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SI LAB
Silizium Labor Bonn

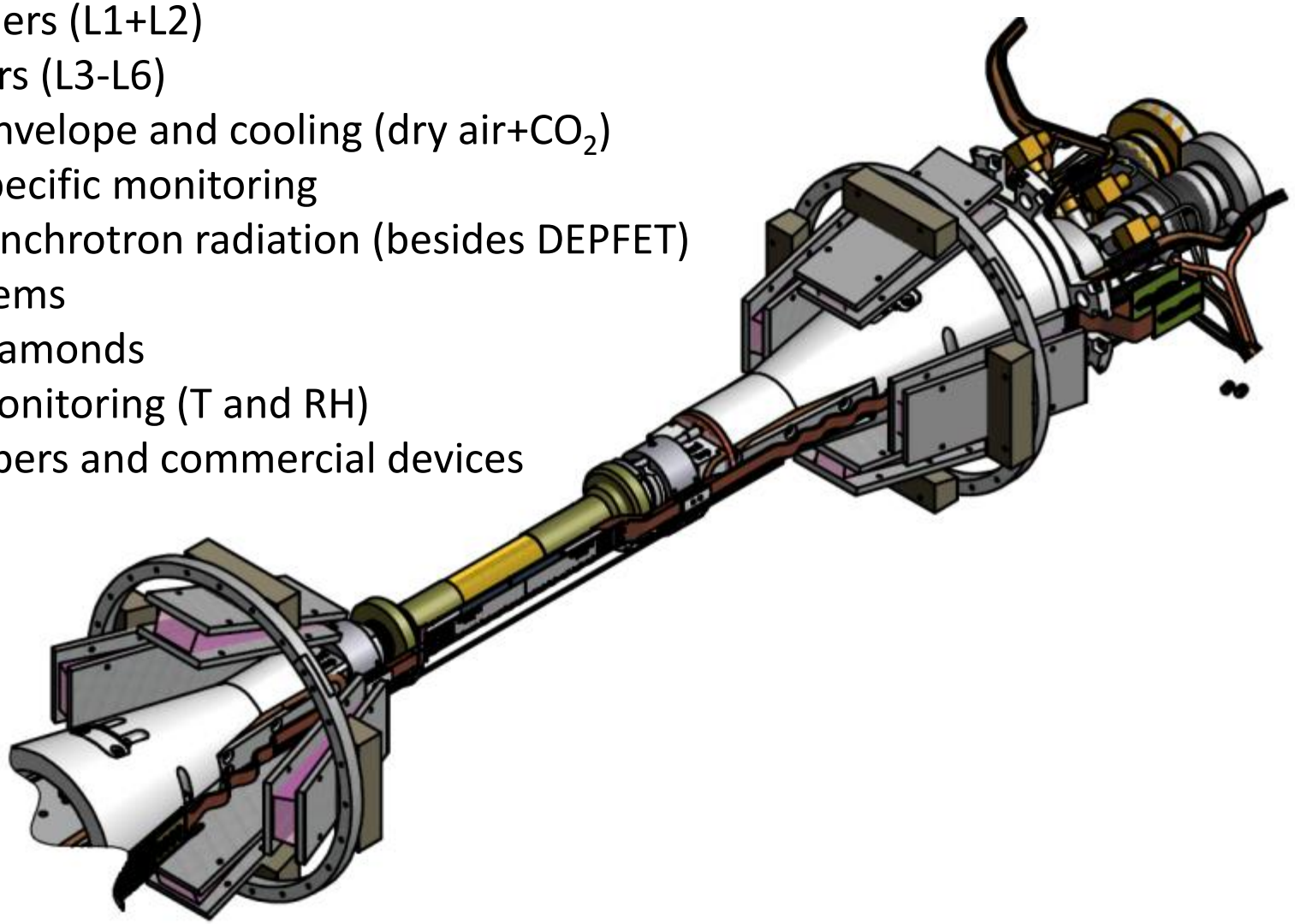
VXD BEAST

PXD-SVD Groups

cmarinas@uni-bonn.de

VXD BEAST II Plan

- 2 PXD ladders (L1+L2)
- 4 SVD layers (L3-L6)
- Thermal envelope and cooling (dry air+CO_2)
- BEAST II specific monitoring
  → Synchrotron radiation (besides DEPFET)
- Abort systems
  → Diamonds
- General monitoring (T and RH)
  → Fibers and commercial devices



FOS for the VXD Mockup

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- All the fibers calibrated with temperature at constant humidity (6 %) (sensitivity)
- Fibers with no tubing will be calibrated with humidity at 4 points (5%,20%, 35%, 50%)
- A new set-up manufactured at IFCA in order to obtain the offset of sensors protected with Teflon tubing.
  - Sensors will be inside a methacrylate cage and in the same position as the expected in the mock-up.
  - The humidity will be reduced at 5% and maintained during 3 days. After this time , sensors measured values will be taken as the offset. A temperature reference sensor positioned near fiber sensors will be used in order to measure the reference temperature for this offset.

FOS Calibration

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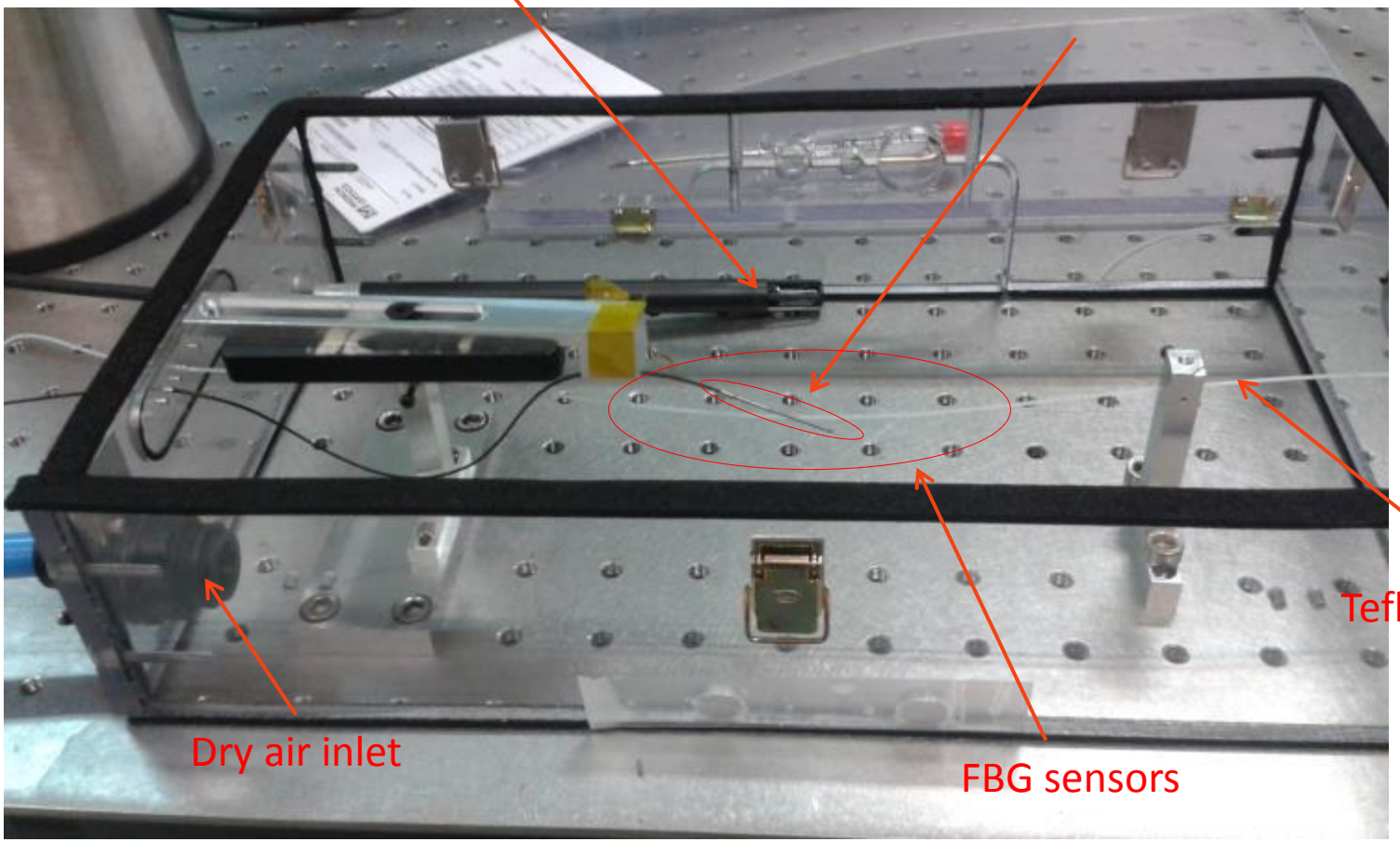
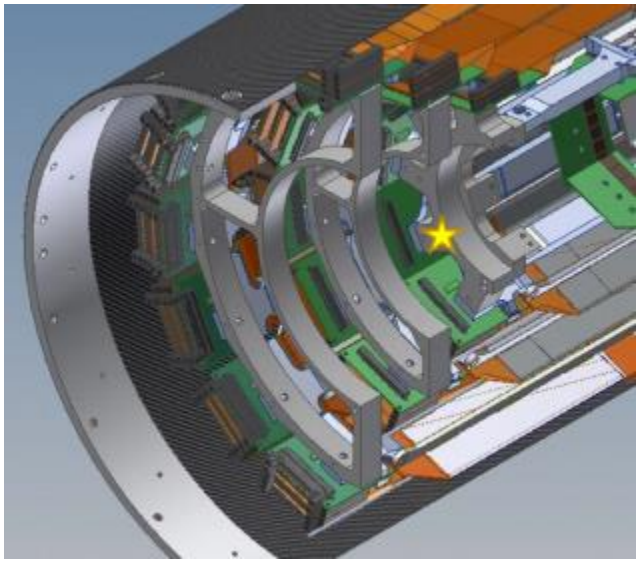
$$Temp = (\lambda - \lambda_{offset}) * sensitivity + T_{referencesensor}$$

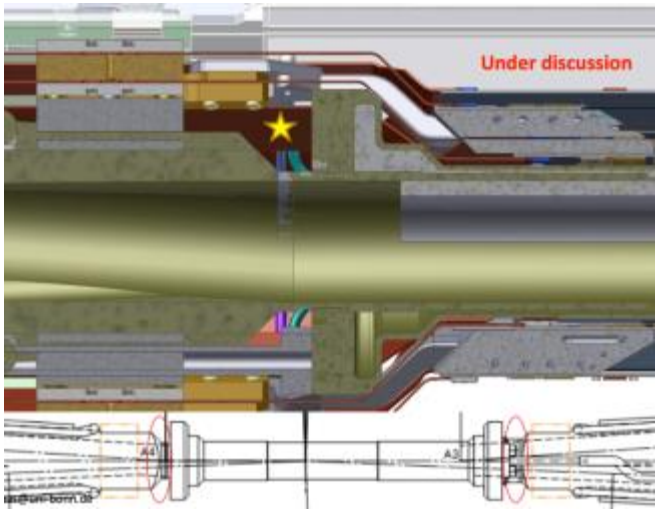


Concept already demonstrated during the Jan test beam

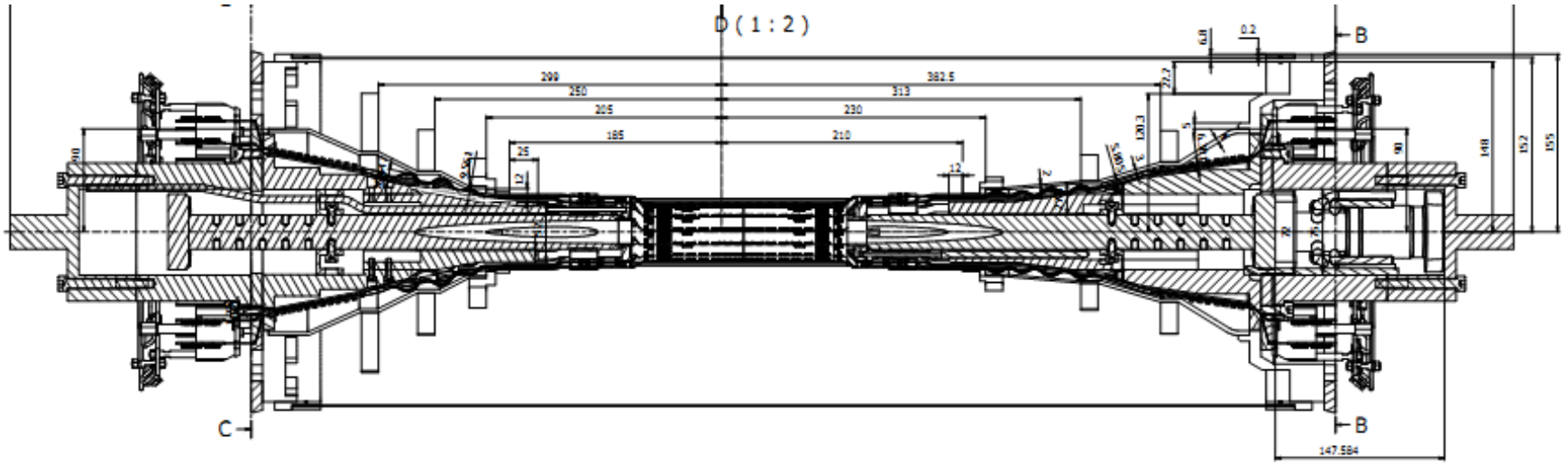
Beam Loss Monitors



4 + 4 diamonds
PXD-beam pipe



6 + 6 diamonds
close to SVD L3
support rings



BLM Readout Electronics

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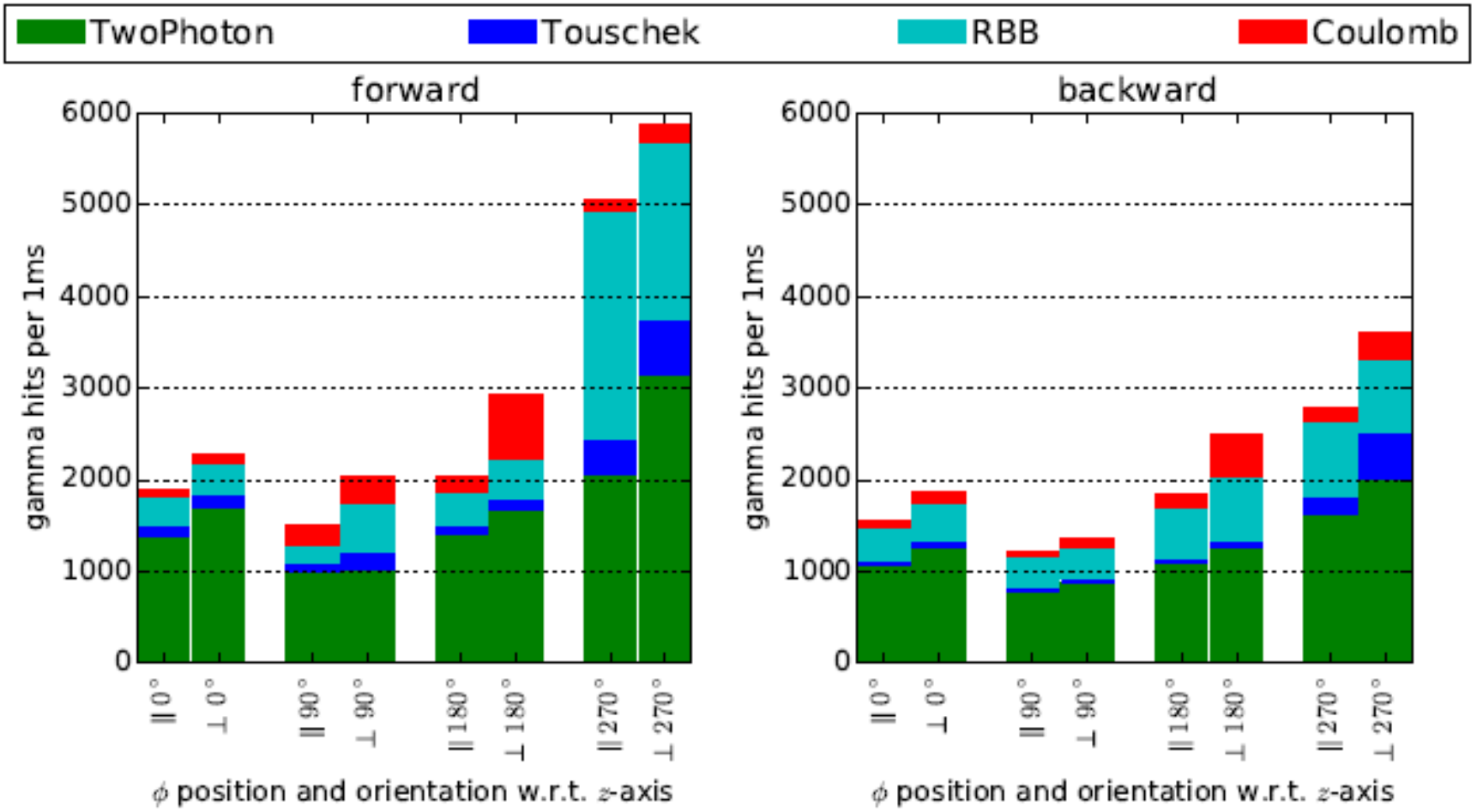
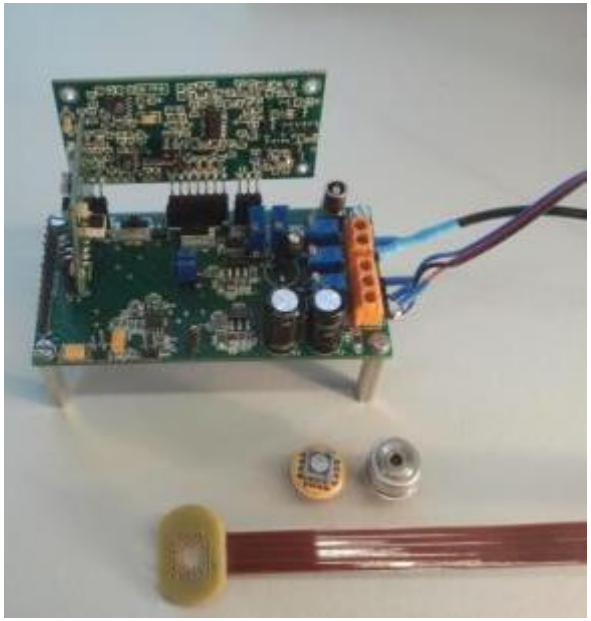
- Collaboration with electronics and detectors group at Elettra, Trieste
  - G. Cautero, D. Giuressi, R. H. Menk + F. Vulpone (student)
- Modular design, FPGA + Memory + ADCs + HV + Ethernet
  - project's kernel: ALTERA DE3 evaluation board, with a STRATIX III FPGA
  - External memory: Transcendt 1GB DDR2 RAM
  - 3 peripheral boards will be connected with DE3
    - board with 4 ADCs, HSMC connector
    - board with 2 Ether-W-ease (ethernet), 2 GPIO connectors
    - board with 4 DACs and 4 HV diamond bias outputs
- Schedule plans:
  - "Final" prototype available for test with 4 sensors at BEAST phase 1
  - "Production" modules ready for BEAST phase 2

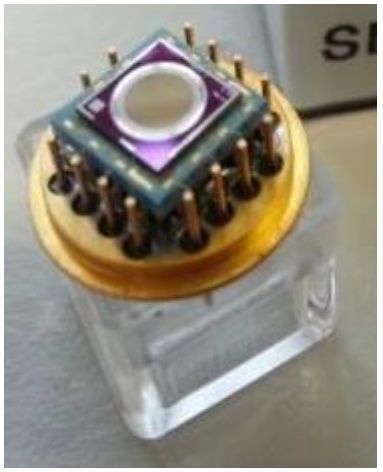
Simulations

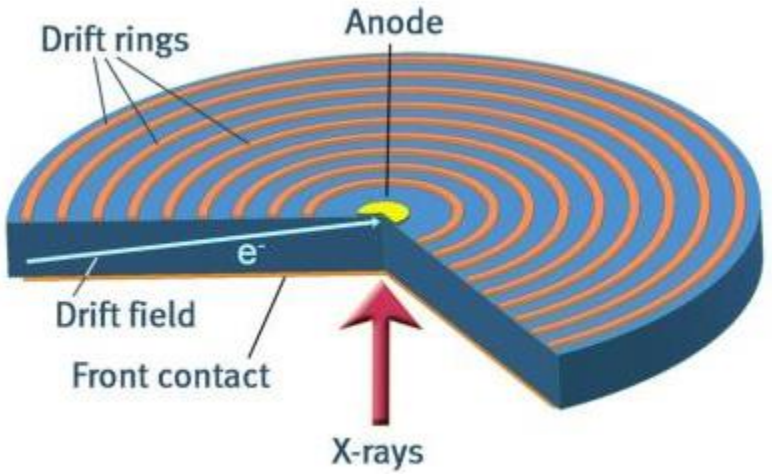


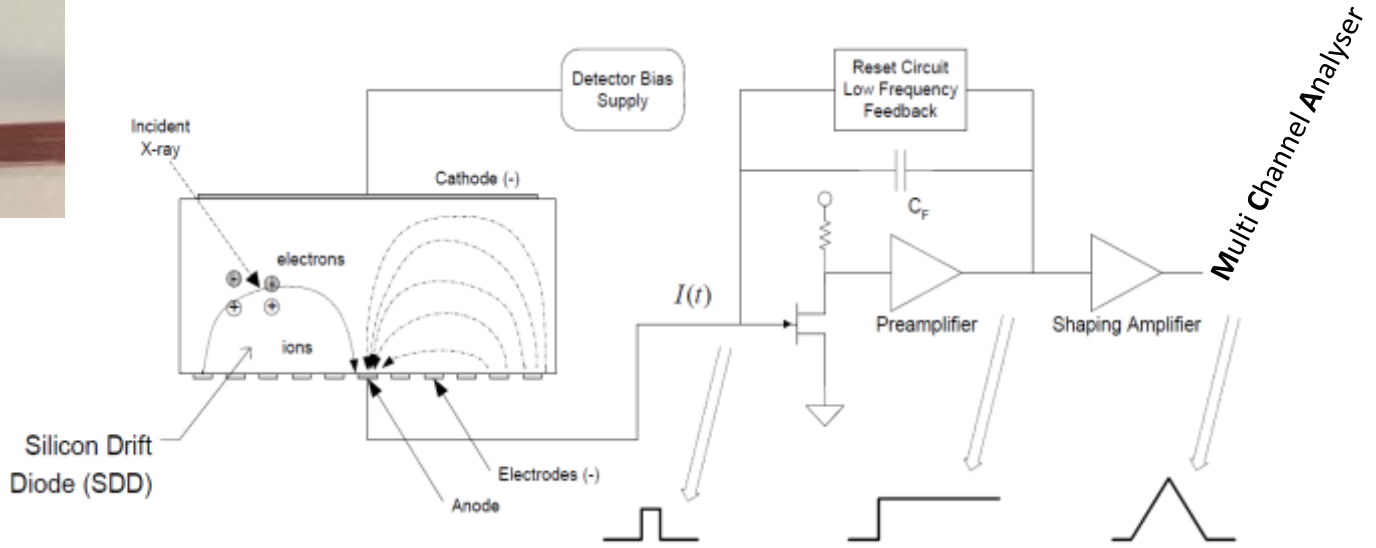
→ Preliminary estimation of the fluences and energy deposition in the BLM (manpower needed)

Synchrotron Radiation Study





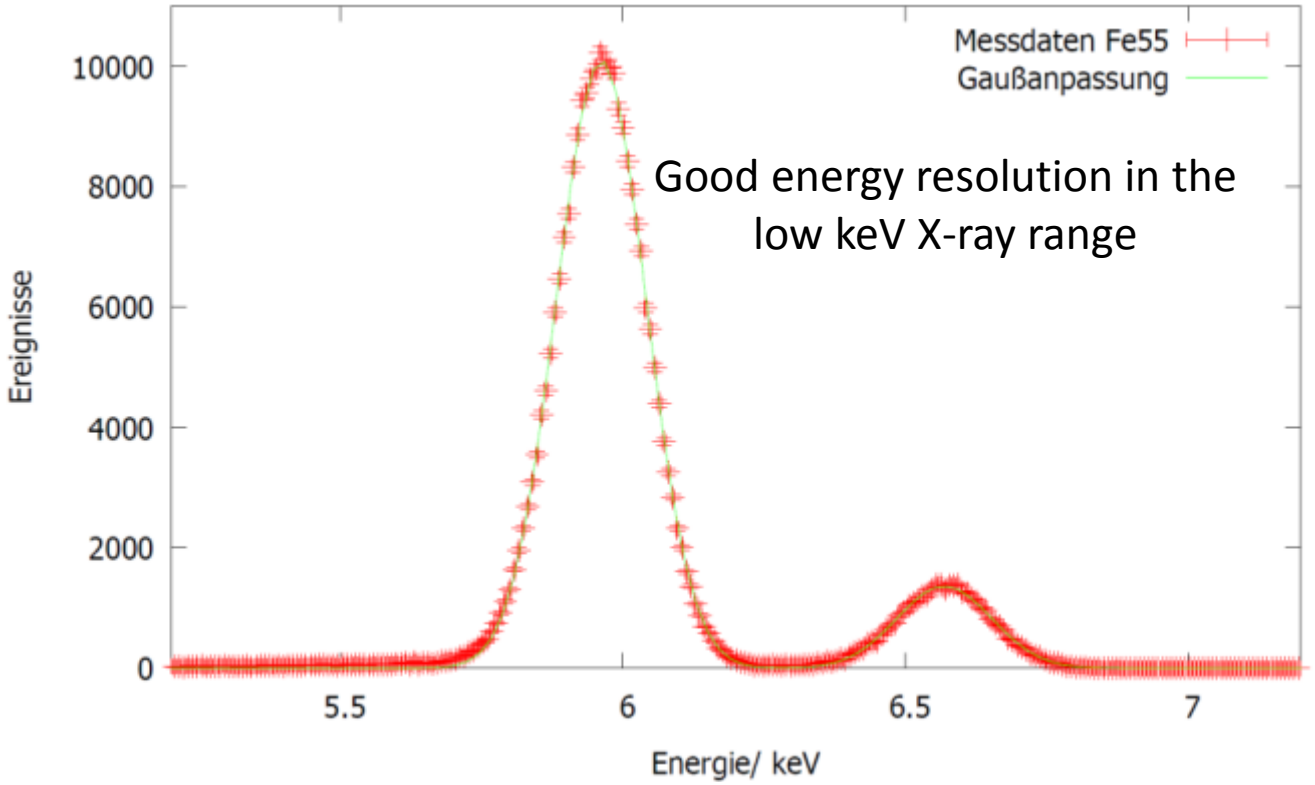




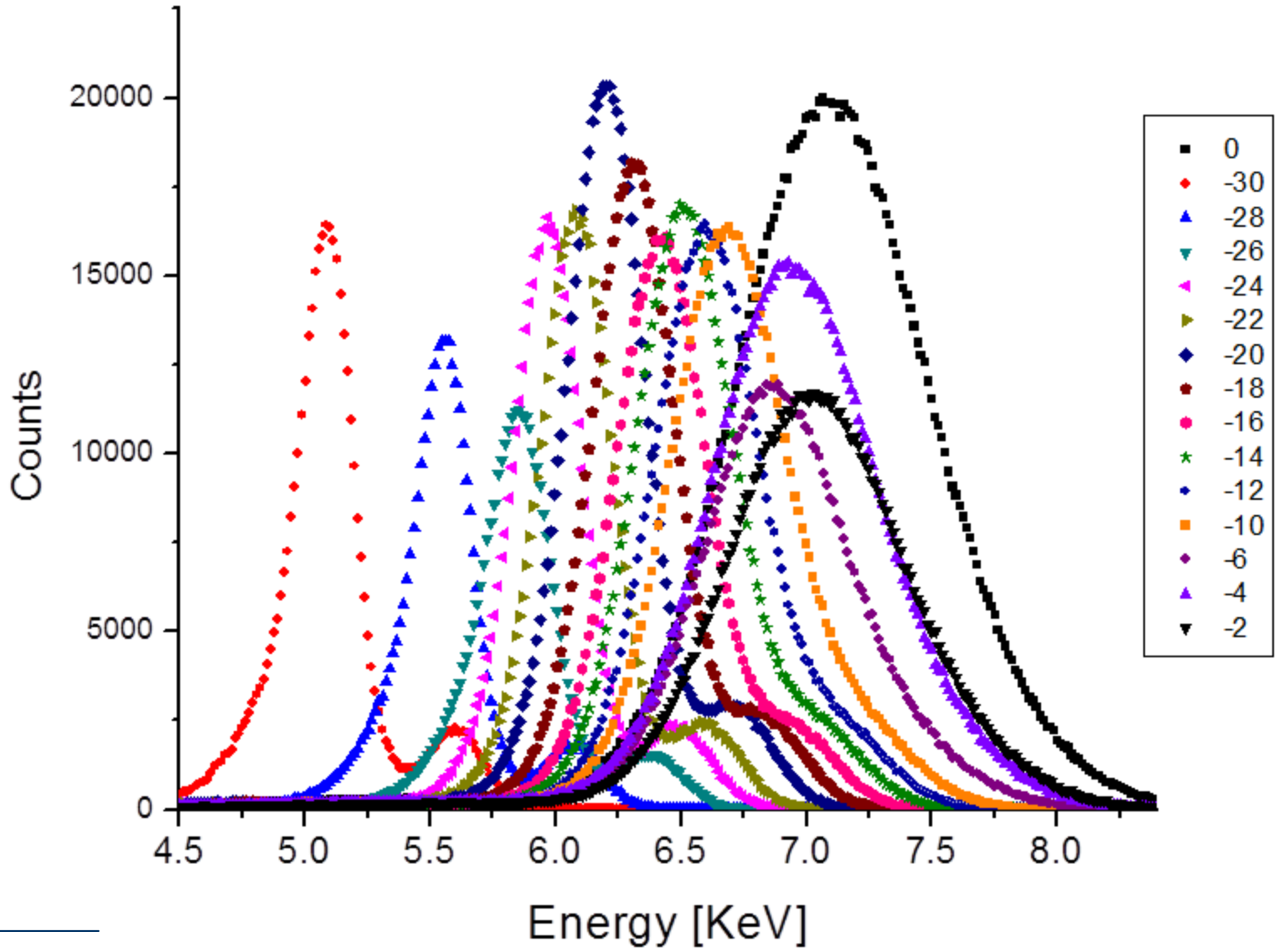
SDD Performance

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

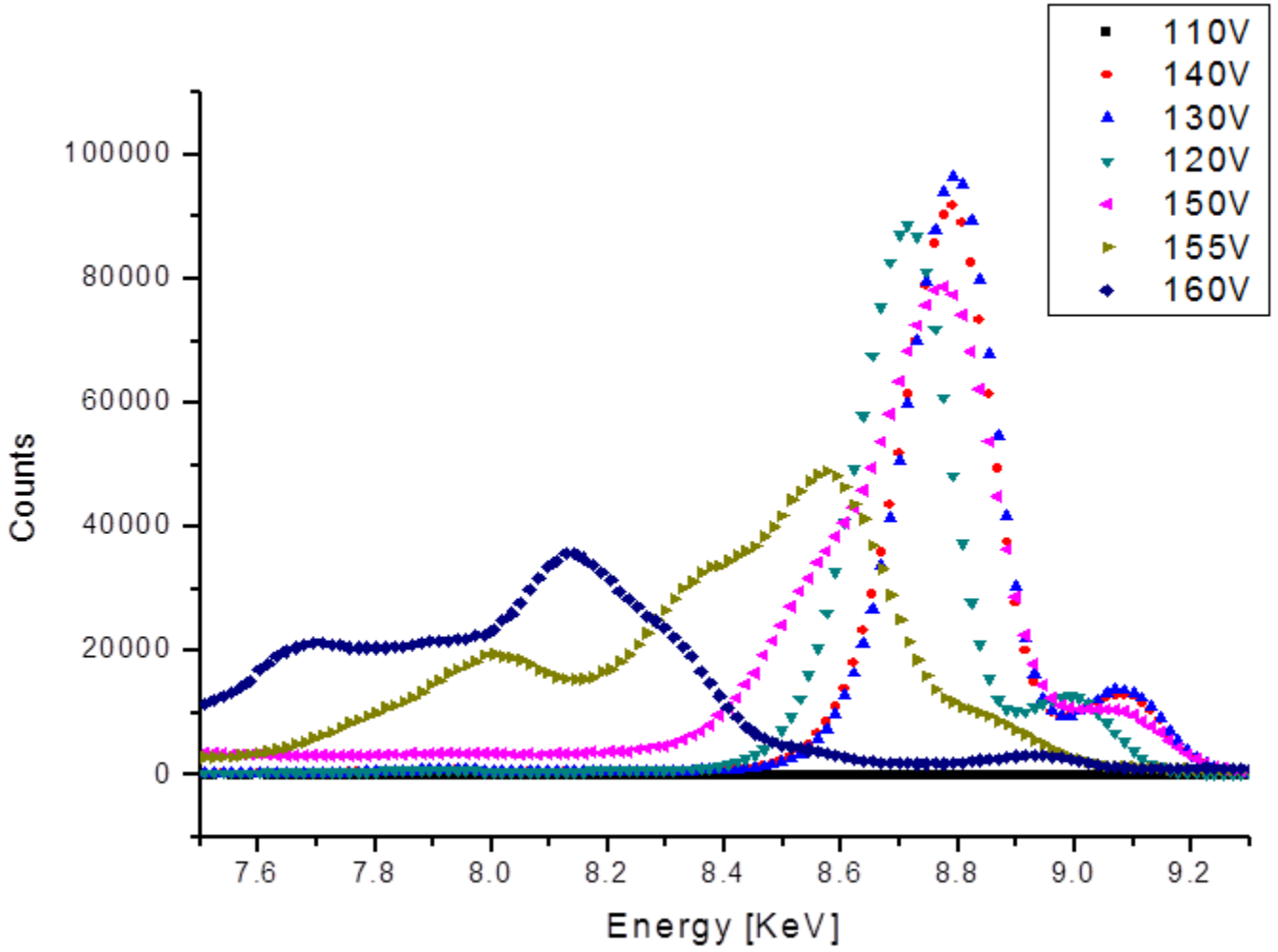
dyn. Grenze/ keV	K_α/ eV	$\Delta E_\alpha / E_\alpha$ / %	K_β/ eV	$\Delta E_\alpha / E_\alpha$ / %
32.5	187.19	3.17	198.49	3.06



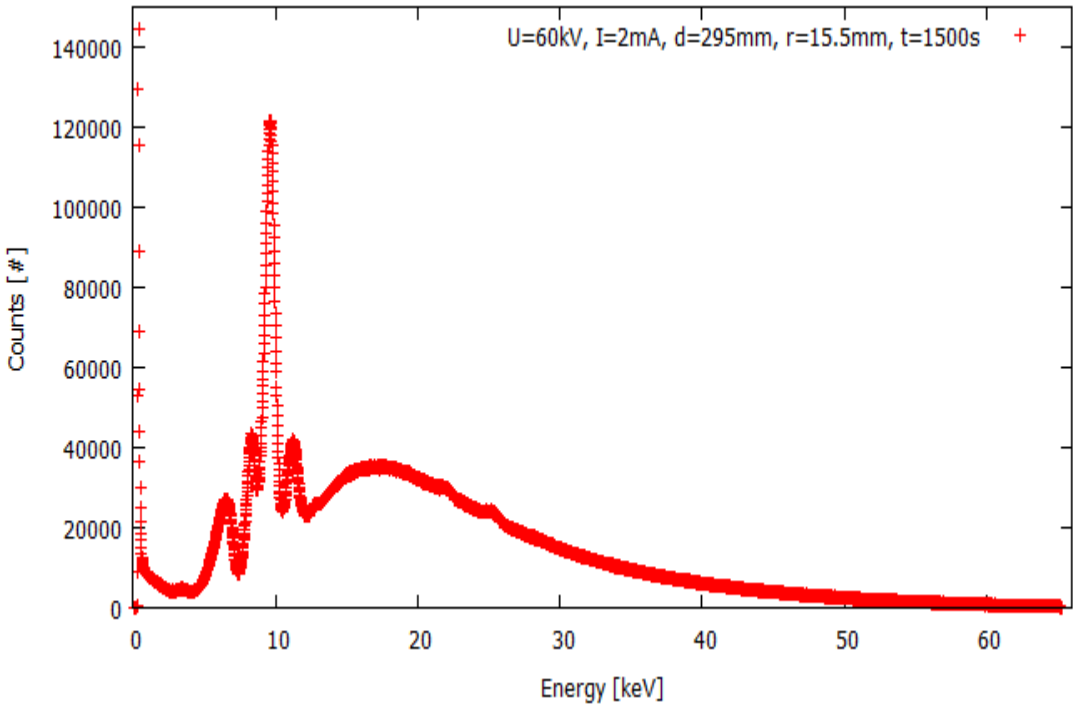
Temperature Dependency

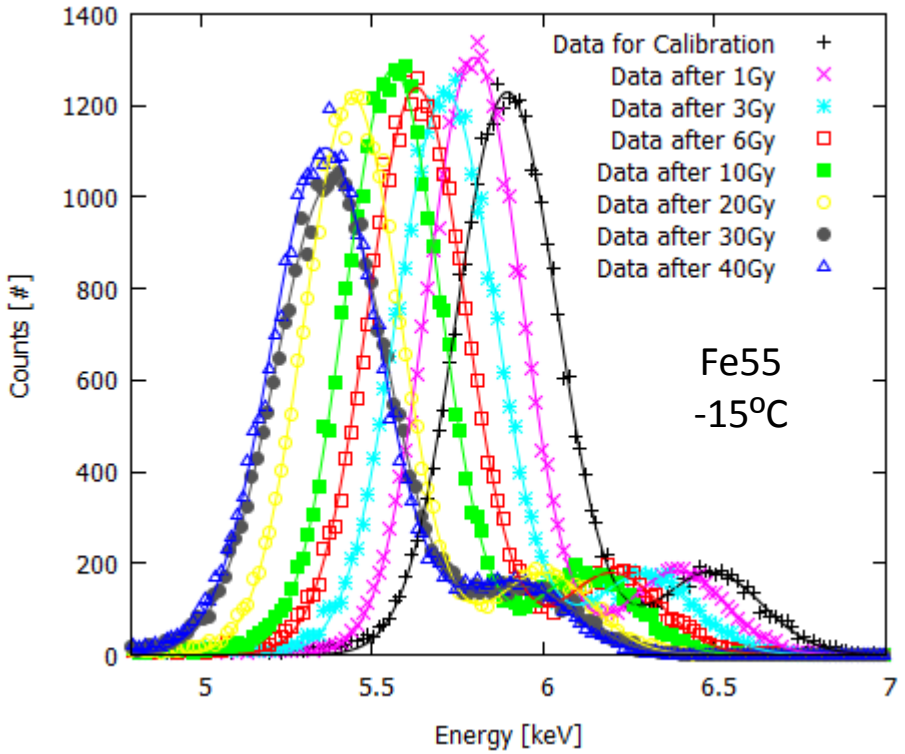


High Voltage Optimization



X-ray Irradiation





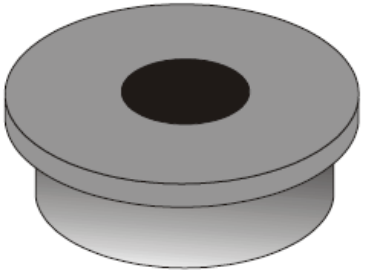
- X-ray irradiation up to 4 Mrad (KIT)
- 60 kV with 15 µm Iron filter
- 100 krad, 300 krad, 600 krad, 1 Mrad, 2 Mrad, 3 Mrad, 4 Mrad
- No annealing. Biased sensor during irradiation.
- SDD temperature during irradiation -5°C. Dry environment (25°C).

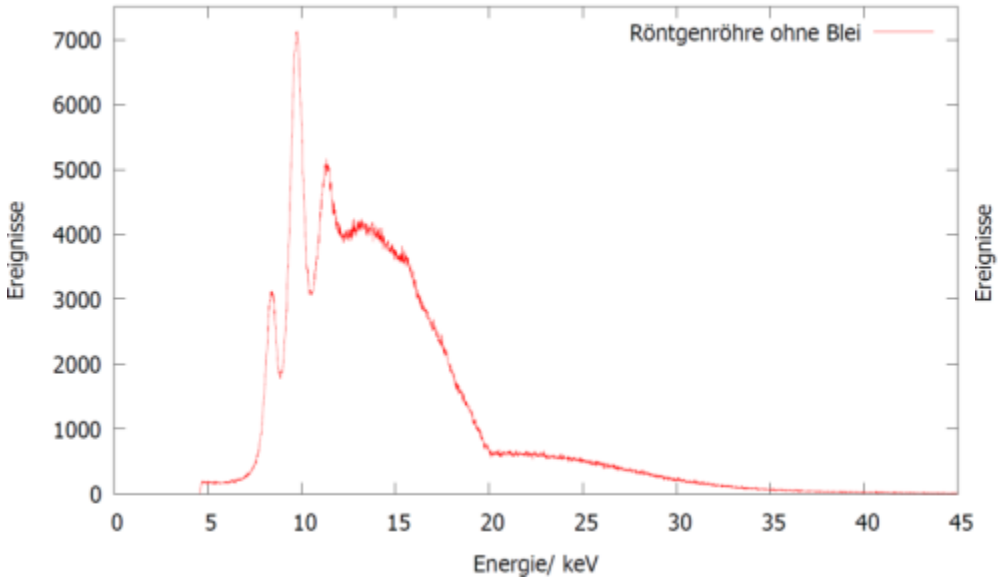
- Resolution is worsened after each step. Gain slightly reduced
- Temperature control is vital

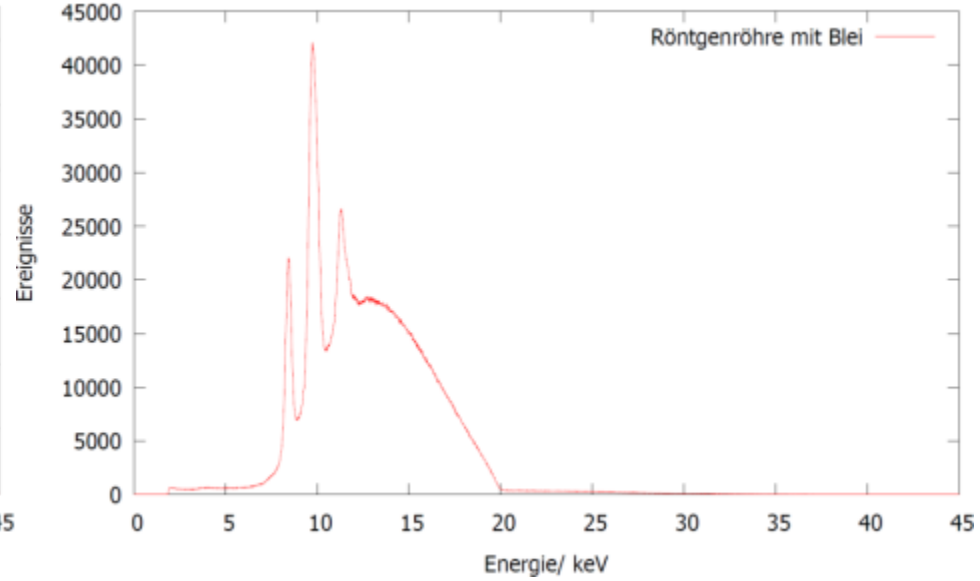
Issues

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)



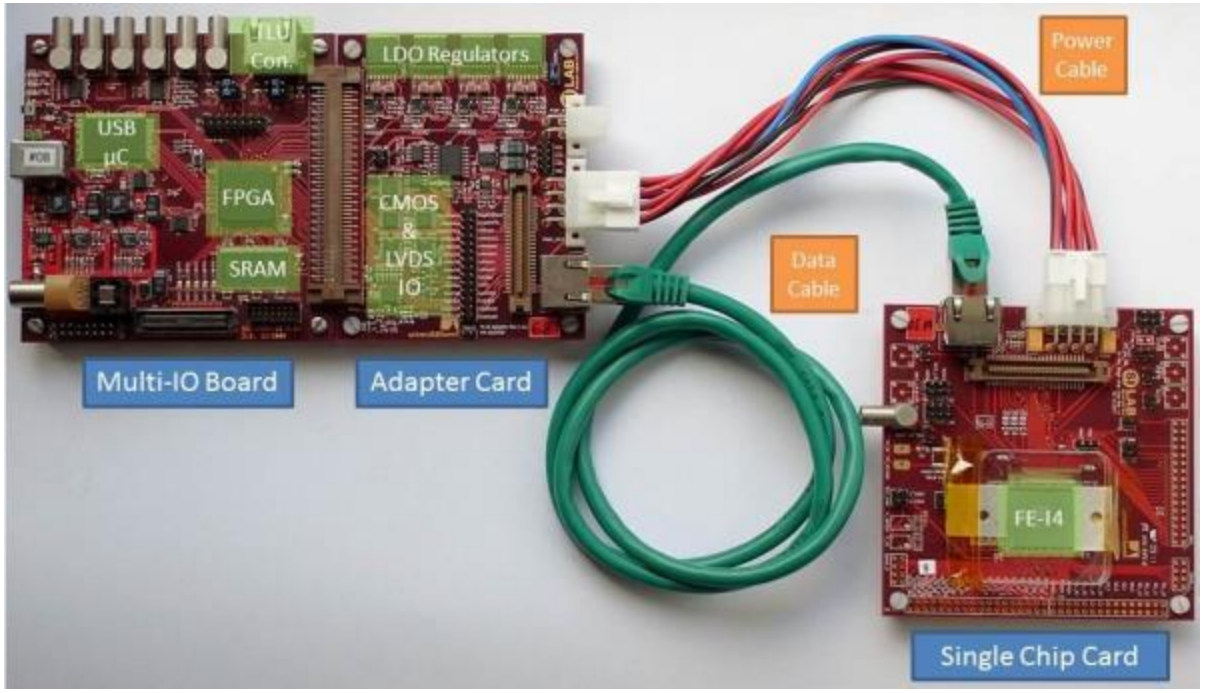




FE-I4 Based Option

Hybrid planar sensor FE-I4 based

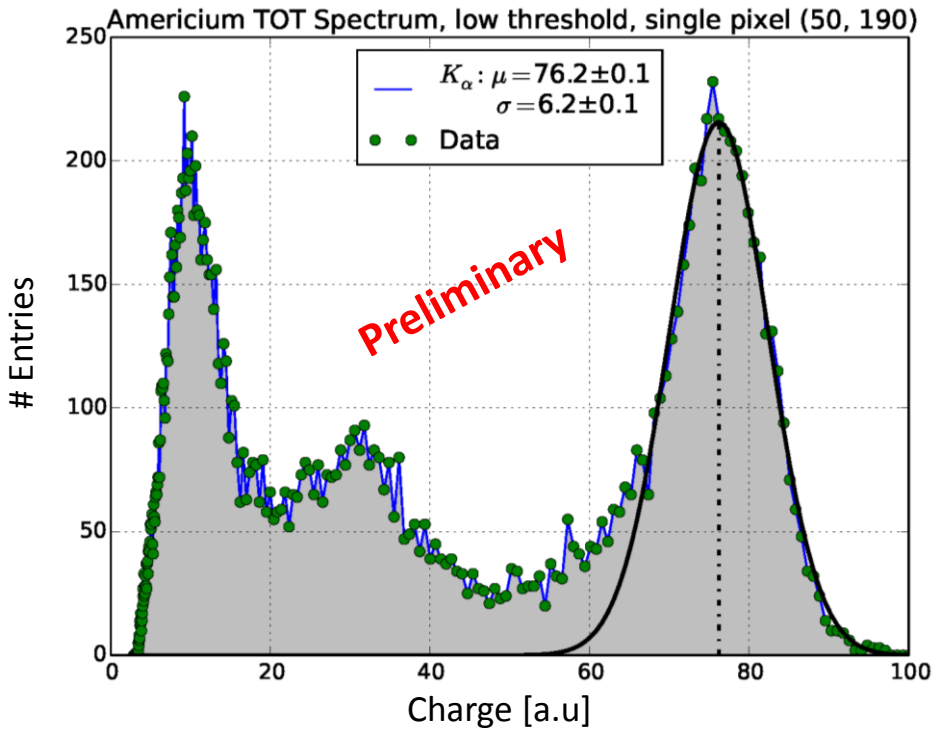
- Pixel size: 50 x 250 μm^2
- Radiation tolerance: 300 Mrad
- Hit-trigger association resolution: 25 ns

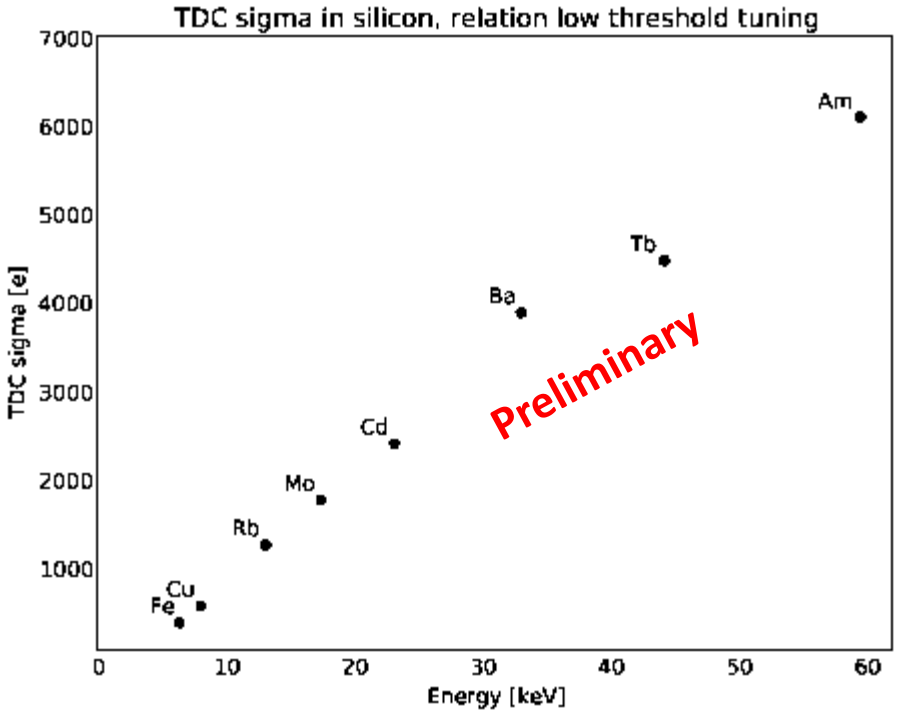


→ Alternative aproach to measure backgrounds

Energy Calibration

D. Pohl, M. Engel



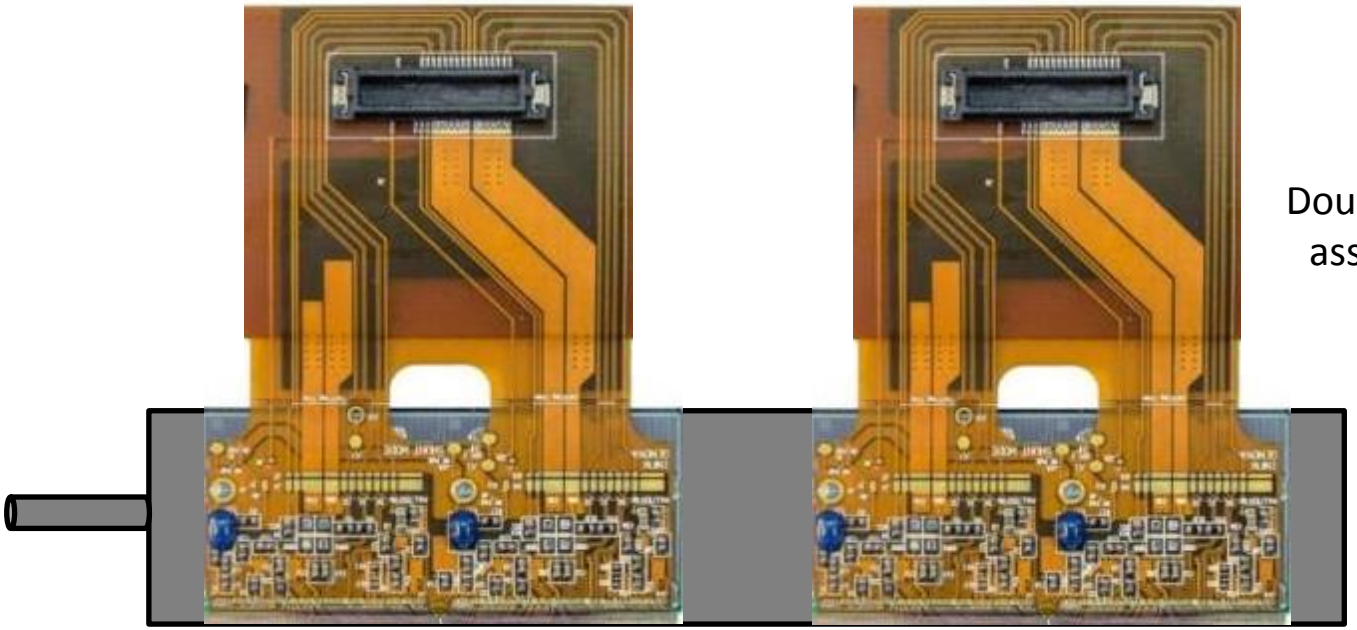


→ If the condition on the energy resolution is relaxed a bit, this device is fast, rad hard and minimizes system related problems

Mechanical Assembly

Support and cooling

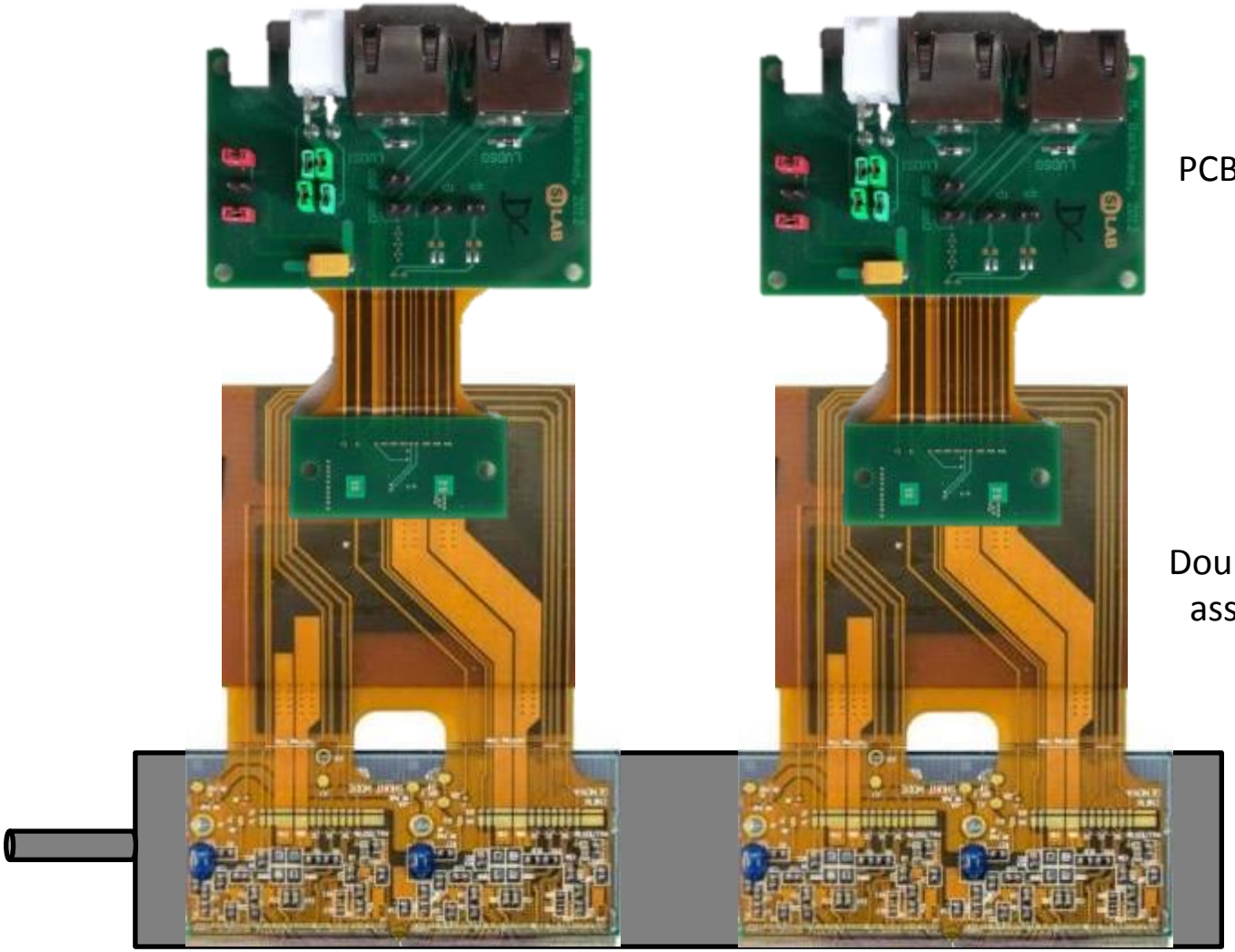
Mechanical Assembly



Double chip assembly

Support and cooling

Mechanical Assembly



PCB

Double chip assembly

Support and cooling

(Professional) Mechanical Assembly

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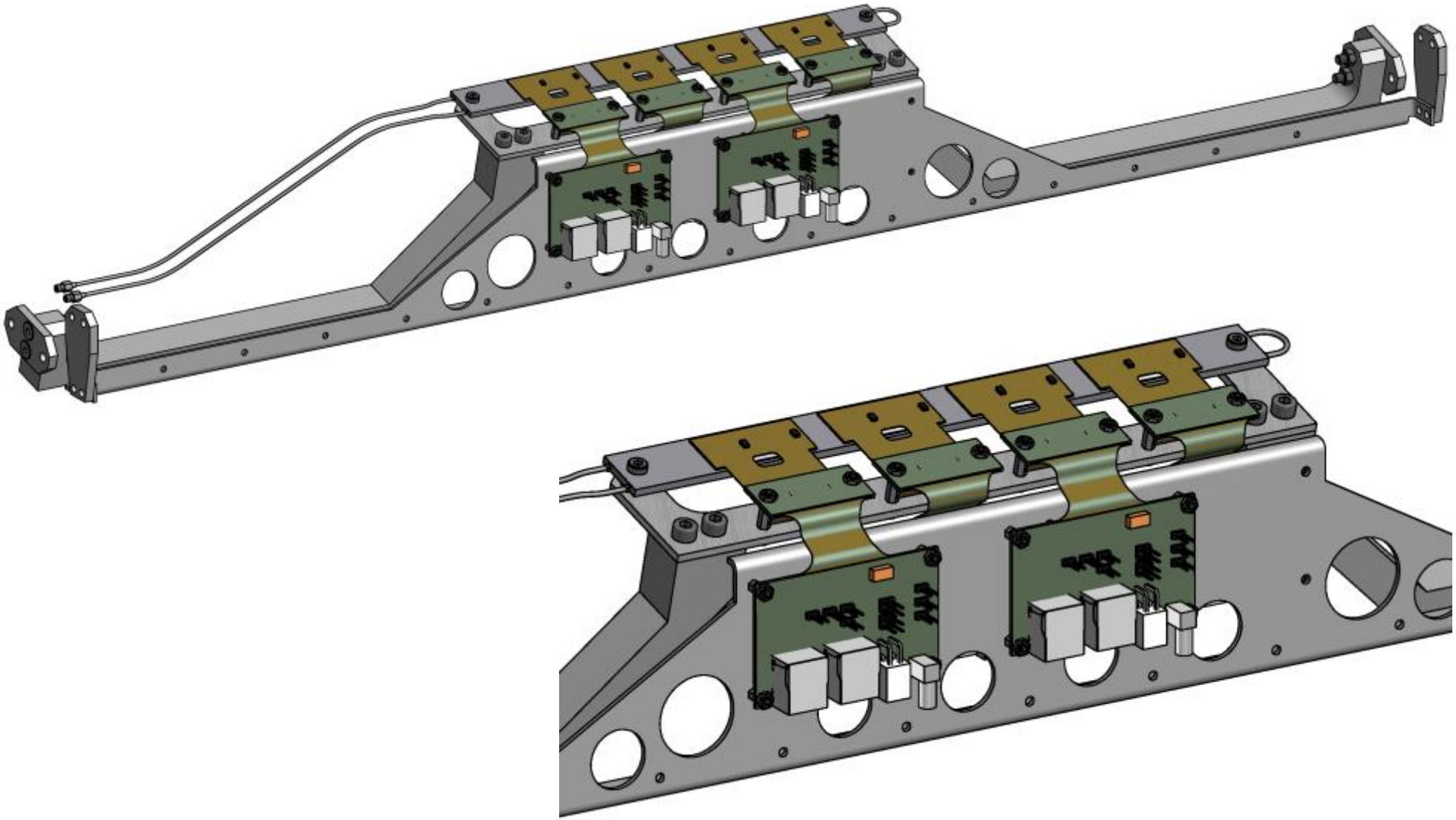

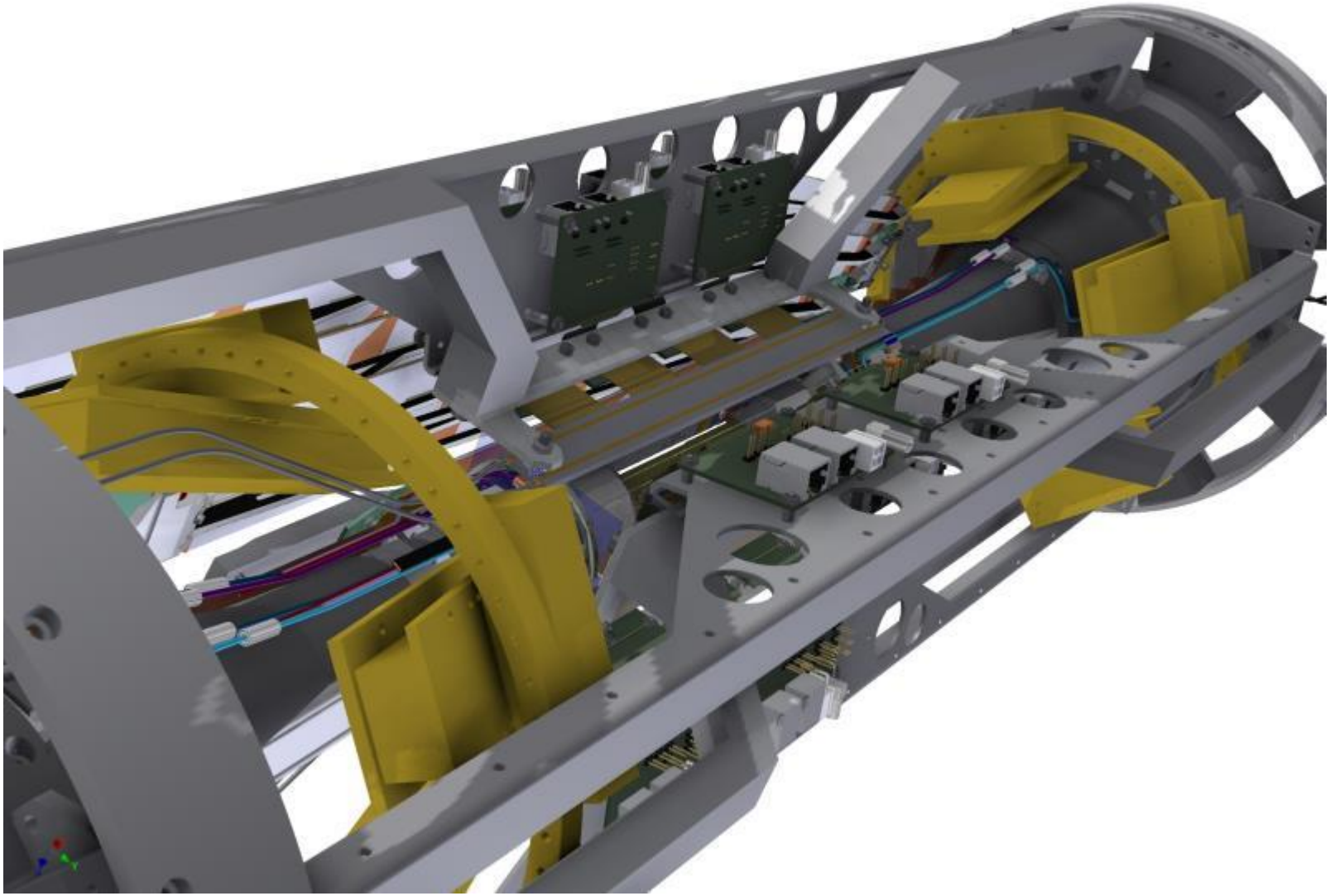

VXD BEAST II

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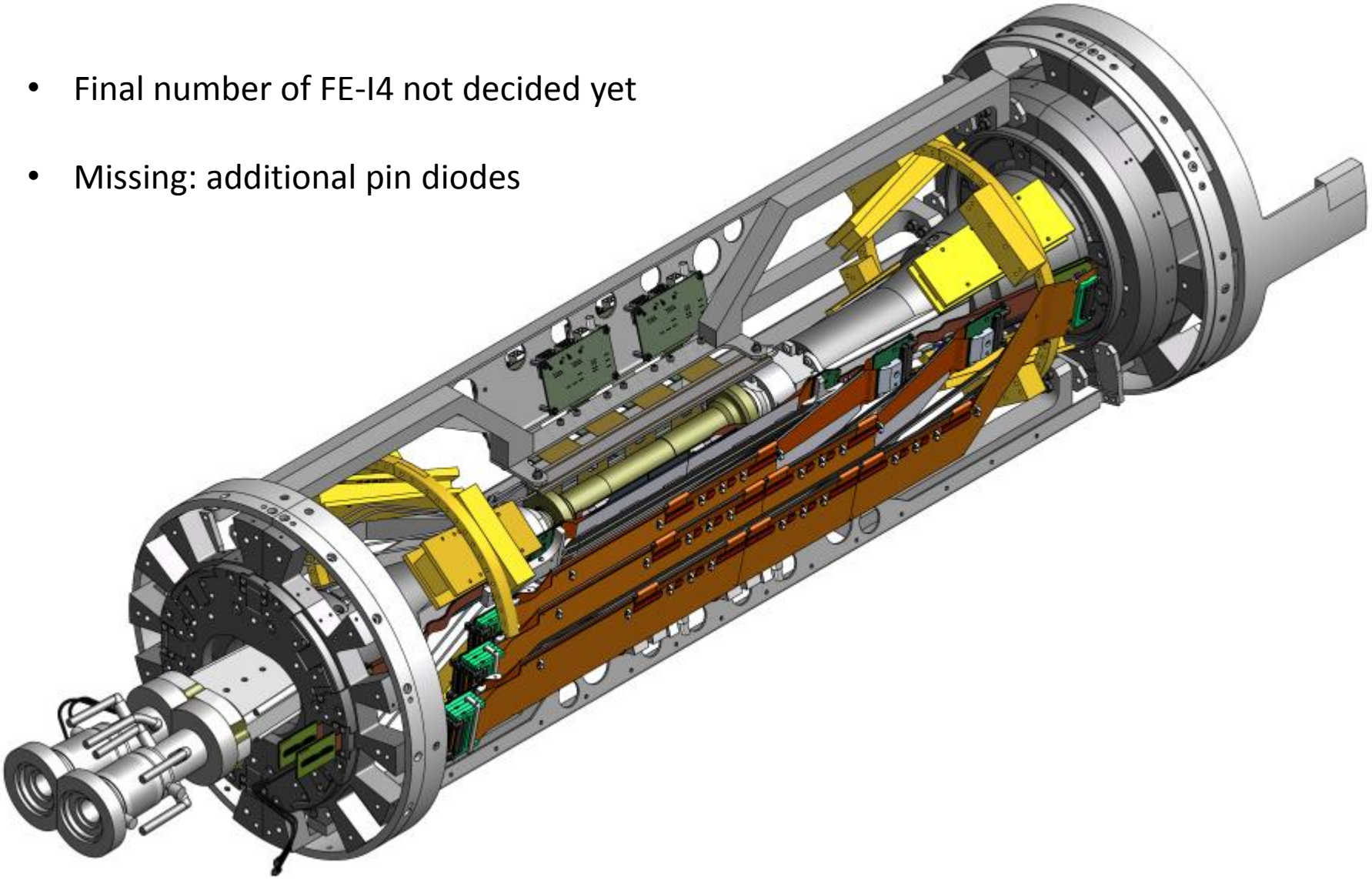
- Final number of FE-I4 not decided yet
- Missing: additional pin diodes



Conclusions

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- SDD shows good energy resolution (if low T) and is radiation hard (3 Mrad)
- Still some issues unresolved (max rates based on simulations, system related aspects and availability) and need further investigations and decisions
- FOS concept demonstrated and ready (# sensors and location tbd)
- BLM presents steady progress and a prototype ready by Phase I
- Full standalone FE-I4 based option seems to satisfy the conditions (fast, rad hard, system development) if we relax the energy resolution requirements
- Simulations are mandatory (manpower)!

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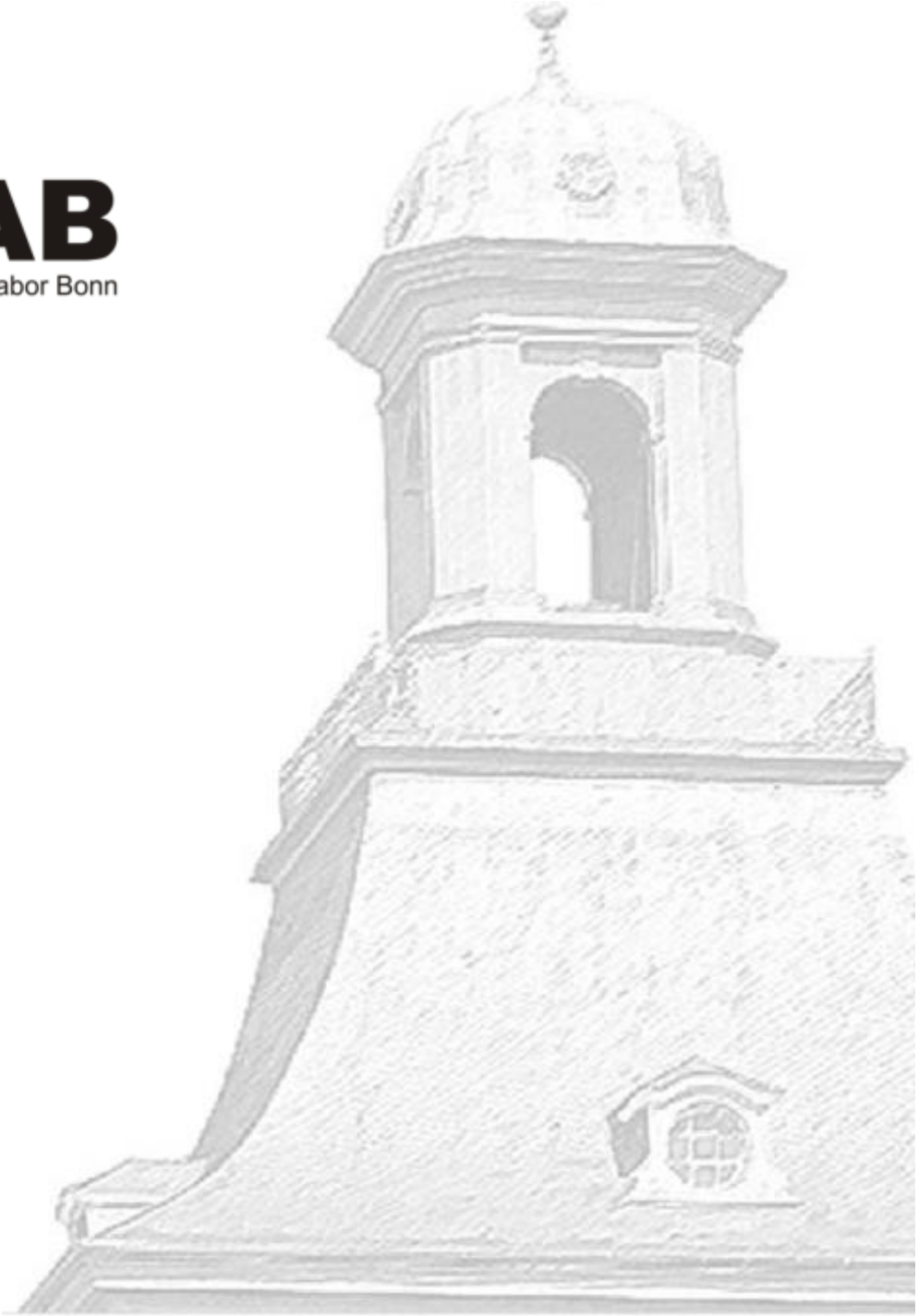

Thank you

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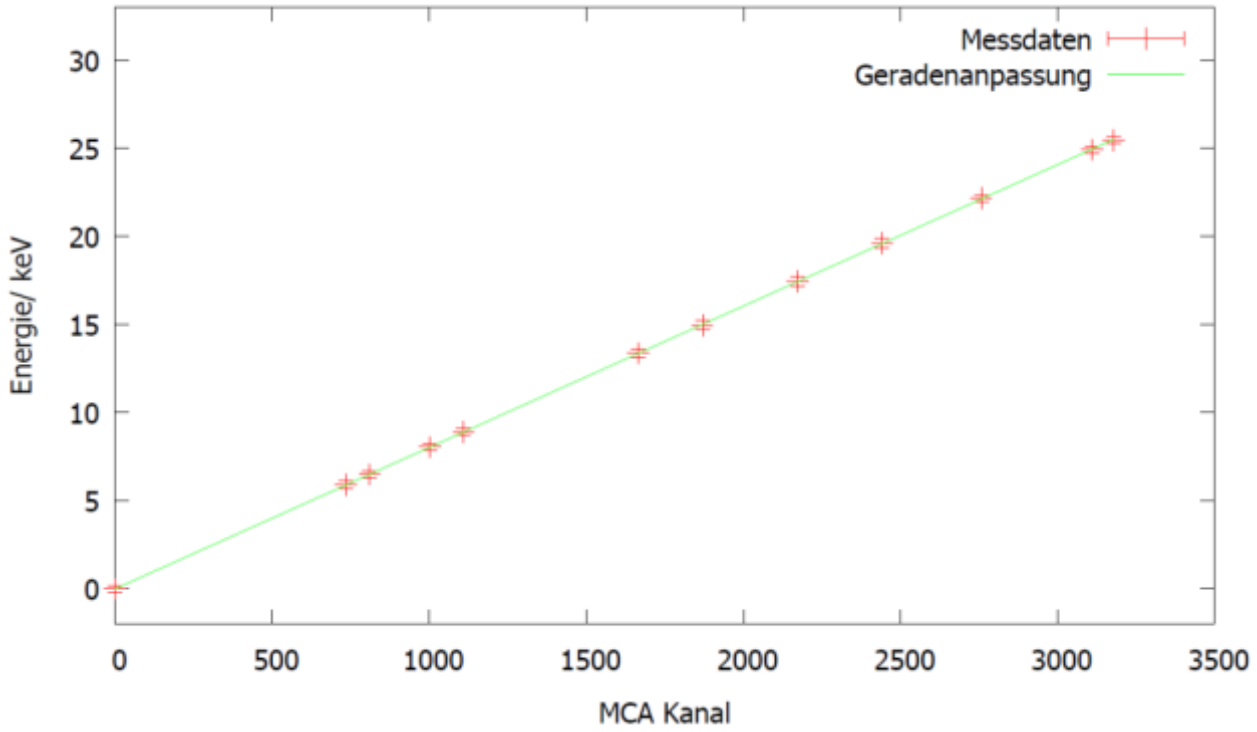
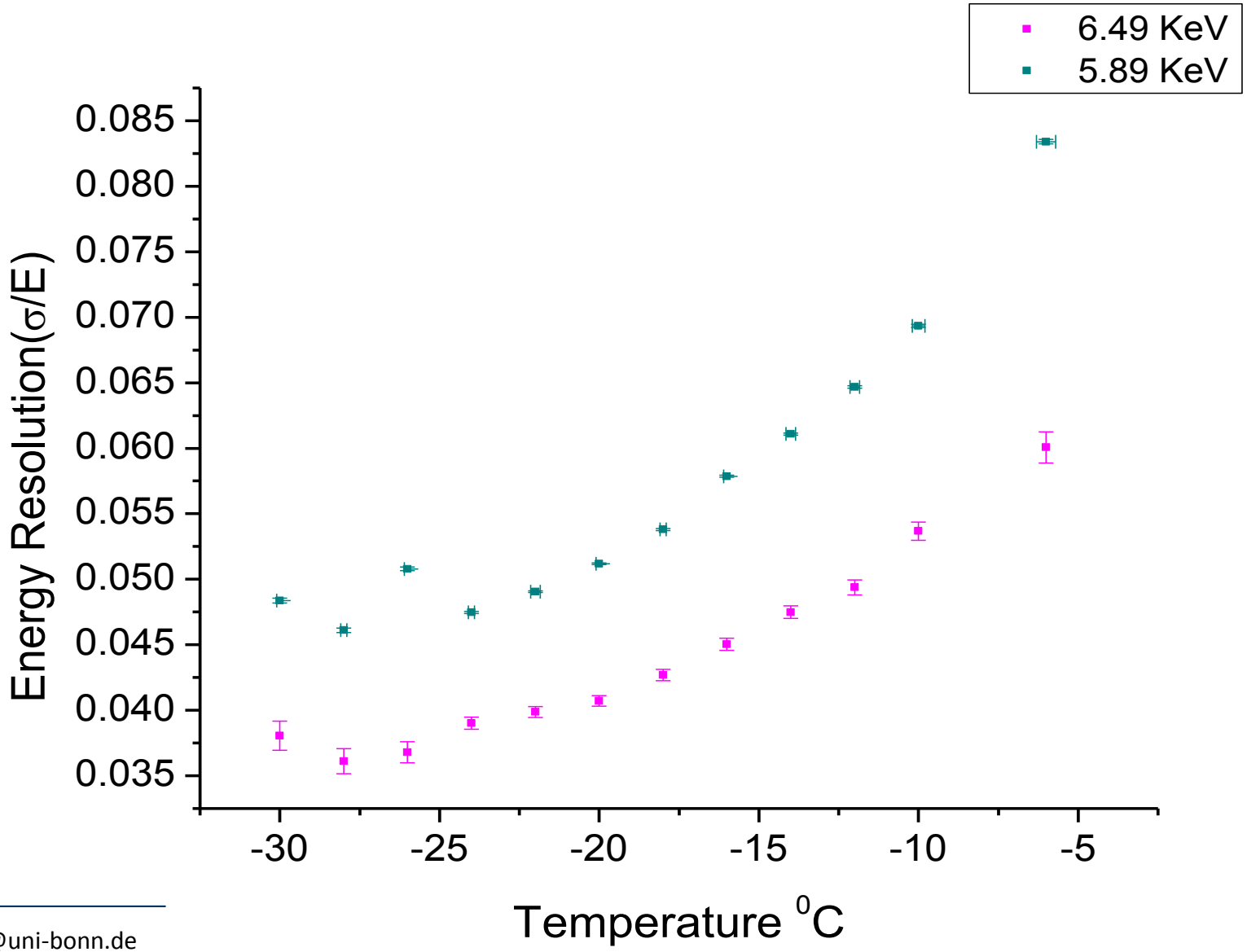
SDD Energy Calibration

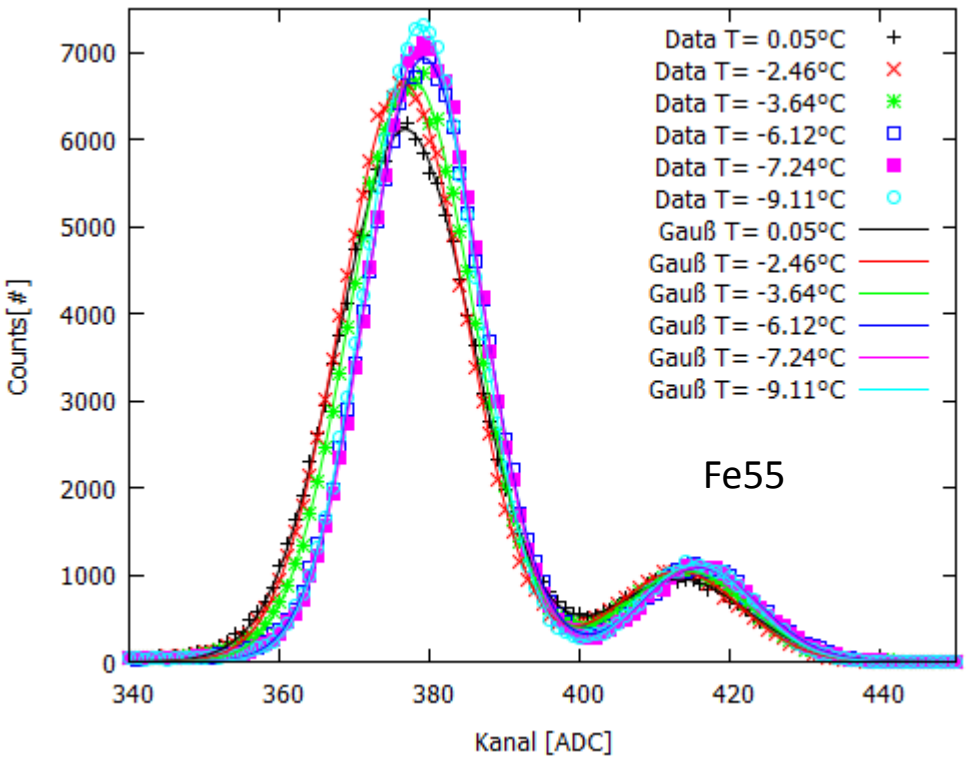
- Measured Gaussian mean value of several K_α and K_β transitions
- Linear response

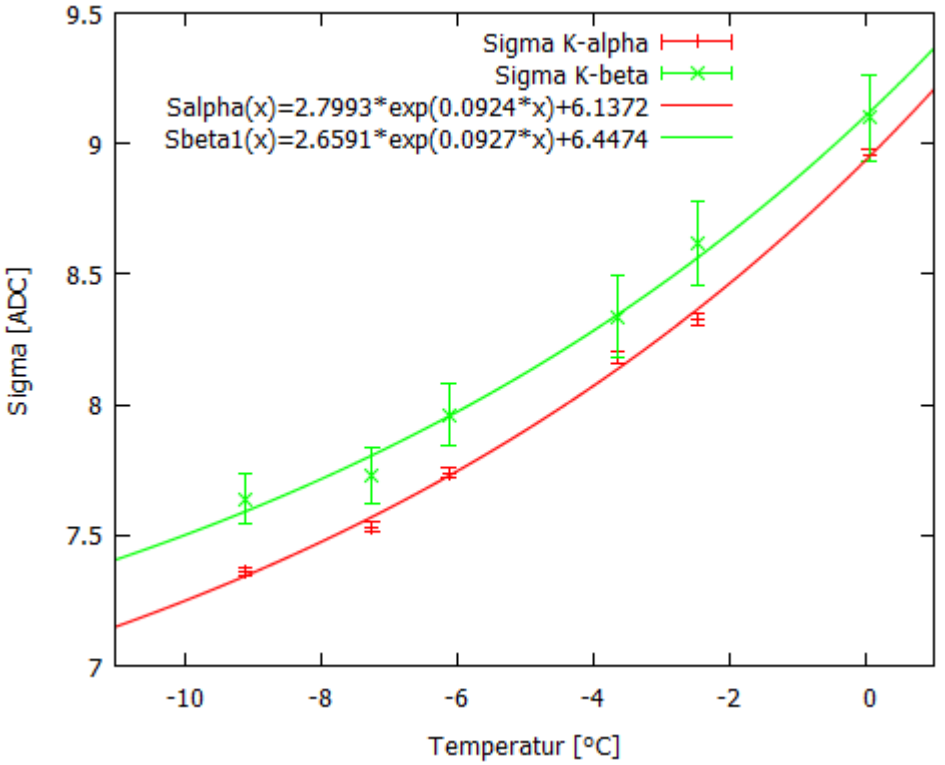


Energy Resolution



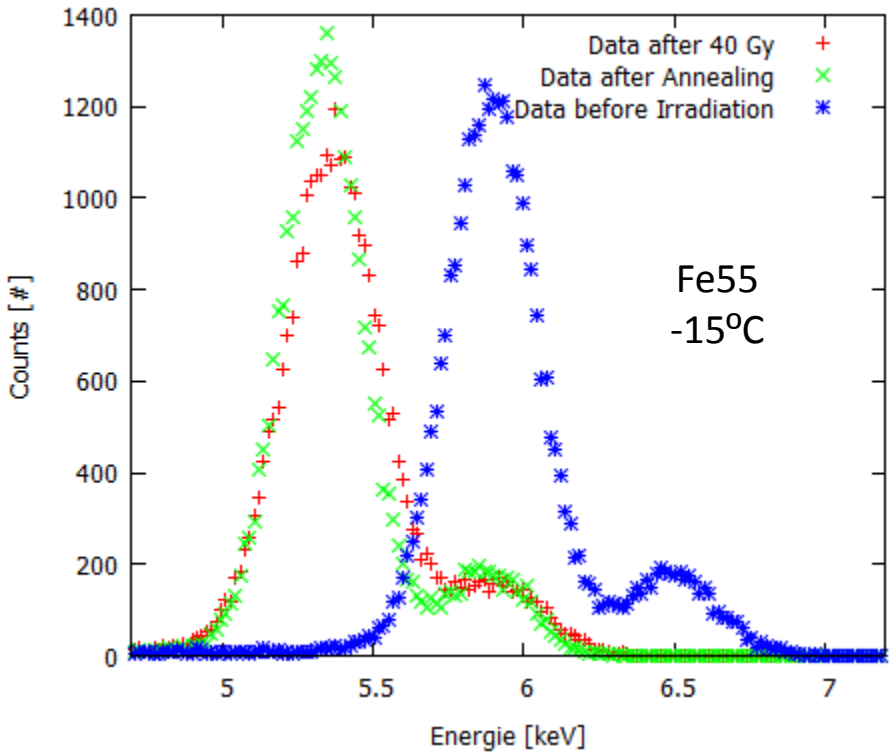
Temperature Dependency





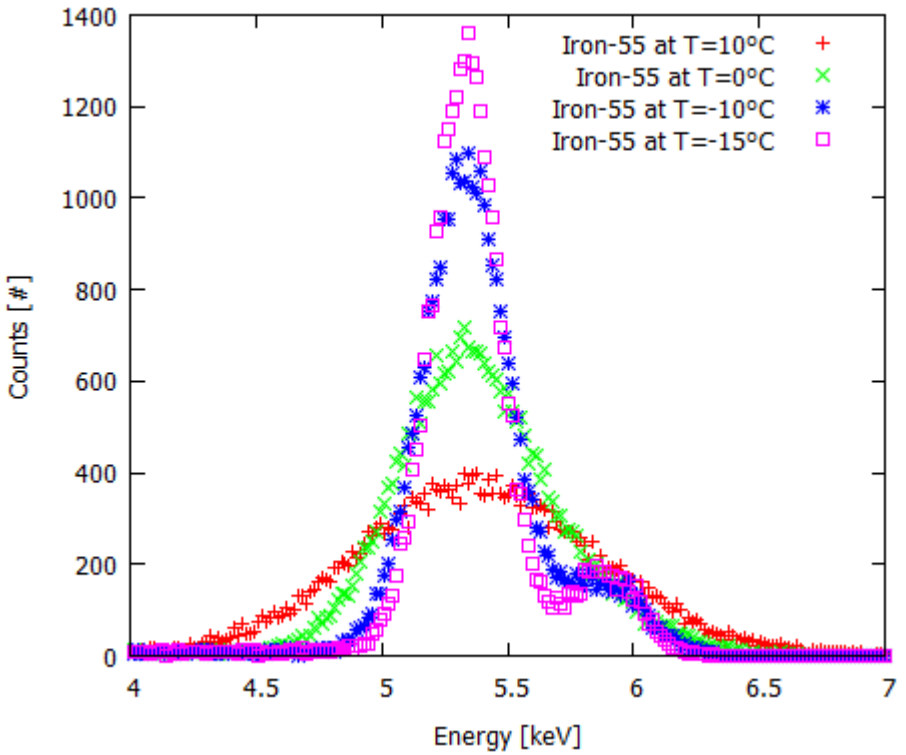
Control of the temperature is vital to keep performance

Temperature Dependence After Irradiation



4 Mrad Annealed

80 °C, 100 min



→ Even after annealing,
low temperature is vital

Digitalise Signal