

Sensor R&D at Brown

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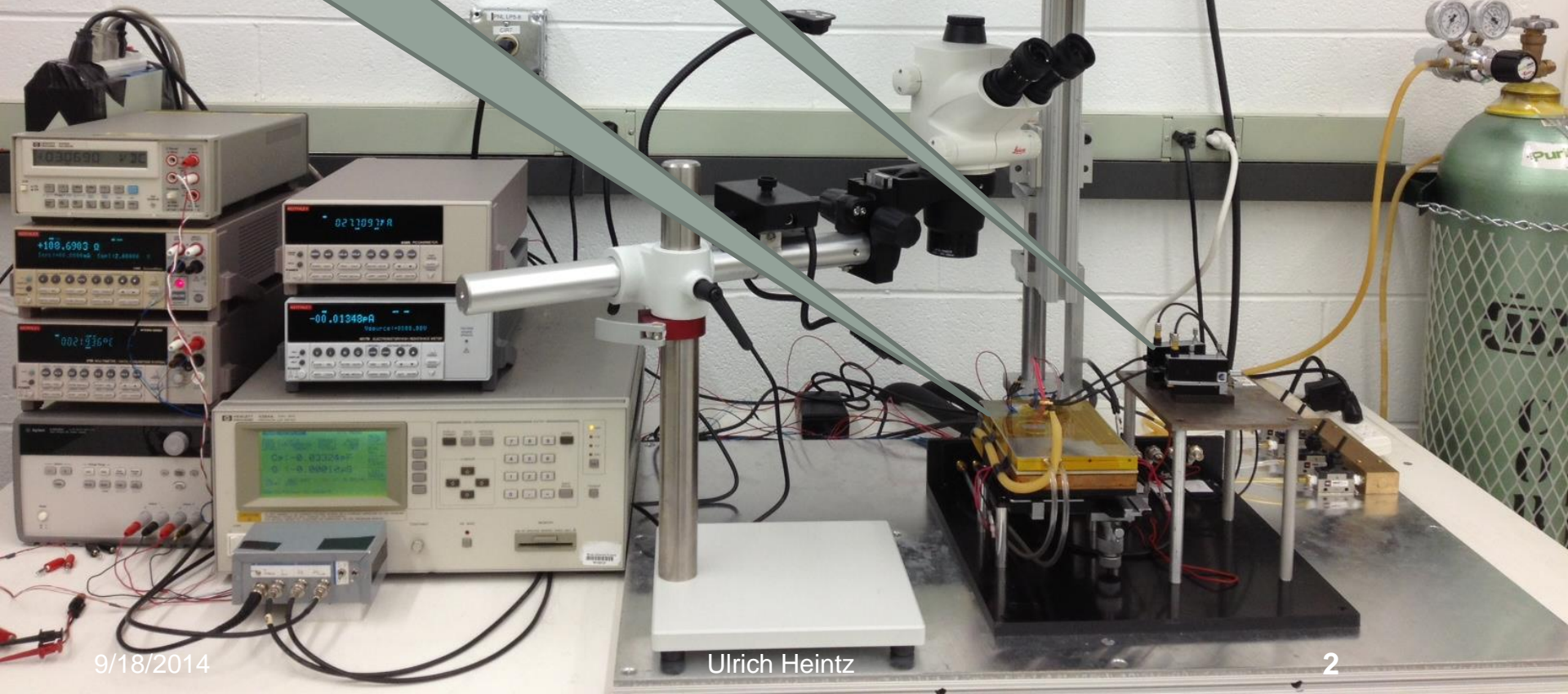
CV/IV setup

light-tight box

dry air

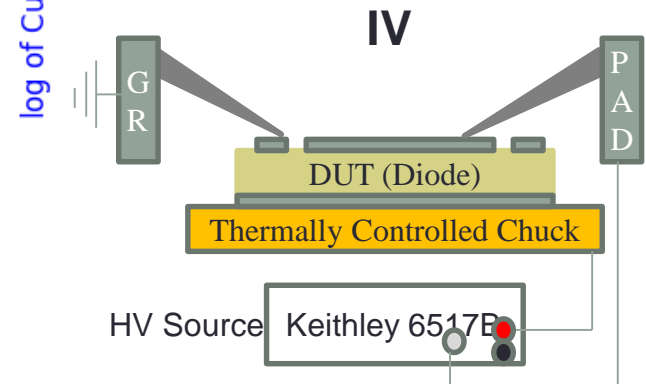
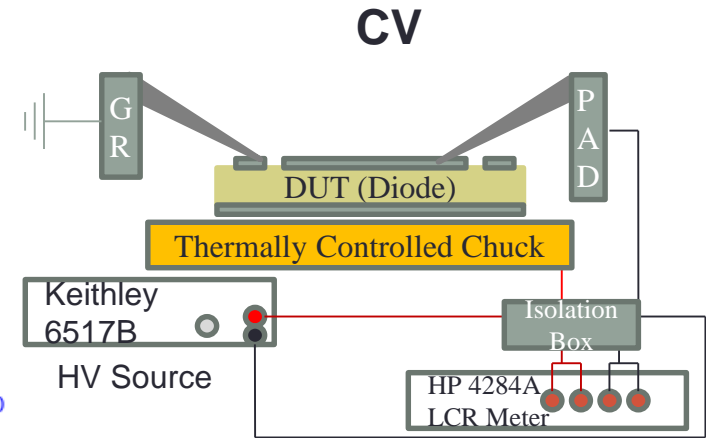
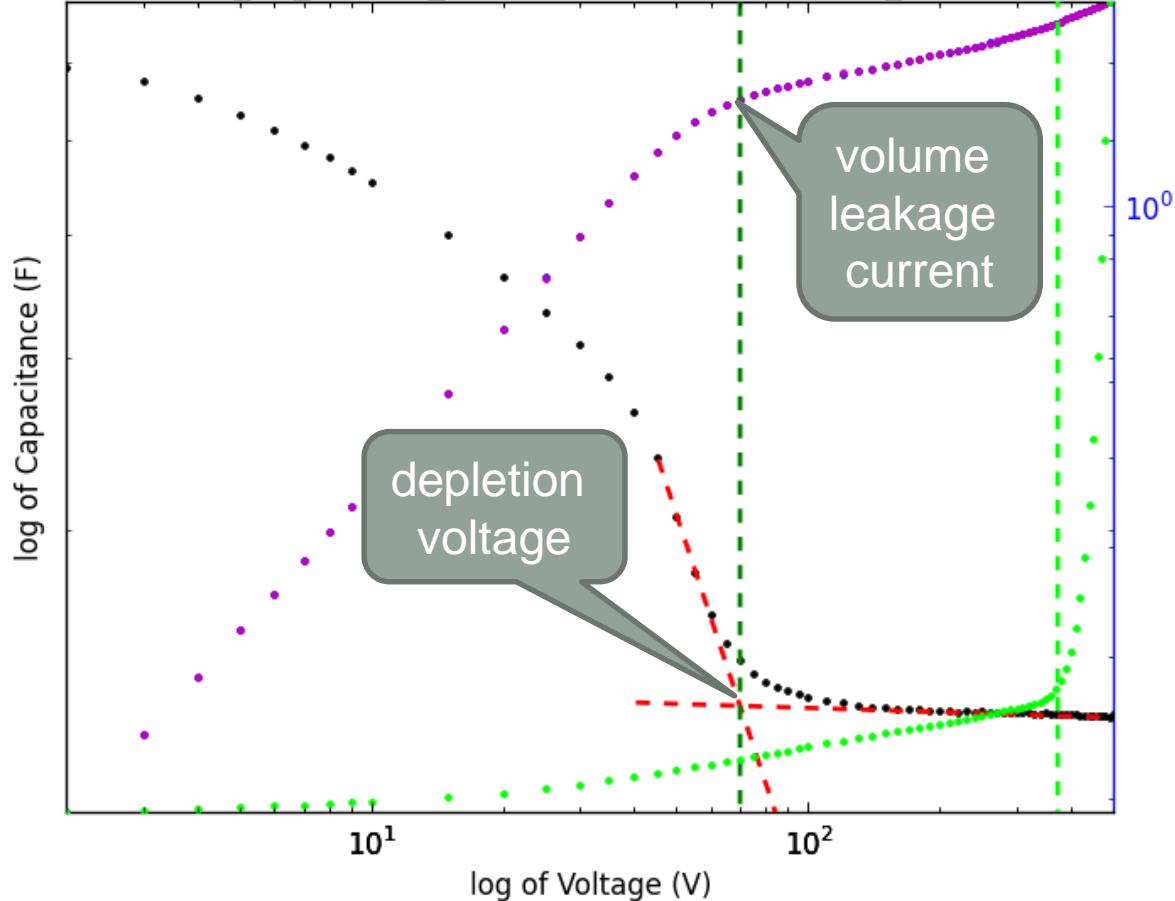
probe needles

vacuum chuck with
Peltier element cooling



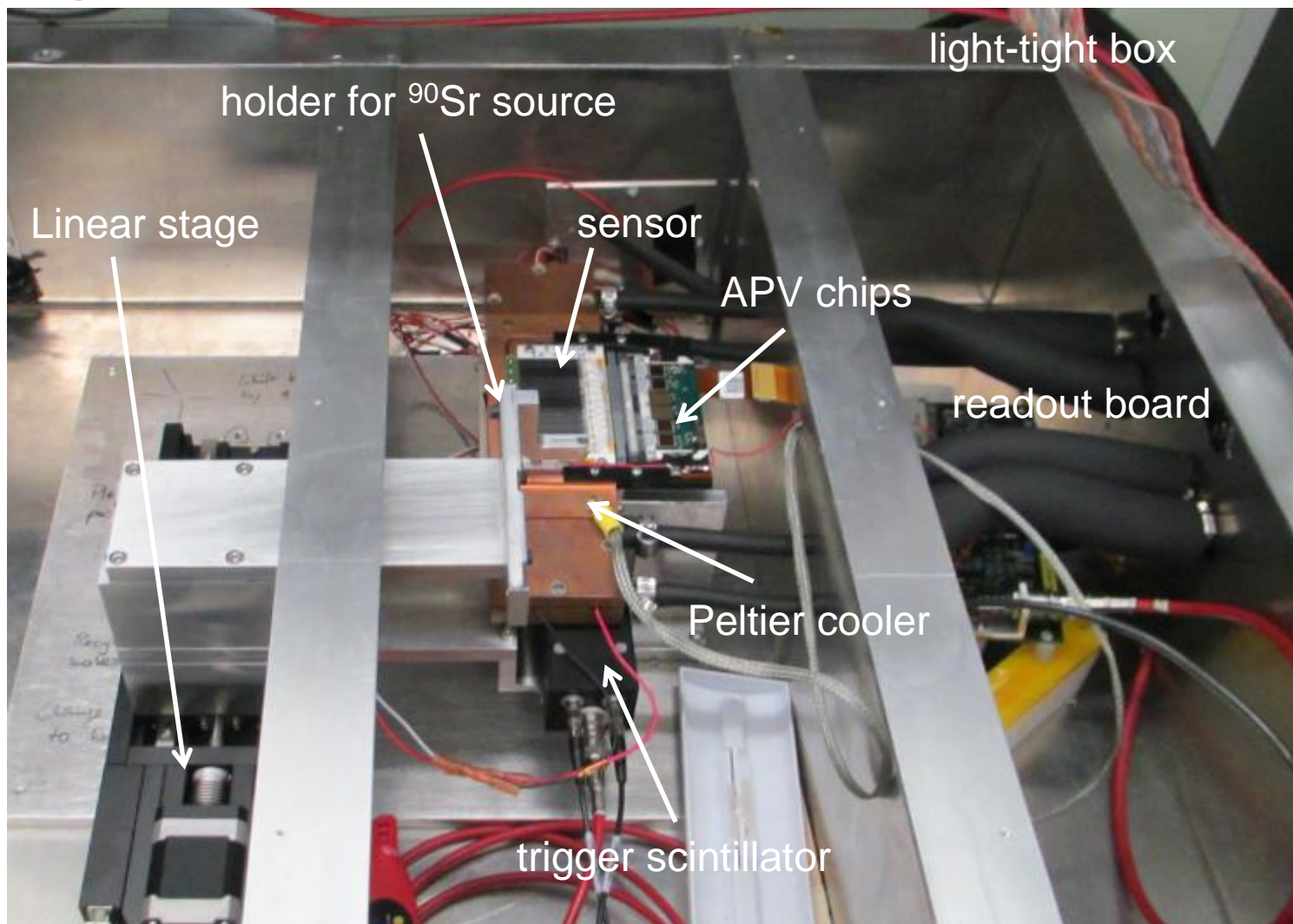
Measurement technique

MCZ200N_09_DiodeL_8, 455Hz, 40min, -20C,GR_CONNECTED



We can measure CV/IV curves at temperatures as low as -30° C

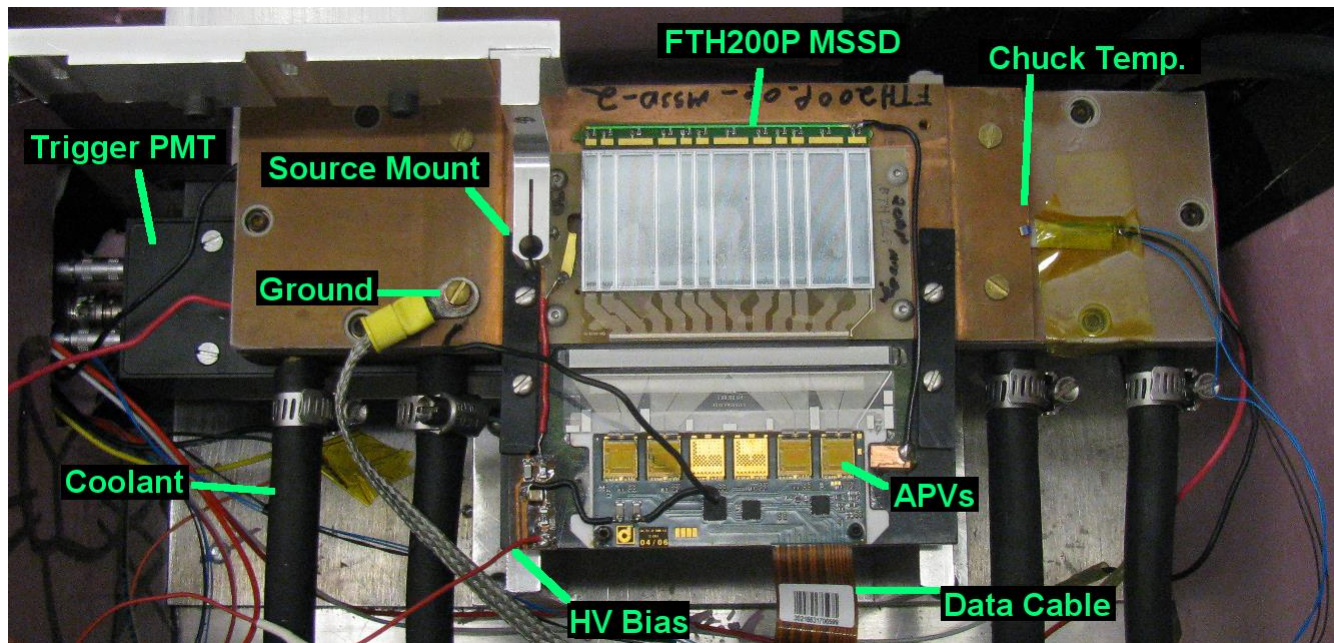
Charge collection measurement setup



Measurements can be taken at temperatures as low as -25°C

Setup for long-term measurements

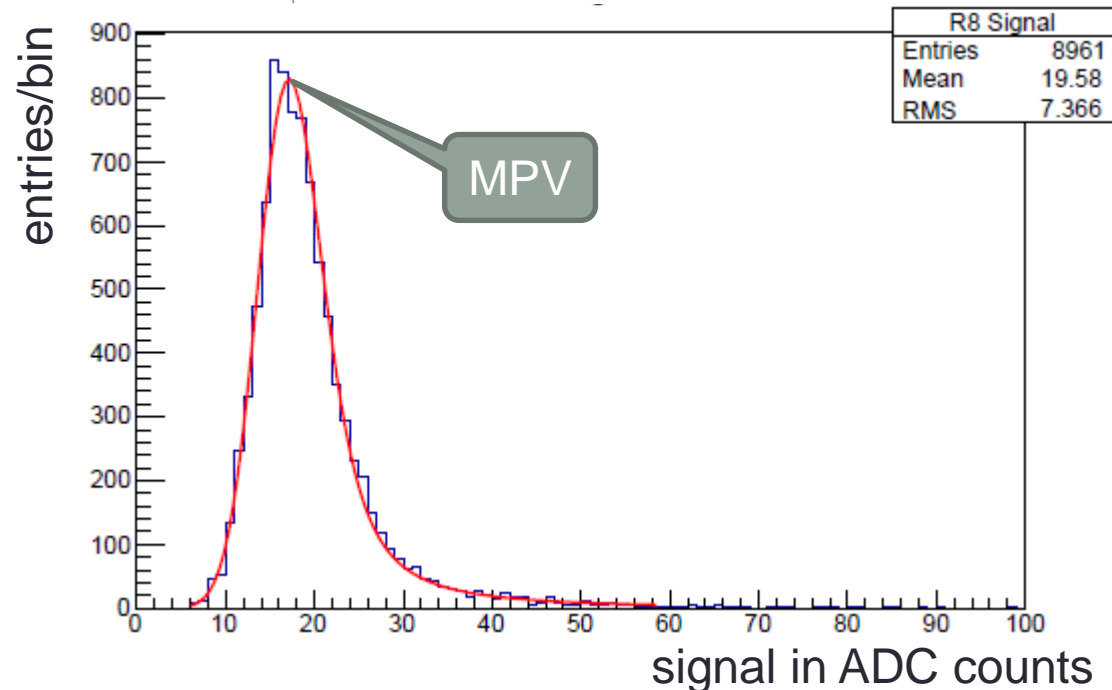
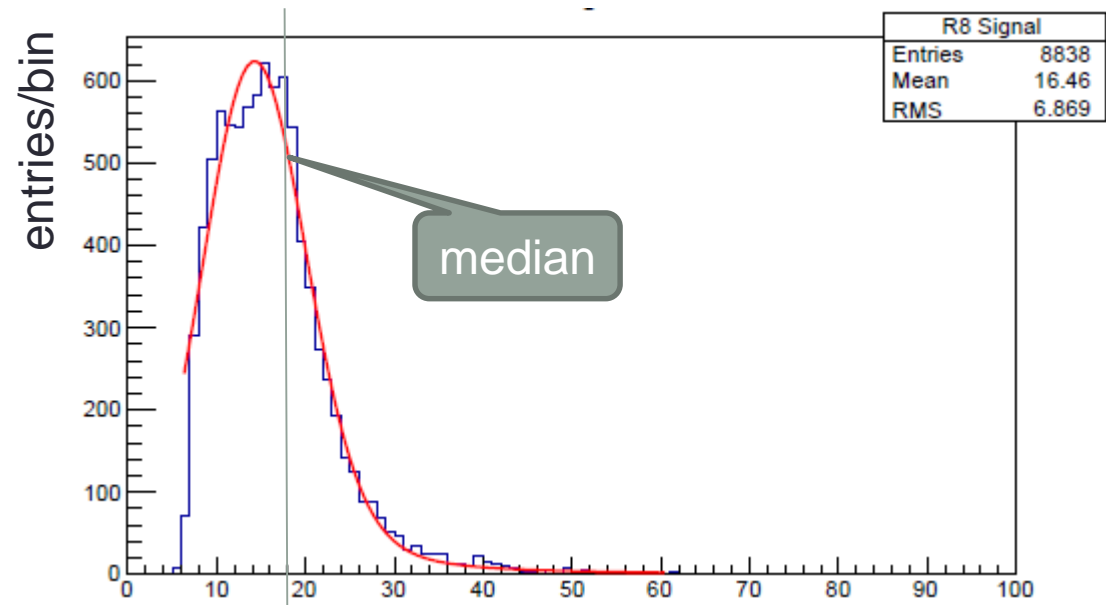
- MSSD sensor
- Sr-90 source (37 MBq)
- ARC station to read out sensor
- bias voltage 700 V
- temperature -20°C
- dry atmosphere
- source remains in same place



Signals

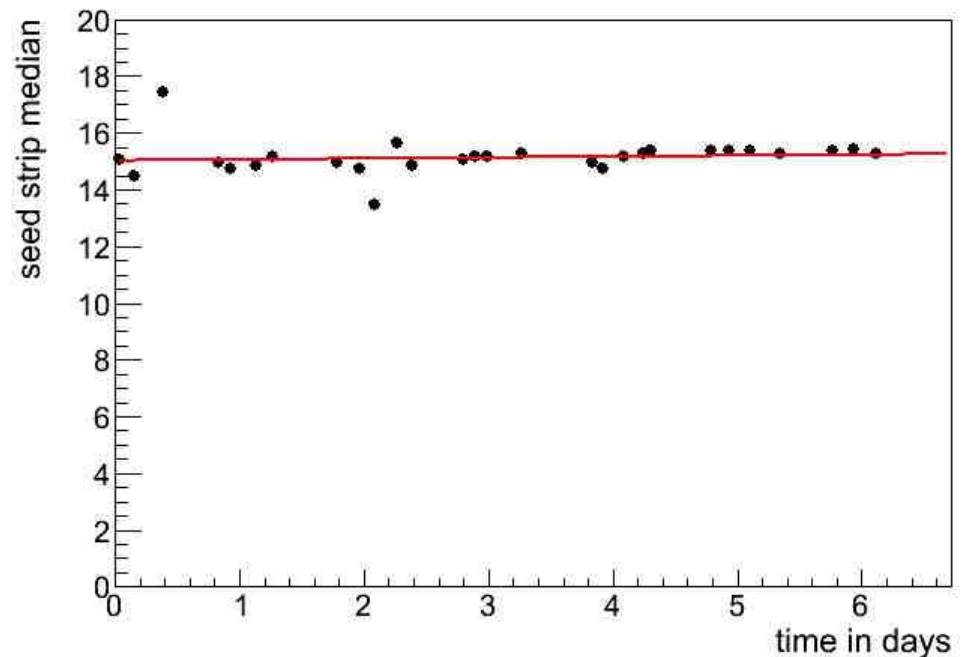
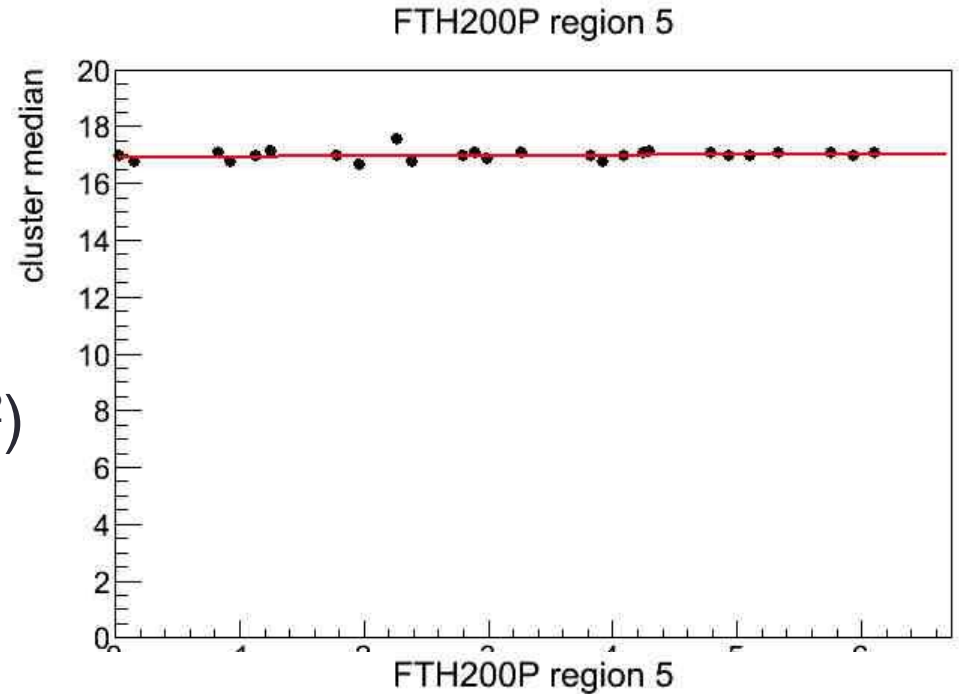
- seed strip
 - $>5 \times$ noise
 - shoulder from hits that straddle two strips
 - hard to fit \rightarrow use median

- cluster
 - add up signal in 5 strips
 - centered on seed strip



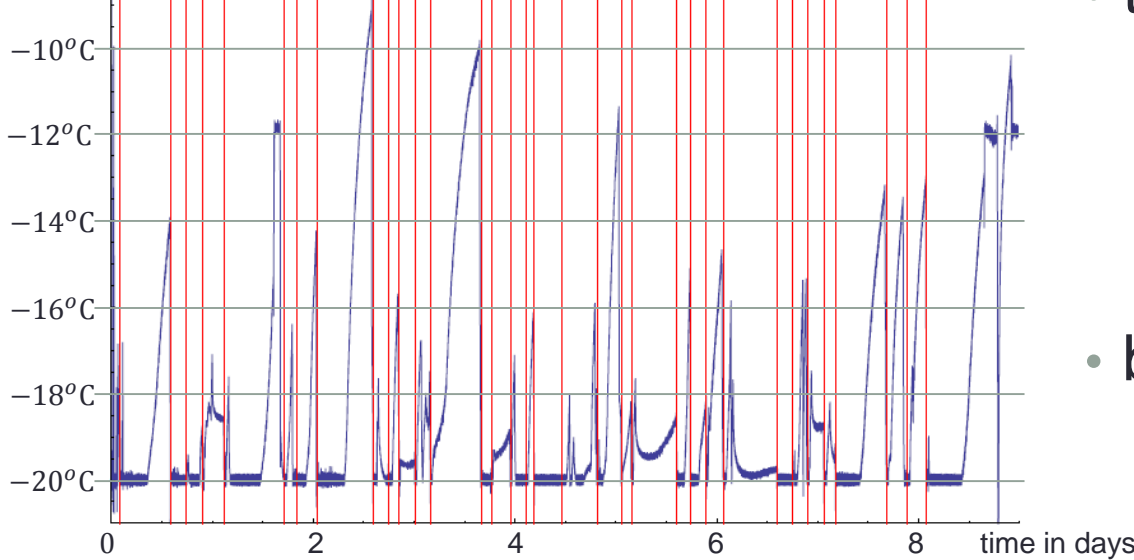
Region 5

- strip pitch 120 μm
- implant width 28 μm
- Irradiated sensor ($10^{15}/\text{cm}^2$)

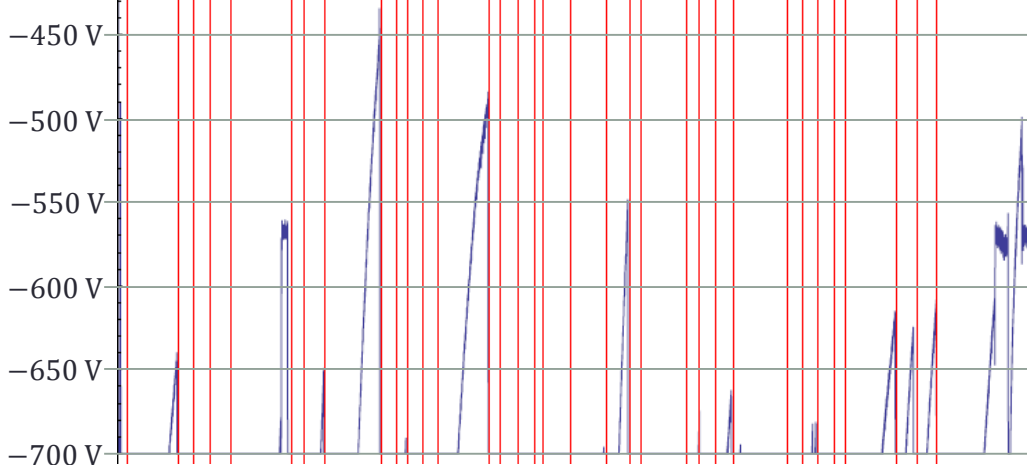


Operational parameters

chuck temperature

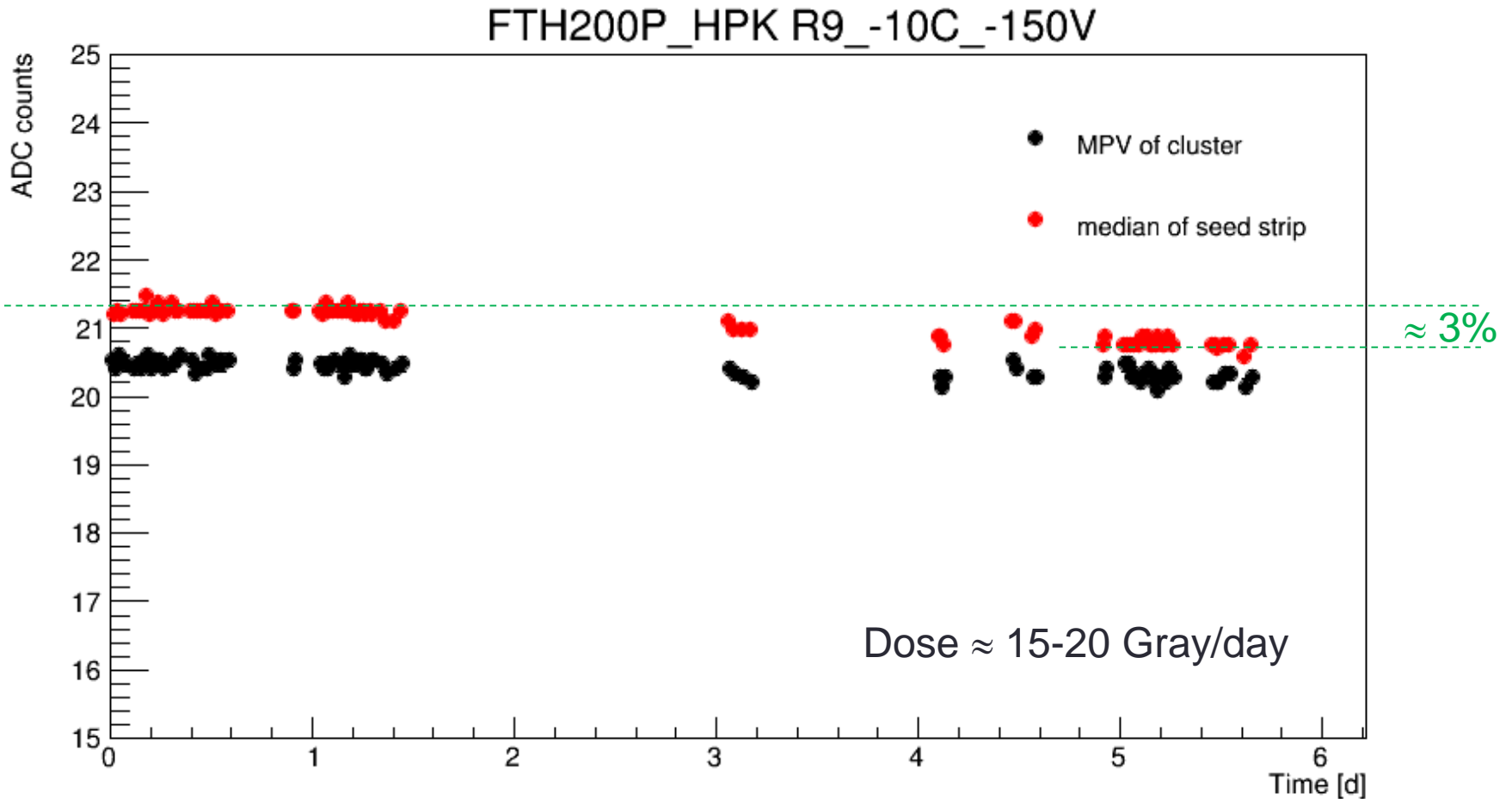


bias voltage



- temperature
 - target is -20°C
 - keep above dew point to prevent condensation
- bias voltage
 - target is -700 V
 - current limit is 1.5 mA
 - when temperature increases current increases and voltage may have to drop
- periodic measurements
 - red lines

Measurement of unirradiated sensor



Difficult to maintain dew point below -20° day/night for days

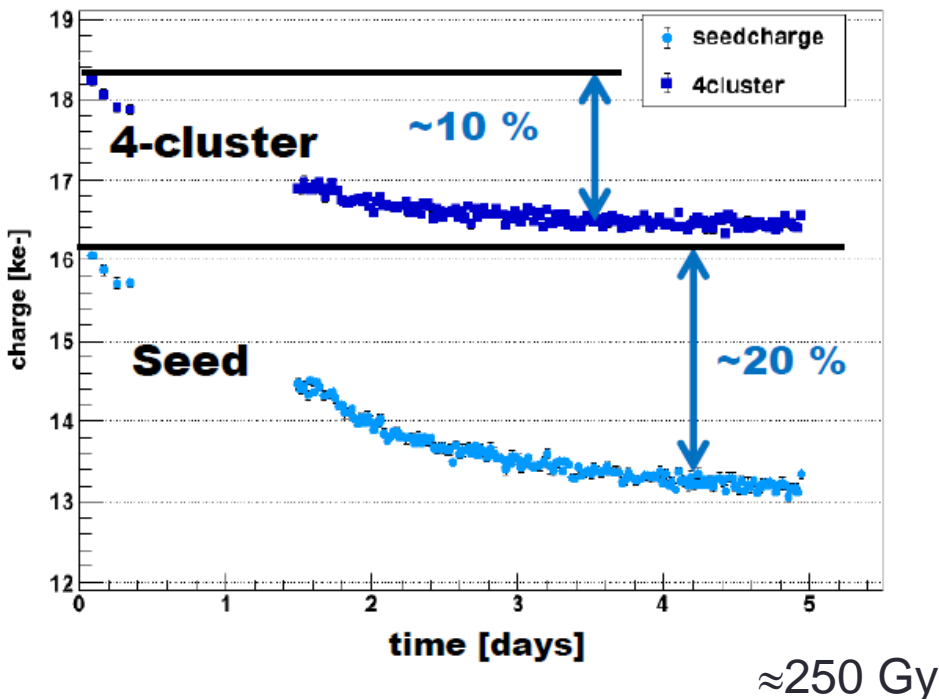
→ measurements at -10° C

We have now solved this problem and can maintain dewpoint stable $< -20^{\circ}$ C

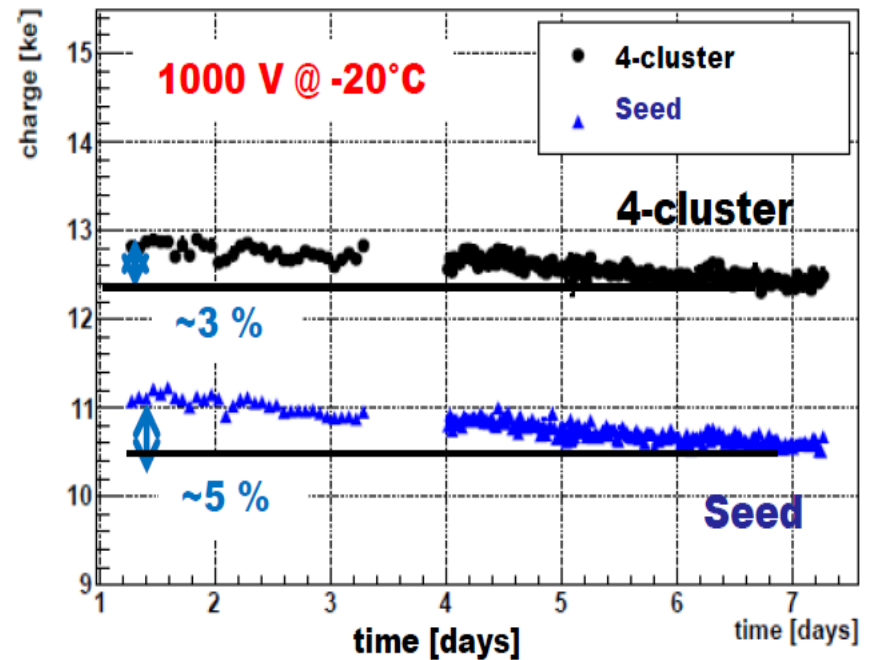
→ Redoing measurements

Hamburg measurements

Unirradiated p-spray sensor
Measured @ 600 V and -20°C

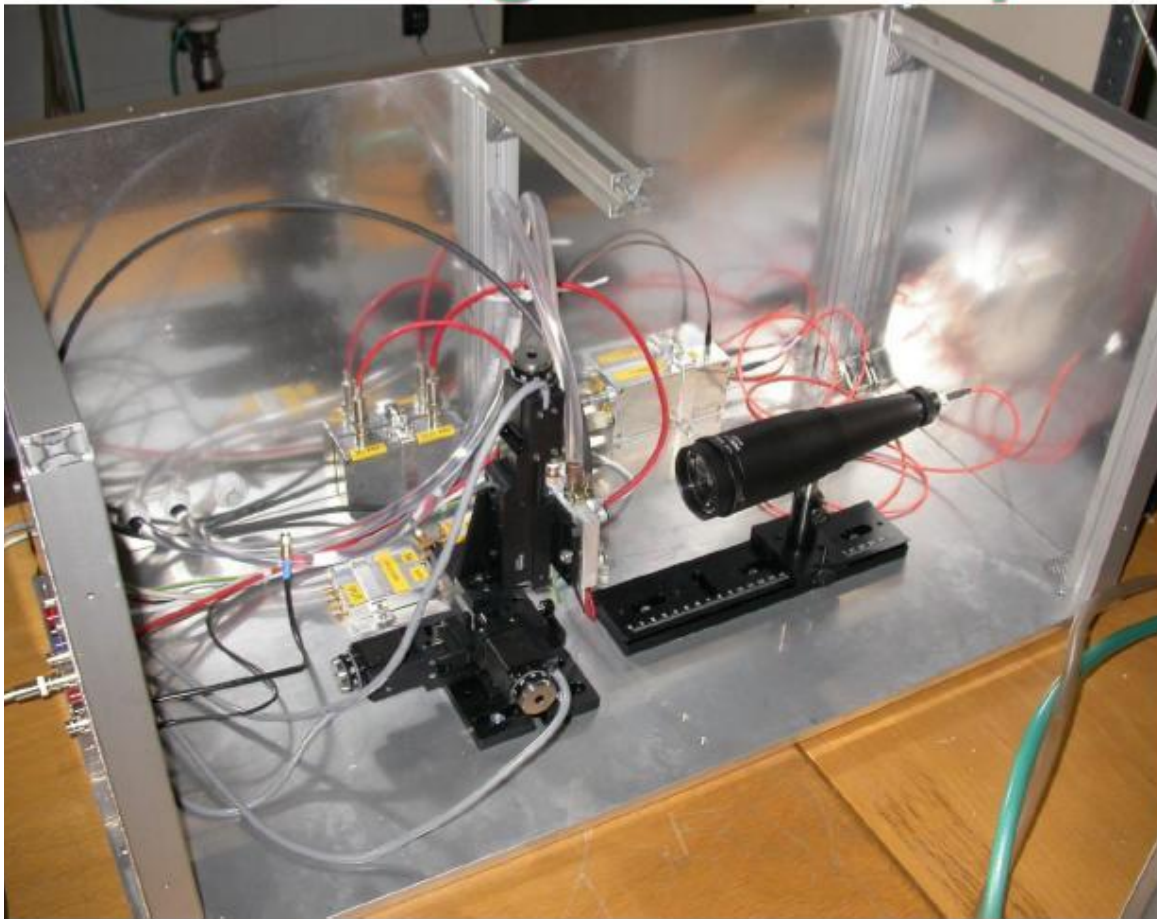


Irradiated p-spray sensor
Fluence = 1.5×10^{14} p + 6×10^{14} n
Measured @ 1000 V and -20°C



Alexandra Junkes at Tracker week July 2014

Scanning-TCT setup



Conectivity:

- LV power supply
- Temperature controller
- HV source
- Oscilloscope

Different detector mounts available (Edge-TCT, Surface-TCT)

Mechanical properties:

- $\sim >1 \mu\text{m}$ resolution in x-y-z
- movement range 5 cm (focus range of Red/Infrared)
- table load 2 kg
- USB controlled positioning

Optical properties:

- spot size $\sim 6 \mu\text{m}$ (red), $\sim 10 \mu\text{m}$ (IR-1064 nm)
- laser fiber coupled
- Intensity variation – neutral density filter (optional), shutter, reduction of laser pulse width

Laser:

- 1064 nm (200 mW in CV)
- From few mip to few 100 mip
- $\sim 350\text{-}4000 \text{ ps}$
- USB controlled pattern/width/freq

Amplifiers:

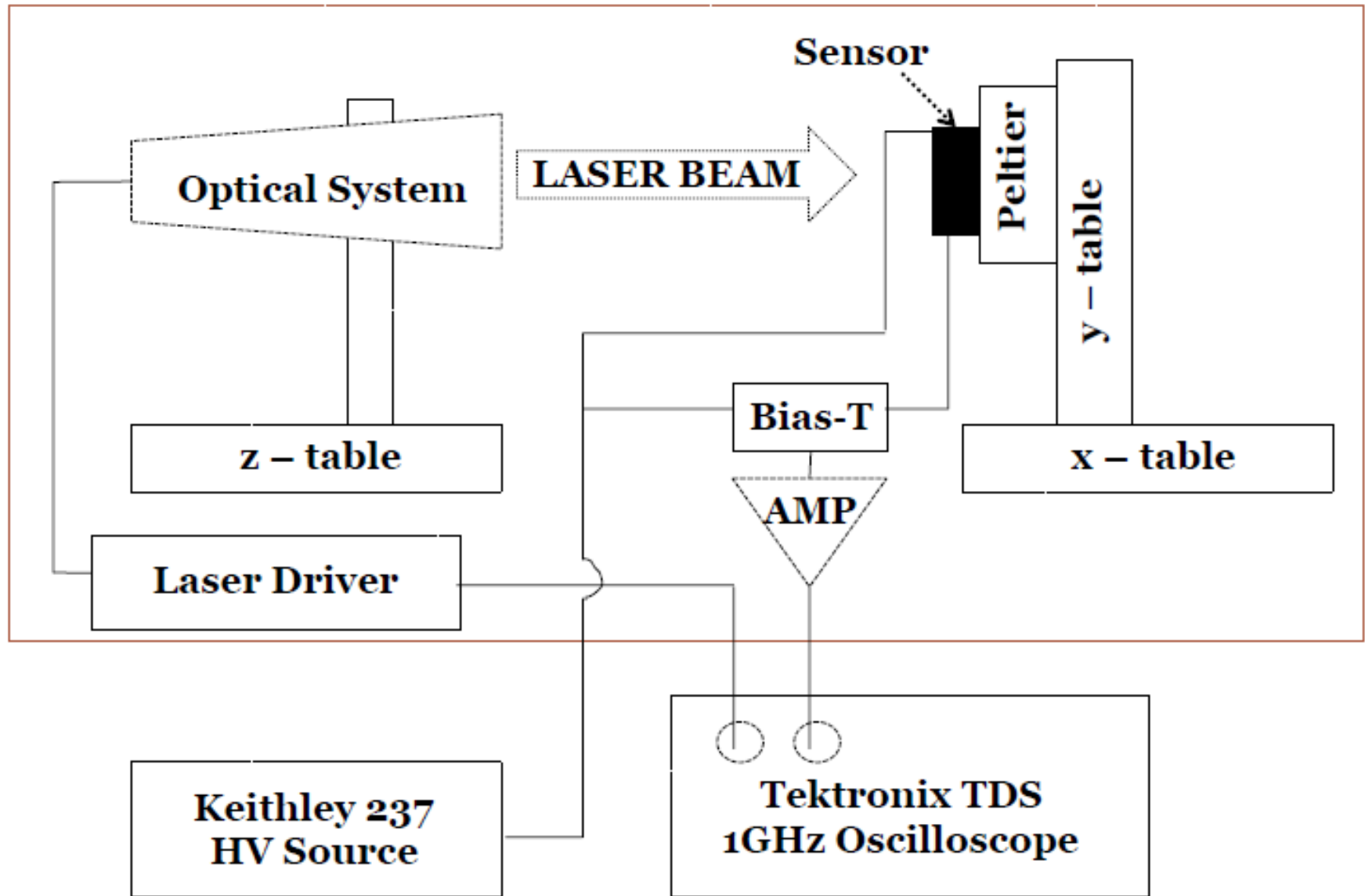
- 52 dB. Flat for $<0.3 \text{ MHz} - >2000 \text{ MHz}$
- 6-15V, 50Ω termination,
- Coupled to bias-T

Temperature control:

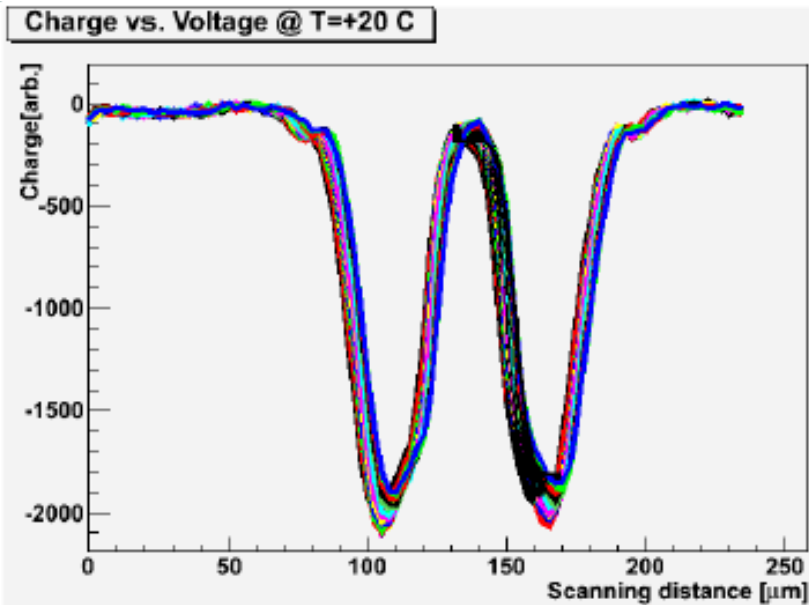
- Water cooled Peltier element
- dry air/gas inlet
- Pt-100 connected to T controller

Measurements can be taken at temperatures as low as -30°C

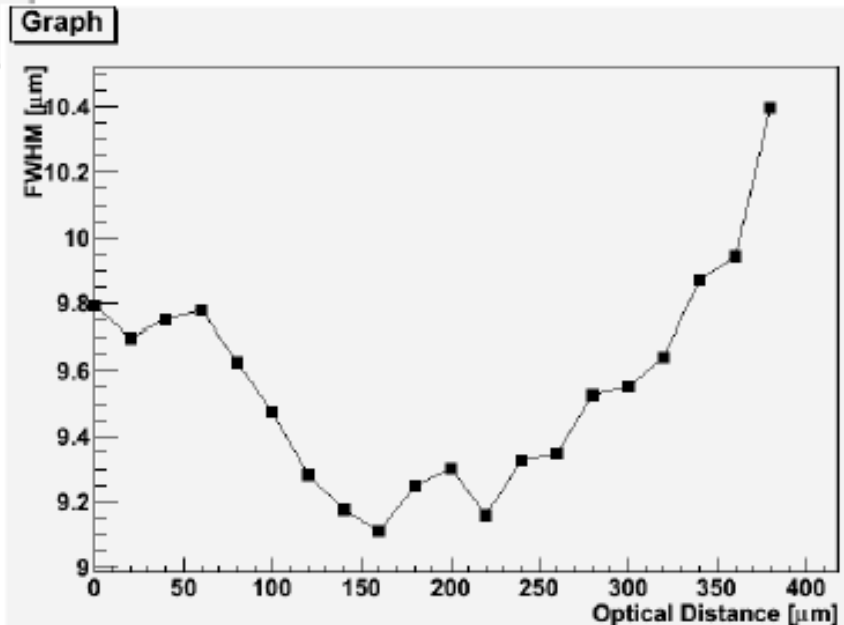
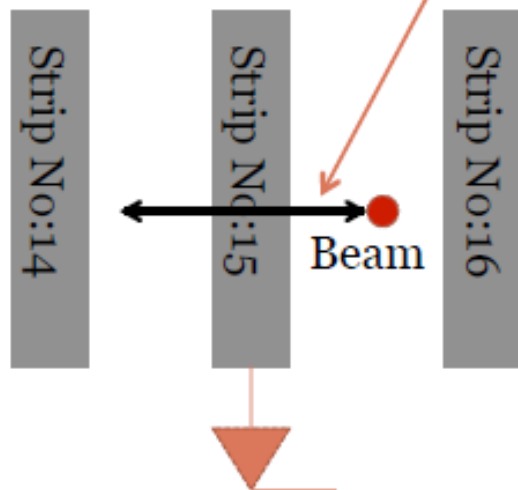
Schematic of TCT setup



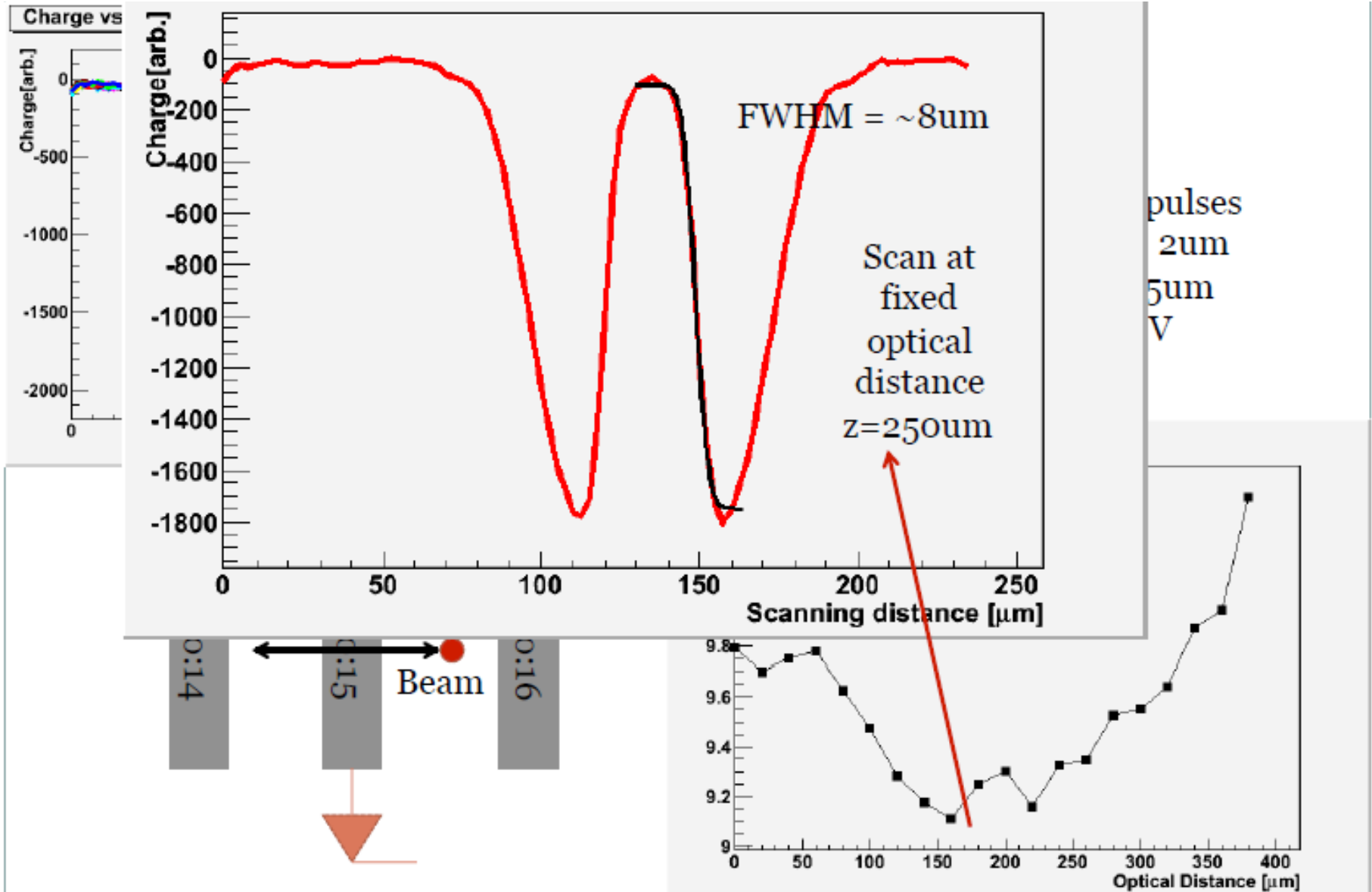
Focus measurement



TCT Method: Top TCT
Laser: Red (658nm)
Pulse Width: 1080mV
Frequency: 500Hz
Average over: 256 laser pulses
Scanning Axis (x) Steps: 2.5 μm
Optical Axis (z) Steps: 20 μm
Depletion Voltage: $\sim 134\text{V}$
Bias Voltage: -300V



Focus measurement



Near term plans

- Irradiation time at LANSCE
 - October 20/21 (?)
 - Plan to irradiate pixel sensors
 - Any other samples?
- Characterizations
 - 19 neutron+proton irradiated HPK sensors
 - Fluences = 1.5×10^{15} p(23 MeV) + 6×10^{14} n (R=15 cm)
 - Different materials FZ/FTH/MCz and p-type/p-type
 - Thickness = 200 μm
 - Have been measured before irradiation and after proton irradiation
 - Measure CV/IV, TCT after neutron irradiation and compare