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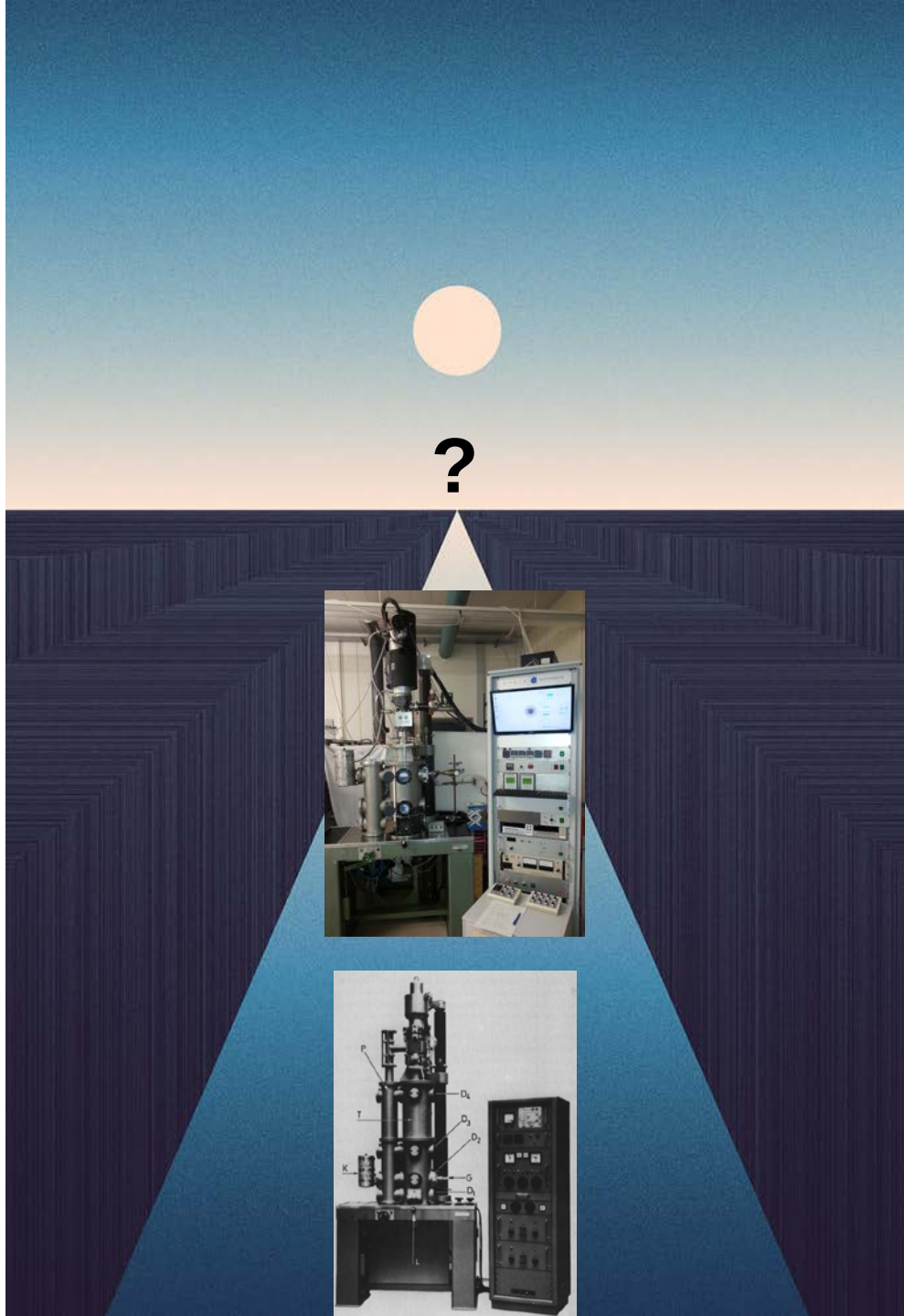
construction of a NEW gas electron diffractometer

–

caught between well-tried technology and new horizons

Sebastian Blomeyer
Inorganic and Structural Chemistry



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improvements over the last decade

2007
first setup in Bielefeld

2009[1]
+ control devices
+ analysers
+ new nozzle

2011–2015[2]
+ digital control
+ data logging
+ new beam stop

2013[2]
+ new diff. pump
+ new back. pump

[1] R. J. F. Berger, M. Hoffmann, S. A. Hayes, N. W. Mitzel, *Z. Naturforsch.* **2009**, *64b*, 1259–1268.
[2] C. G. Reuter, Yu. V. Vishnevskiy, S. Blomeyer, N. W. Mitzel, *Z. Naturforsch.* **2016**, *71b*, 1–13.

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improvements over the last decade

2015
+ Hiden MS

2017/2018
+ extra vacuum chamber for MS

2018/2019
+ new IP scanner

2019
+ lifting device for MS chamber

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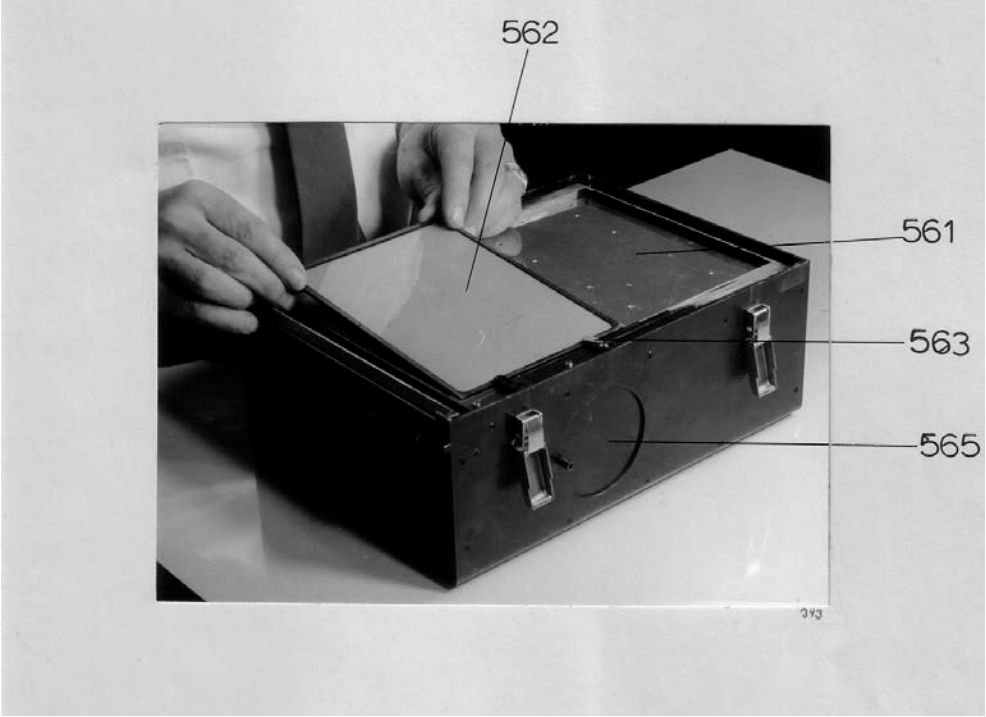
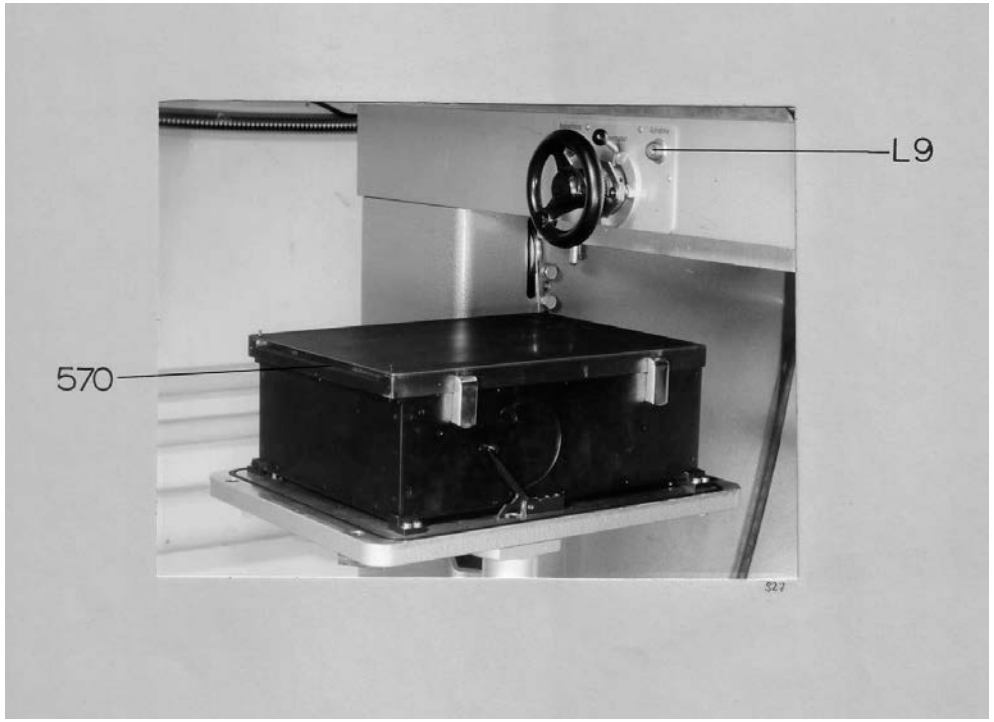
what currently cannot be improved

limitation to twelve image plates



breaking vacuum after each set of experiments



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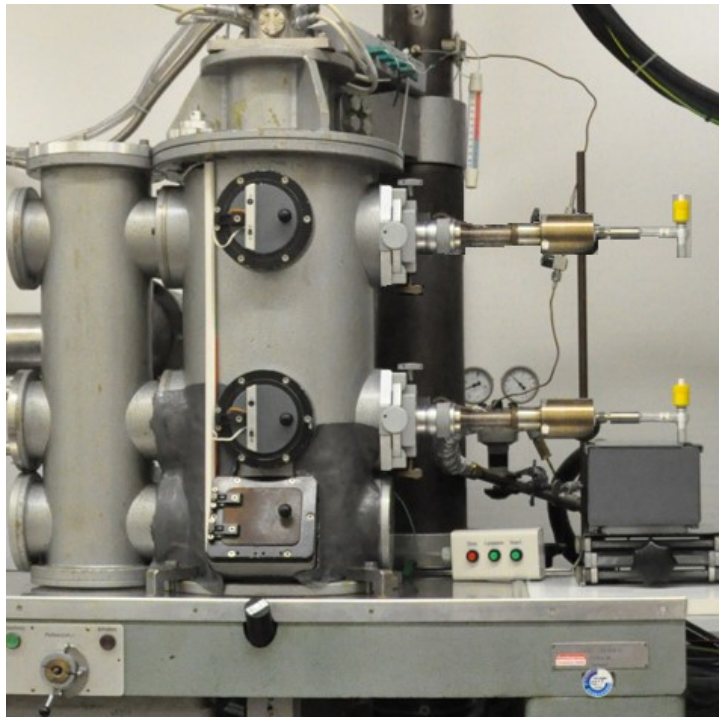
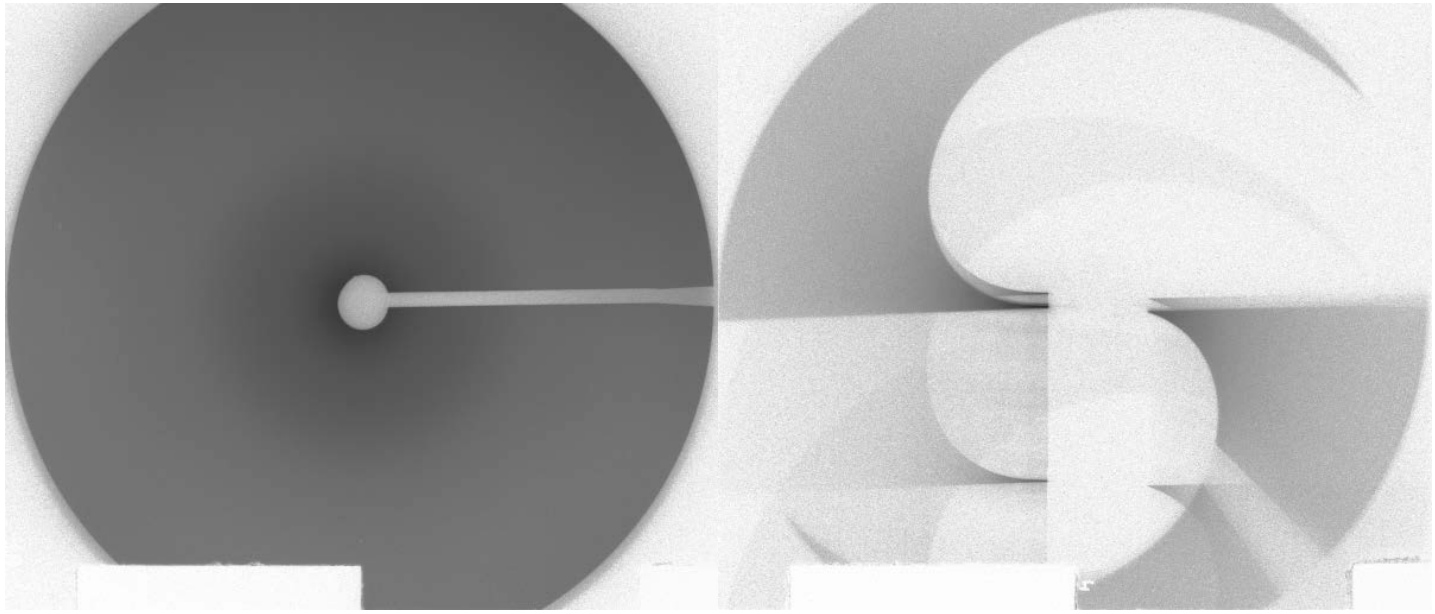
what currently cannot be improved

two camera distances



risk of failure (no diffraction pattern, operating errors)



theoretical performance

12 plates/d → 9 substance plates/d → 3 data sets/2–3 d

real performance

2–3 data sets/month

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consequences

bottlenecks of data acquisition and quality cannot be tackled within the current setup

→ construction of a completely new gas electron diffractometer with

- additional on-line detection system
- feedthrough system for cooling trap
- feedthrough system for image plates
- more than twelve image plates
- better vacuum (<10^{-8} mbar)

additional ideas
- horizontally oriented (for modular concept)
- without any oil-based pumps (for better MS)
- only one camera distance, through
  - bigger IPs
  - better vacuum

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getting people/companies together

electron gun ✓

STAIB INSTRUMENTS

well-known
well-tried
still up-to-date

vacuum chamber

???

moveable parts

???

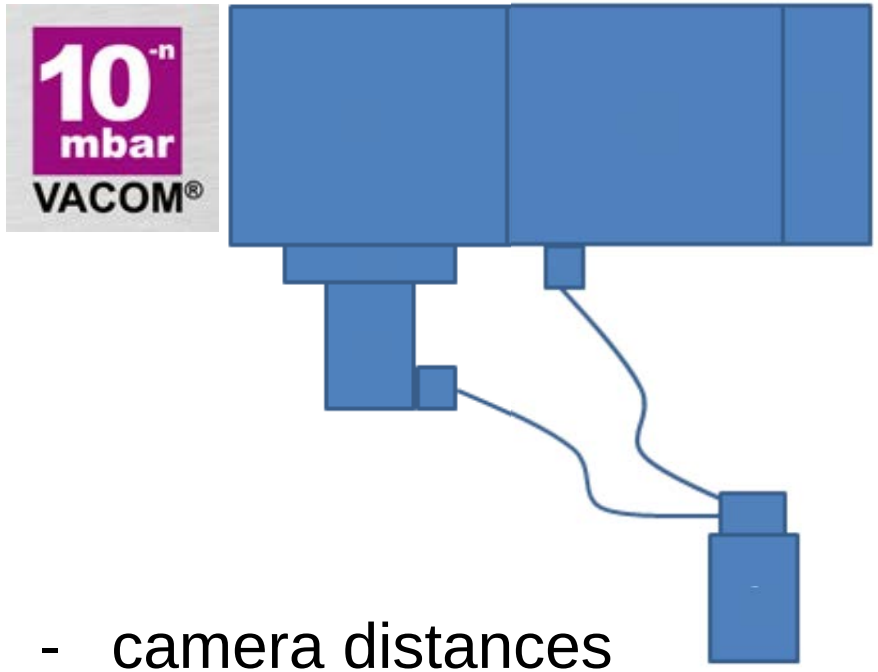
nozzles, cooling traps,… ✓

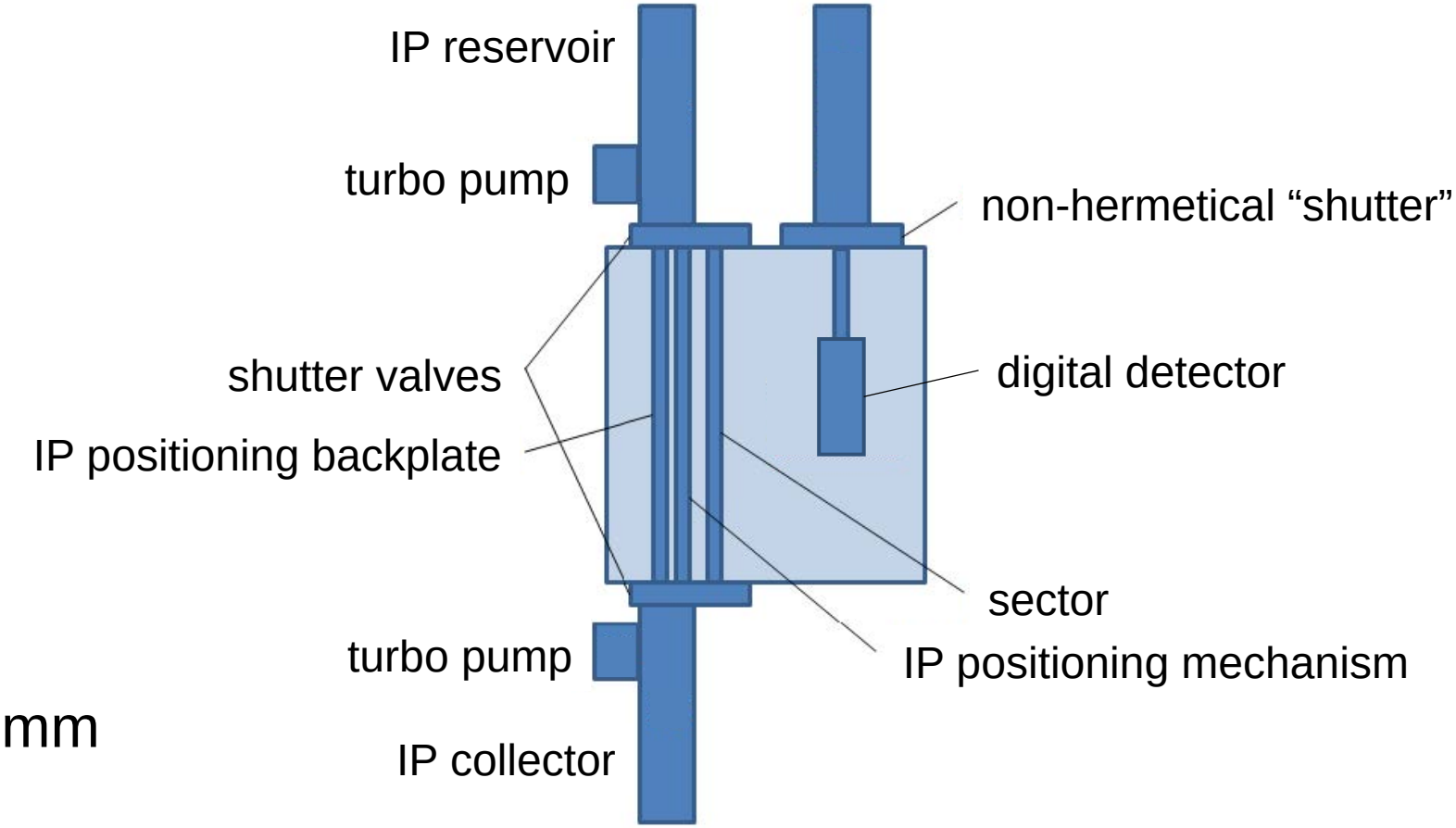
mechanical
workshop

digital detector

???

vacuum chamber & mechanical parts





- camera distances
  - IPs: 400 mm
  - digital detector: 200–250mm
  - adjustable via additional modules
- reservoir of ~30 IPs

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vacuum chamber ✓

10^-n mbar VACOM®

custom development department

IP feed mechanics ✓

10^-n mbar VACOM®

nozzles, cooling traps,… ✓

10^-n mbar VACOM®

\+ mechanical workshop ✓

digital detector

???

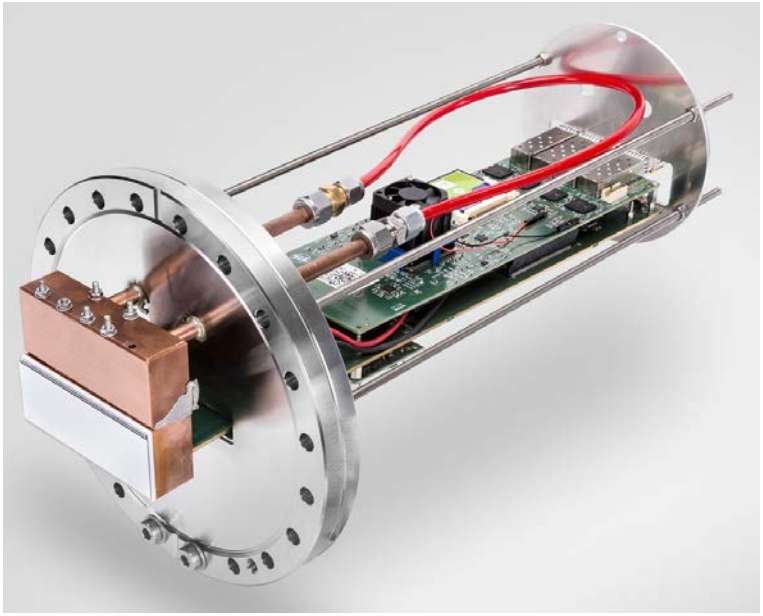
digital detector

DECTRIS
detecting the future

- C. Schulze-Briese (ESGED15/16)
- inherently not compatible with vacuum
- company not focusing on small/single batch projects
- expensive (~ 1€/pixel)

XSPECTRUM

- founded out of DESY detector development group
- all products are compatible with vacuum
- focus on customised solutions



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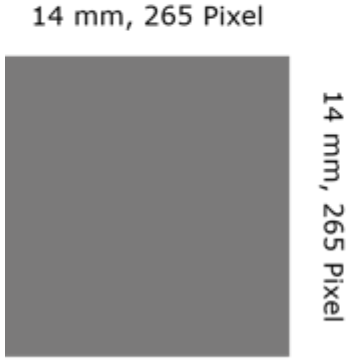
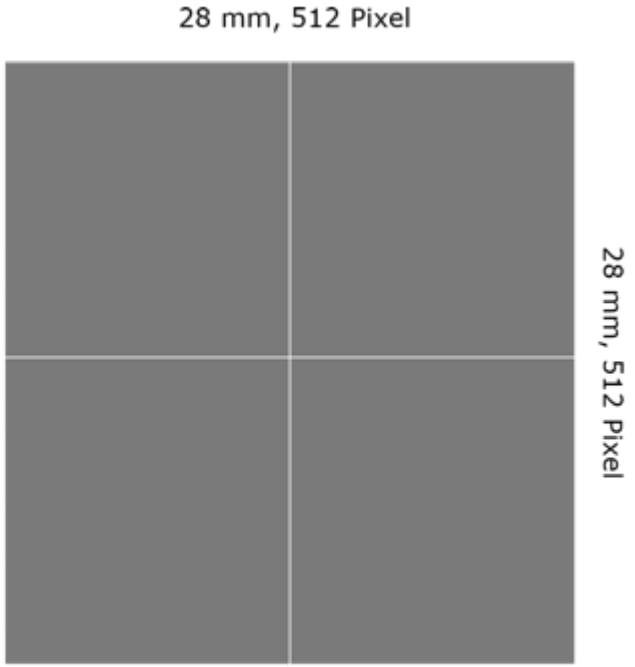
X-Spectrum Lambda – the detector

- single-photon (electron) counting
- 24bit counter depth
- energy thresholds/energy bins
- up to 2,000 fps
- 55 µm pixel size (IPs + scanner: 25–50 µm)
- modular concept



60 k



250 k

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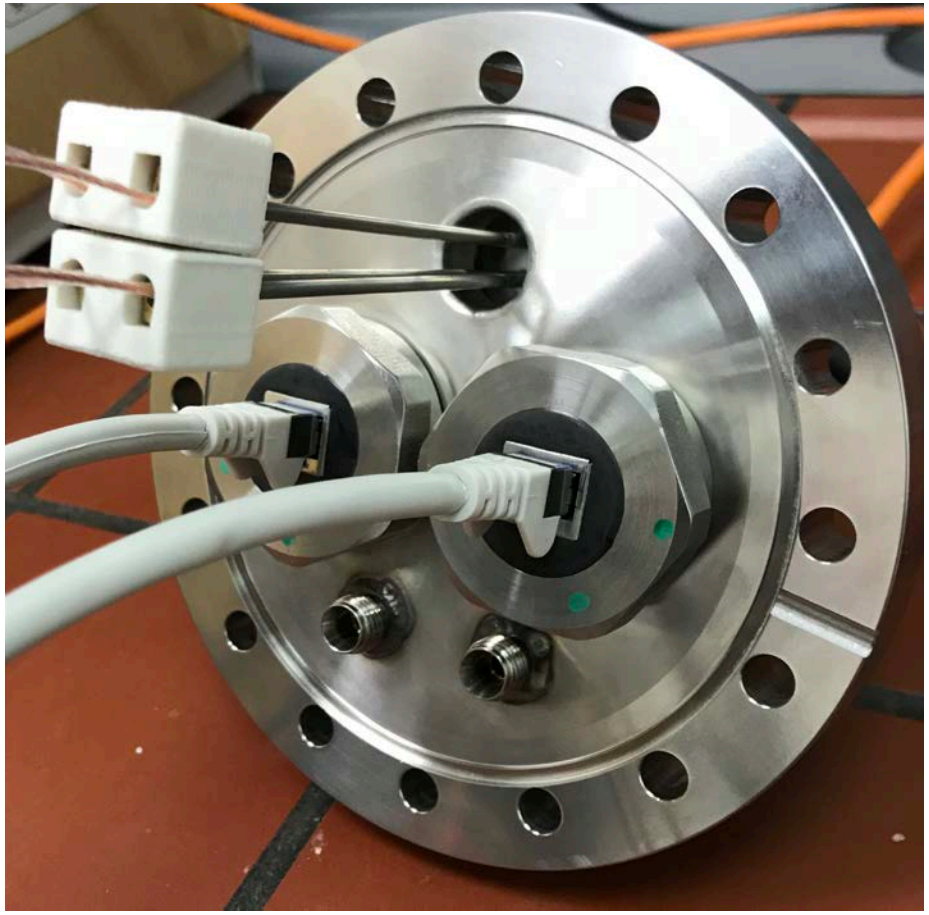
X-Spectrum Lambda 60k – testing period



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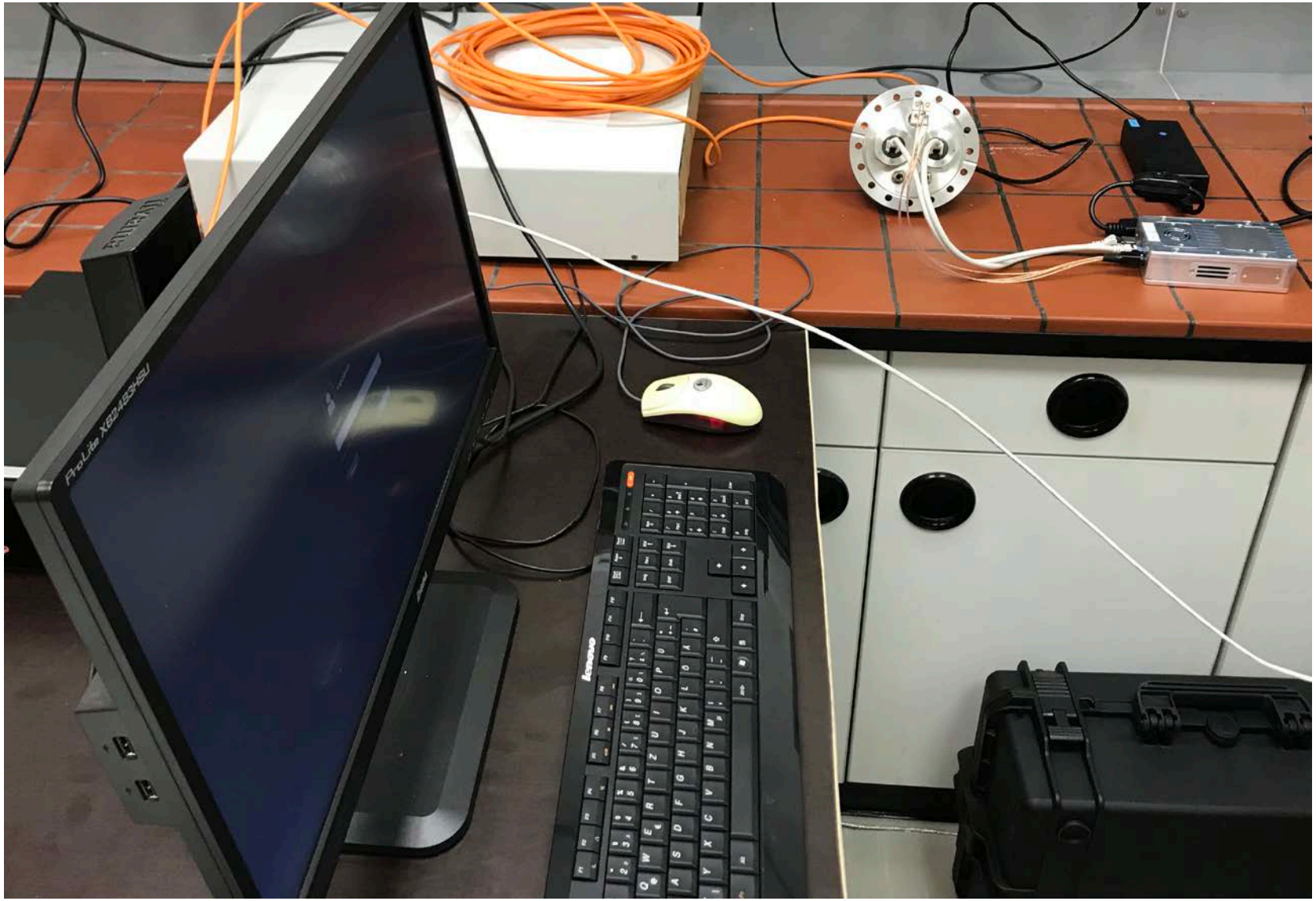

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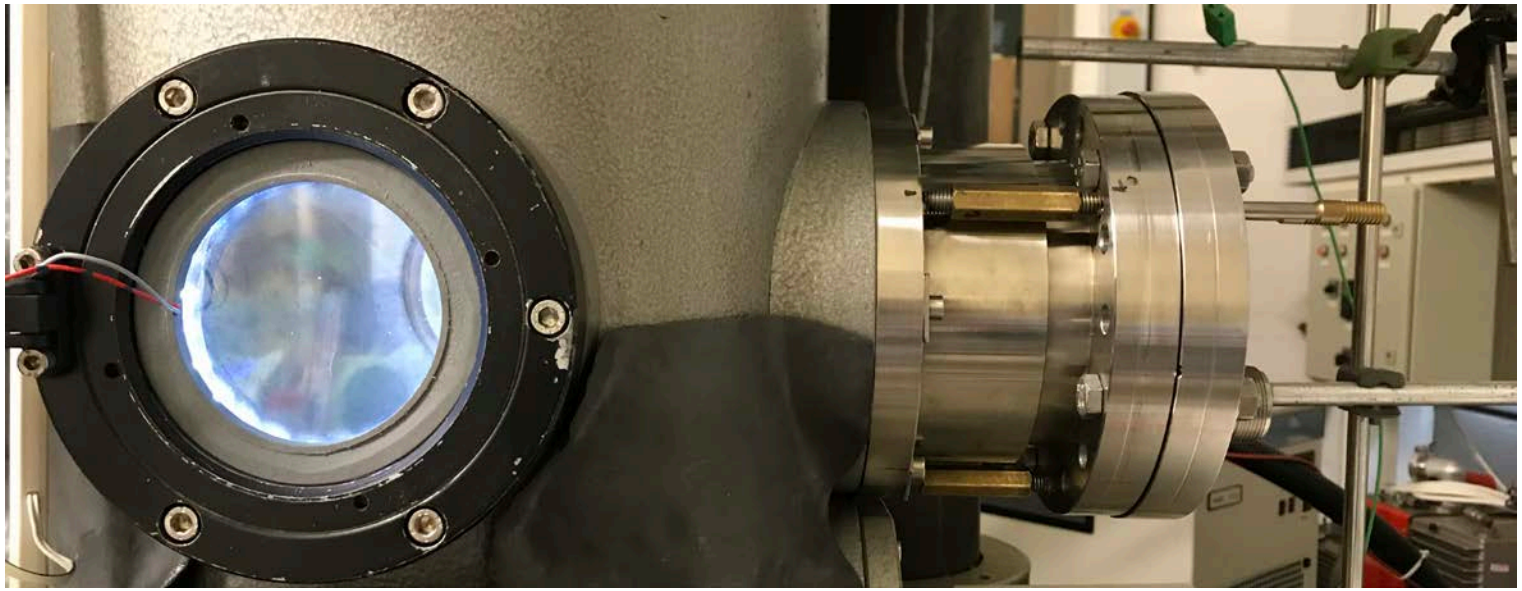

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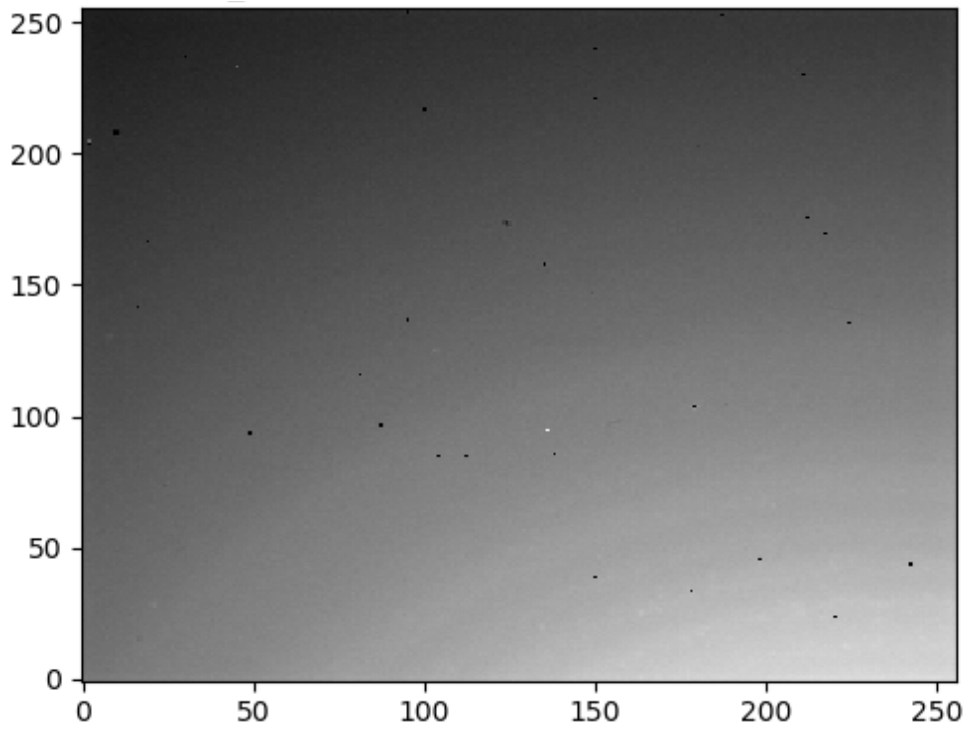
X-Spectrum Lambda 60k – testing period

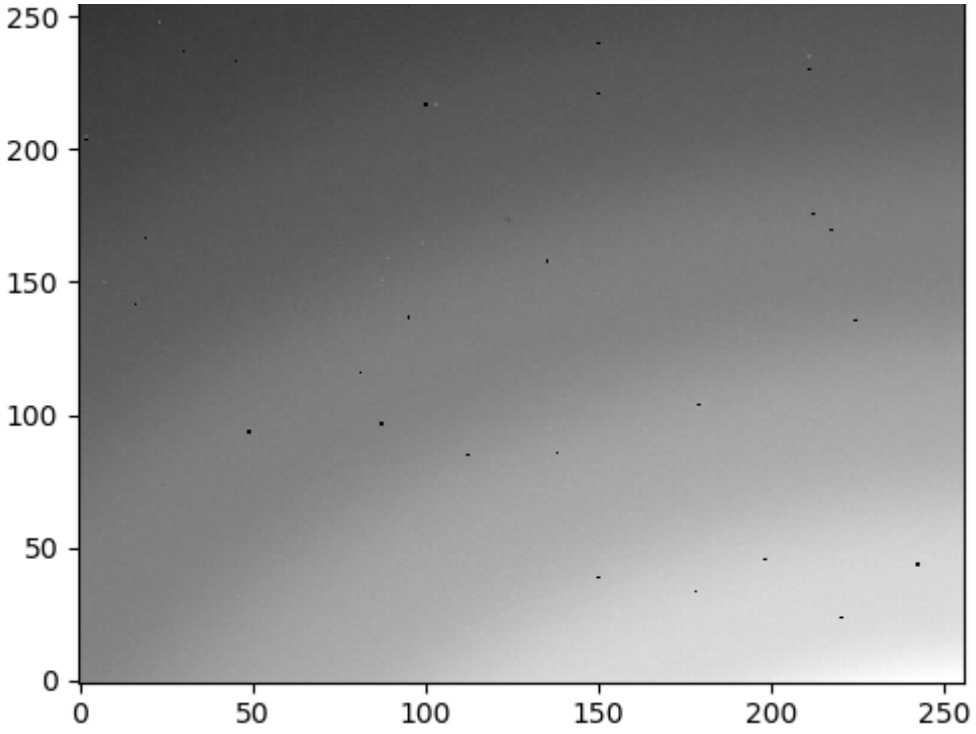
ZnO (2s, 500 nA)



max (255,0): 1,138,240 counts
min (0,255): 288,596 counts

reminder: saturation at 16,777,215 counts/s!

CCl_4 (5s, 500 nA)



max (255,0): 48,293(154,462) counts
min (0,255): 1,129(3,895) counts

energy cut-off: 30 kV (2 kV)

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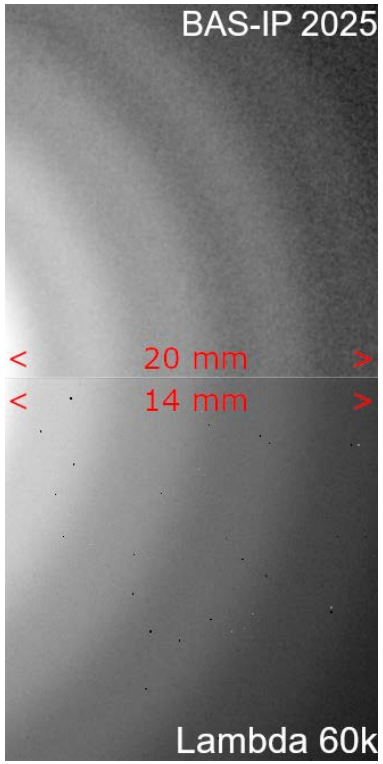
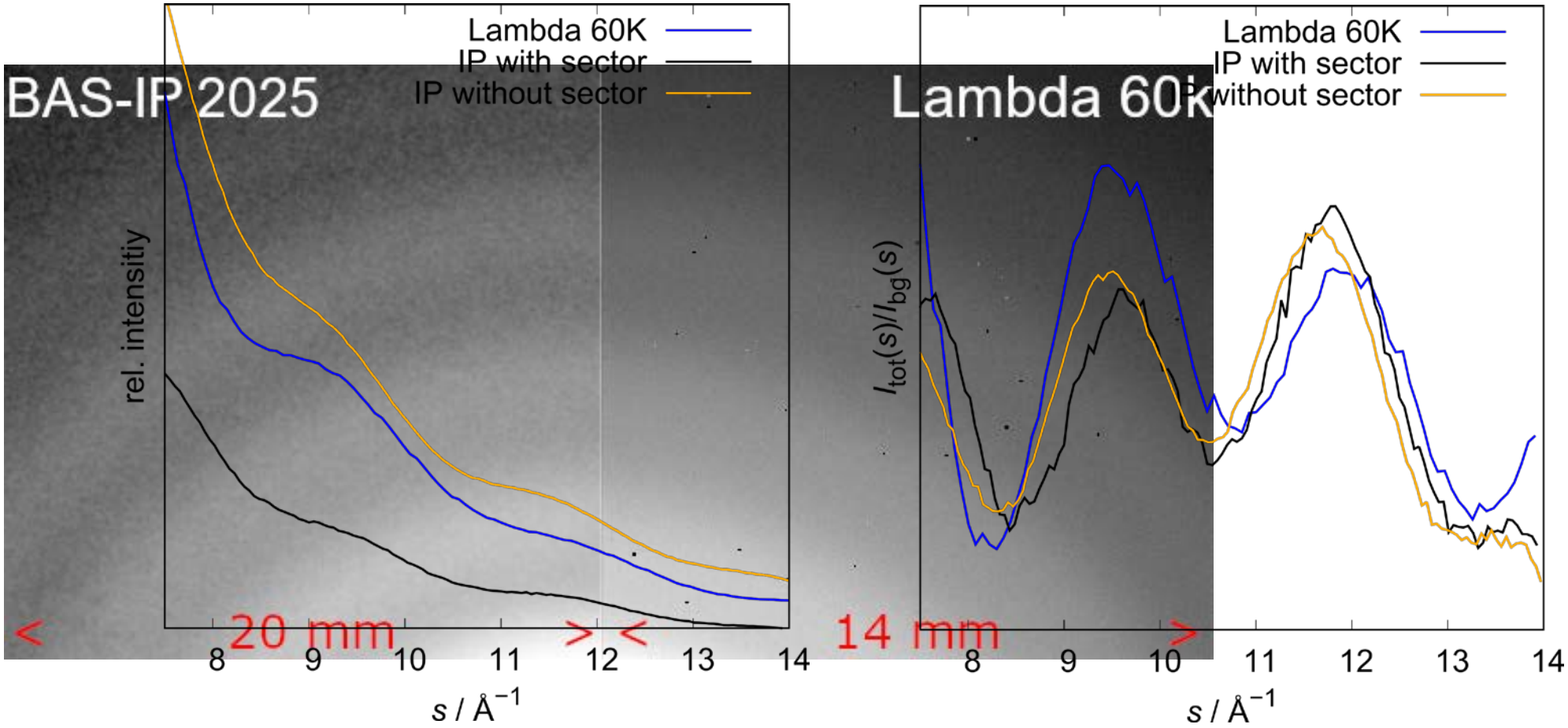
X-Spectrum Lambda 60k – testing period





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+ mechanical workshop ✓

digital detector ✓

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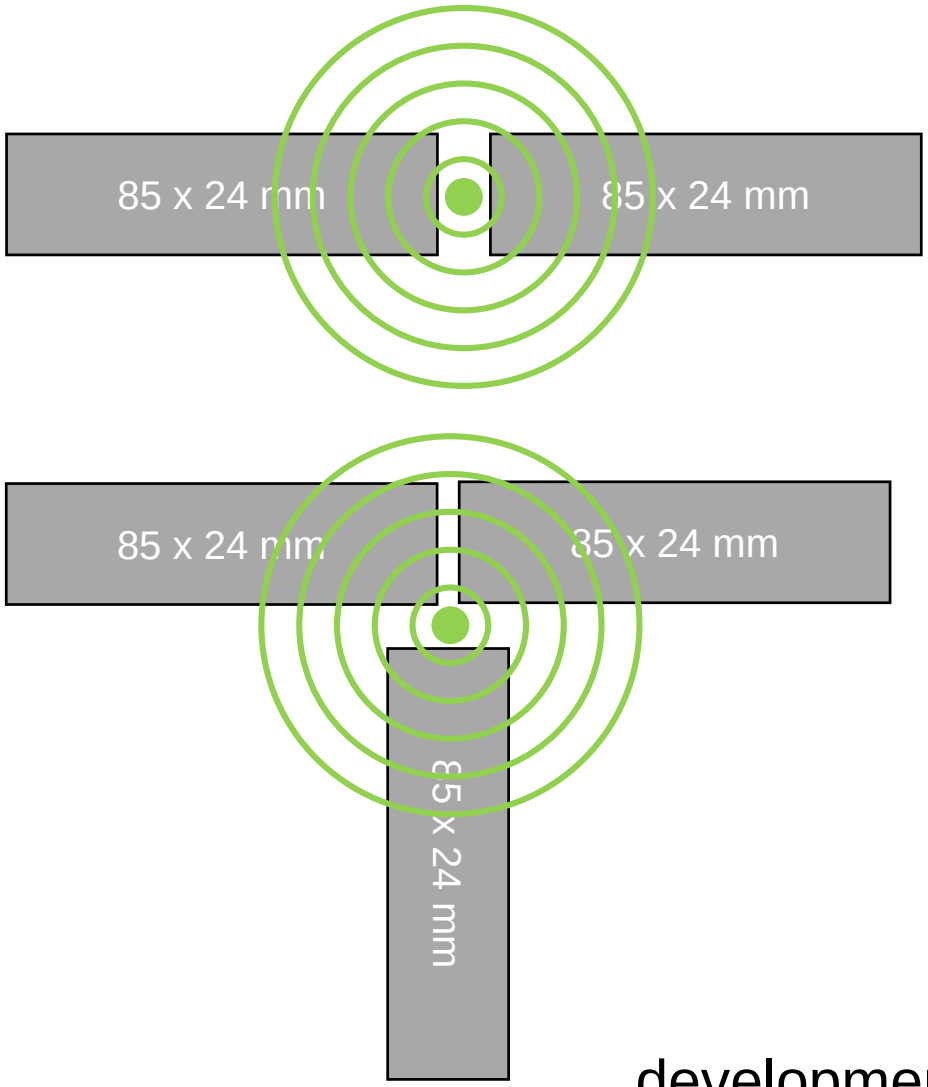
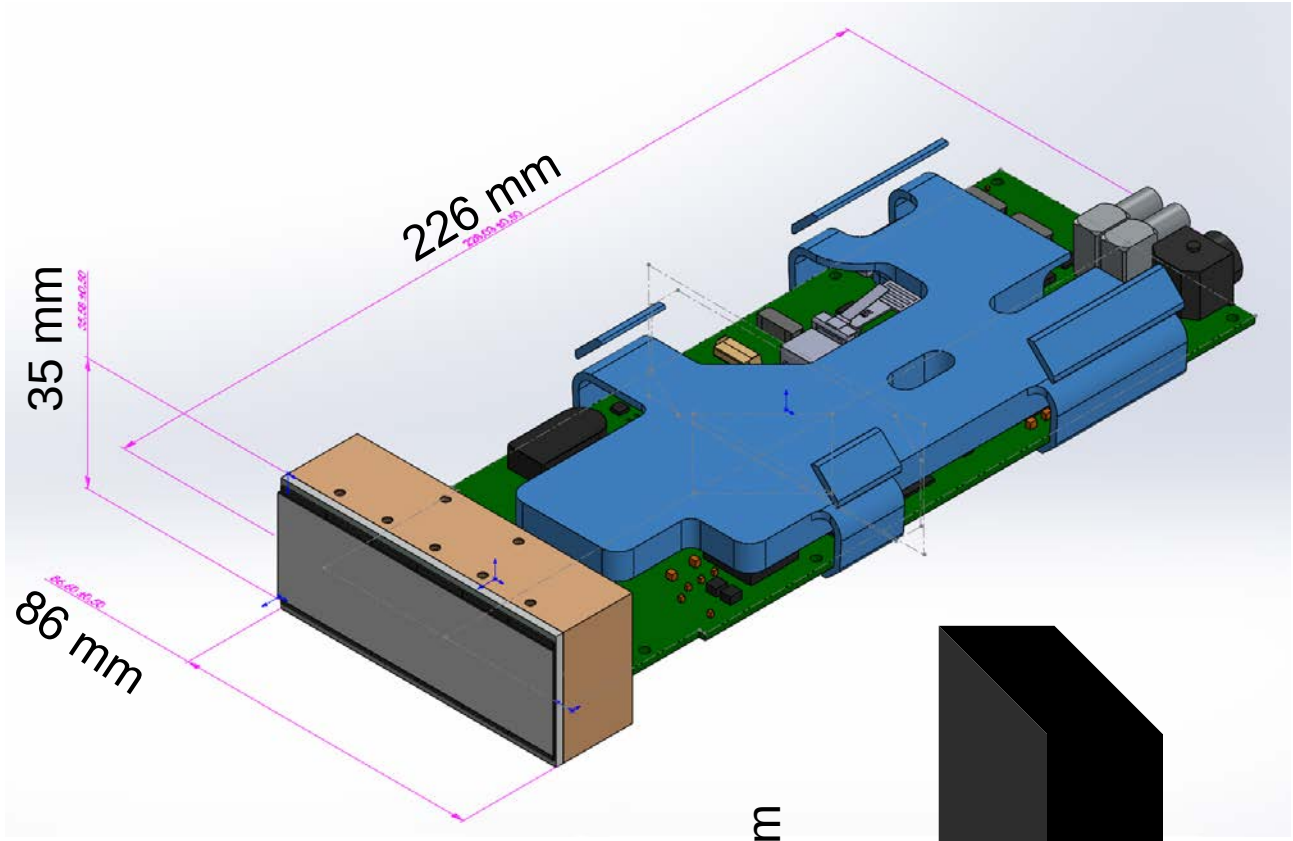
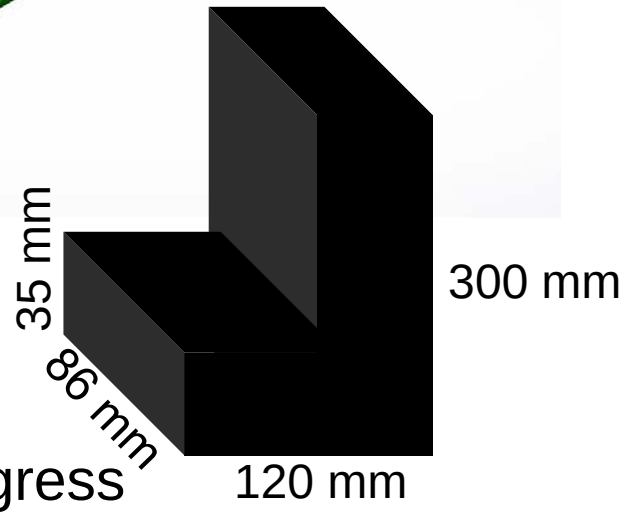
X-Spectrum Lambda 60k – possible setups







development of new L-shaped setup in progress

end

!