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SI LAB Silizium Labor Bonn

DEPFET Active Pixel Detector

PXD BEAST

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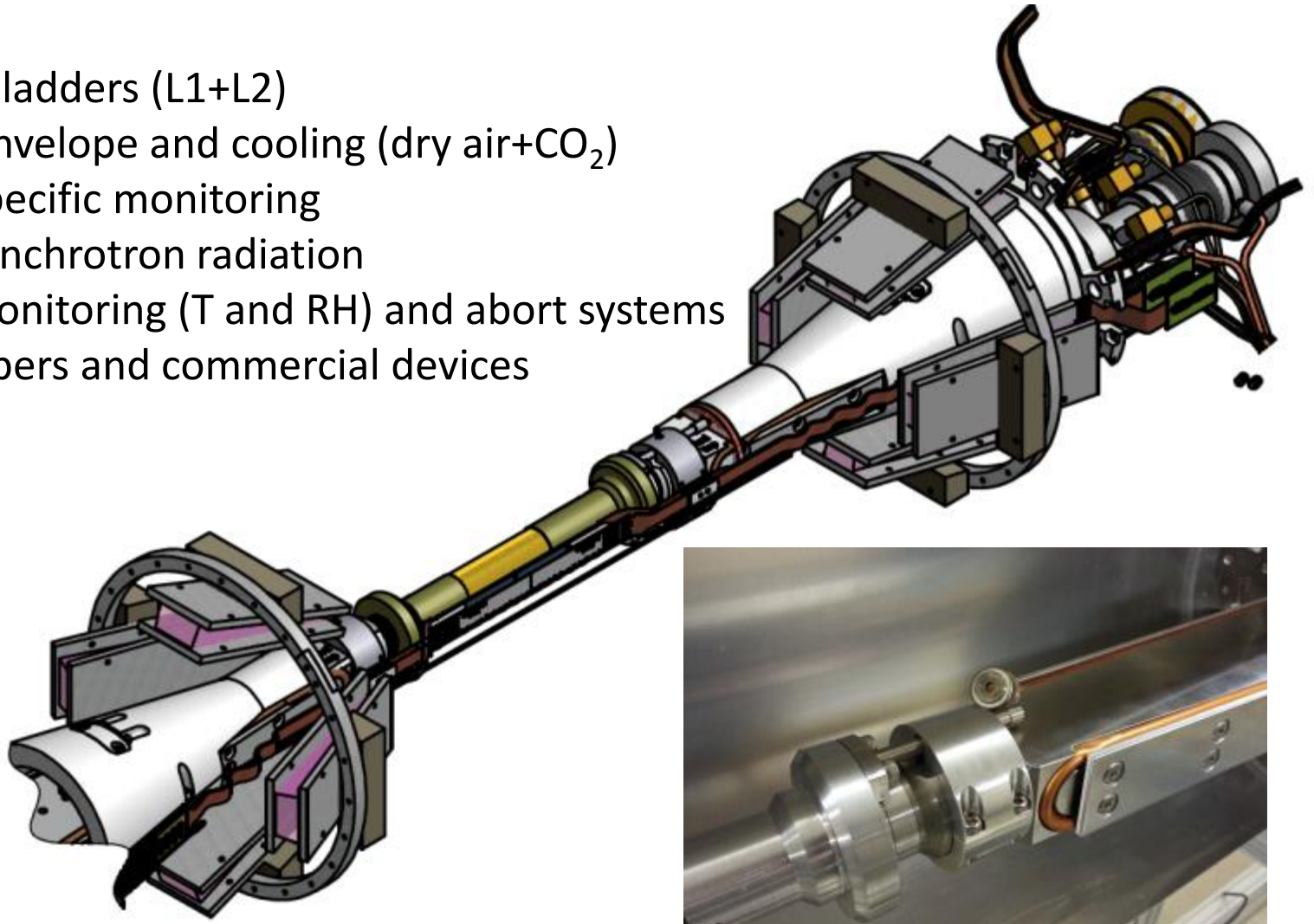
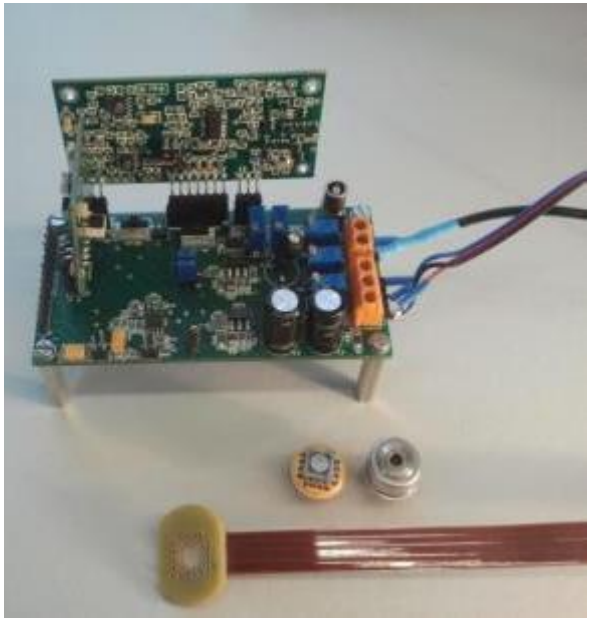
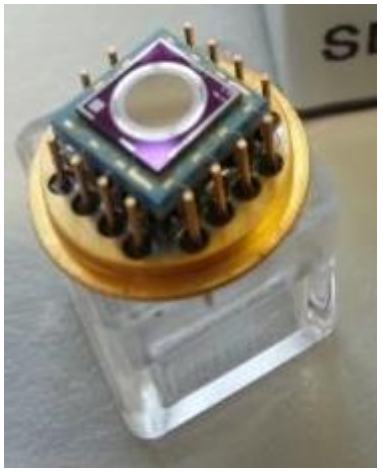
PXD BEAST II Plan

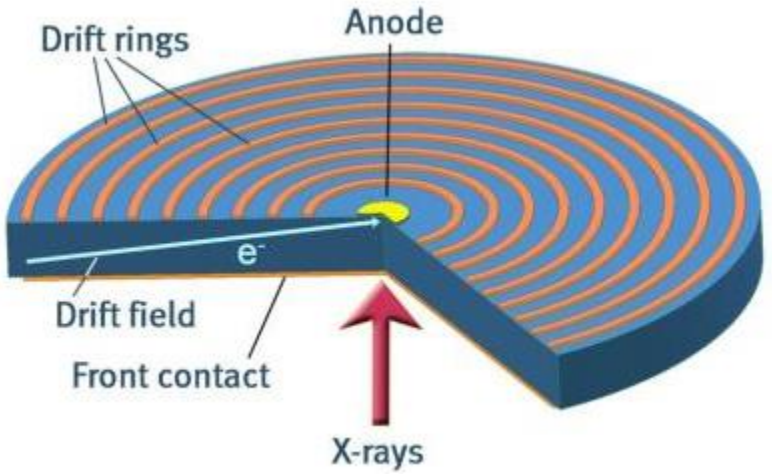
- 2 PXD half ladders (L1+L2)
- Thermal envelope and cooling (dry air+CO_2)
- BEAST II specific monitoring
  → Synchrotron radiation
- General monitoring (T and RH) and abort systems
  → Fibers and commercial devices

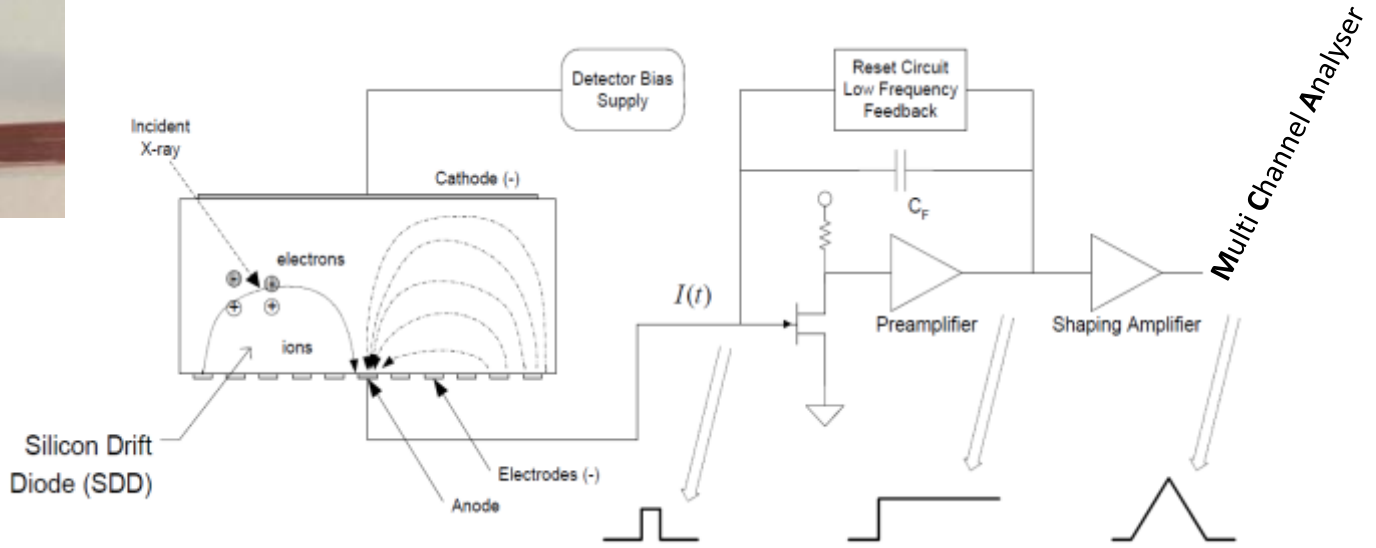


Synchrotron Radiation Study





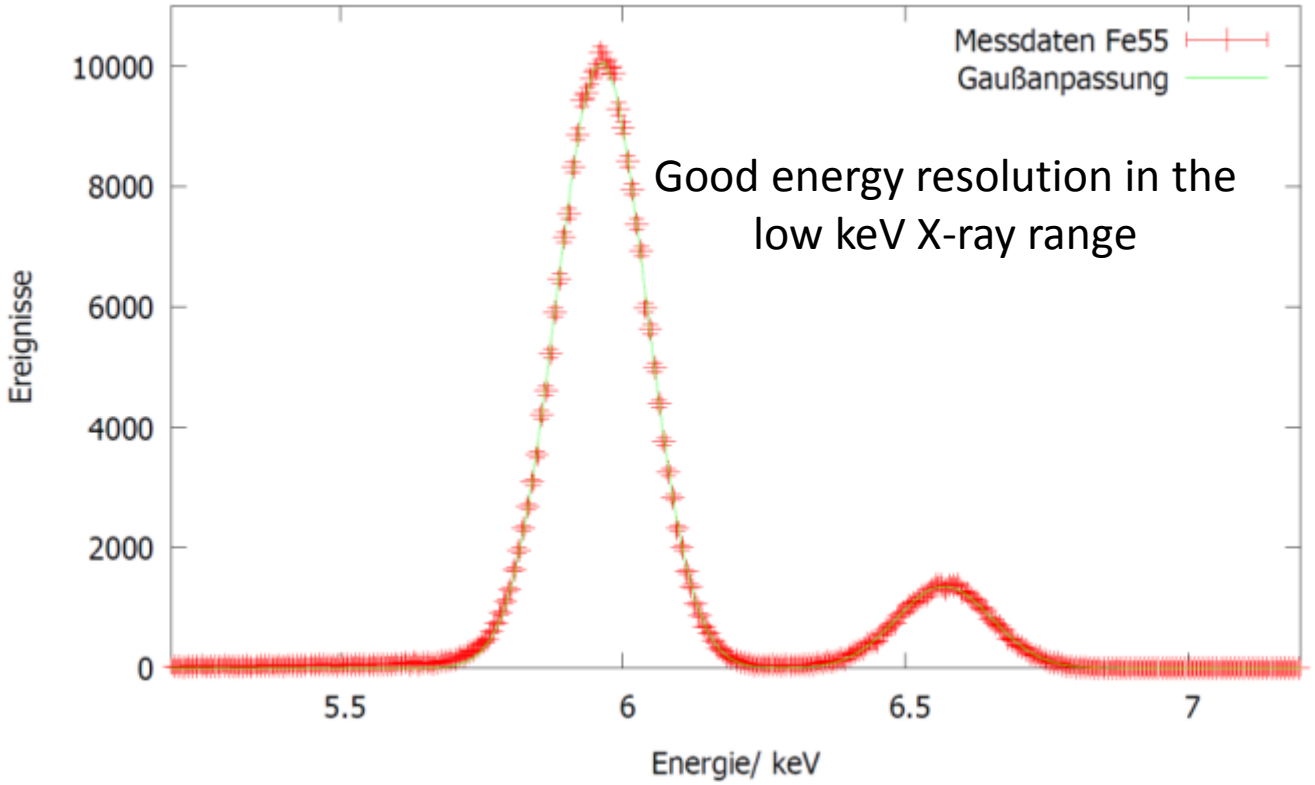




SDD Performance

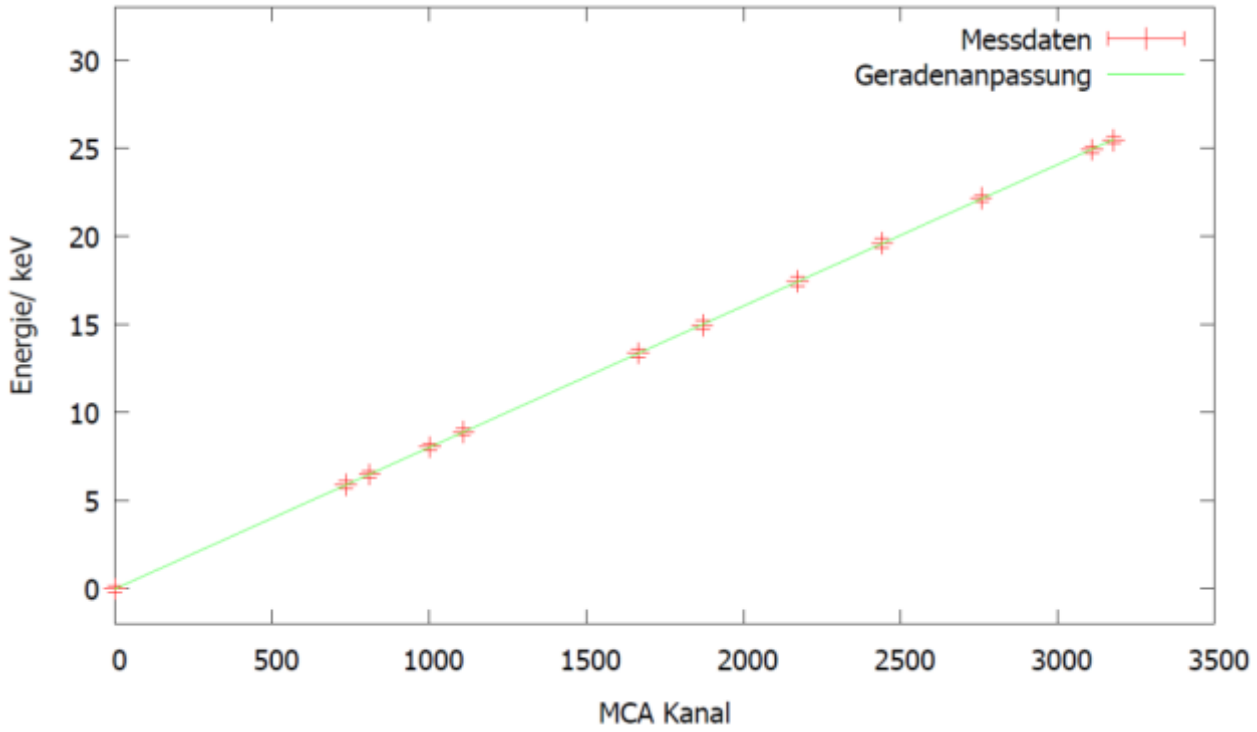
- K_α - and K_β -line of the ^{55}Fe decay

dyn. Grenze/ keV	K_α/ eV	$\Delta E_\alpha / E_\alpha$ / %	K_β/ eV	$\Delta E_\alpha / E_\alpha$ / %
32.5	187.19	3.17	198.49	3.06

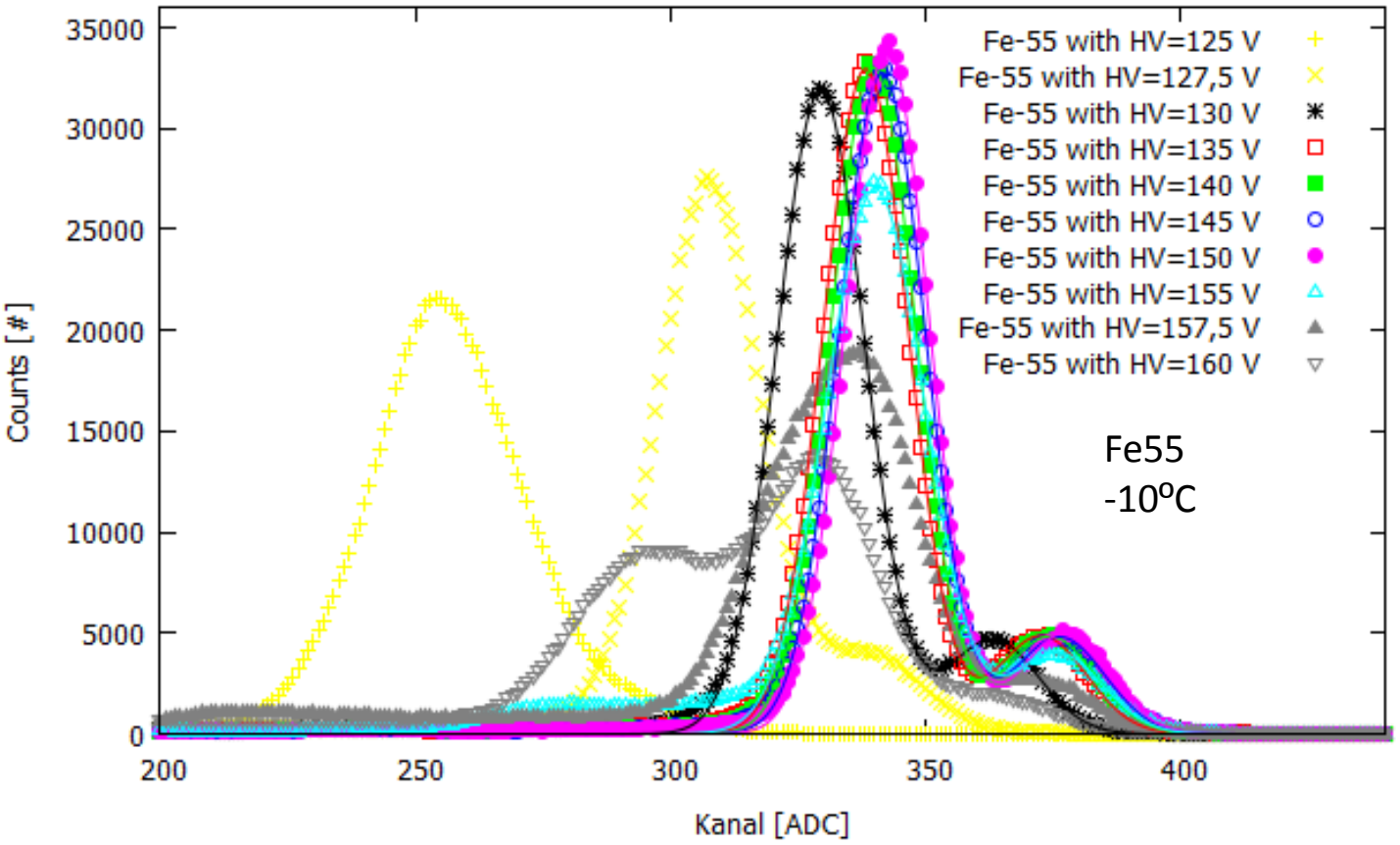


SDD Energy Calibration

- Measured Gaussian mean value of several K_α and K_β transitions
- Linear response

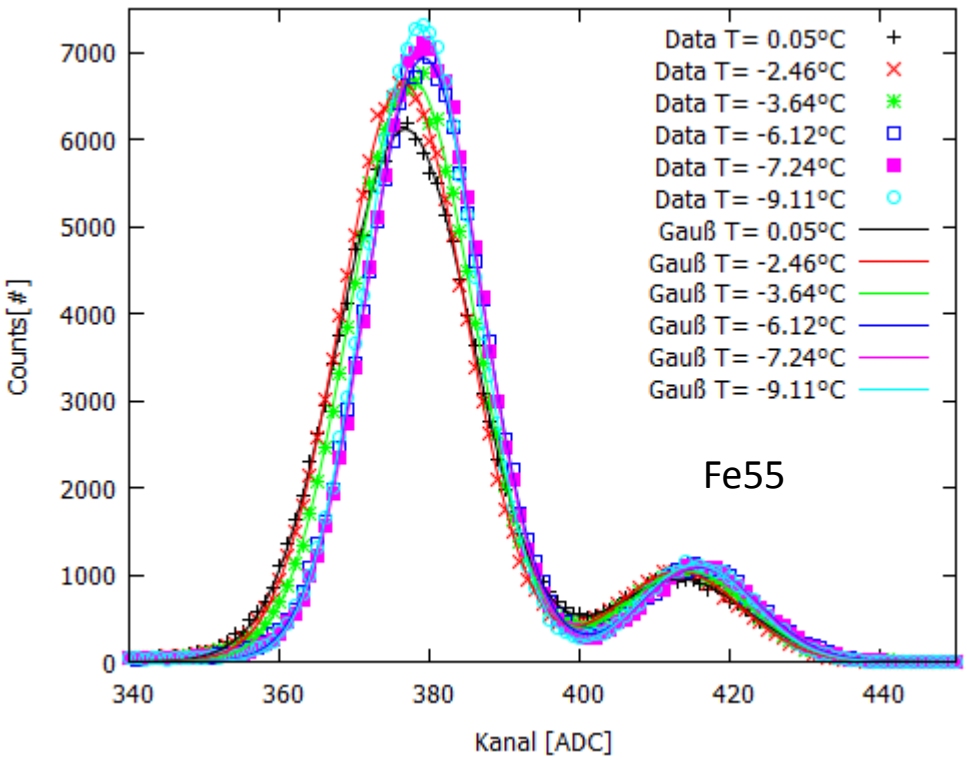


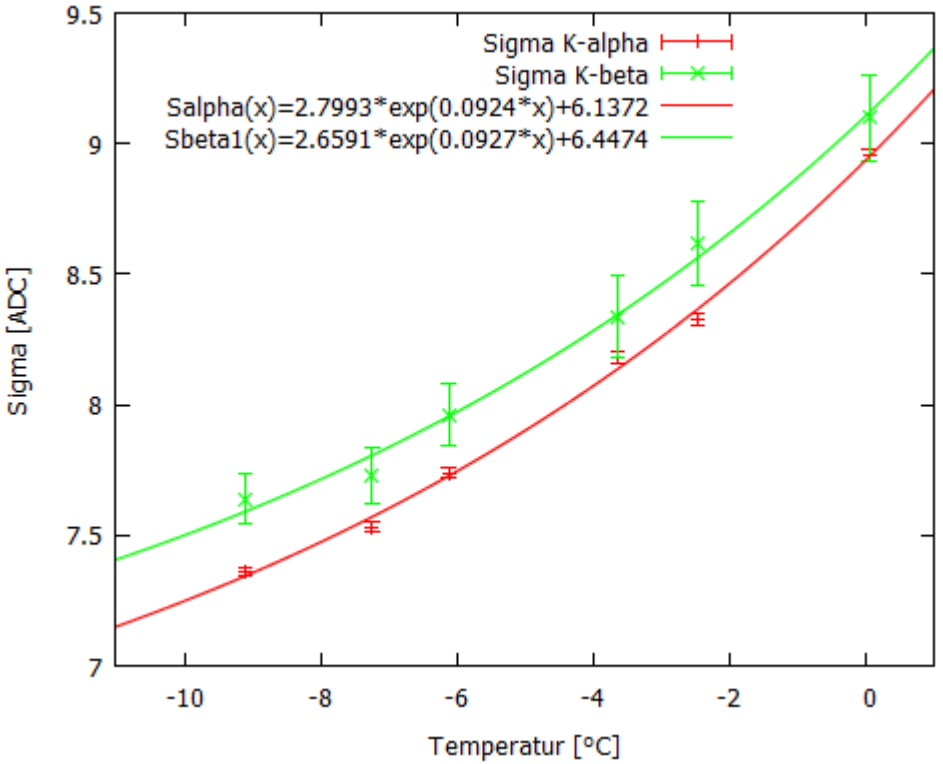
High Voltage Optimization



Optimum range 135 V ≤ HV ≤ 150 V

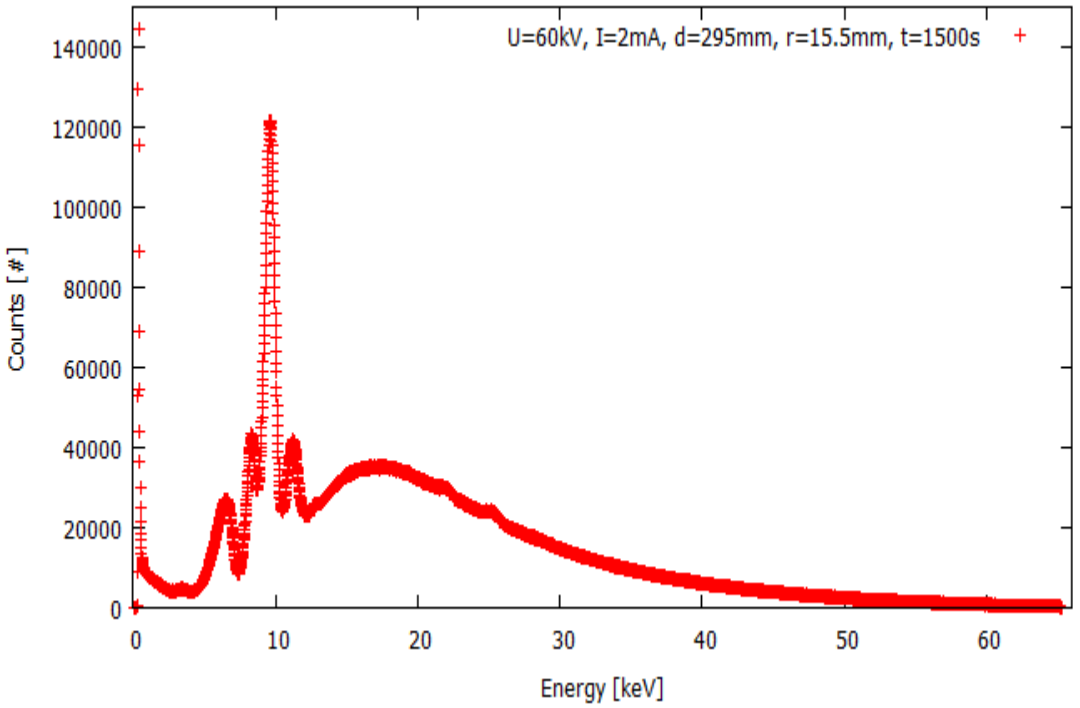
Temperature Dependency

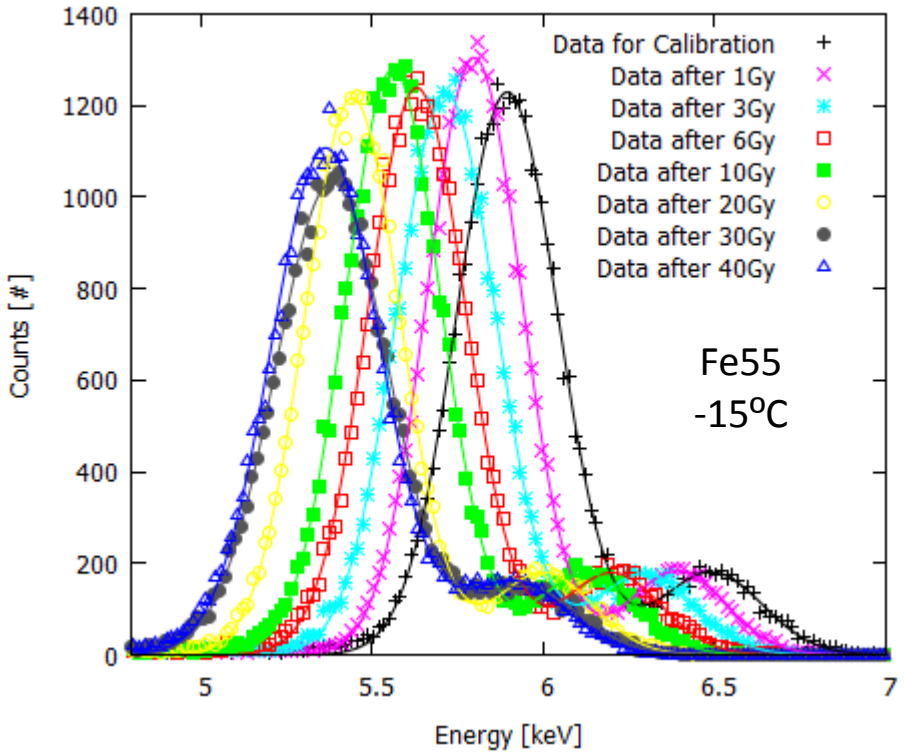




Control of the temperature is vital to keep performance

X-ray Irradiation

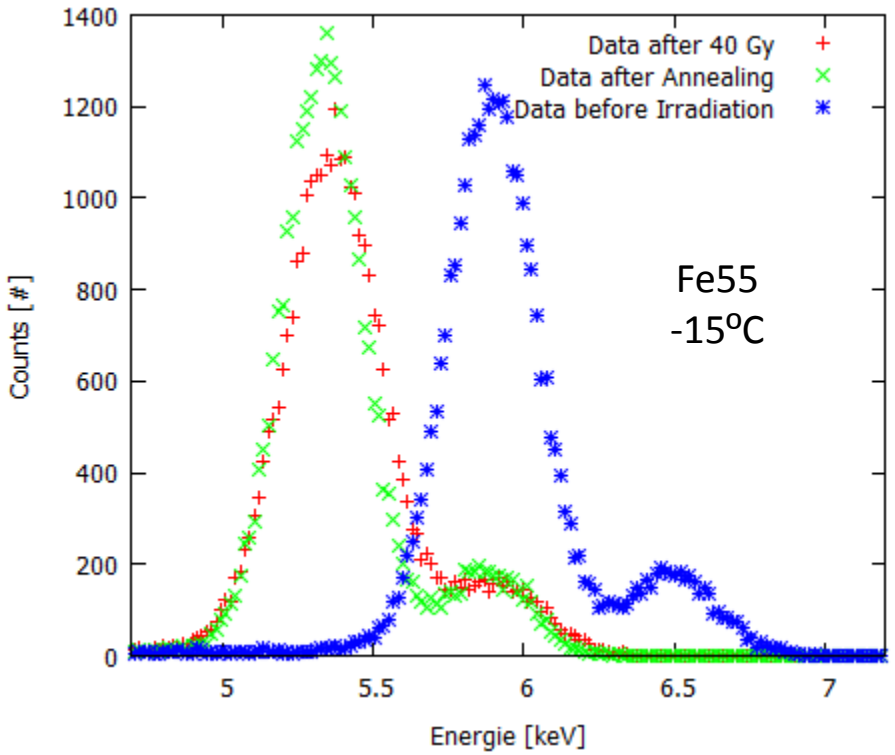




- X-ray irradiation up to 4 Mrad (KIT)
- 60 kV with 15 µm Iron filter
- 100 krad, 300 krad, 600 krad, 1 Mrad, 2 Mrad, 3 Mrad, 4 Mrad
- No annealing. Biased sensor during irradiation.
- SDD temperature during irradiation -5°C. Dry environment (25°C).

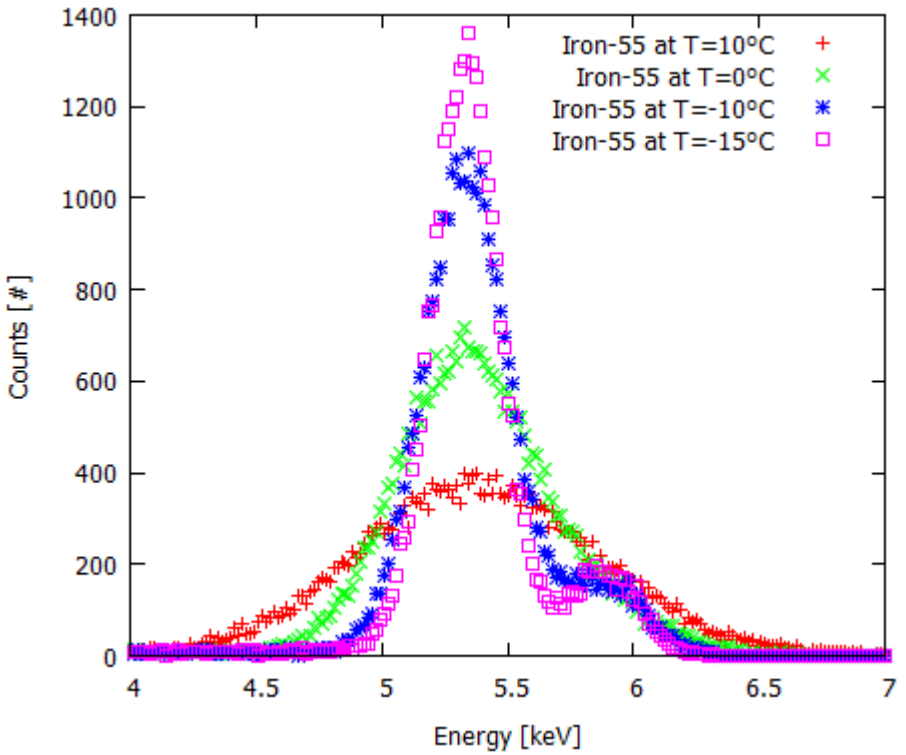
- Resolution is worsened after each step. Gain slightly reduced
- Temperature control is vital

Temperature Dependence After Irradiation



4 Mrad Annealed

80 °C, 100 min

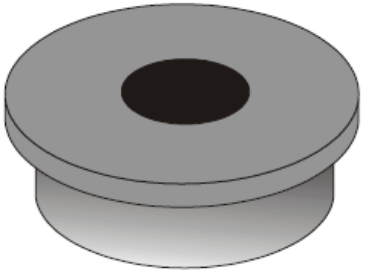


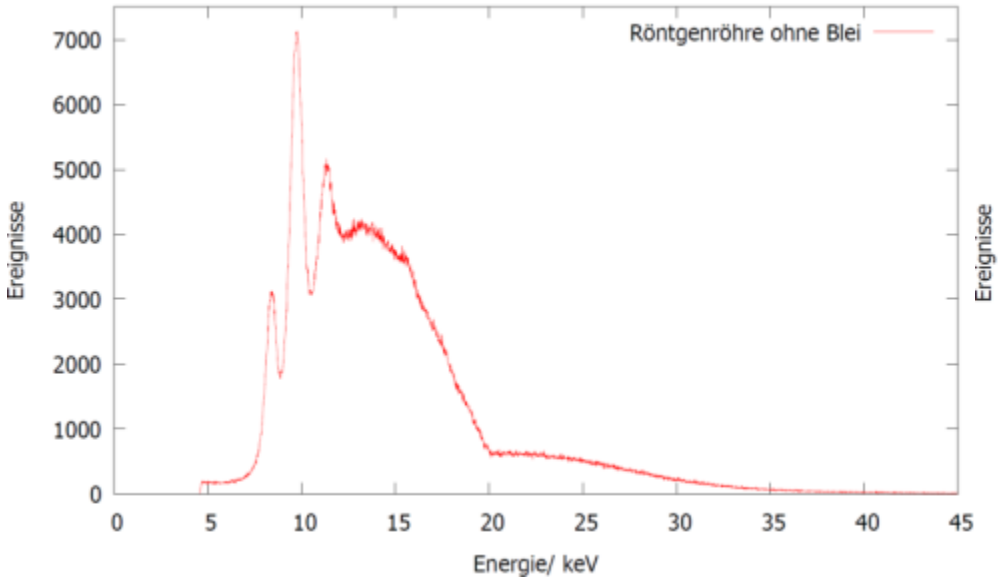
→ Even after annealing,
low temperature is vital

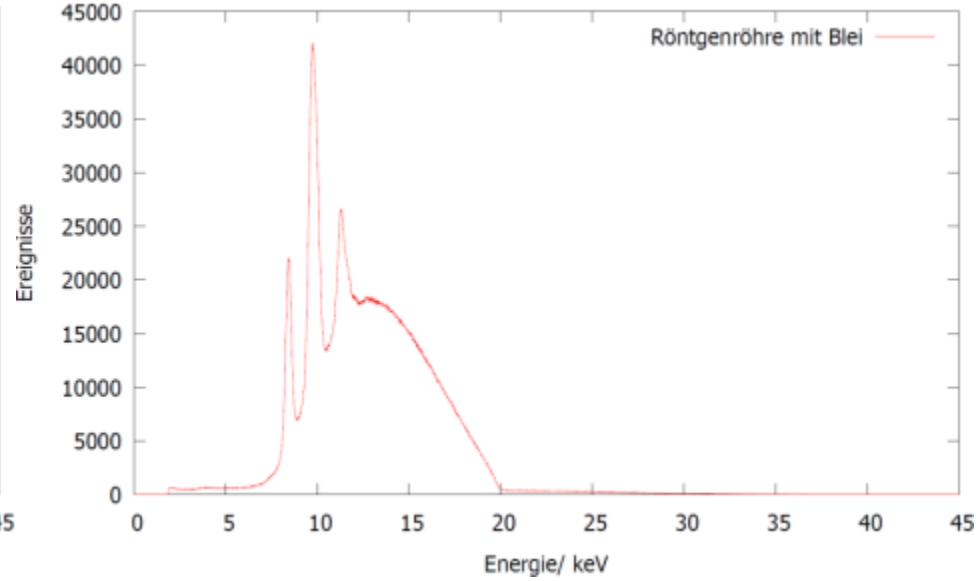
Issues

Still, issues remain:

- Operation in magnetic field
- Limited count rate (simulations needed!)
- System related aspects (cable length and electronics)
- Availability and costs (Amptek, Ketek, FBK)



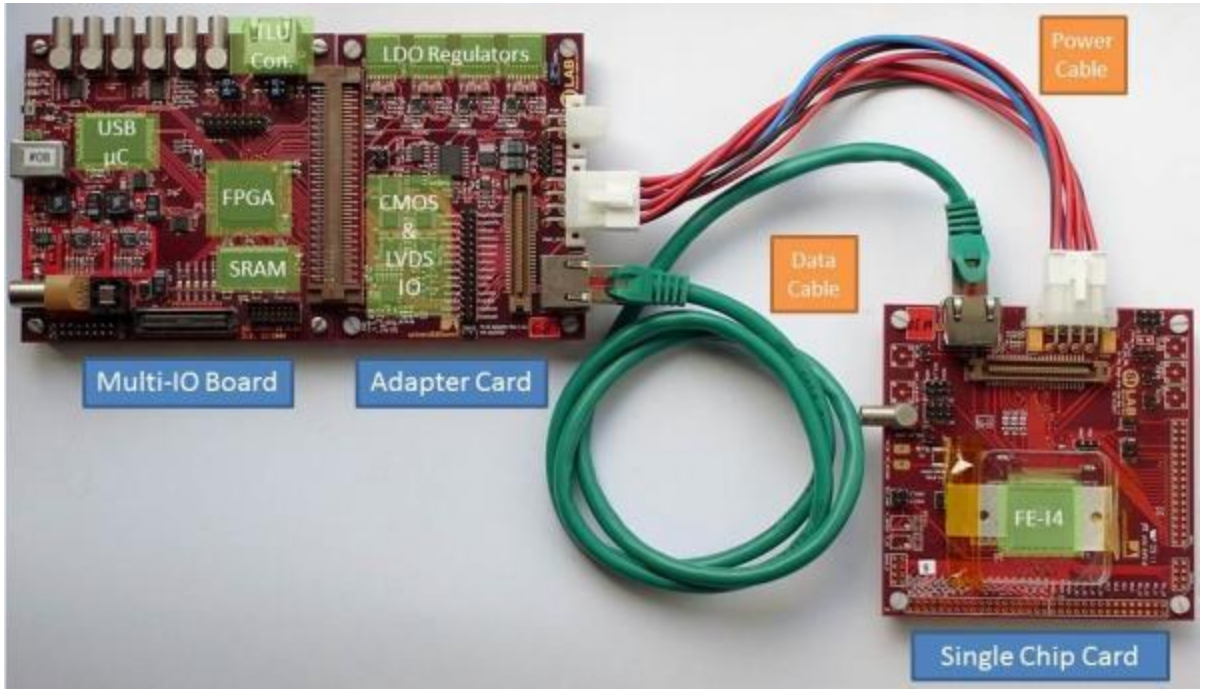




FE-I4 Based Option

Hybrid planar sensor FE-I4 based

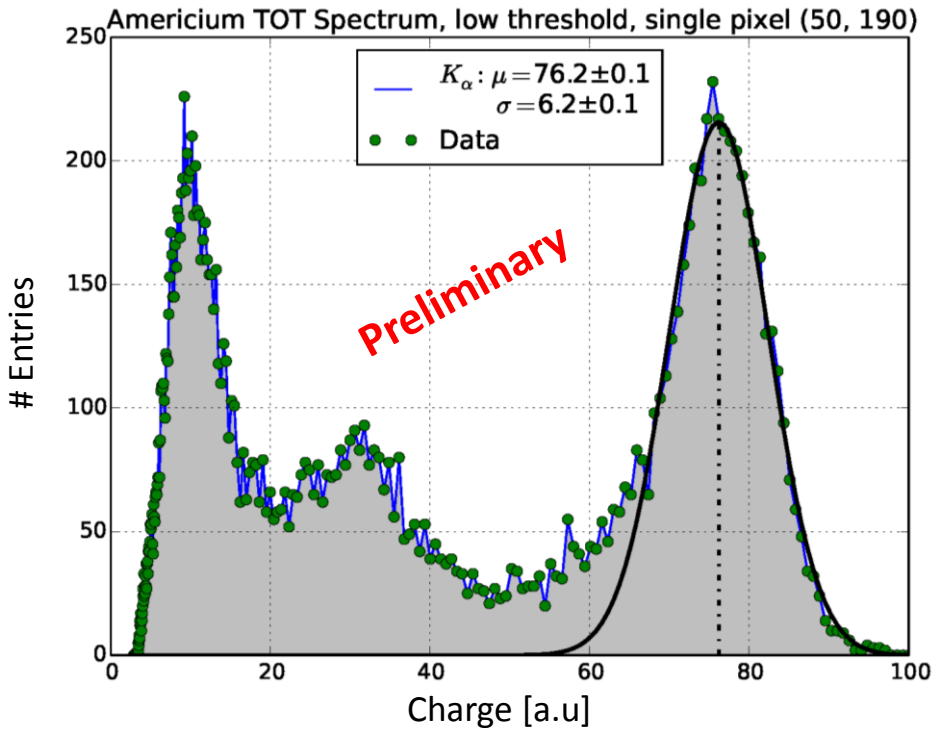
- Pixel size: 50 x 250 µm^2
- Radiation tolerance: 300 Mrad
- Hit-trigger association resolution: 25 ns

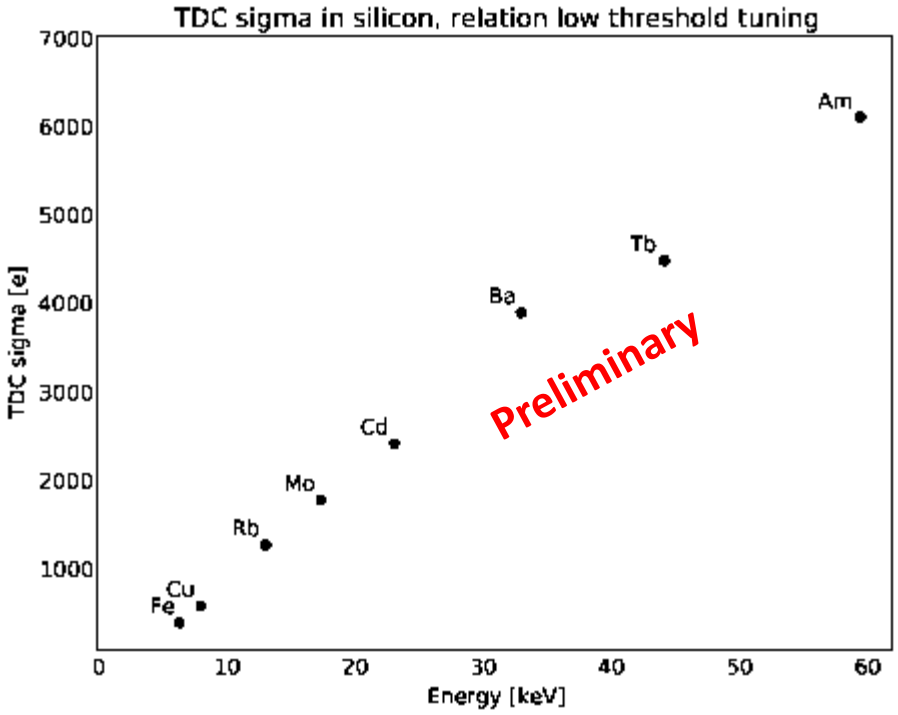


→ Alternative aproach to measure backgrounds

Energy Calibration

D. Pohl, M. Engel



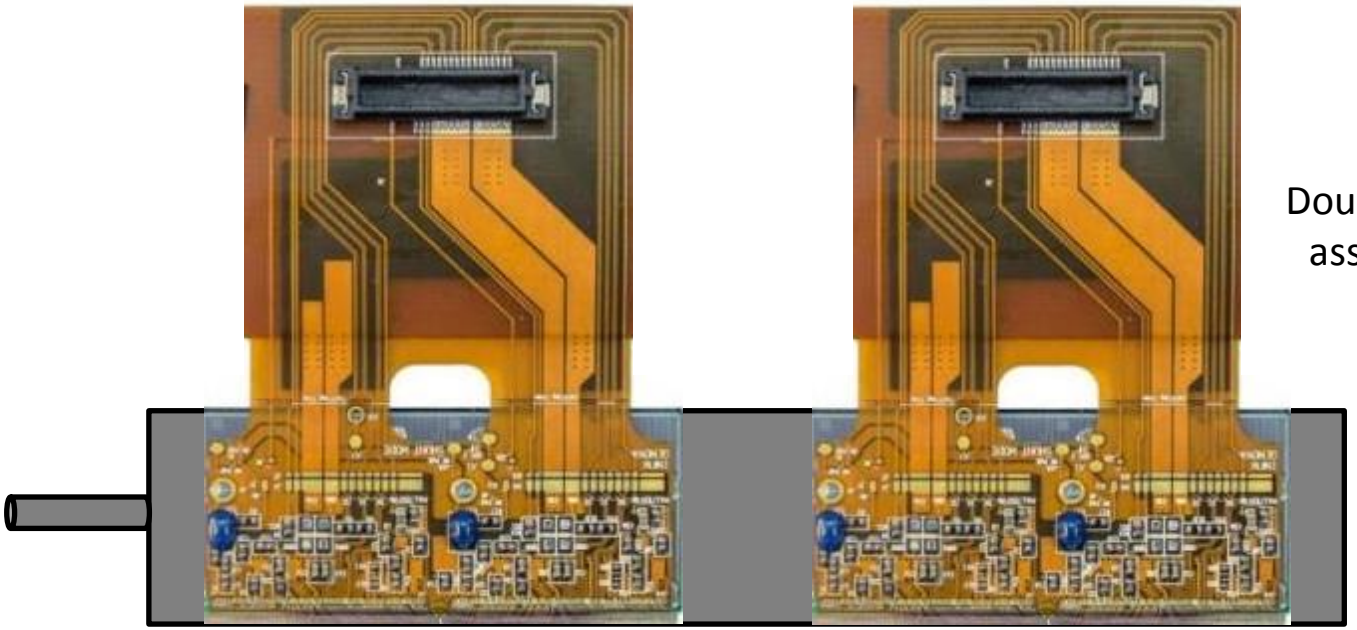


→ If the condition on the energy resolution is relaxed a bit, this device is fast, rad hard and minimizes system related problems

Mechanical Assembly

Support and cooling

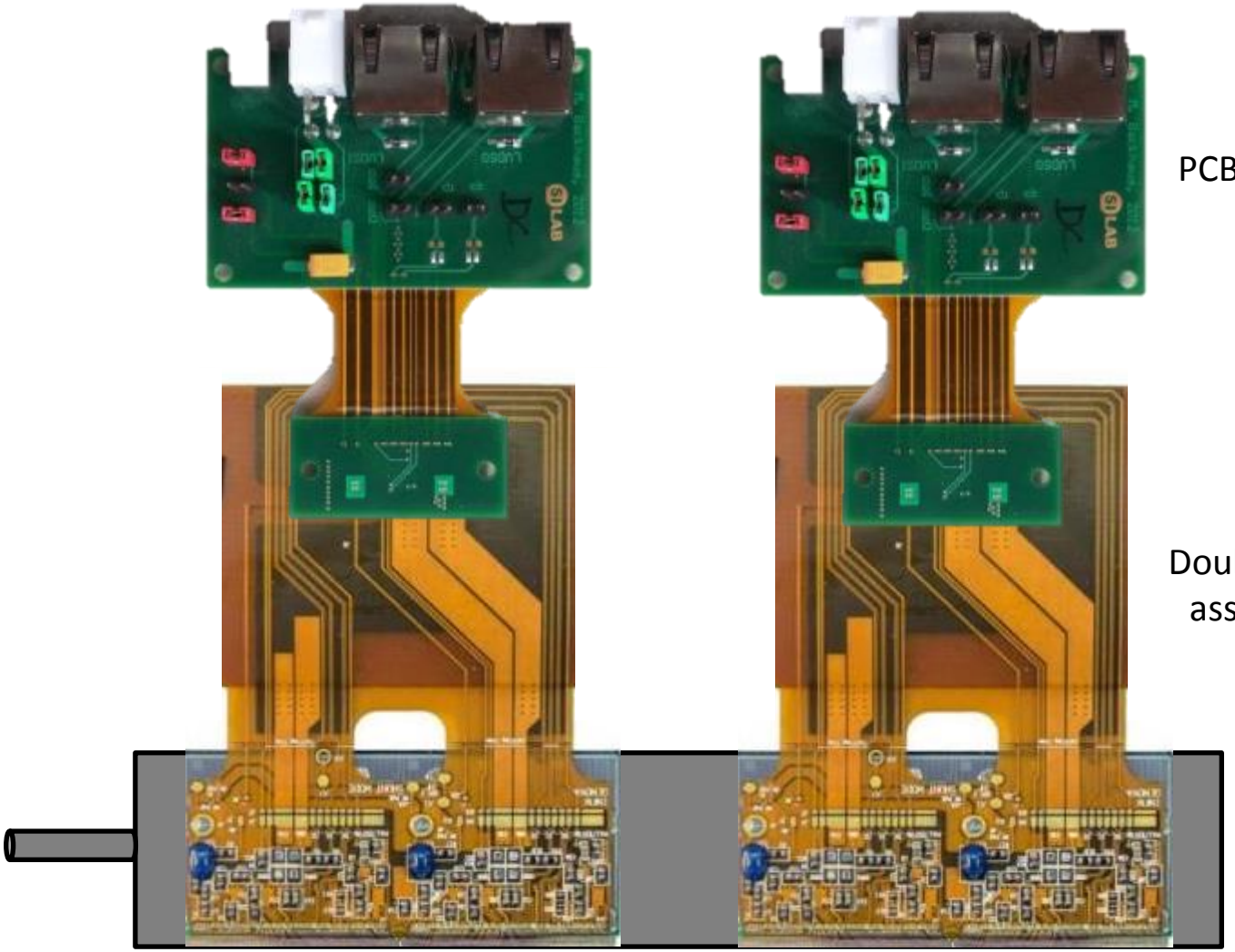
Mechanical Assembly



Double chip assembly

Support and cooling

Mechanical Assembly



PCB

Double chip assembly

Support and cooling

Conclusions

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- SDD shows good energy resolution and is radiation hard (3 Mrad)
  → Operation temperature **< -15°C**

- Still some issues unresolved (max rates based on simulations, system related aspects and availability) and need further investigations and decisions

- Full standalone FE-I4 based option seems to satisfy the conditions (fast, rad hard, system development) if we relax the energy resolution requirements

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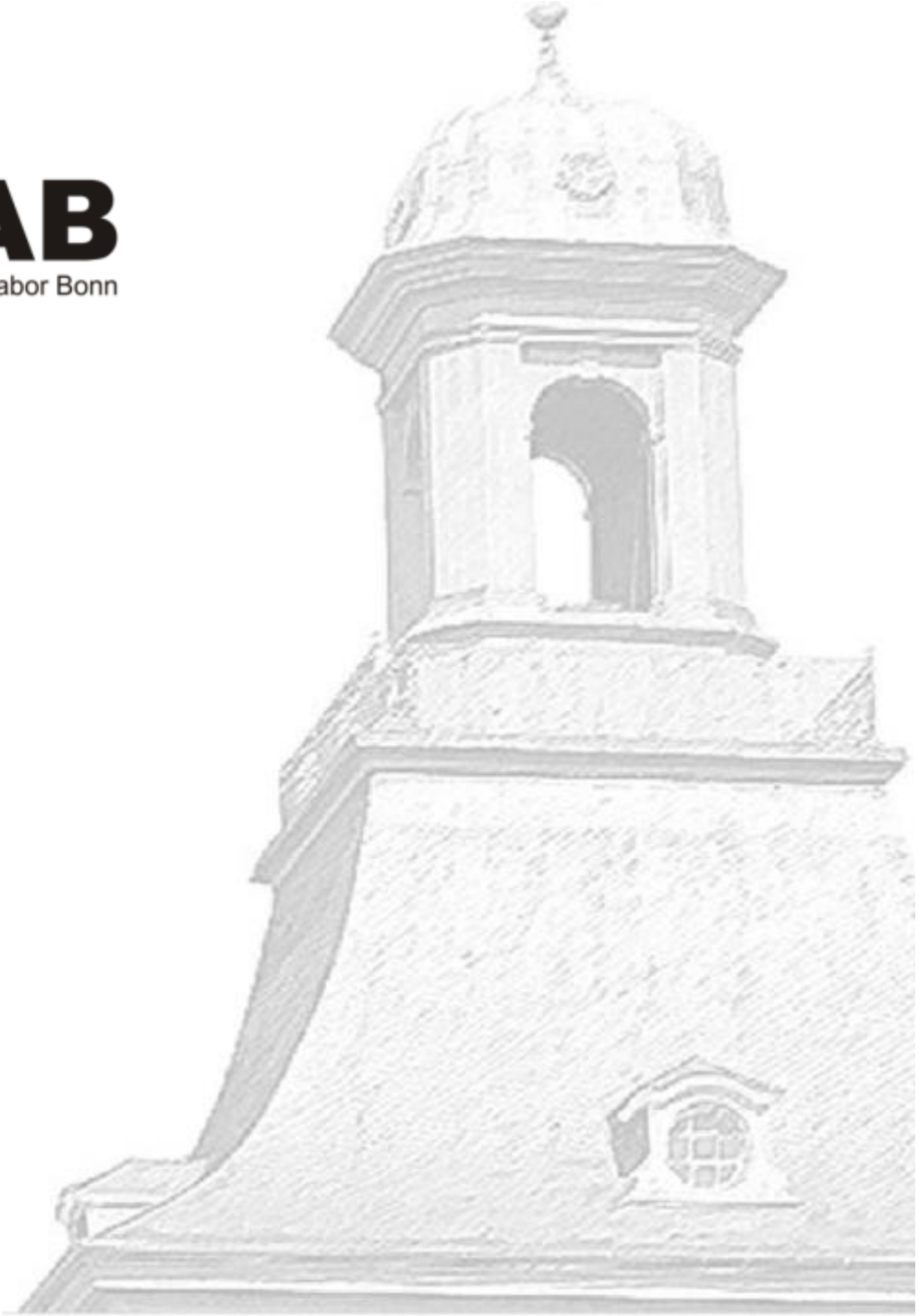

Thank you

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