

# Swedish Materials Science Beamline (SMS) at PETRA III: In-line branch (P21.2).

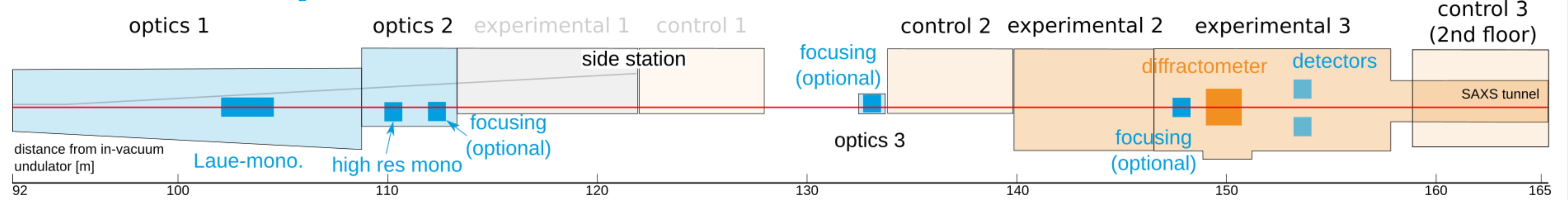


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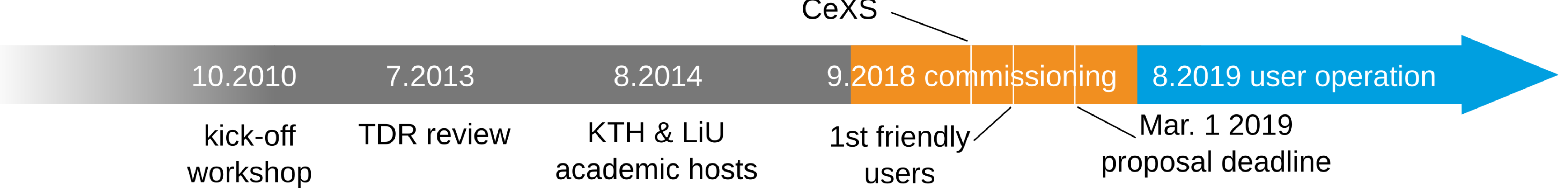
## ID card

- Energy range 40 – 150 keV
- *In situ* materials characterization
- Combination of WAXS (bulk & interfaces) with SAXS, imaging
- Optimized use of area detectors
- “zoom-in” data acquisition
- Beam size (h × v, FWHM): 5.7 μm × 0.24 μm – 6.0 mm × 3.6 mm
- Broad band diffraction side-station P21.1
- Funded by Swedish Research Council & administered by the Center for X-rays in Swedish Materials Science (CeXS)
- Privileged beamtime access for Swedish users (all DESY beamlines)

## Beamline layout



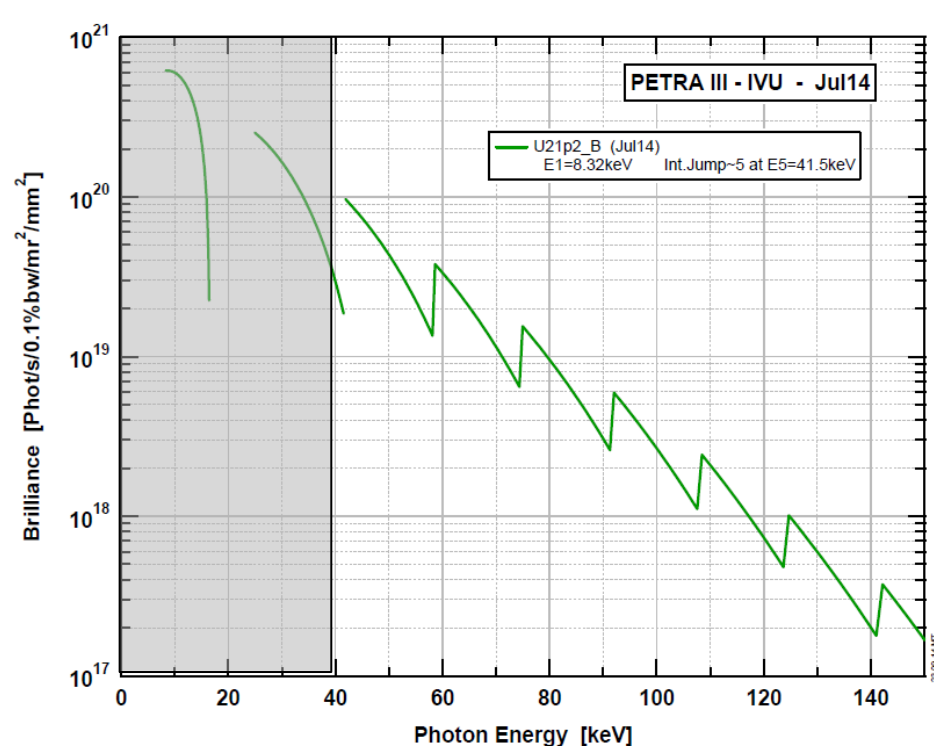
## Milestones



## Optics

### In-vacuum undulator (IVU)

- First in-vacuum undulator at PETRA III
- Minimum gap: 7.0 mm
- Period: 21.2 mm, length: 4 m
- $B_0 = 0.76$  T,  $K = 1.49$ ,  $E_1 = 7.8$  keV
- Total power: 5.2 kW



### Broad band monochromator

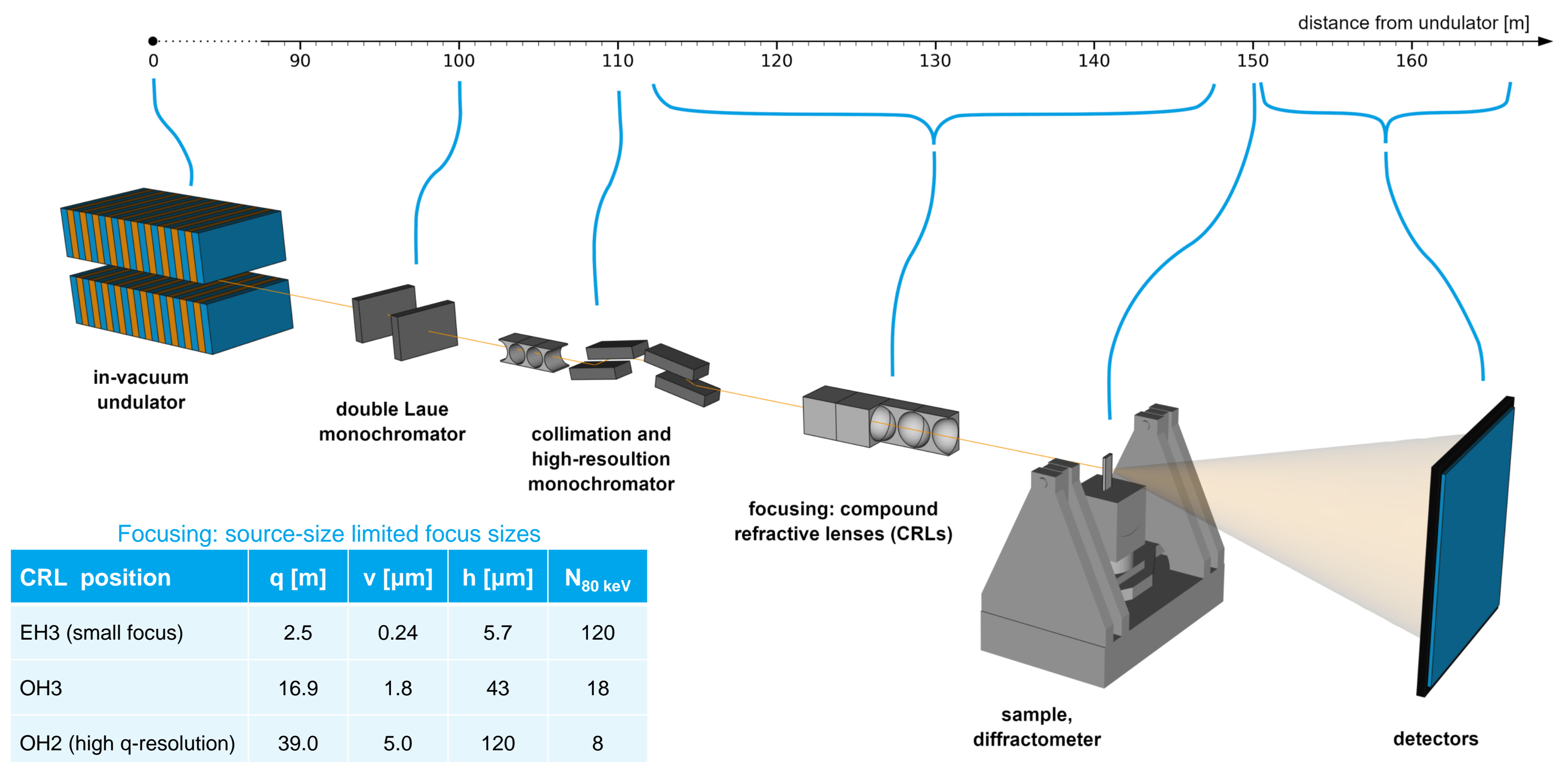
- Double bent Laue Si (111)
- Horizontal diffraction plane
- Rowland circle bending
- Cryogenic cooling
- Bandwidth 50 μrad:  $\Delta E/E = 0.1\%$  (0.2%) at 40 keV (80 keV)

### High resolution monochromator (optional)

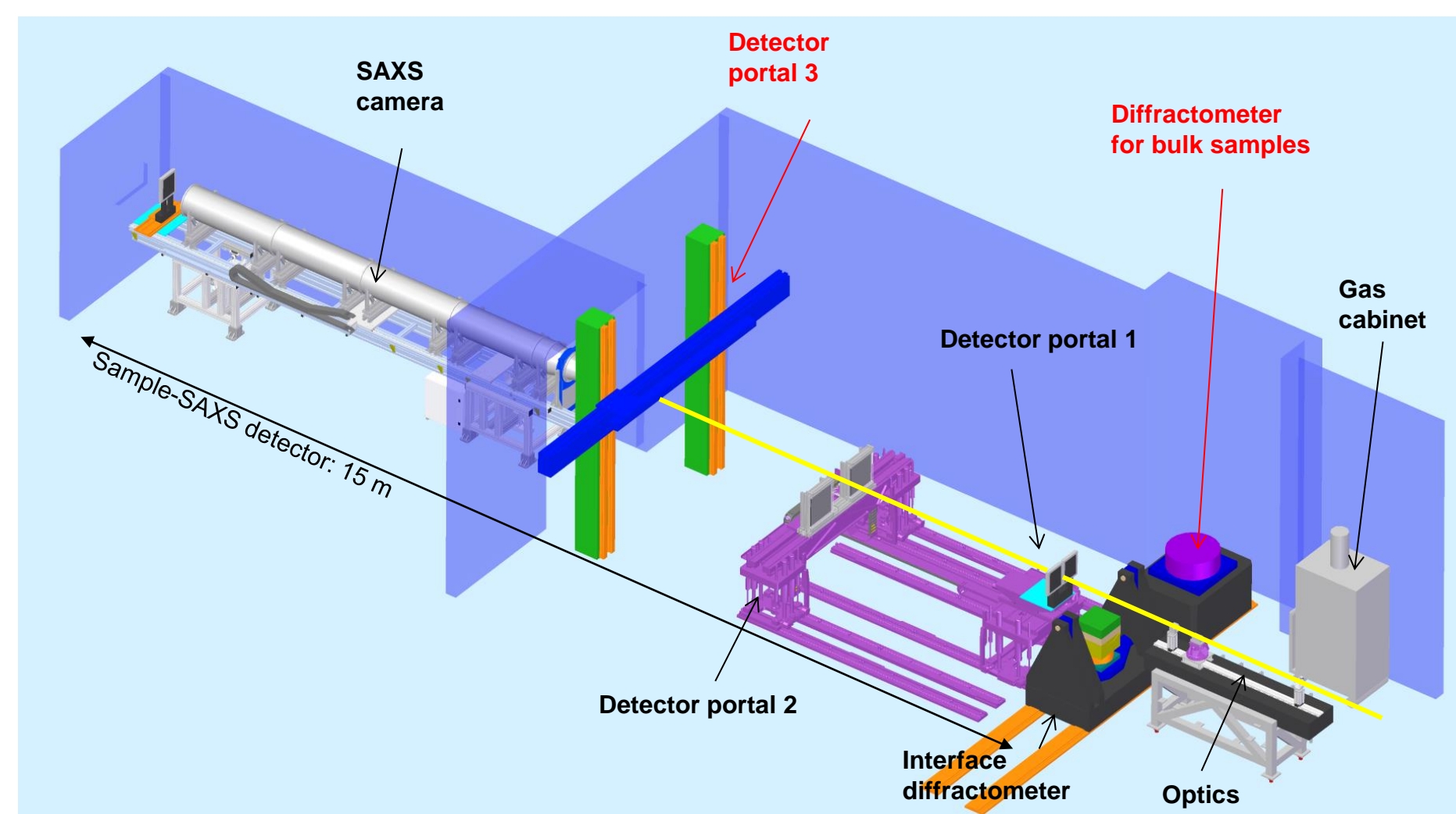
- Two Si (111) Bragg channel cuts
- Collimation with 1D Al CRLs
- Energy range: 40 – 100 keV
- Bandwidth:  $\Delta E/E = 0.01\%$

### Focusing

- Aluminum CRLs
- Different focusing positions to realize different focus sizes and q resolutions



## Diffraction & imaging station EH3



### Sample environments

- Compact load frame: uniaxial tension / compression, max. 5 kN
- Large load frame (2020)
- Induction furnace (2020): inert atmosphere / rotation / 1500 °C

### Detectors

#### Area detectors

- Two Varex XRD4343CT
- Dectris Pilatus X CdTe 2M (pool device, 25% time share)
- MAR165
- LuAG scintillator with Allied Vision Manta G-1536 or with pco.edge 5.5 (imaging detector)

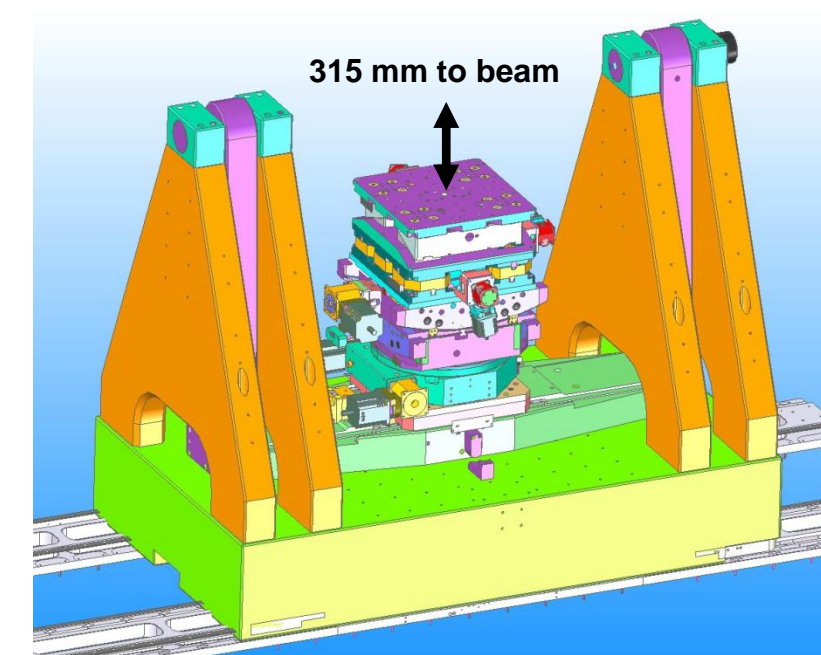
#### Point detectors:

- Amptek XR-100T-CdTe (fluorescence detector)
- FMB Oxford Cyberstar YAP scintillation detector

### Diffractometers

#### 6-axis interface diffractometer

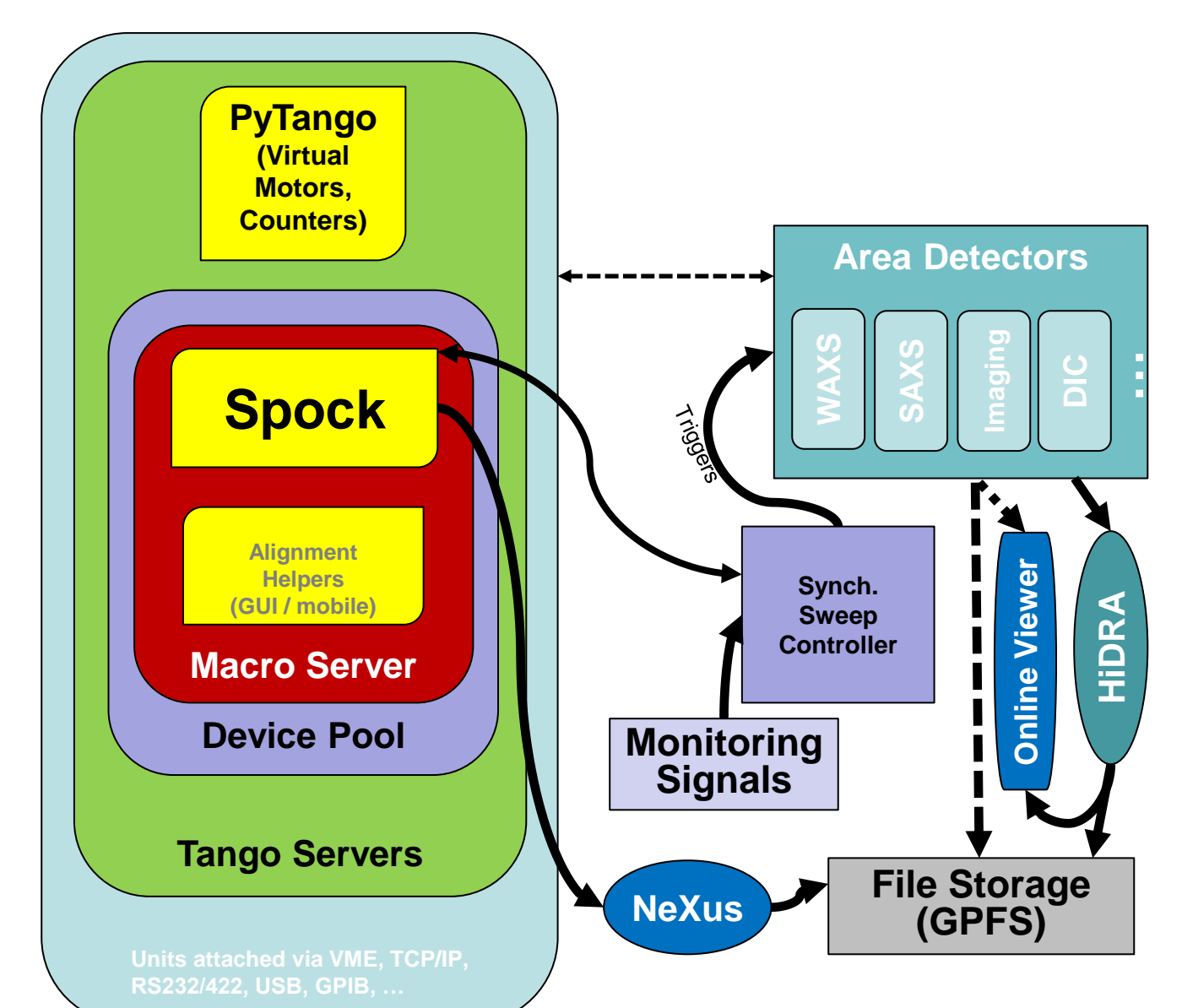
- Precise setting of incidence angle with rotation and translation stages
- Maximum load: 200 kg



#### Bulk diffractometer (2020)

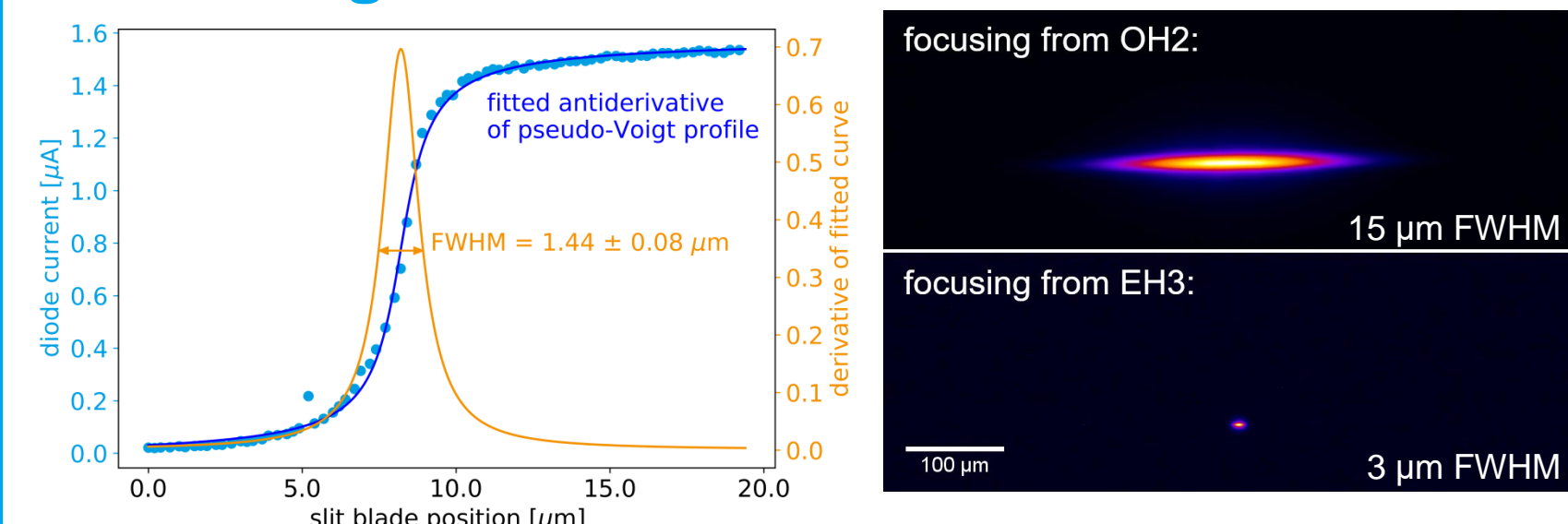
- Heavy load alignment table (500 kg)
- Precise & fast horizontal rotation stage combined with a hexapod

## Beamline control



## Commissioning results

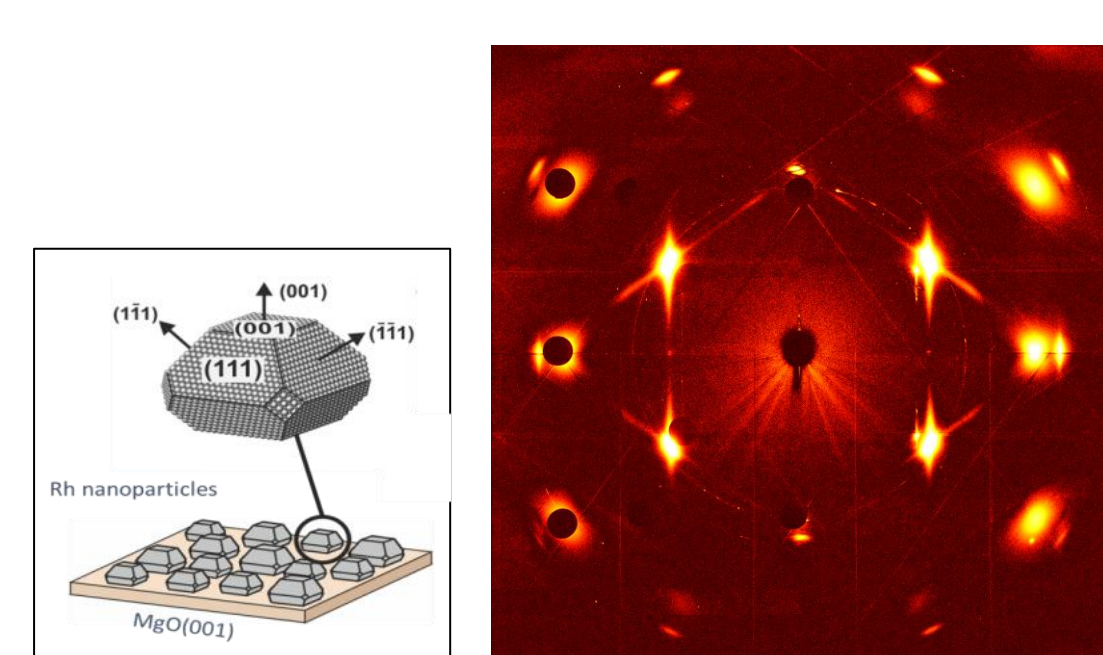
### Focusing



#### smallest measured focus: CRLs in EH3

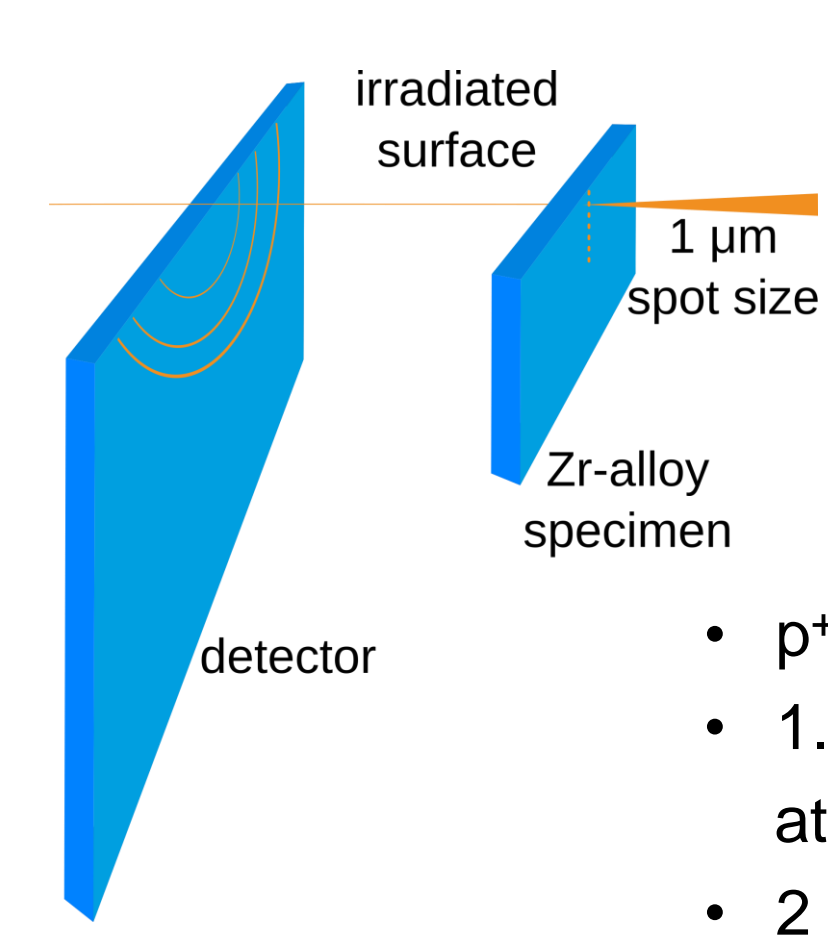
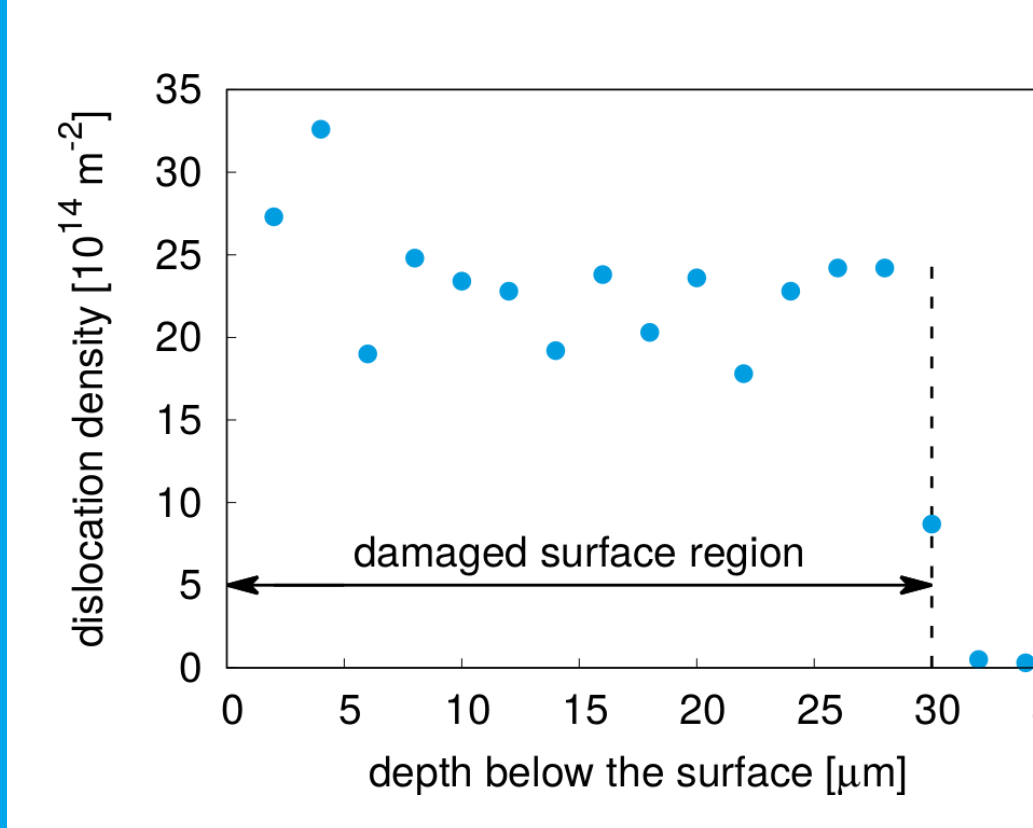
- knife edge scan: 1.4 μm FWHM
- X-ray eye: 3 μm FWHM (resolution limit)

### Surface diffraction



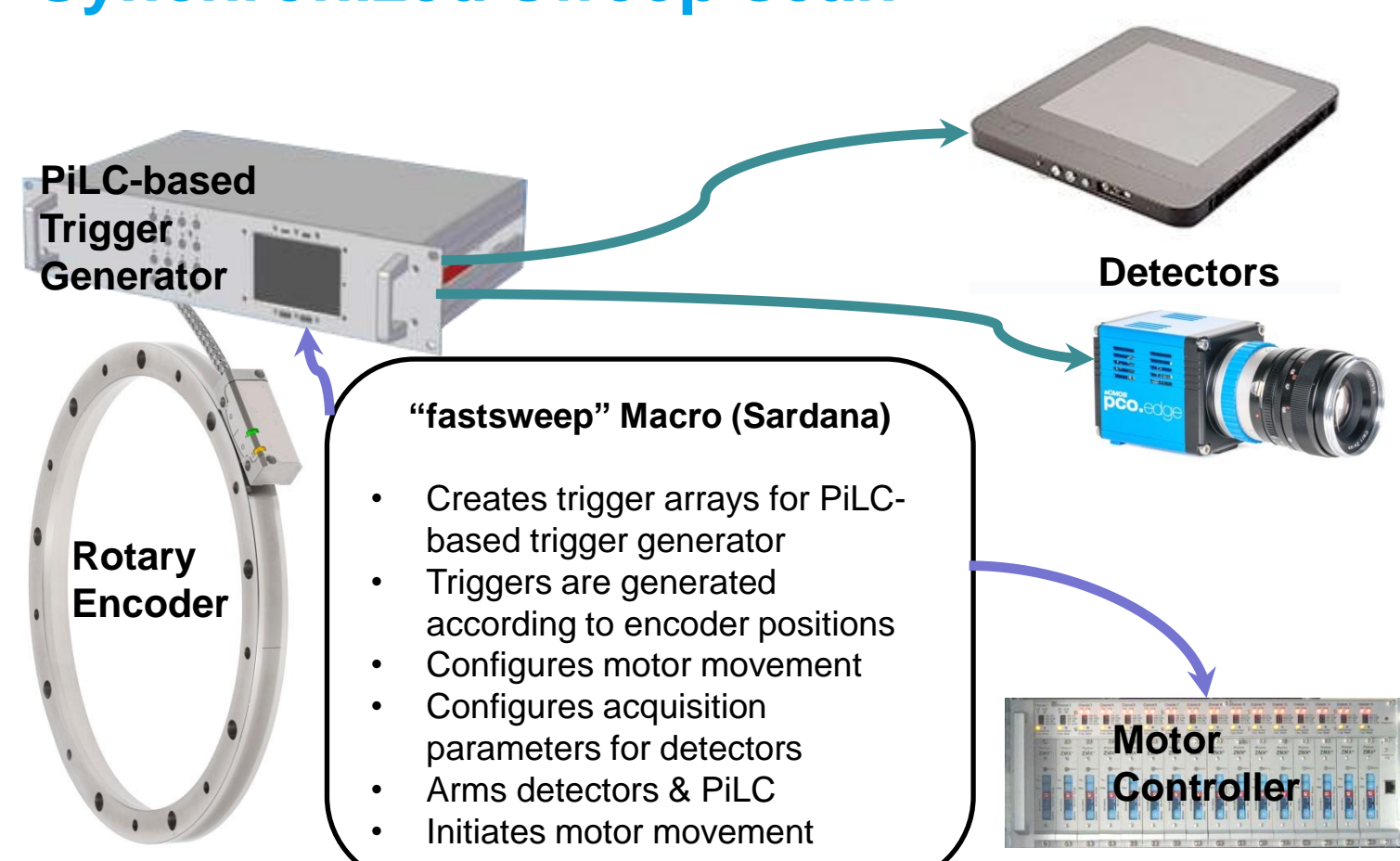
Nanoparticle facet signal: epitaxial Rh particles on MgO(001)

### Depth profiling

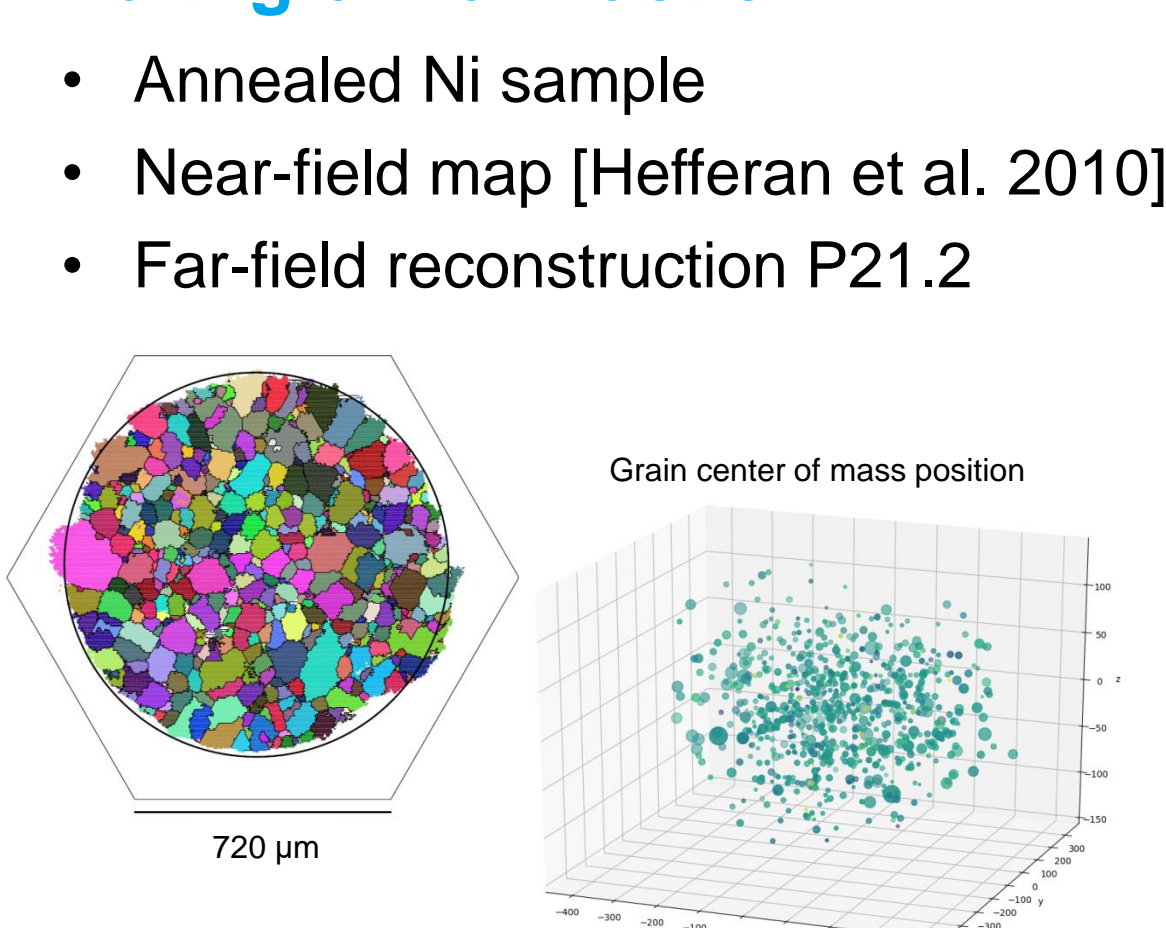


- p<sup>+</sup> irradiated Zr-alloy
- 1.4 μm vertical spot size at 67.5 keV
- 2 μm depth resolution

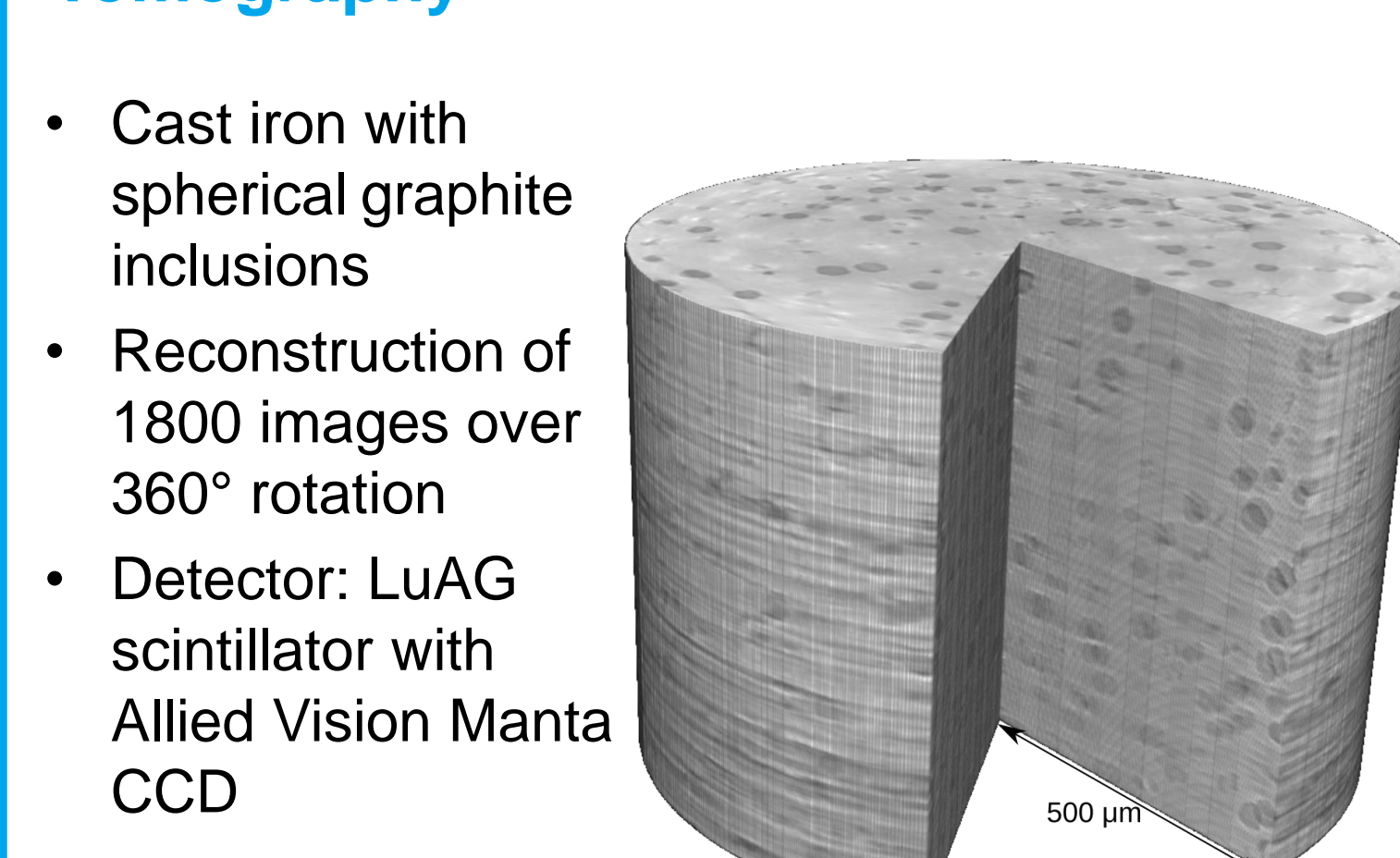
### Synchronized sweep scan



### Multi-grain diffraction



### Tomography



### Upcoming commissioning activities

- Small-angle X-ray scattering (SAXS)
- Source size limited focusing
- High resolution monochromator
- In situ experiments
- Completion of beamline instrumentation