

PAUL SCHERRER INSTITUT



WIR SCHAFFEN WISSEN – HEUTE FÜR MORGEN

Rasmus Ischebeck

Key Components of a Synchrotron

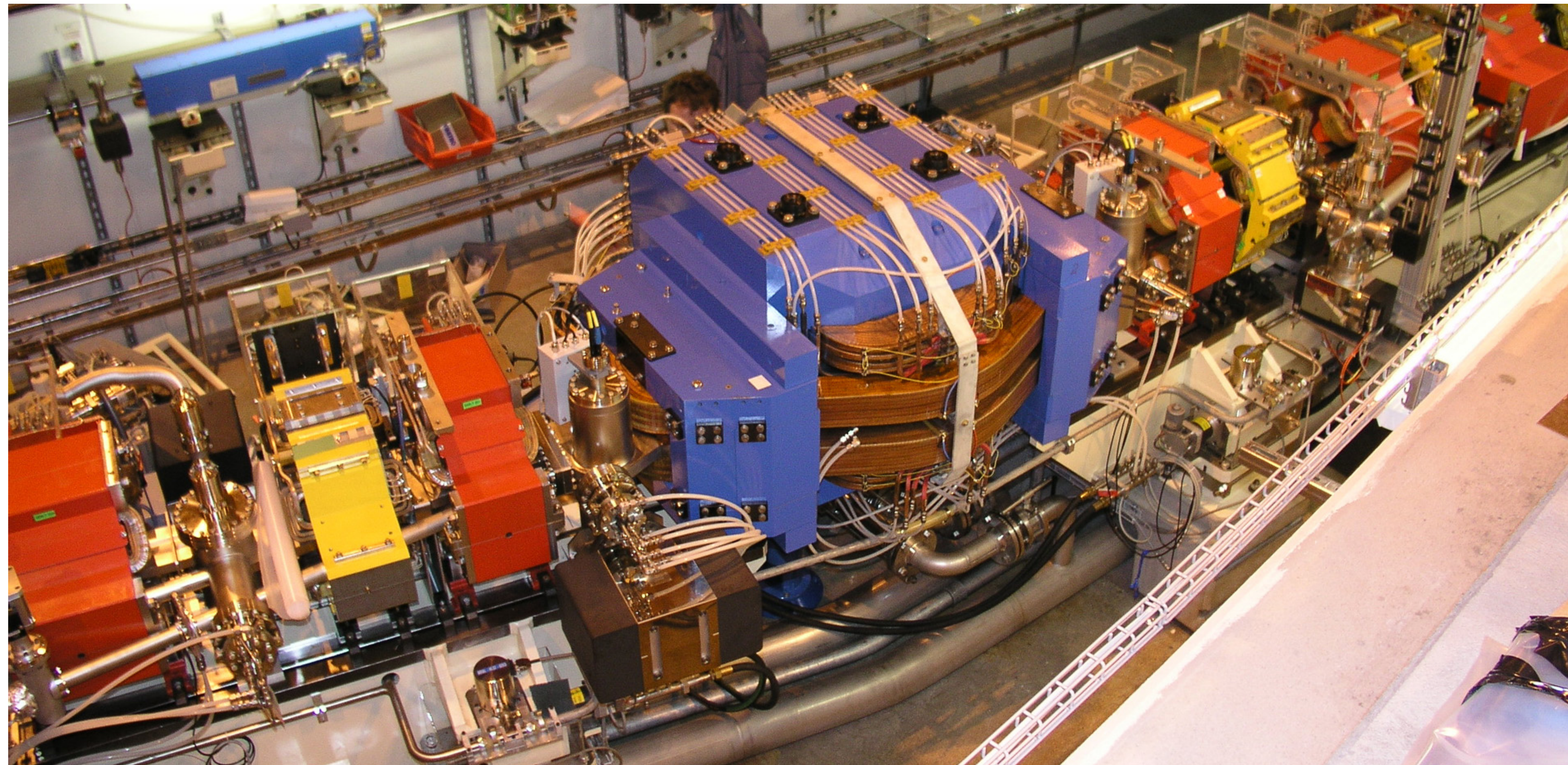
Joint Universities Accelerator School

Magnets: Dipoles

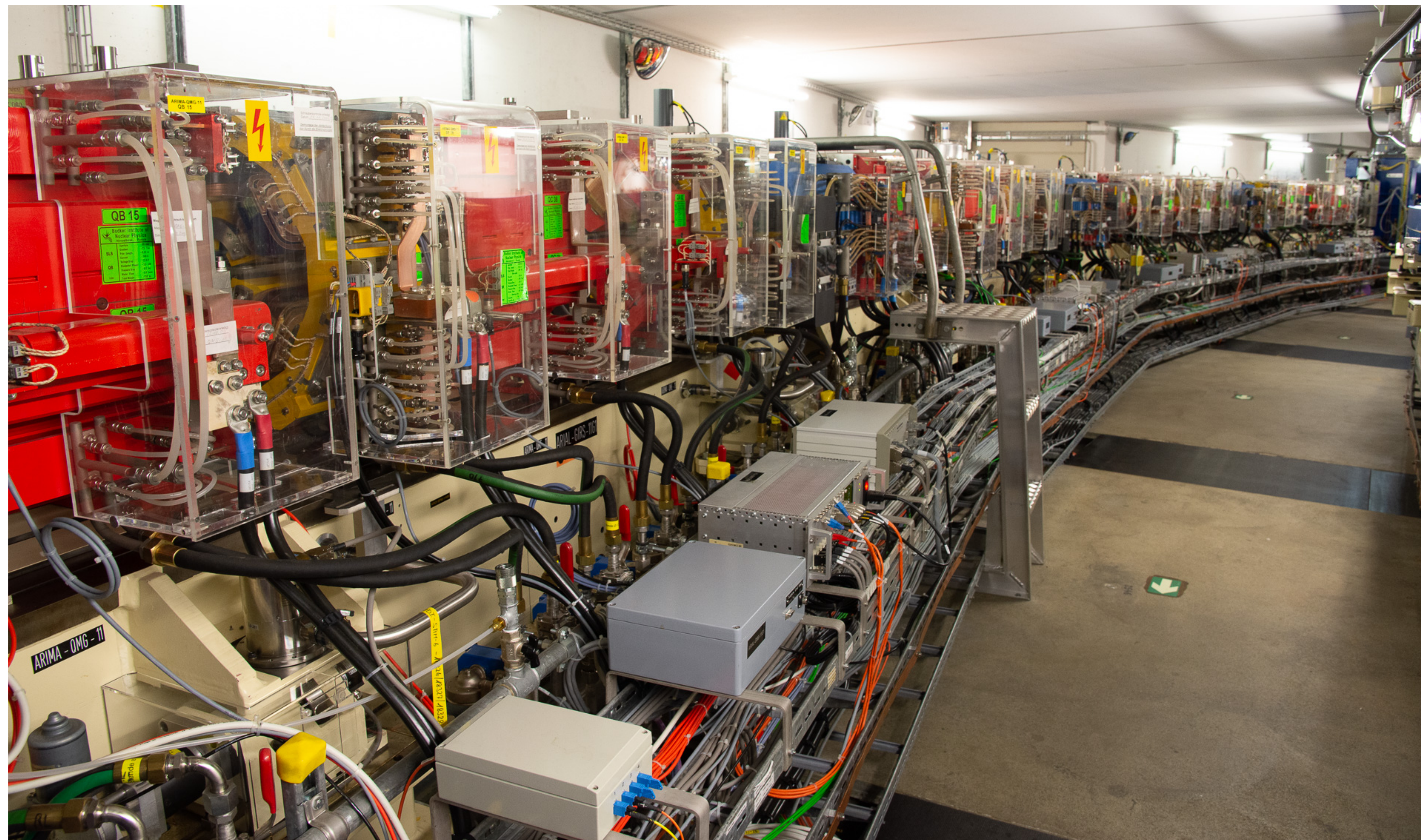


$$\rho = -\frac{p}{eB}$$

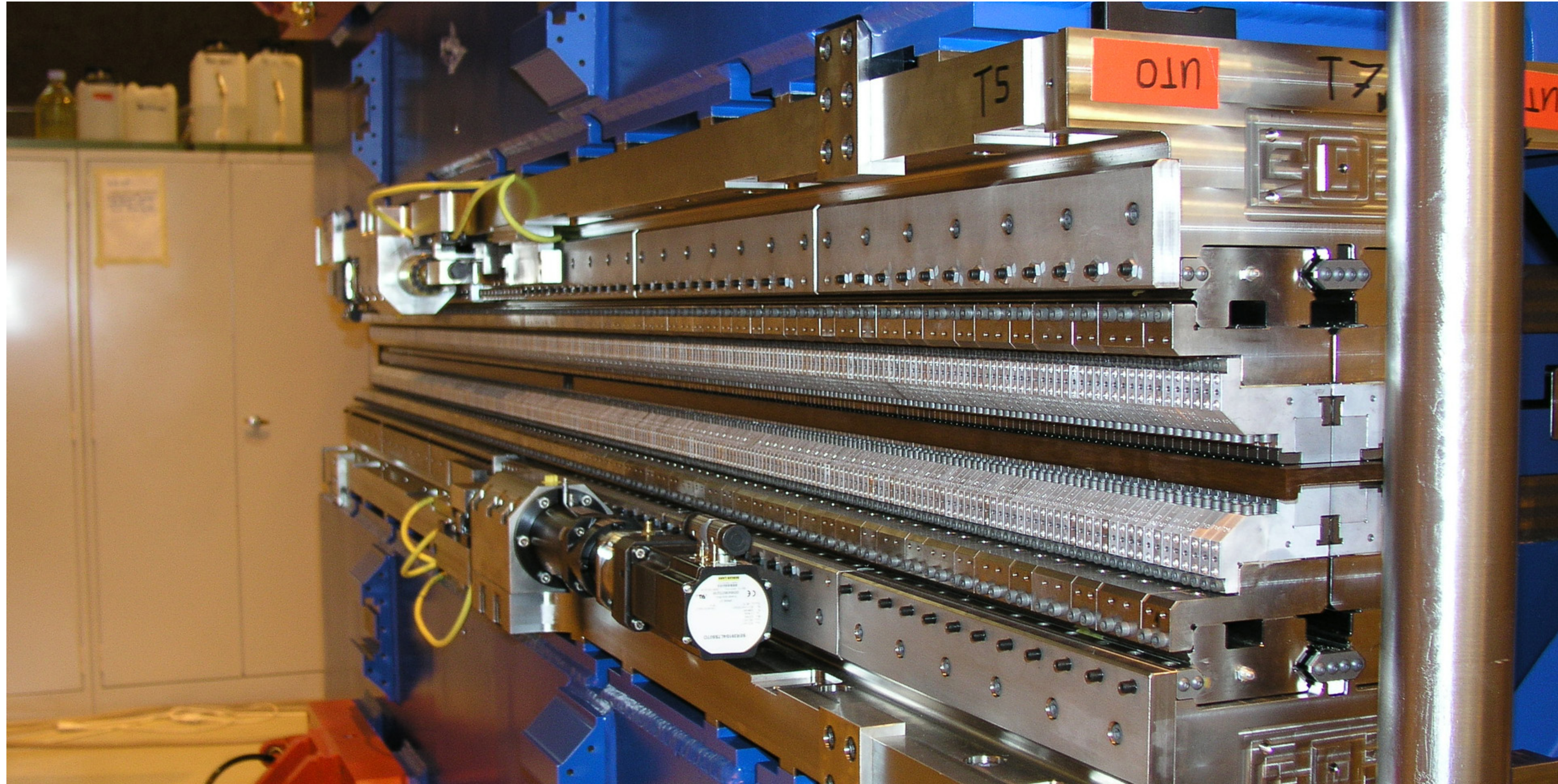
Magnets: Superbend

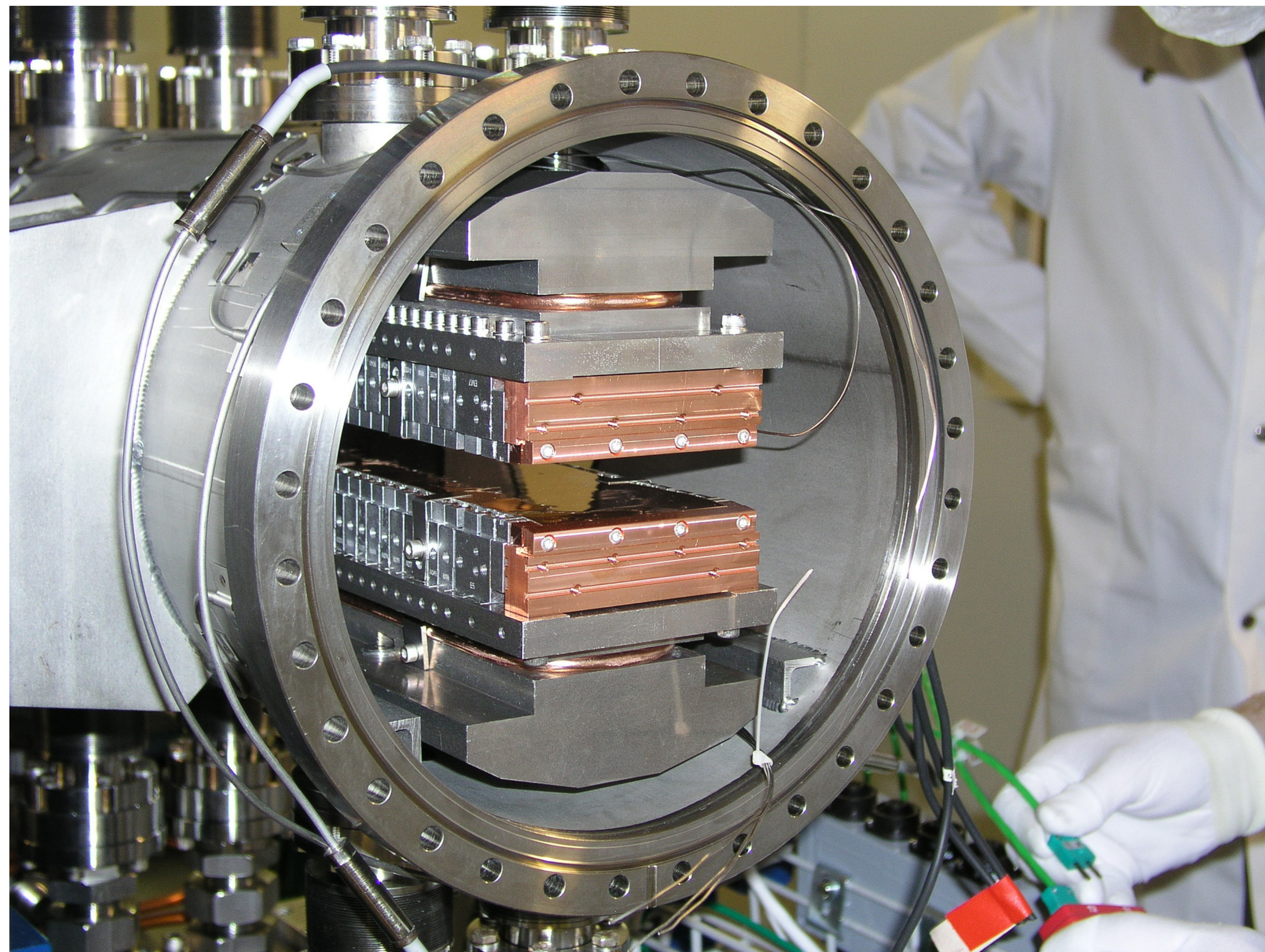


Magnets: Quadrupoles and Sextupoles

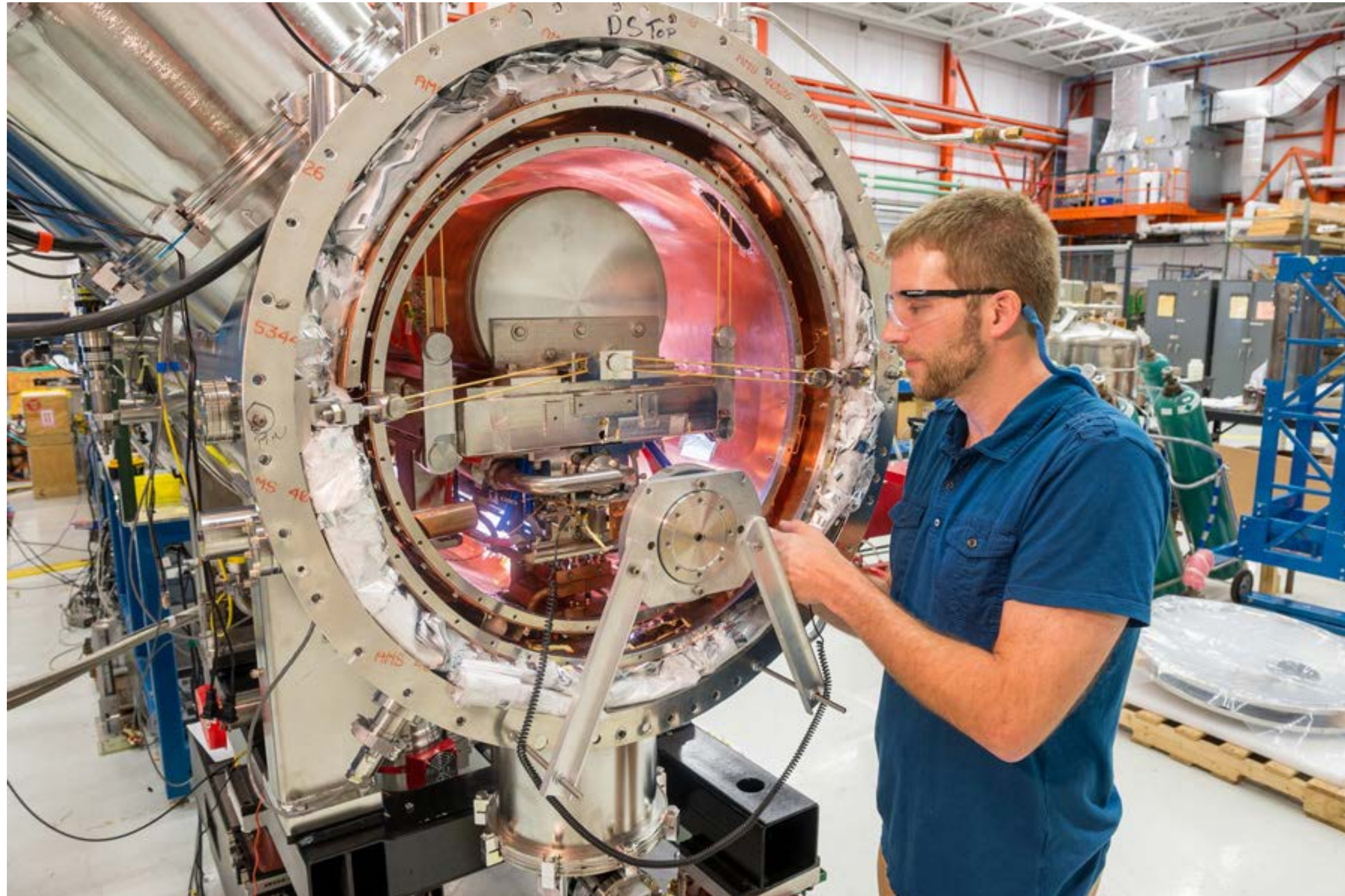


Magnets: Insertion Devices Undulator





Superconducting Undulator

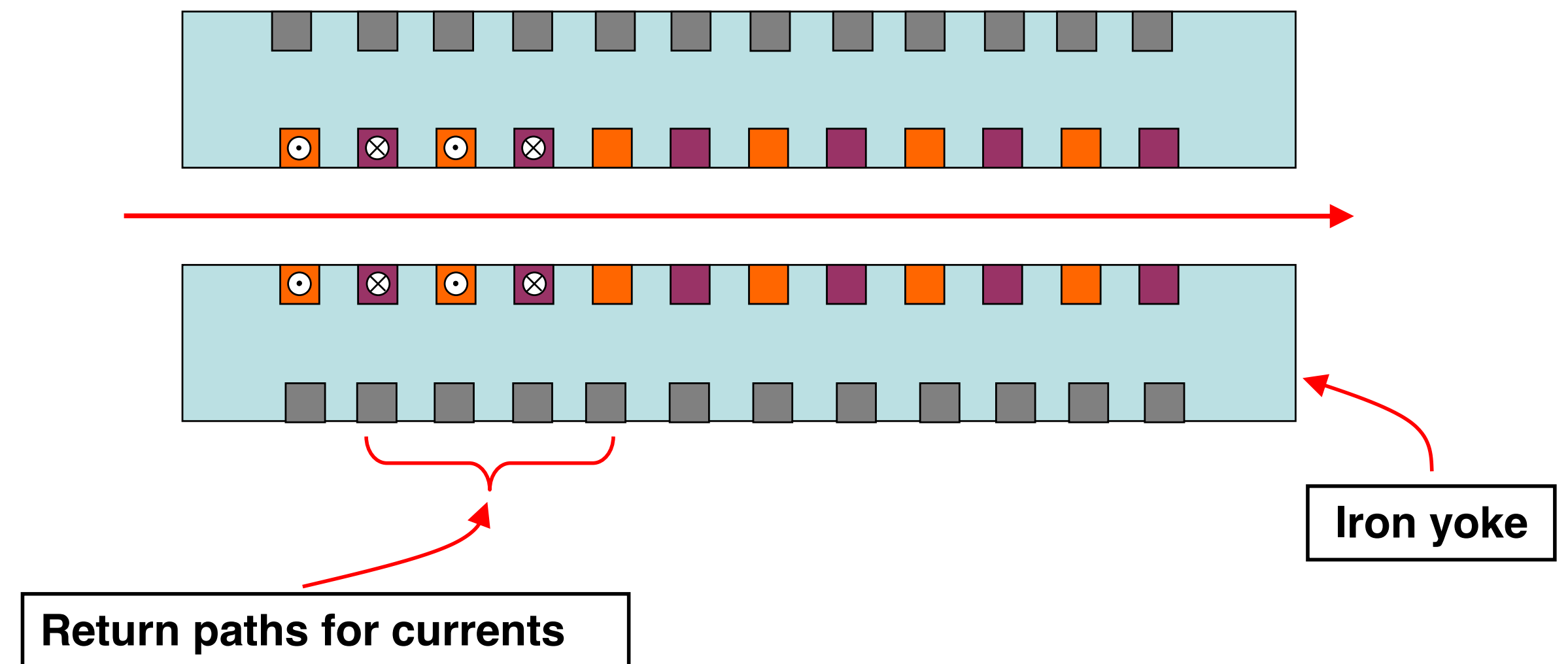


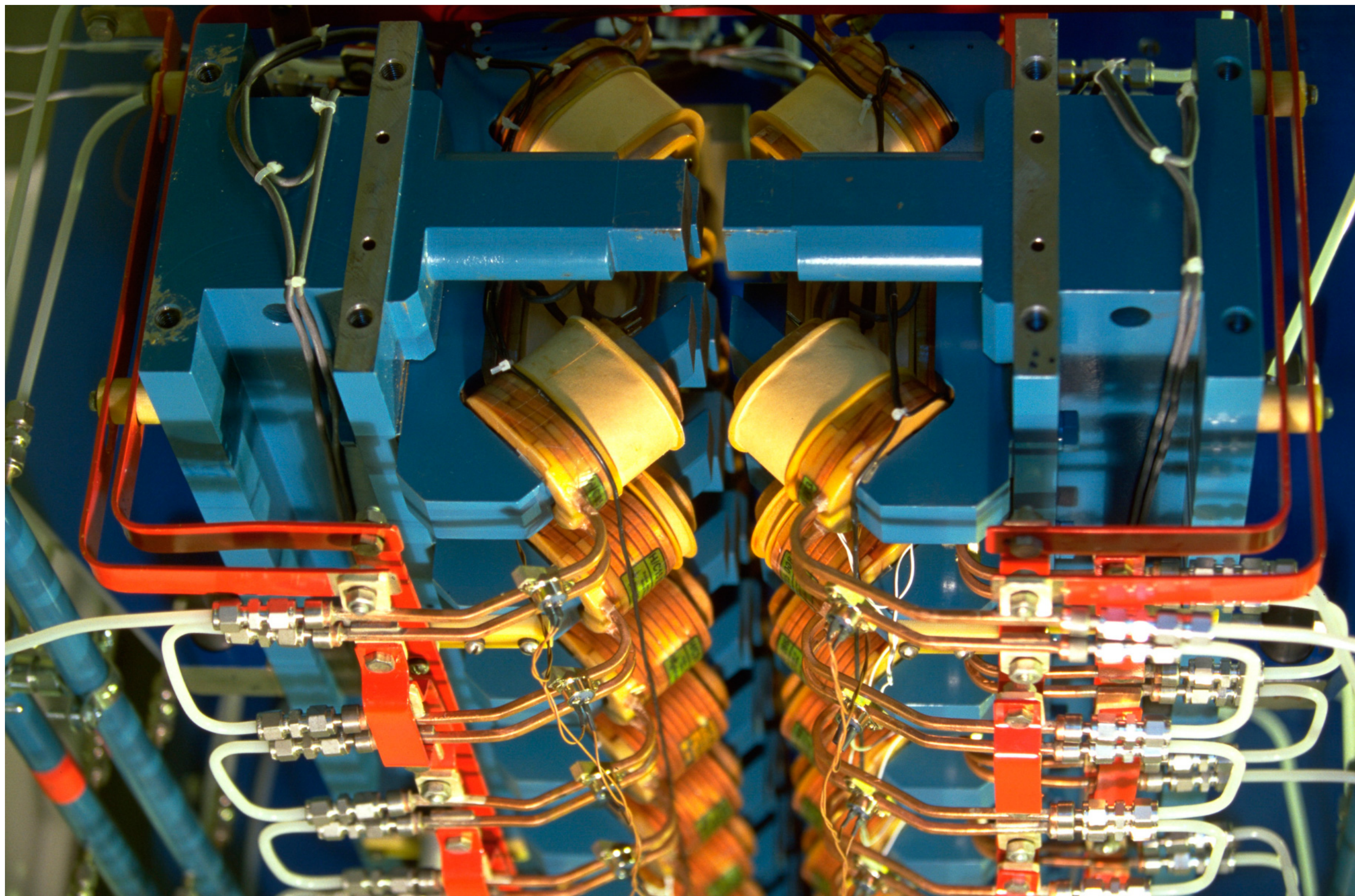
- 4.2 T, 48 mm period, 45 poles



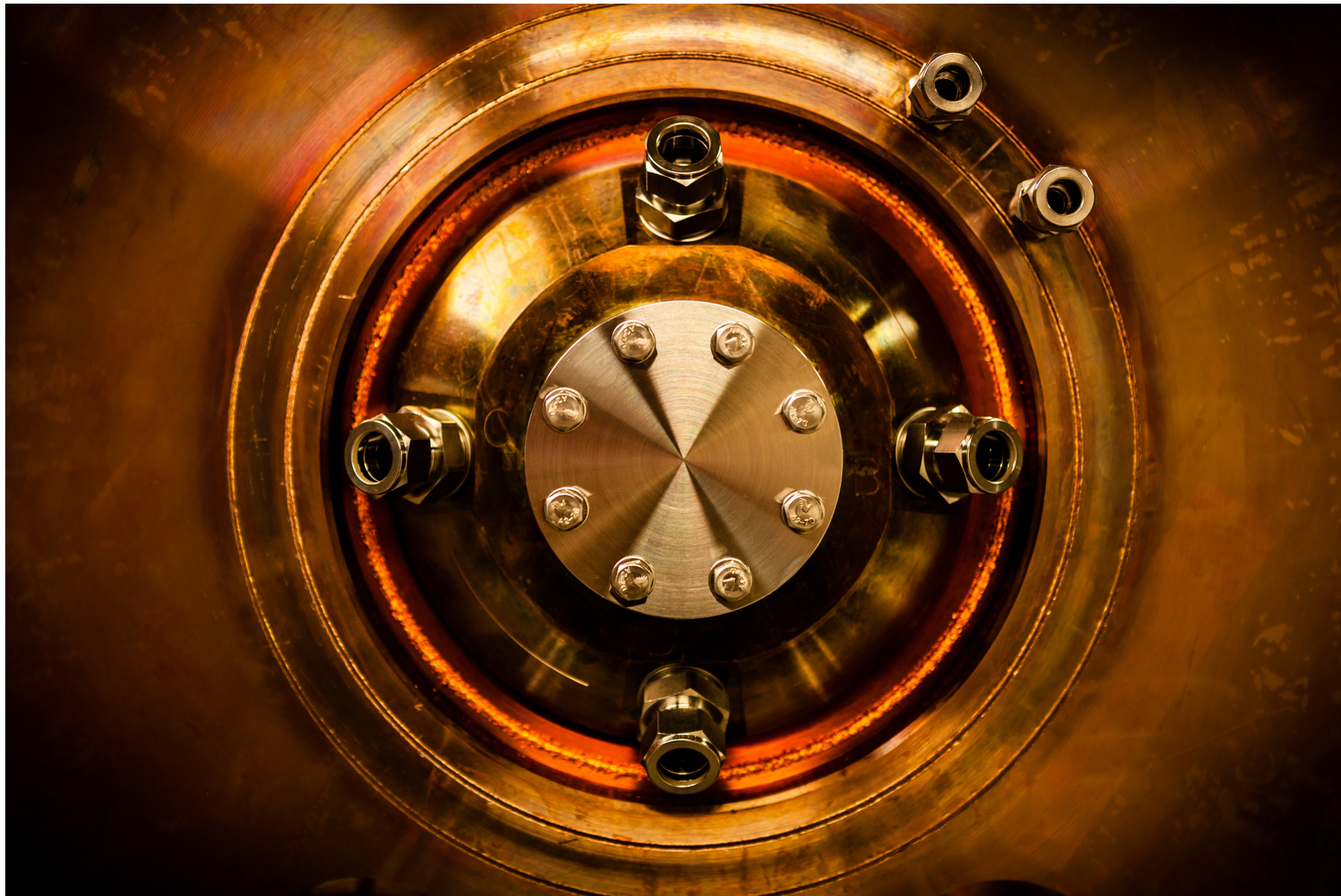
The standard solution is very simple – currents flowing perpendicular to the beam axis

The challenge is nearly all engineering

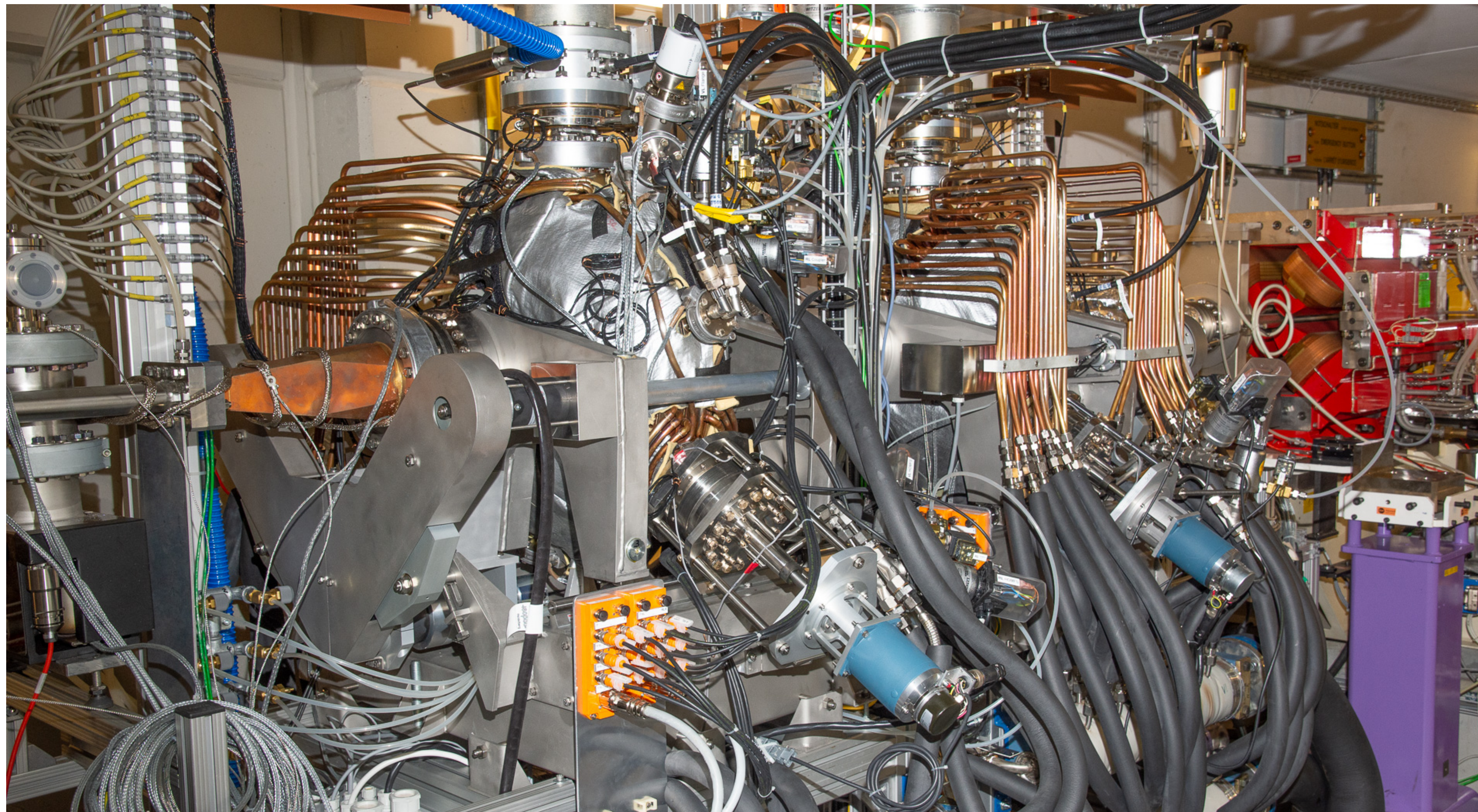




Radio Frequency Accelerator



Normal-Conducting RF



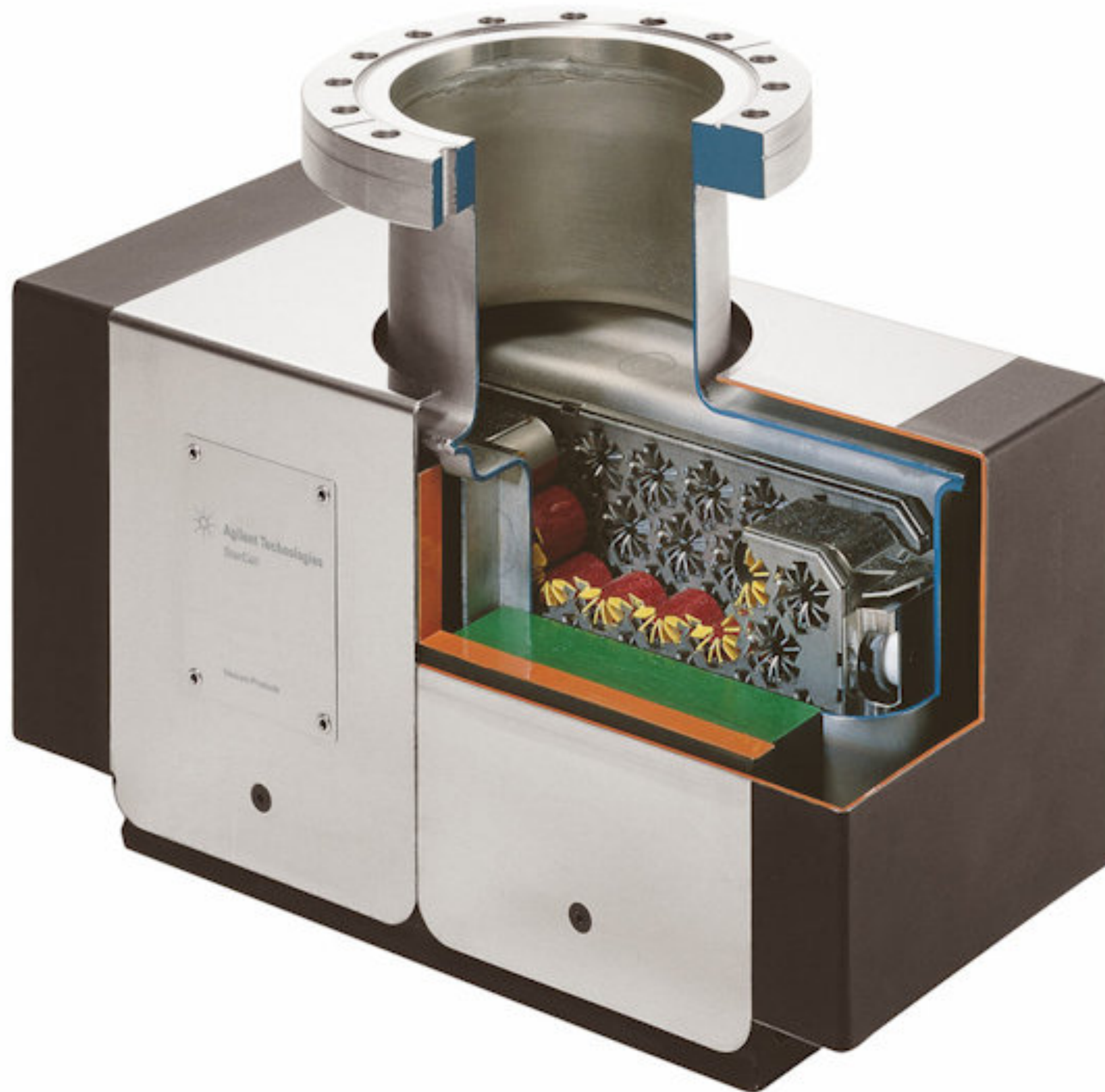
Superconducting RF

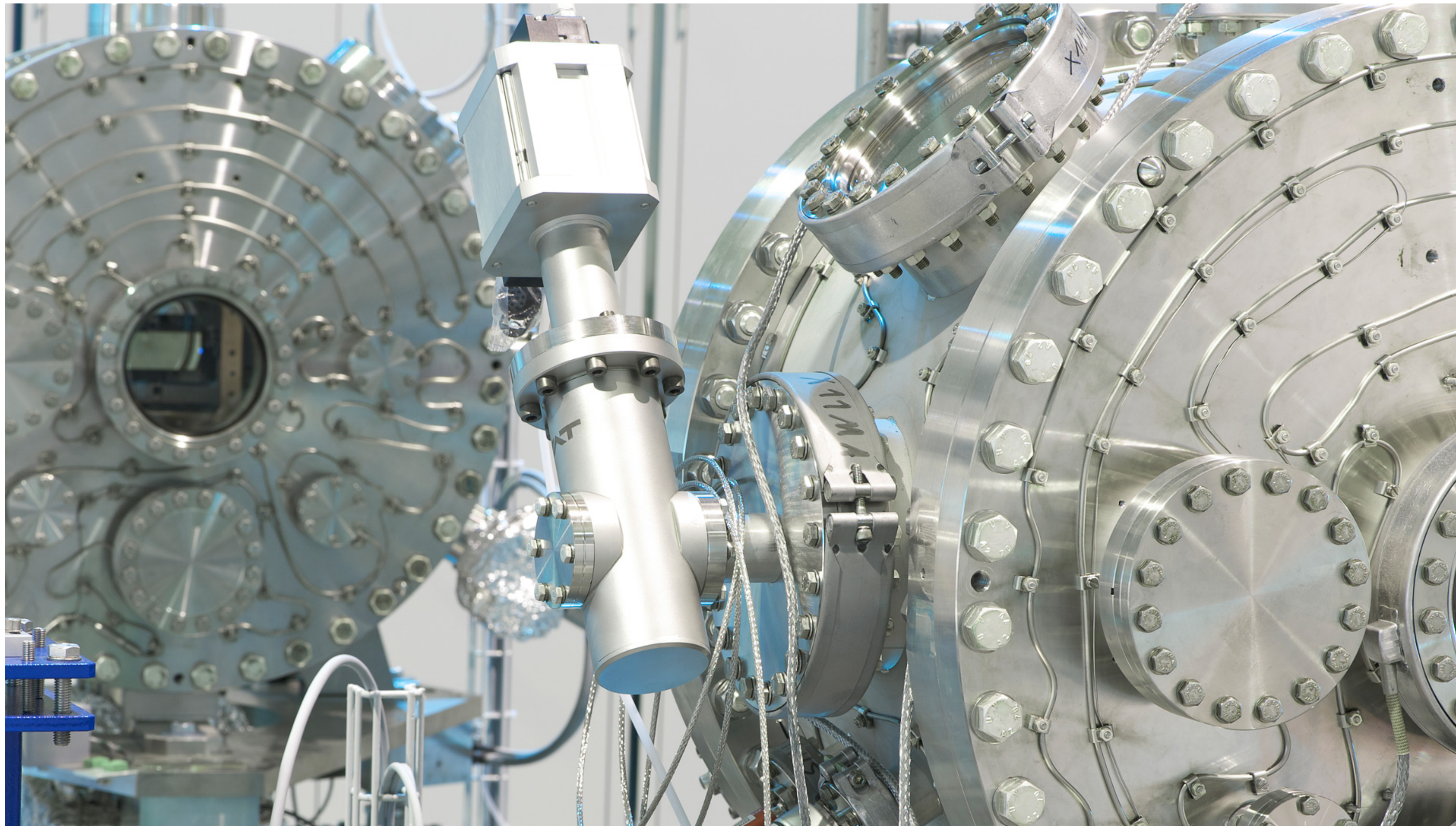


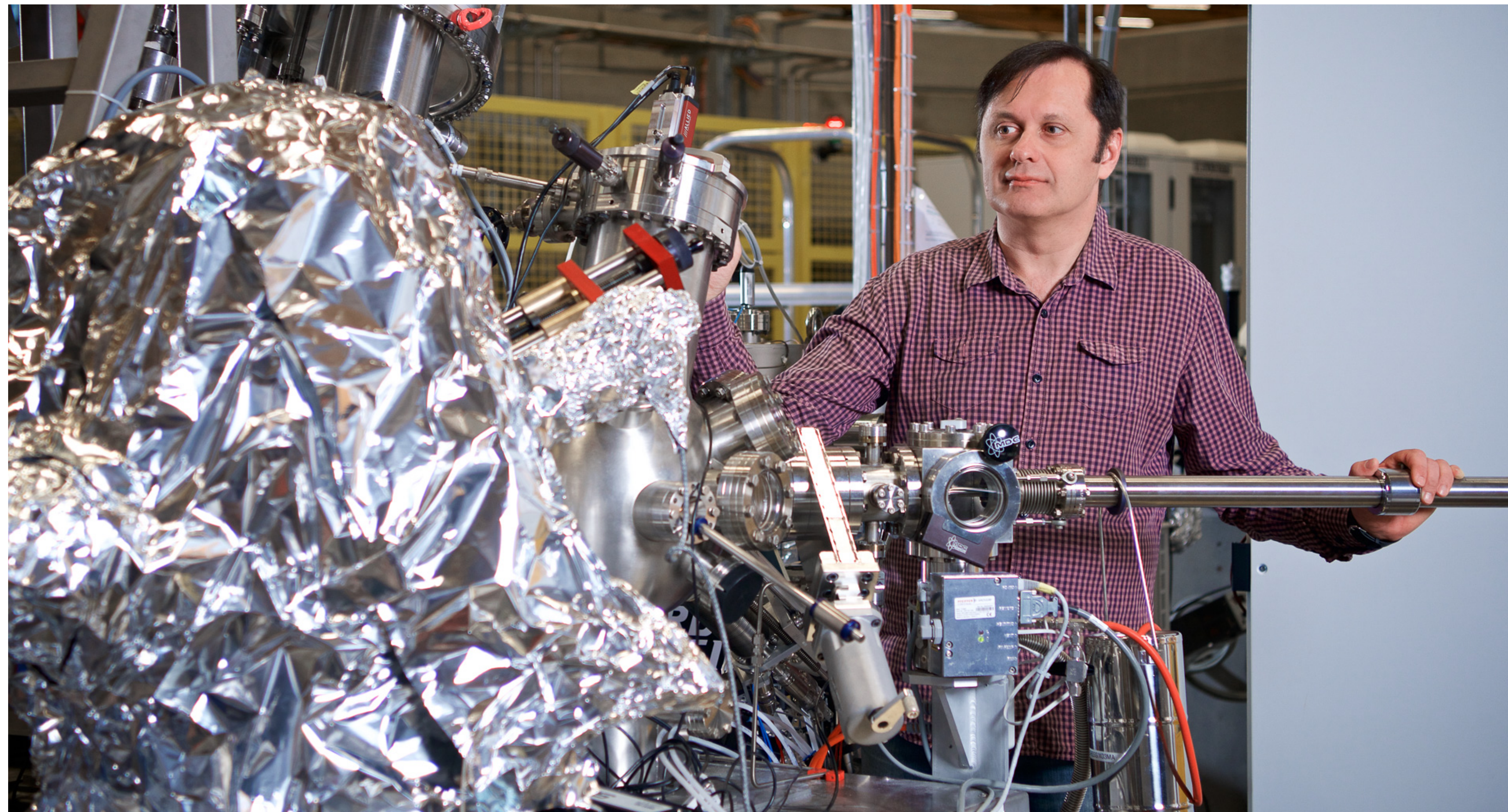
Vacuum System



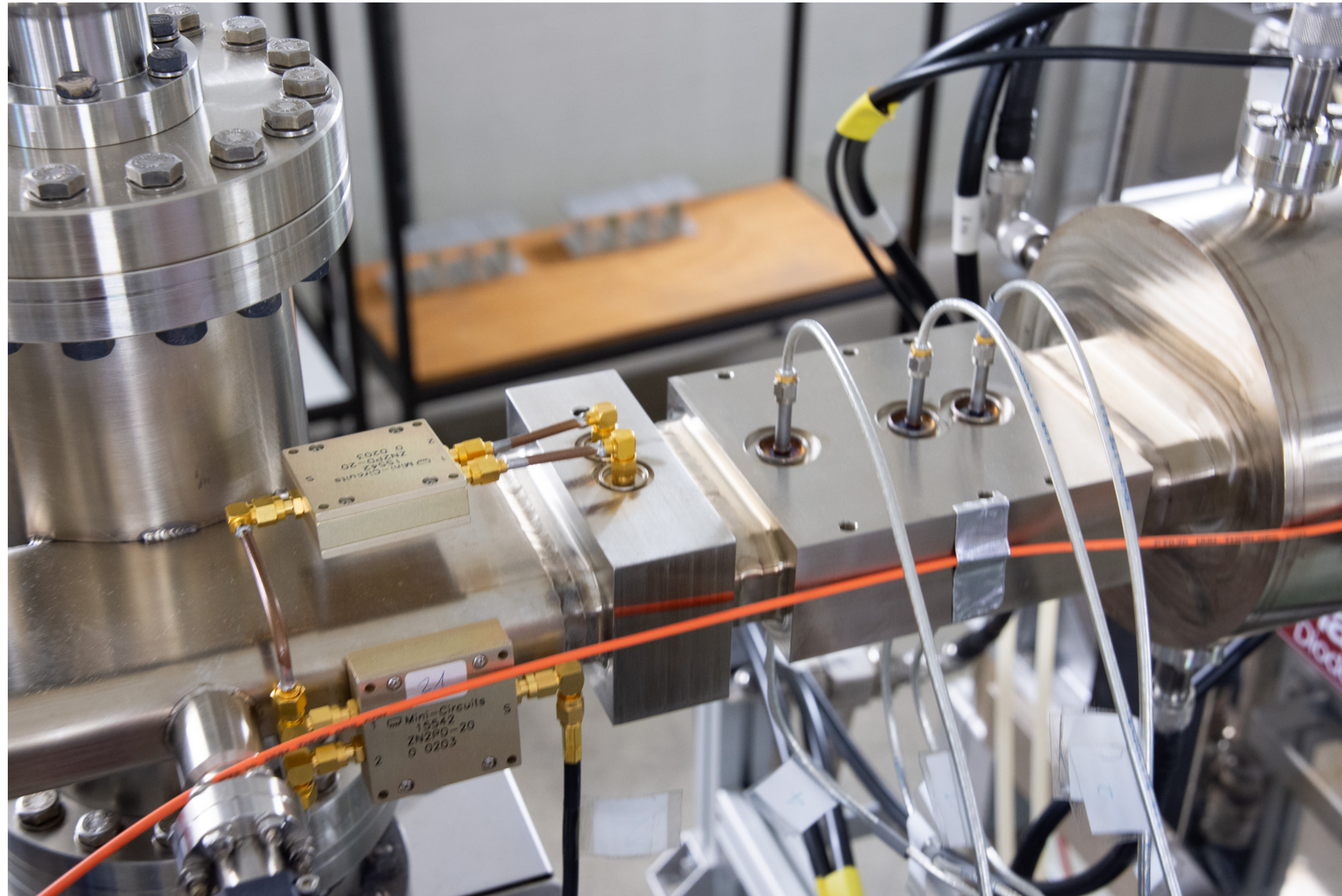
Vacuum System

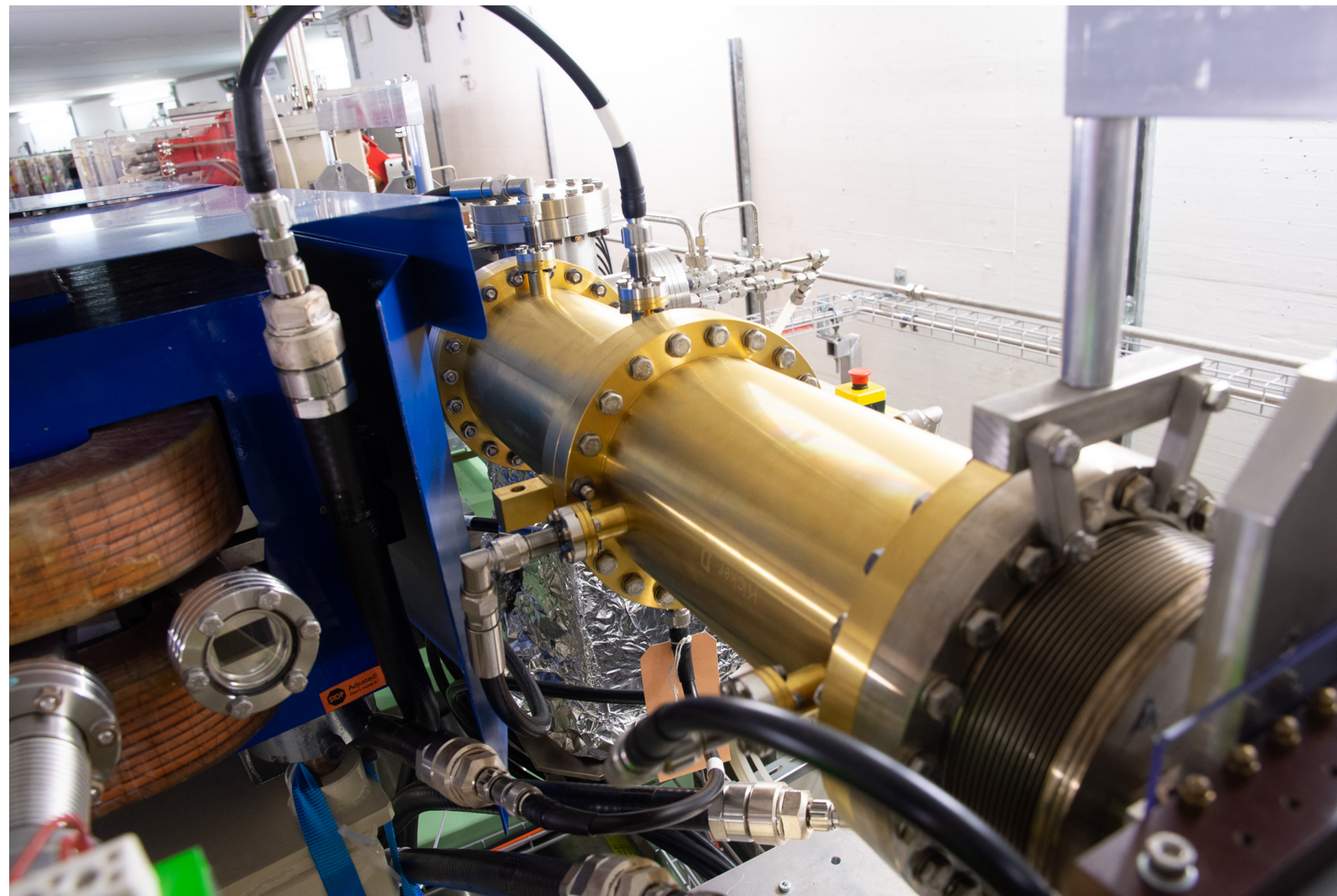






Instrumentation: Beam Position Monitor Pick-ups → Measurement of Beam Orbit

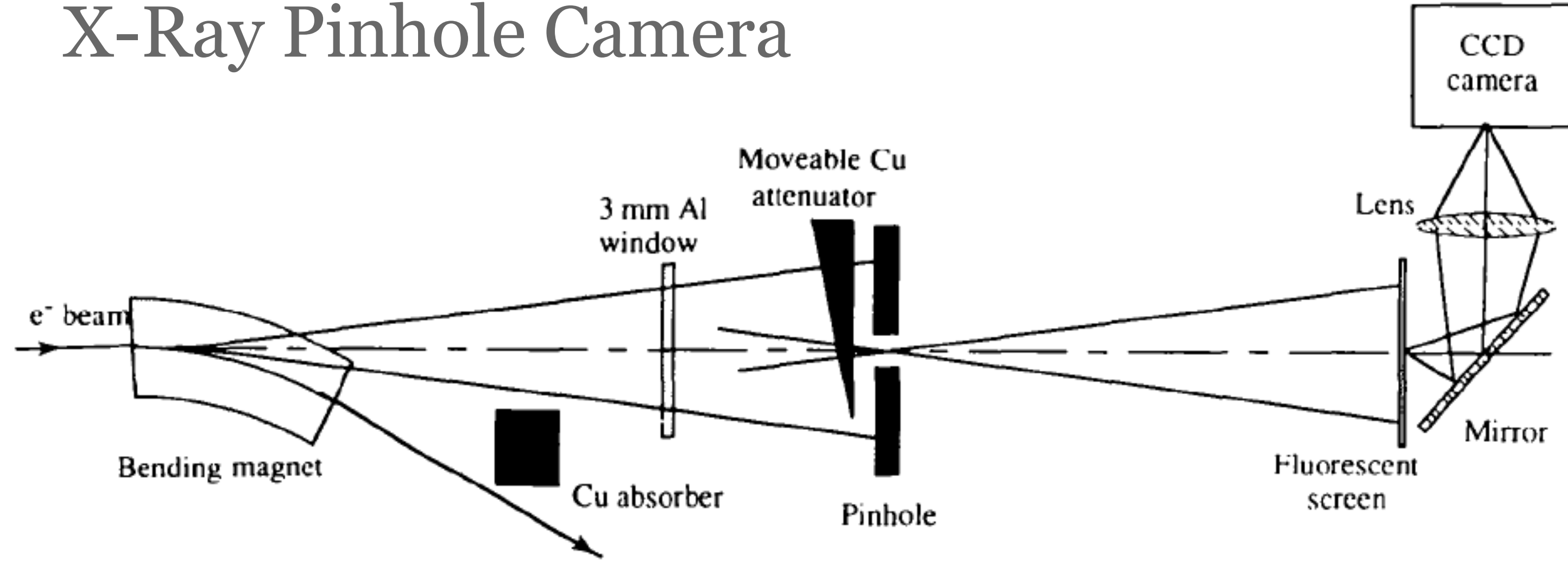




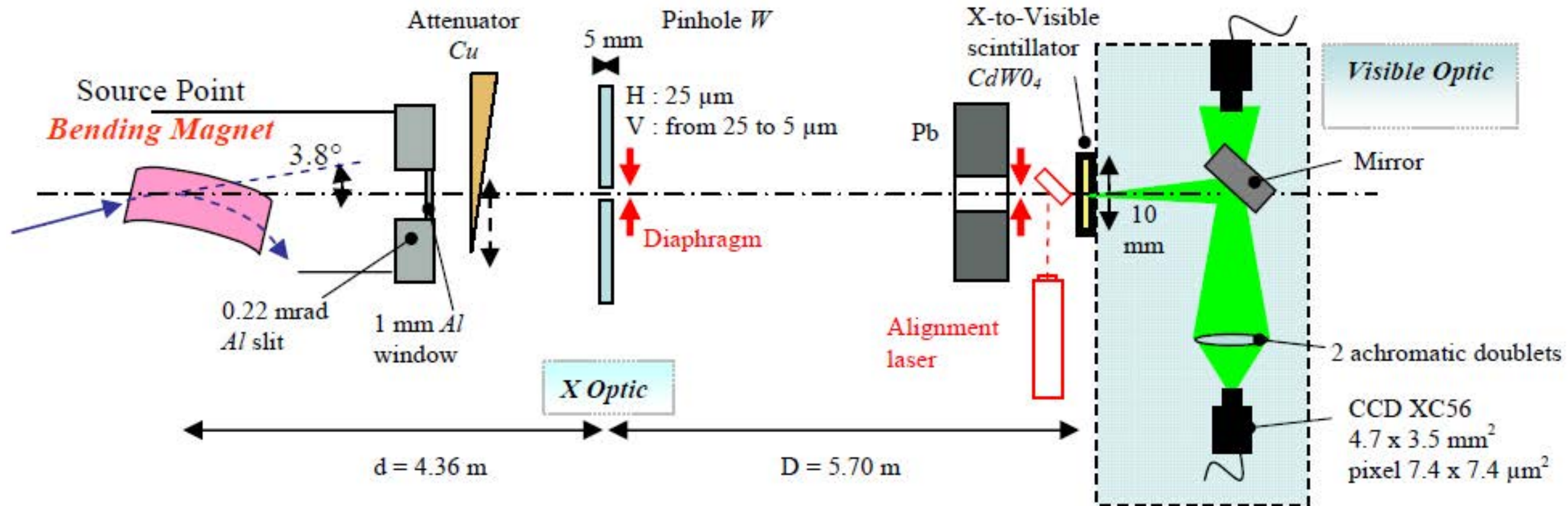
Instrumentation: Synchrotron Radiation



Instrumentation: Emittance X-Ray Pinhole Camera



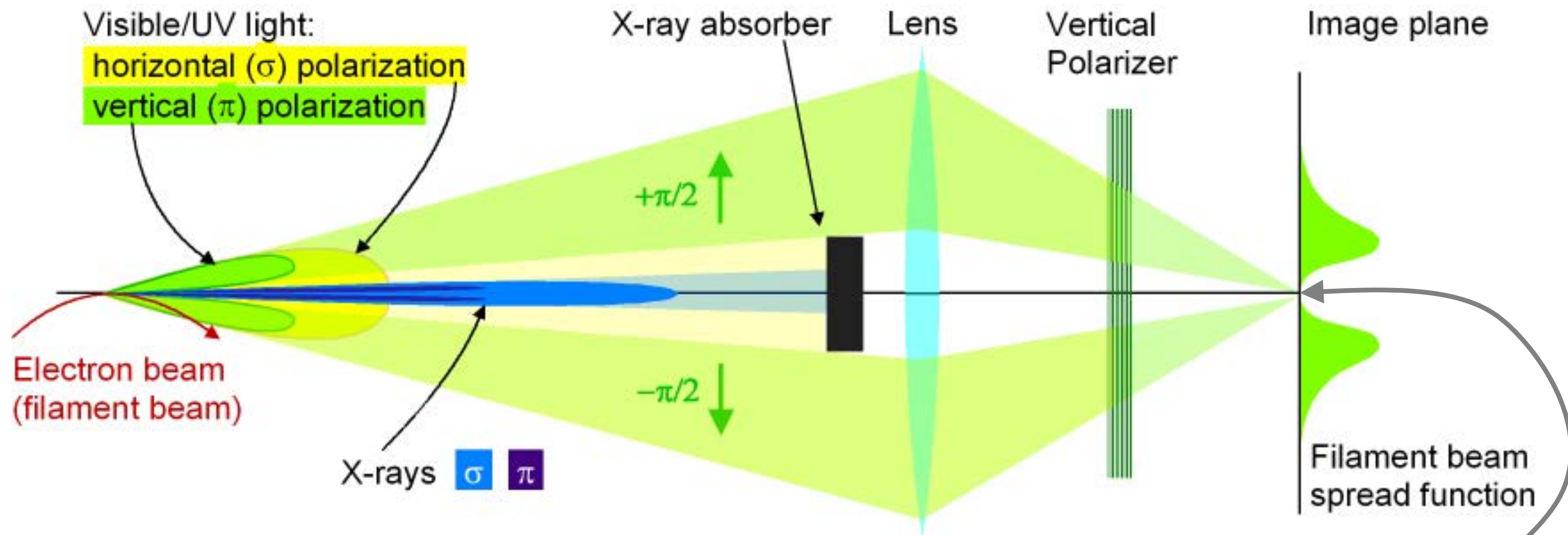
SPEAR



Soleil

The π -polarization method

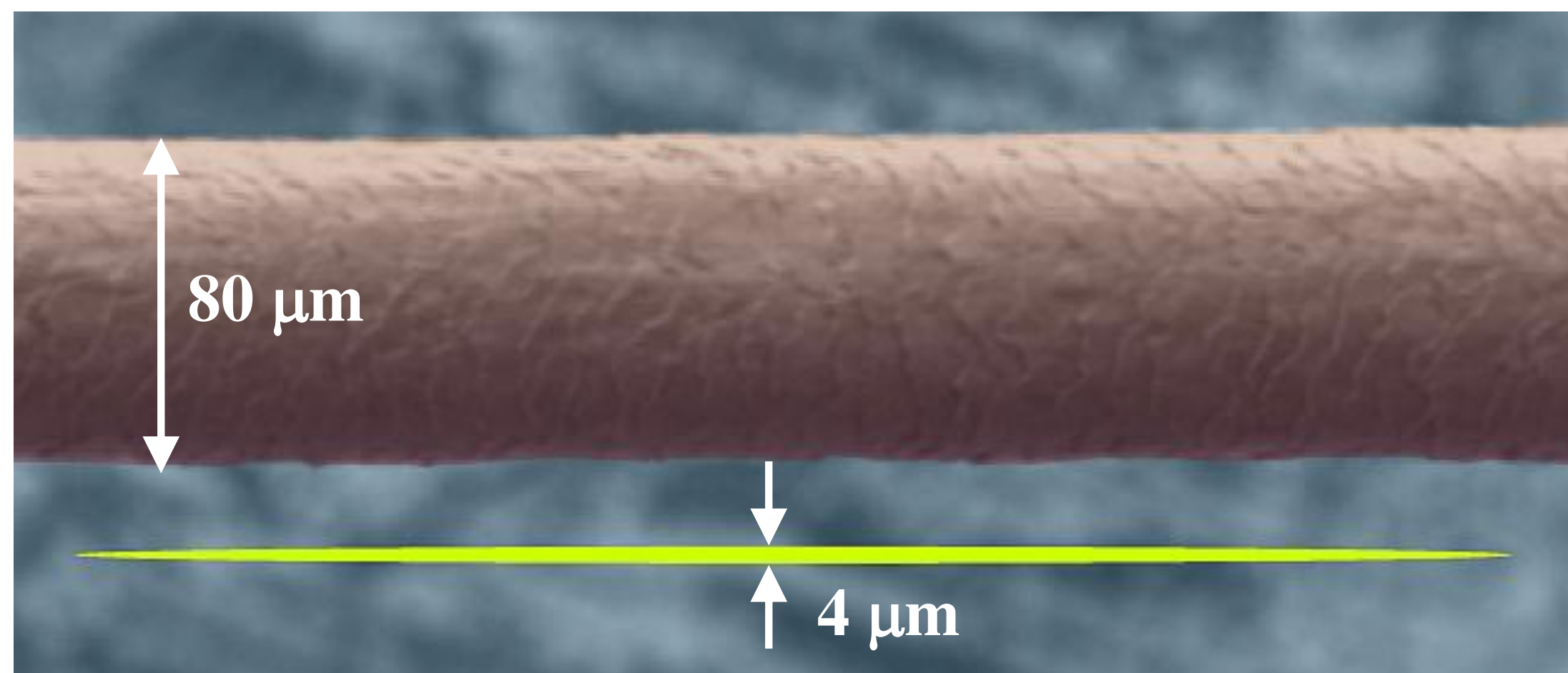
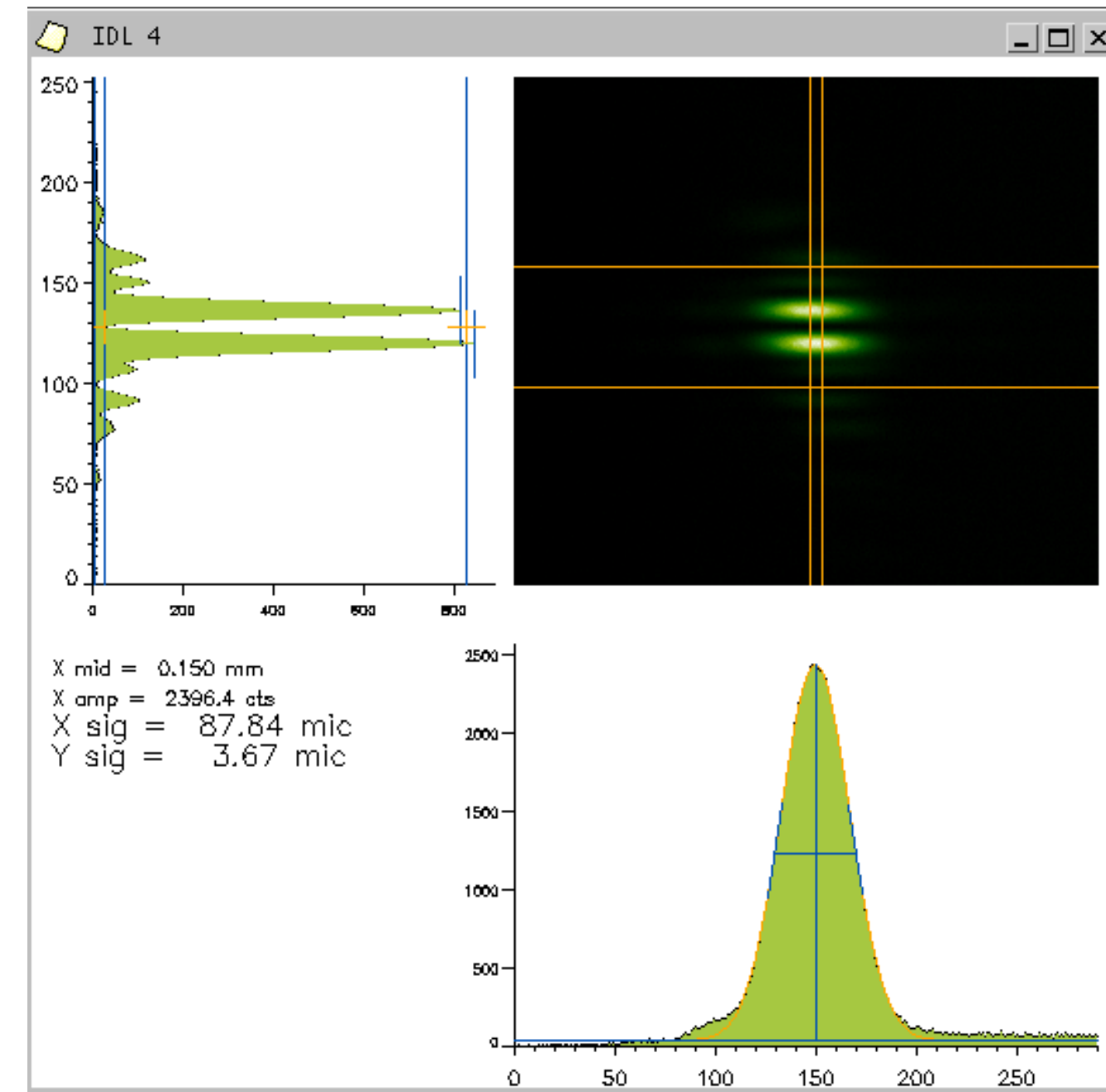
- Å. Andersson et al., *Determination of small vertical electron beam profile and emittance at the Swiss Light Source*, NIM A 592 (2008) 437-446



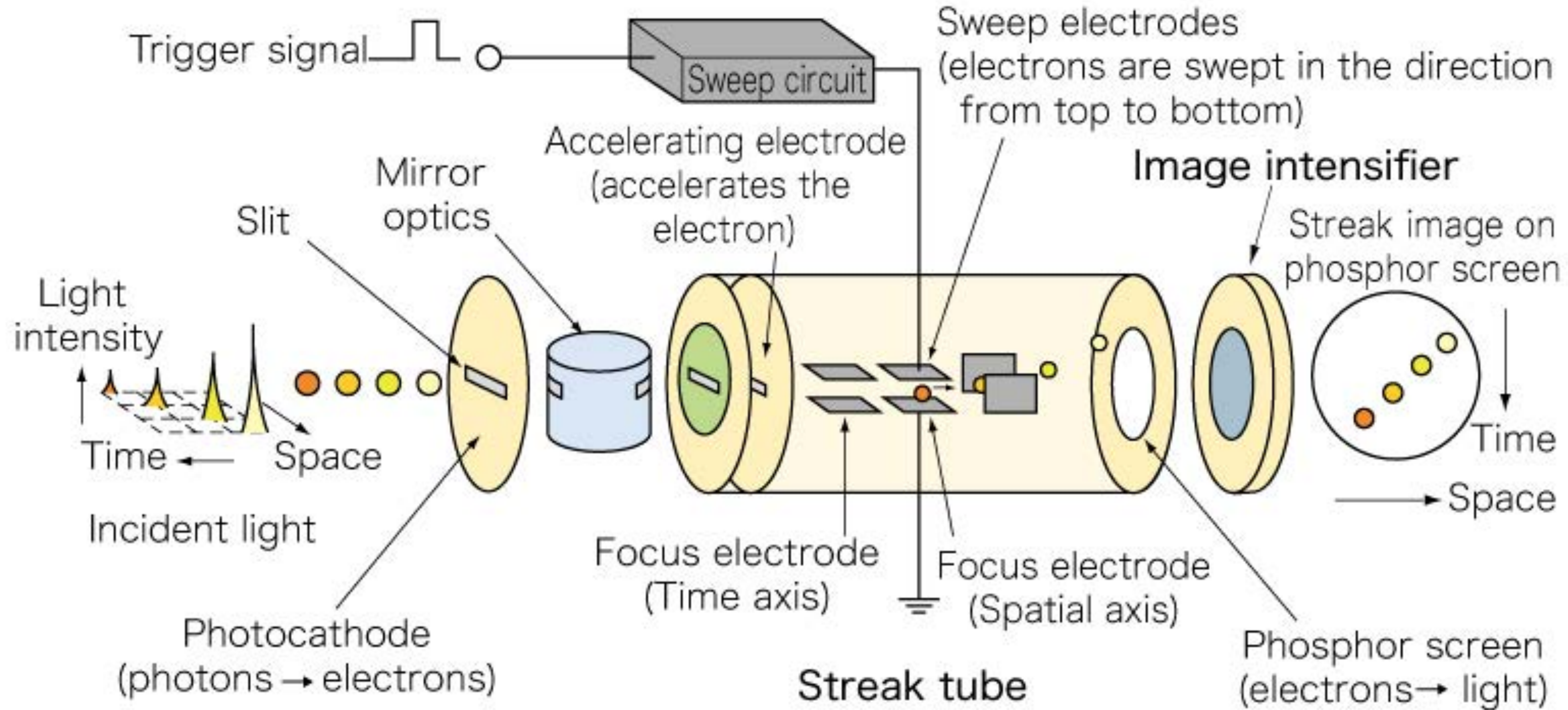
- Image of vertically polarized visible/UV synchrotron radiation
- Phase shift π between the two radiation lobes
→ destructive interference in mid plane: $I_{y=0} = 0$ in FBSF
- Finite vertical beam size: $I_{y=0} > 0$

Vertical Emittance Record

- Beam size $3.6 \pm 0.6 \mu\text{m}$
- Emittance $0.9 \pm 0.4 \text{ pm}$
- Error estimate from beam size and beta function at monitor.
- Dispersion not subtracted.
- SLS beam cross section (in short undulator straight, 2σ) compared to a human hair:

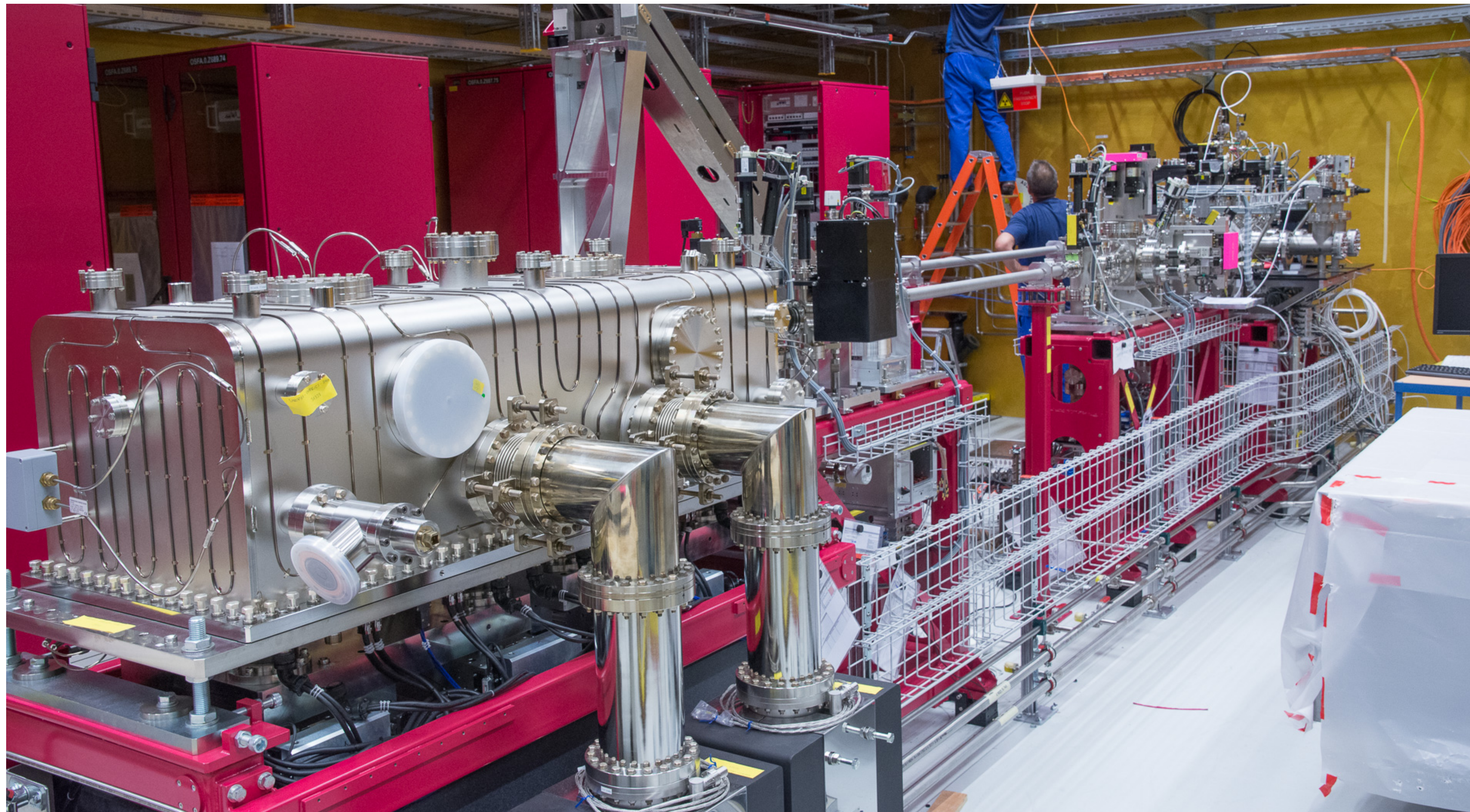


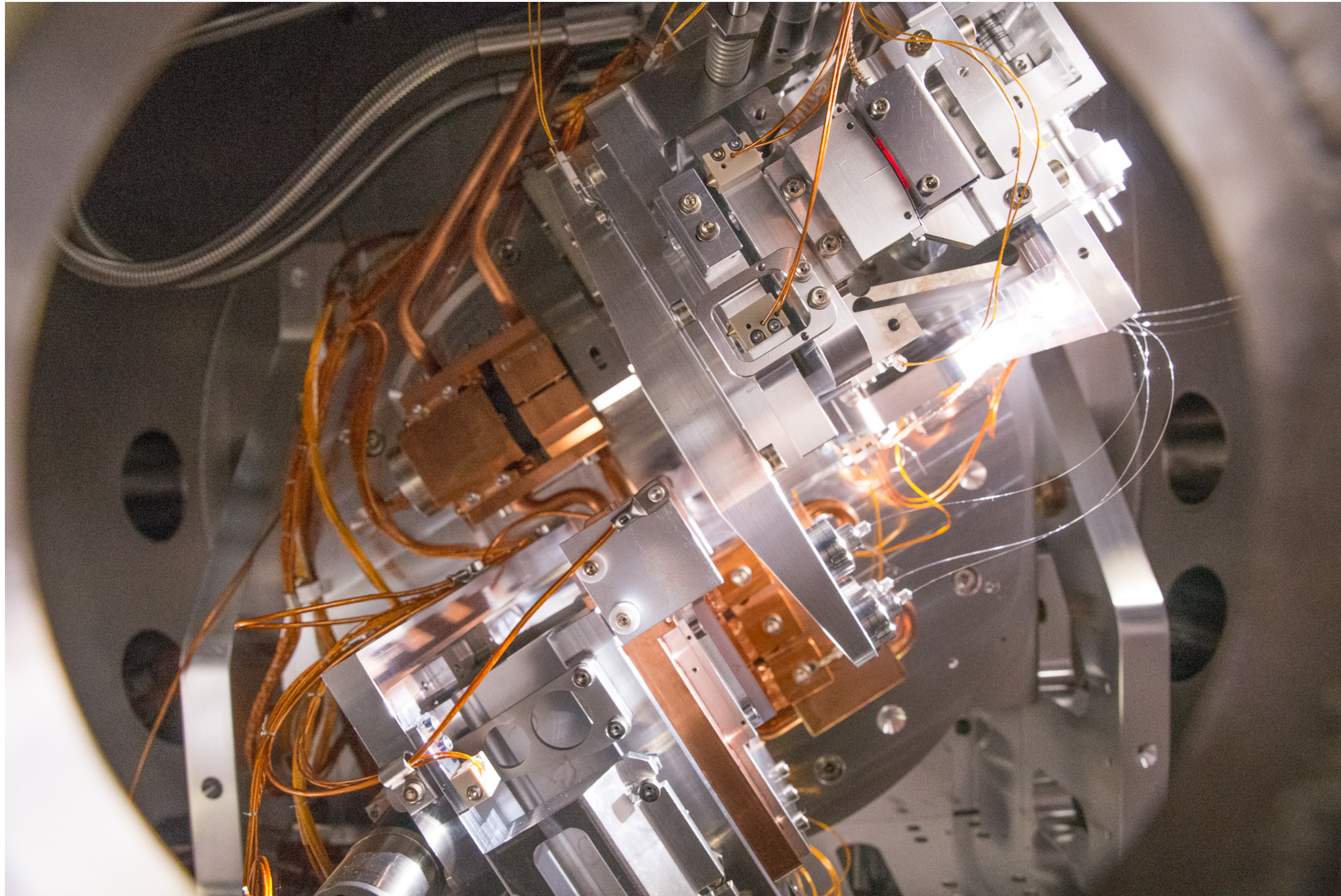
Instrumentation: Time Structure



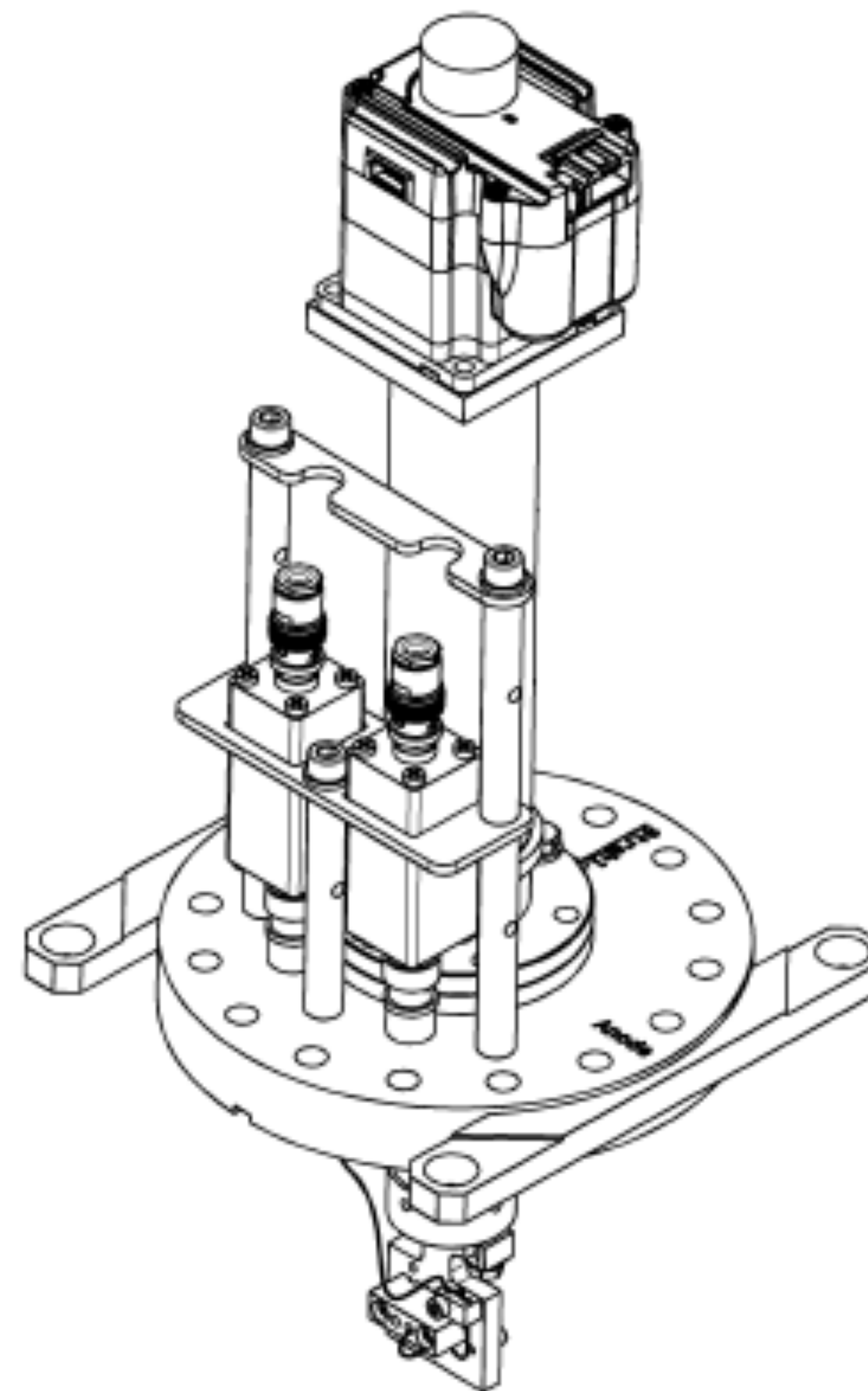
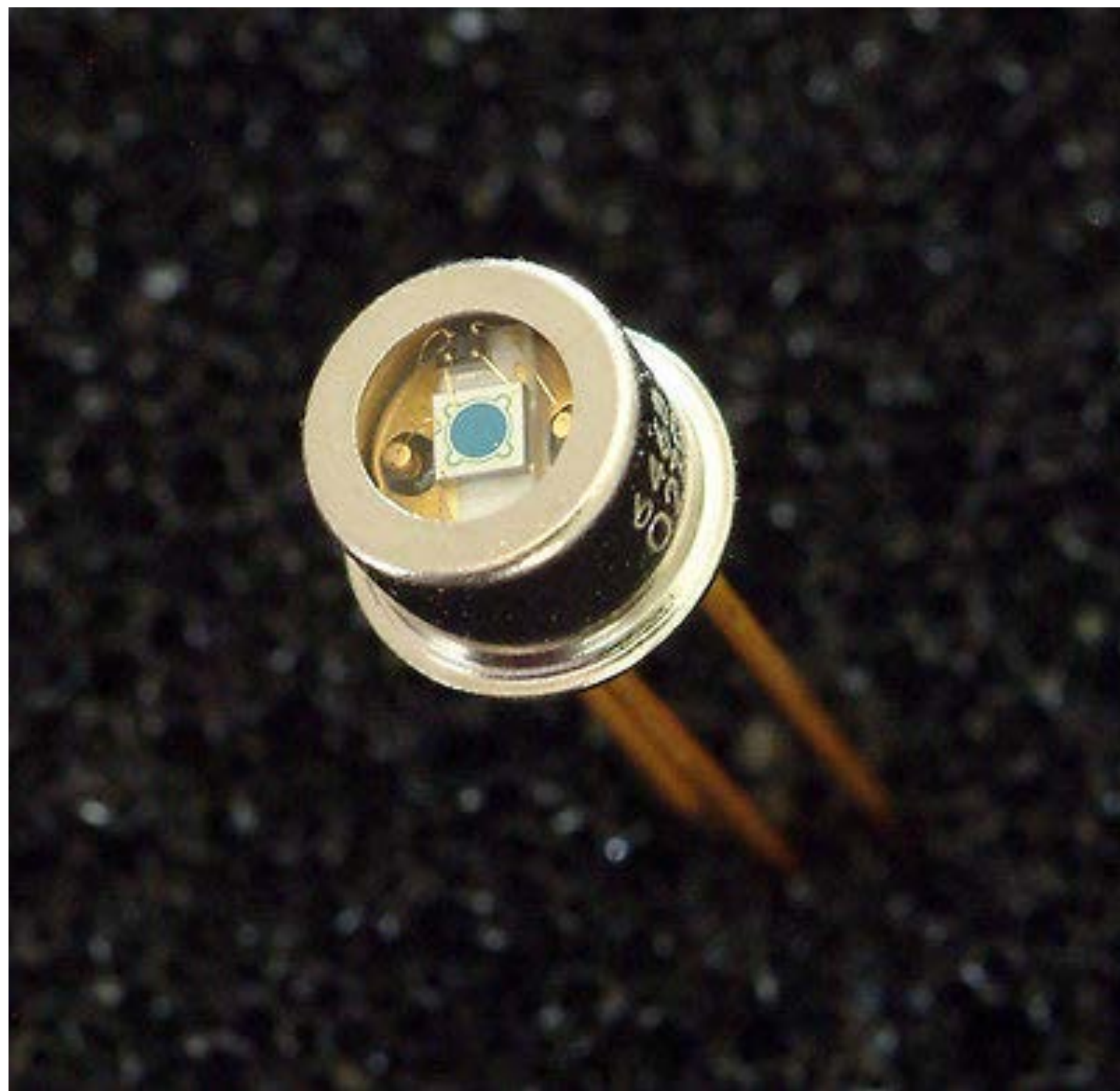
Instrumentation: Time Structure



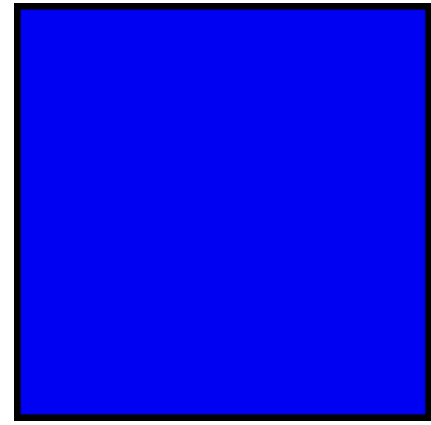




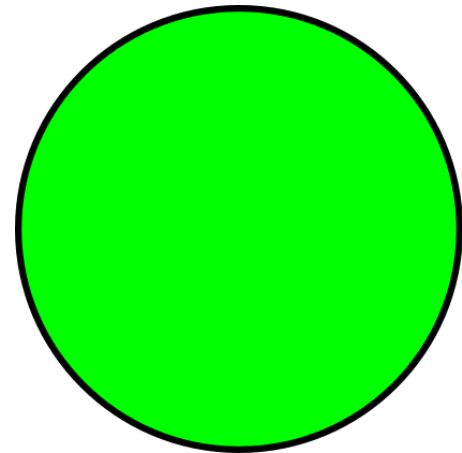
- Photodiode



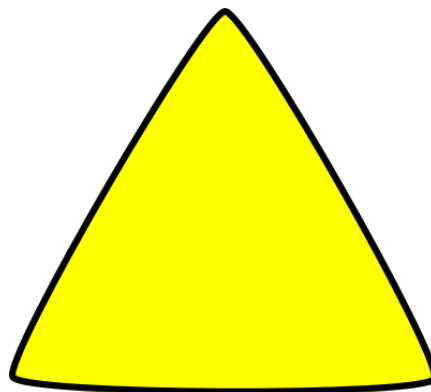
Who Brought Their Personal Photodiodes to the Lecture Today?



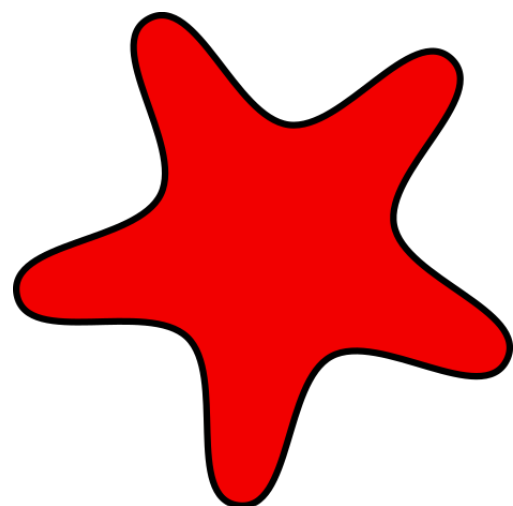
I brought my photodiode with me



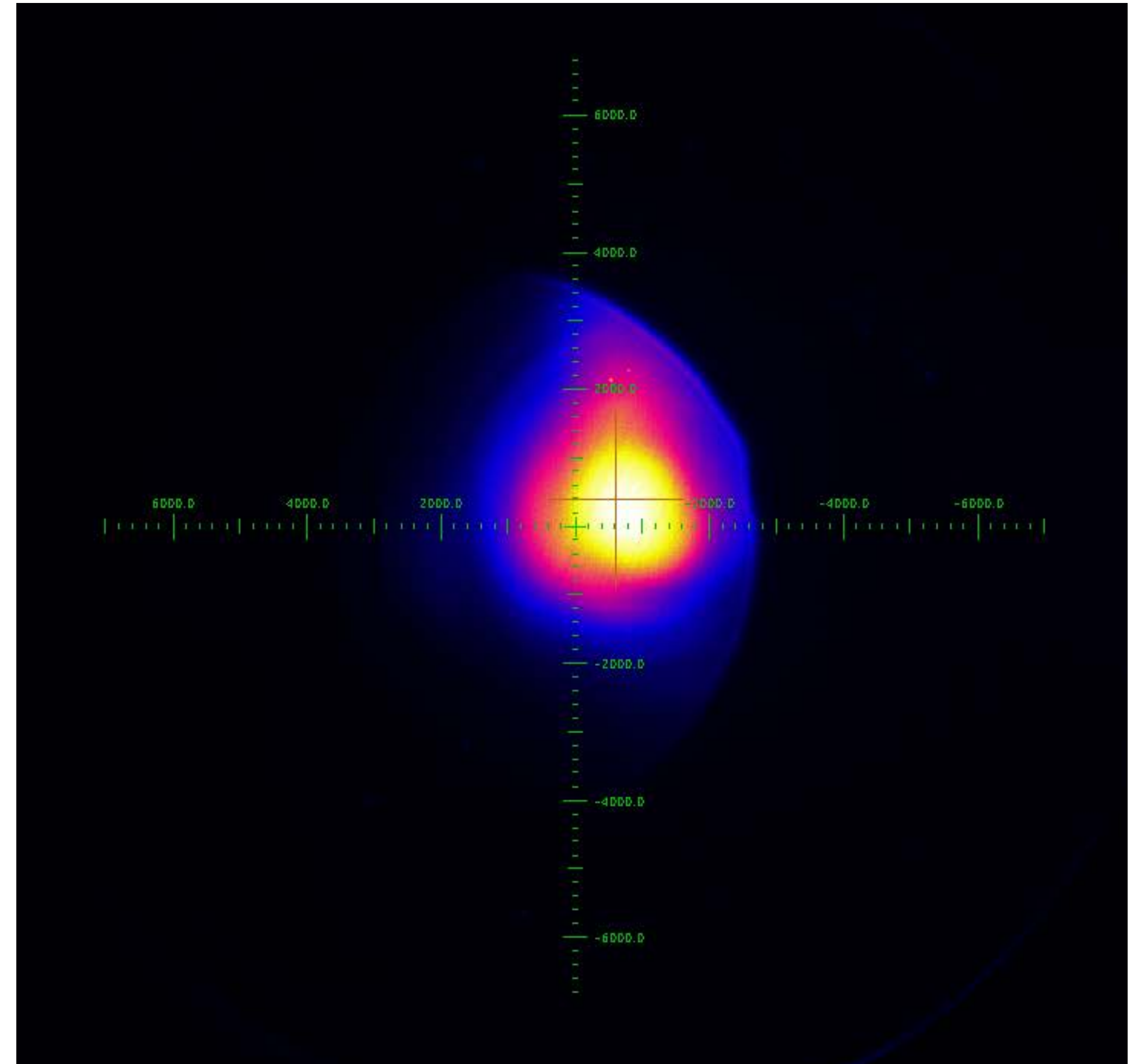
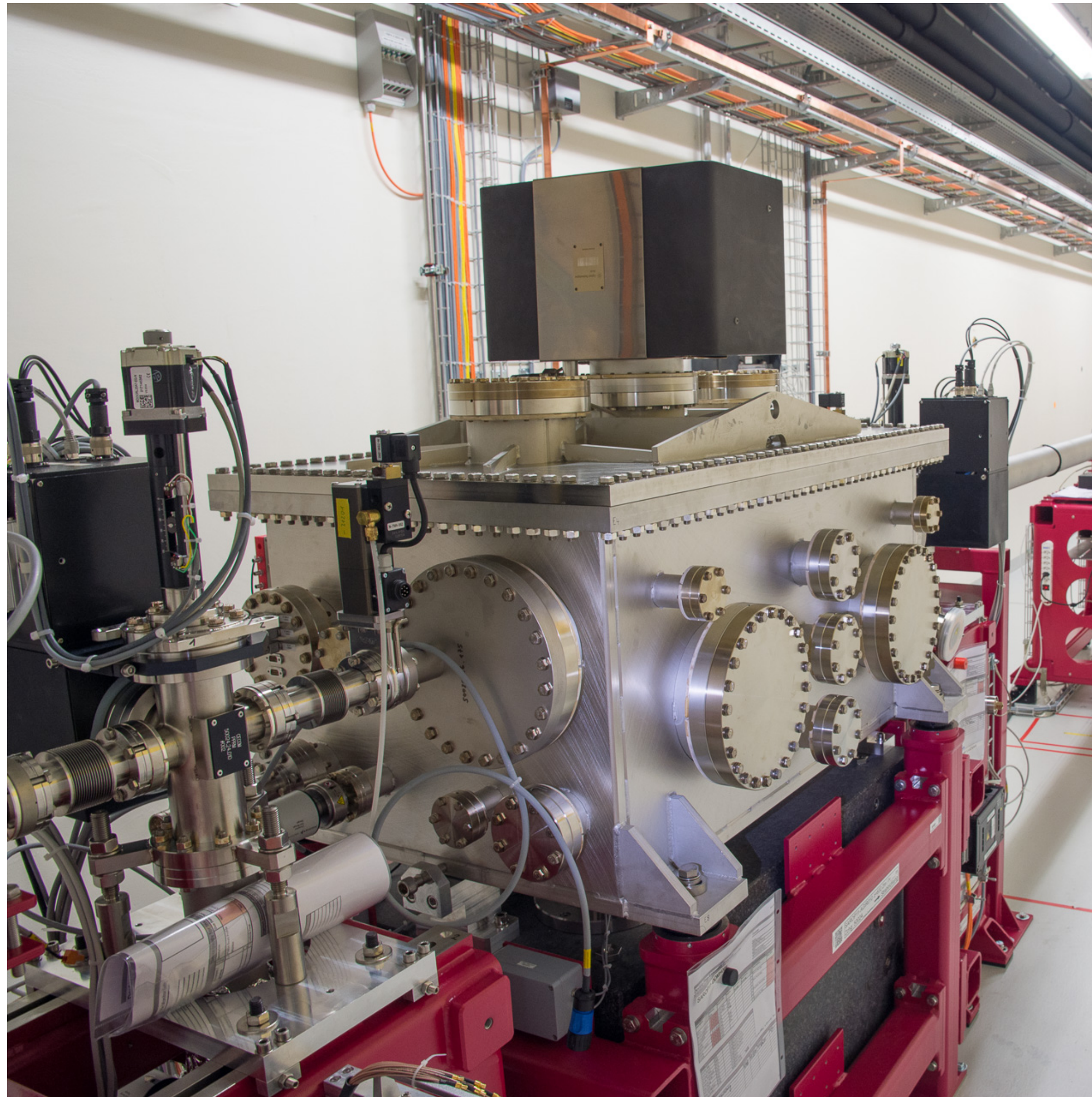
My neighbor brought her / his photodiode



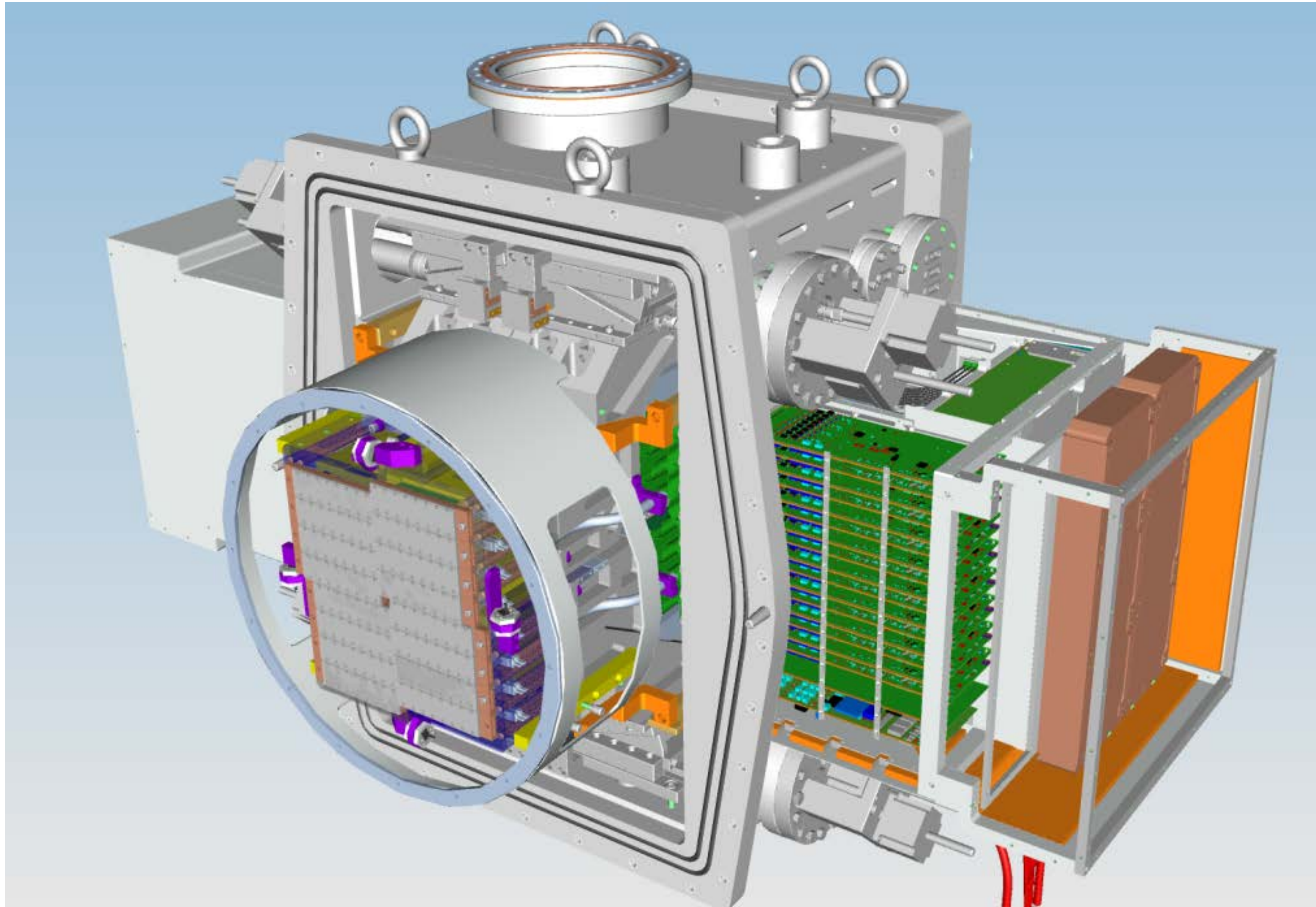
I own a photodiode, but I left it at home

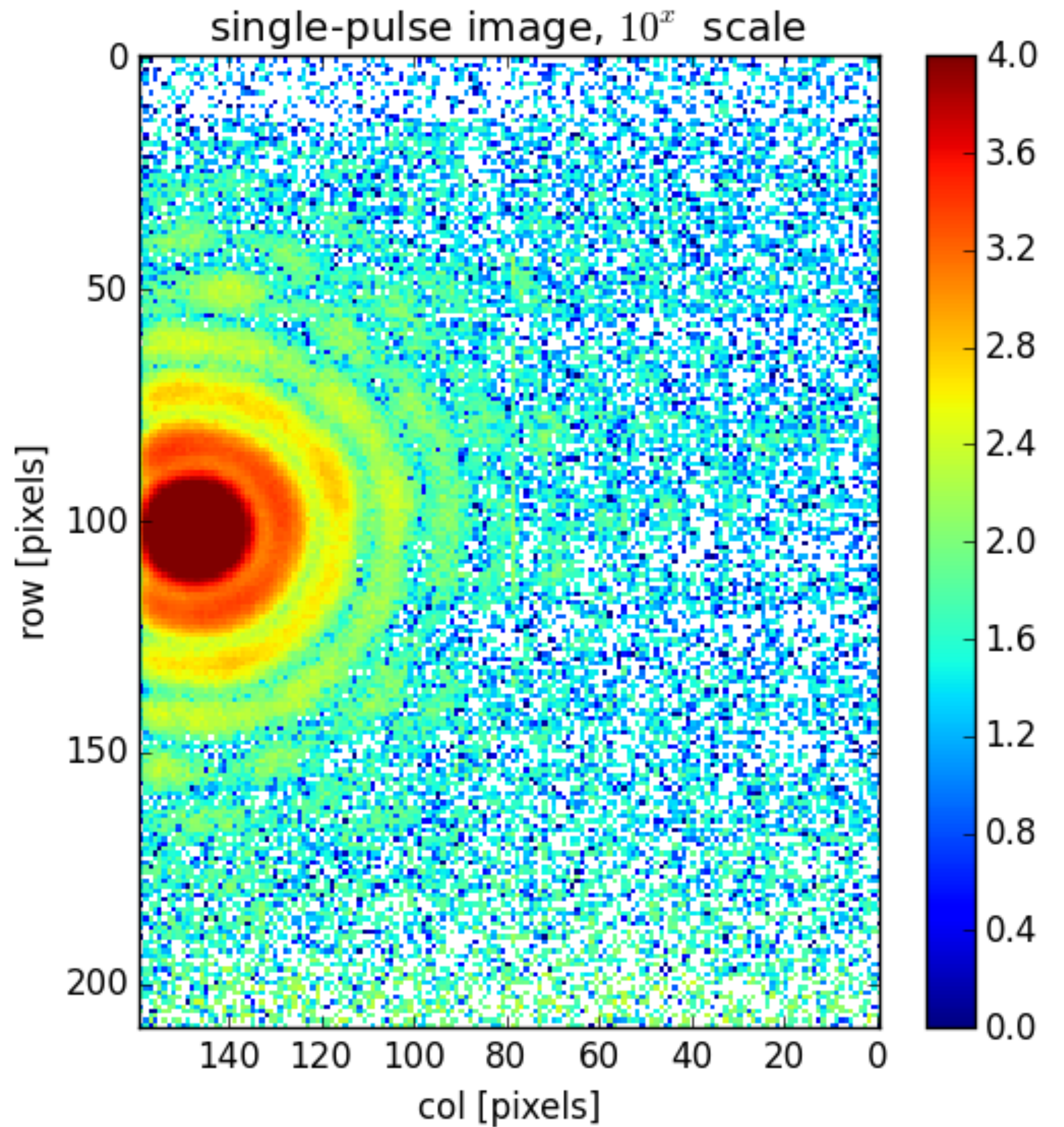
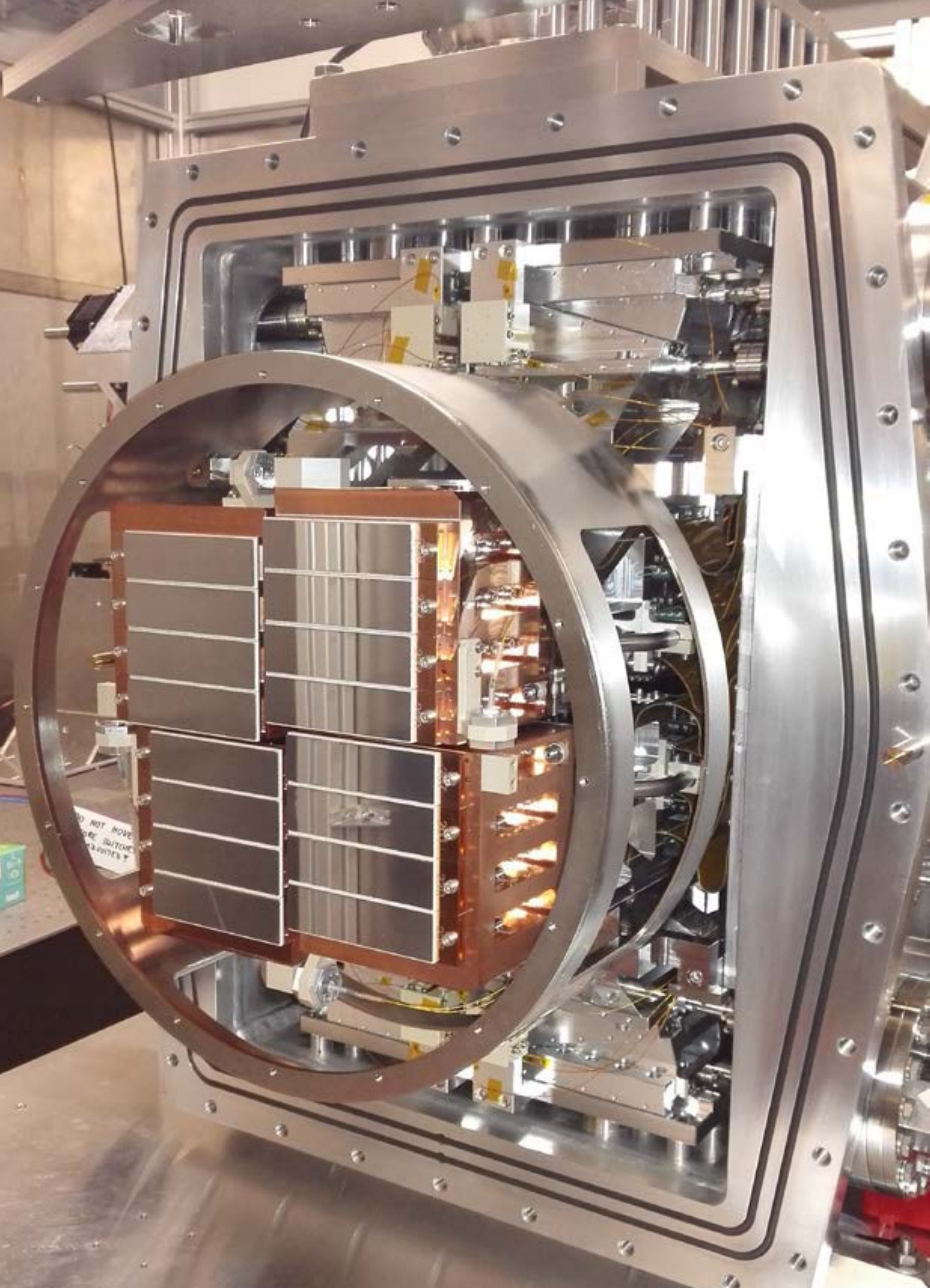


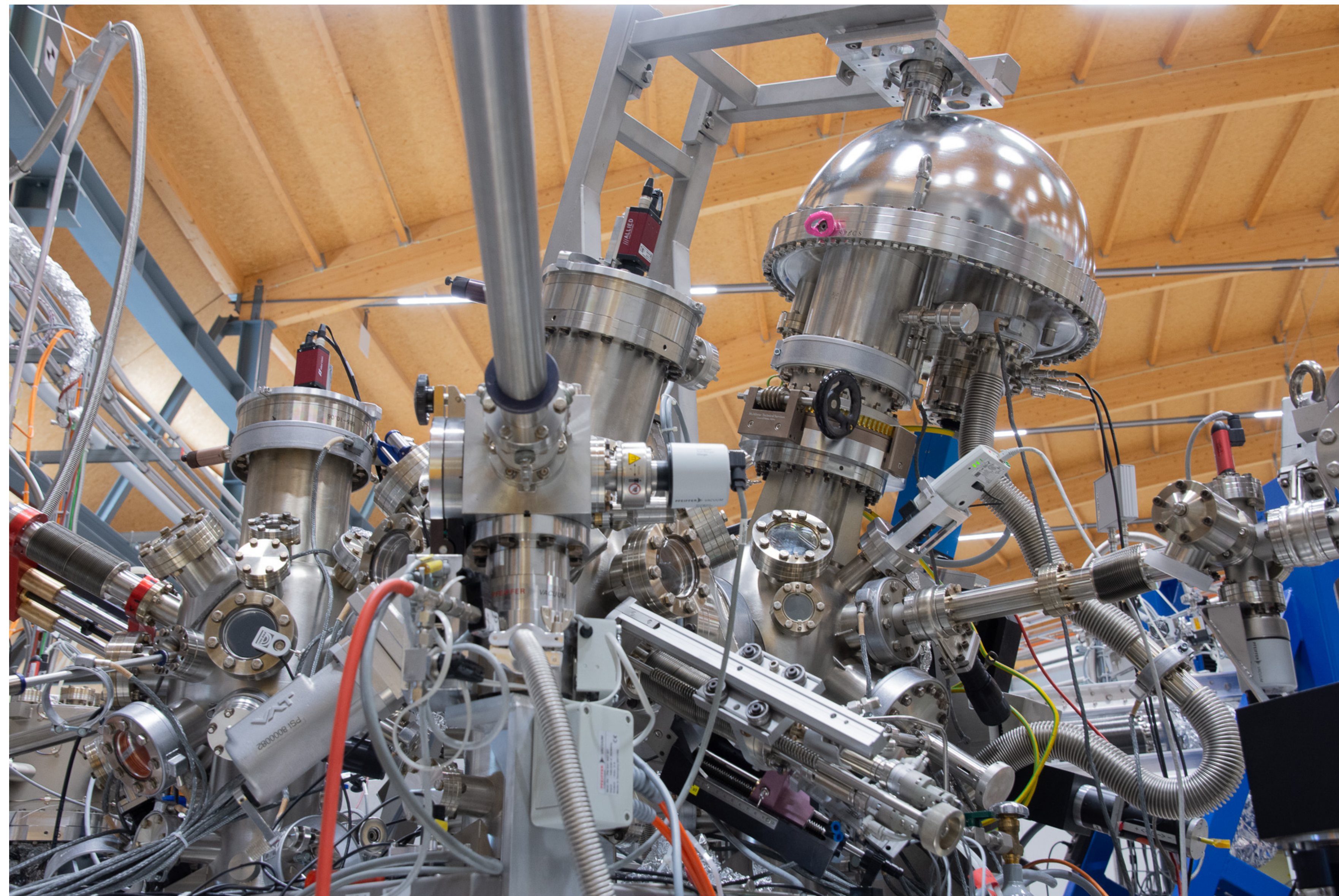
I brought millions of photodiodes











Questions?

