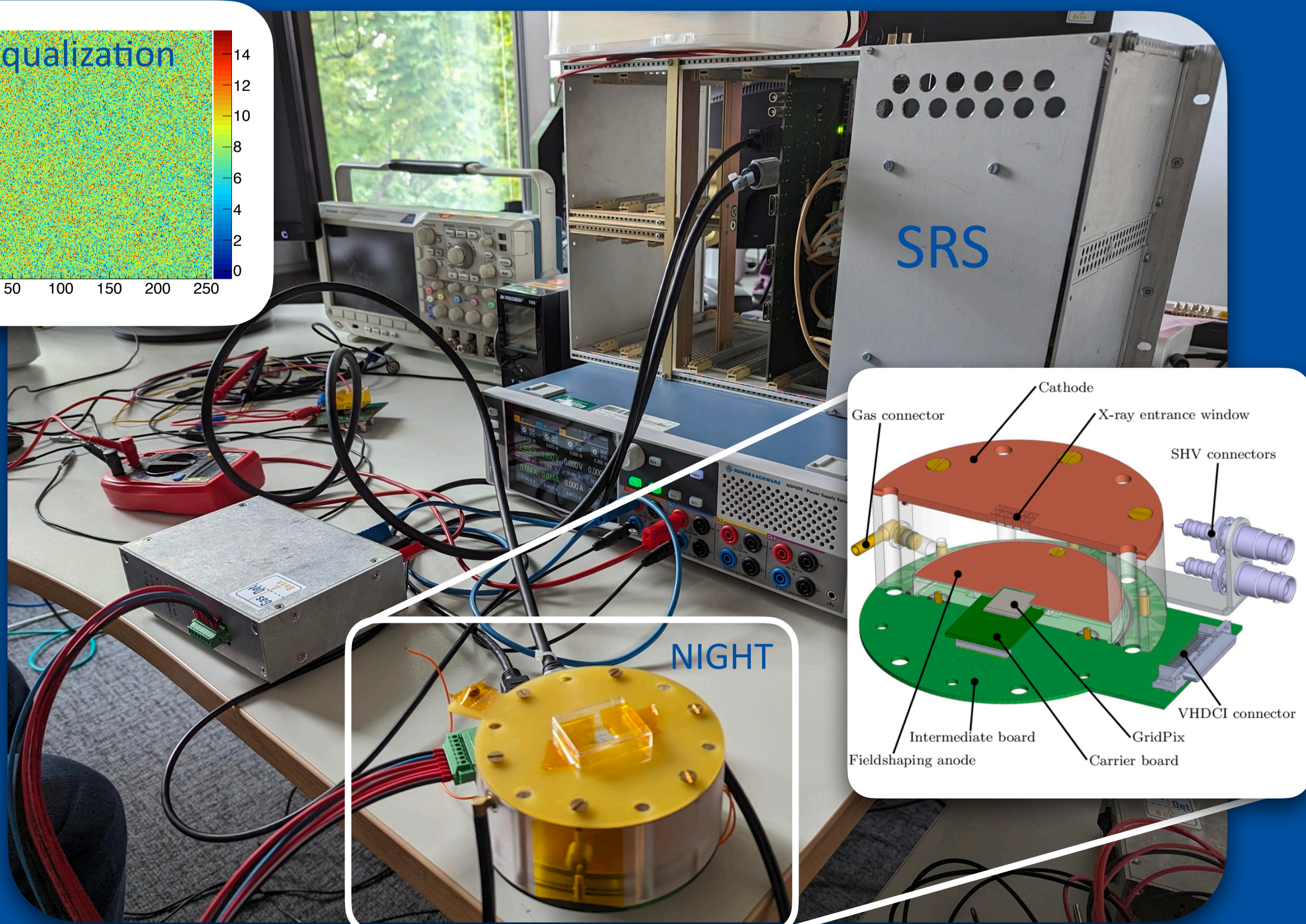
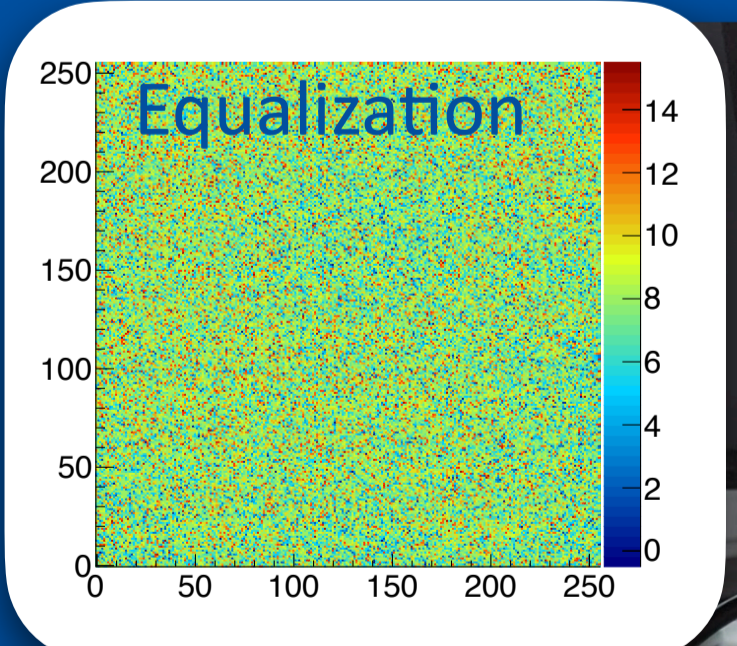
Gas system and selection of gas mixture

- Negative Ion Drift (NID) gas SF_6
- Low diffusion
- Close to atmospheric pressure by mixing with He
- $\text{He}:\text{SF}_6$ at different ratios and pressures
- A gas mixing unit controlled and monitored by a PC

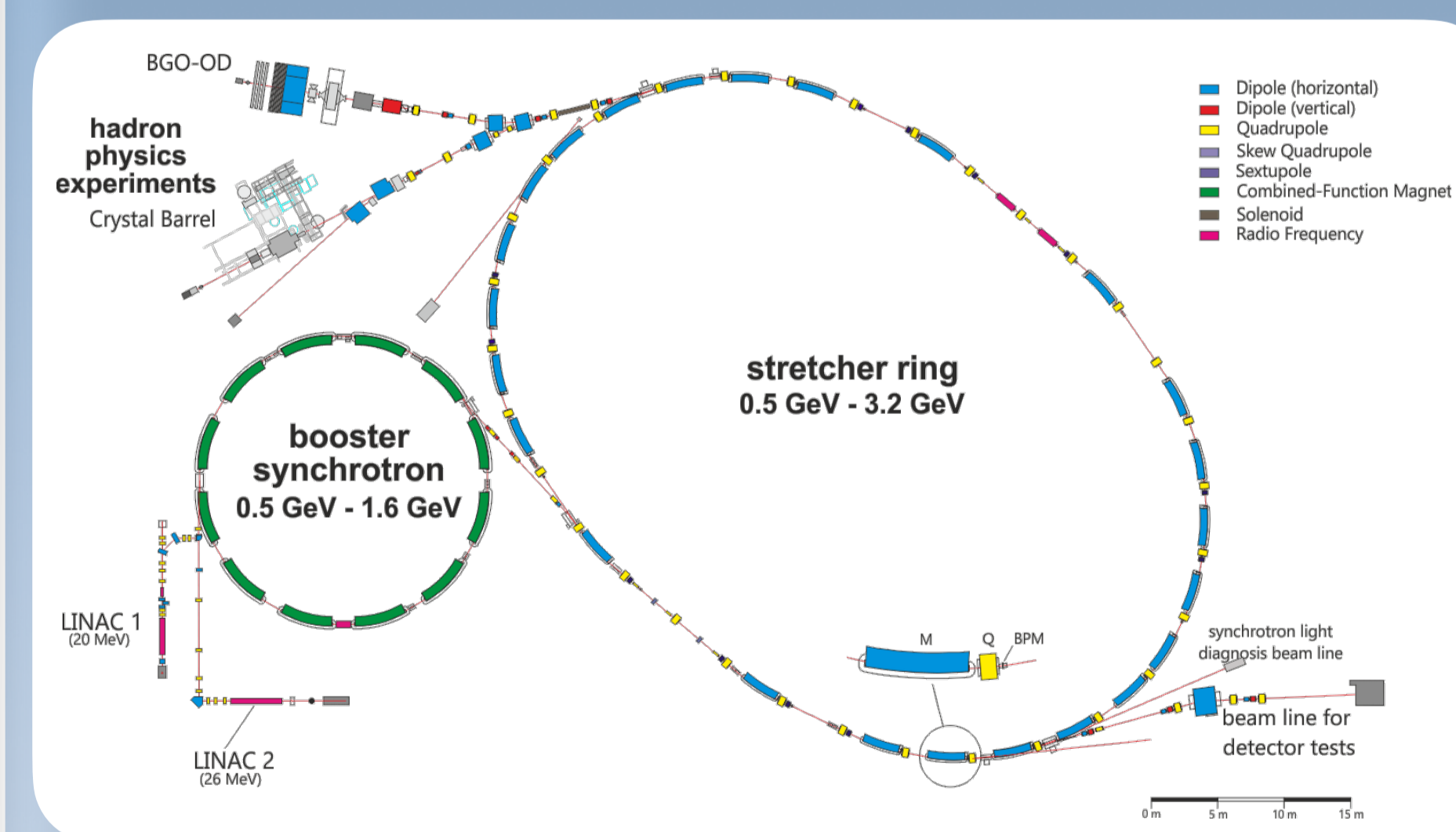


The proof of concept detector: NIGHT

- GridPix readout to detect single primary electrons
 - High spatial and time resolution
 - Active area of 1.4 cm x 1.4 cm
- Drift length of 3 cm
- Scalable Readout System (SRS) \rightarrow an FPGA board developed by the RD51 Collaboration at CERN
- Easy to scale readout system for larger detector



Testing the detector at ELSA beam line



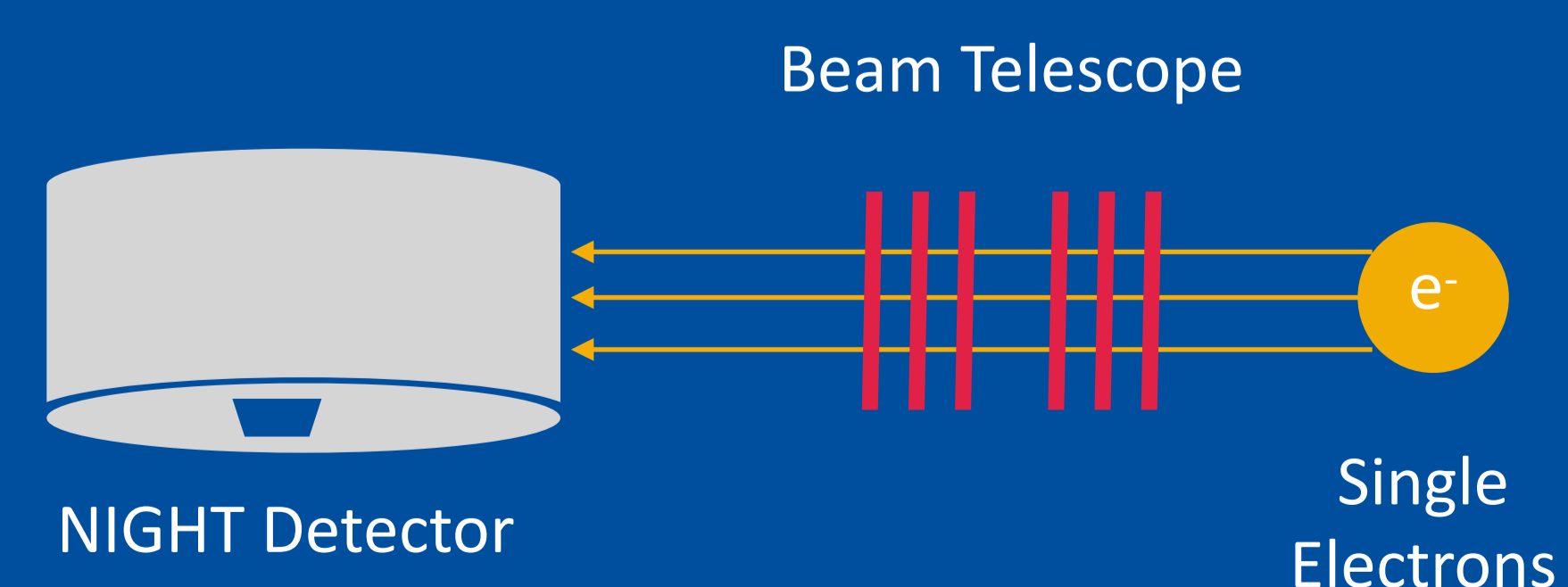
Beam Parameters [6]:

Beam Size: 3mmx3mm - 10mmx10mm

Rate: 1Hz - 625MHz

Energy Range: 0.8GeV - 3.2GeV

@ low rate: 1 electron/bunch (95%)



- Detector test beam line of the ELSA electron accelerator
- Single electrons at a rate less than 100 Hz
 - The resonant extraction method
- The beam telescope
 - Trigger
 - The track of the electron

Variables to be changed:

Drift distance

Electron energy

TPC Voltage

SF_6 Percentage

Parameters to measure:

Drift velocity

Diffusion constant

Amplification

