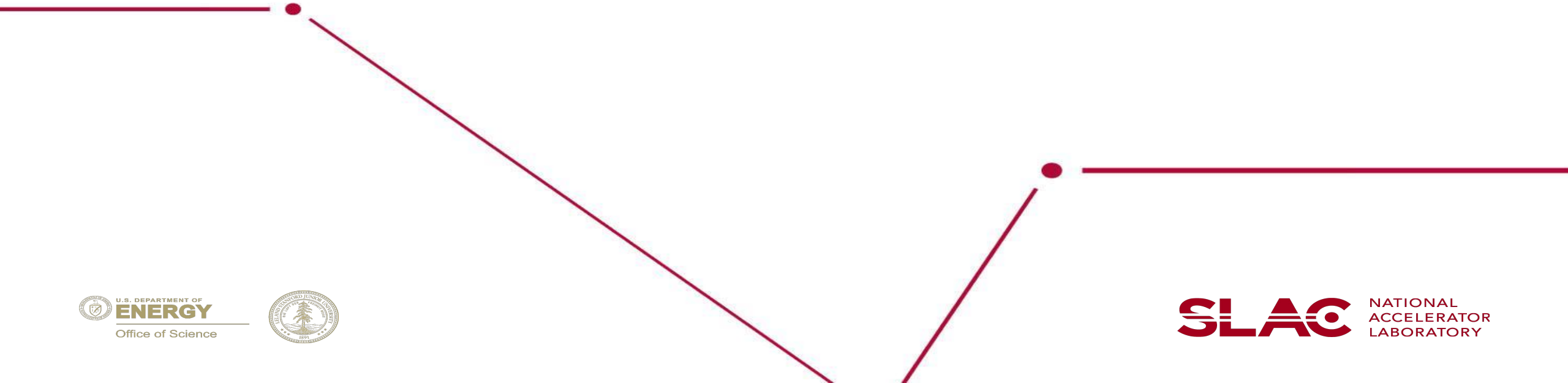
Materials Science Capabilities Breakout

March 3rd, 2022
LCLS Town Hall



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Materials Science Capabilities: qRIXS Update

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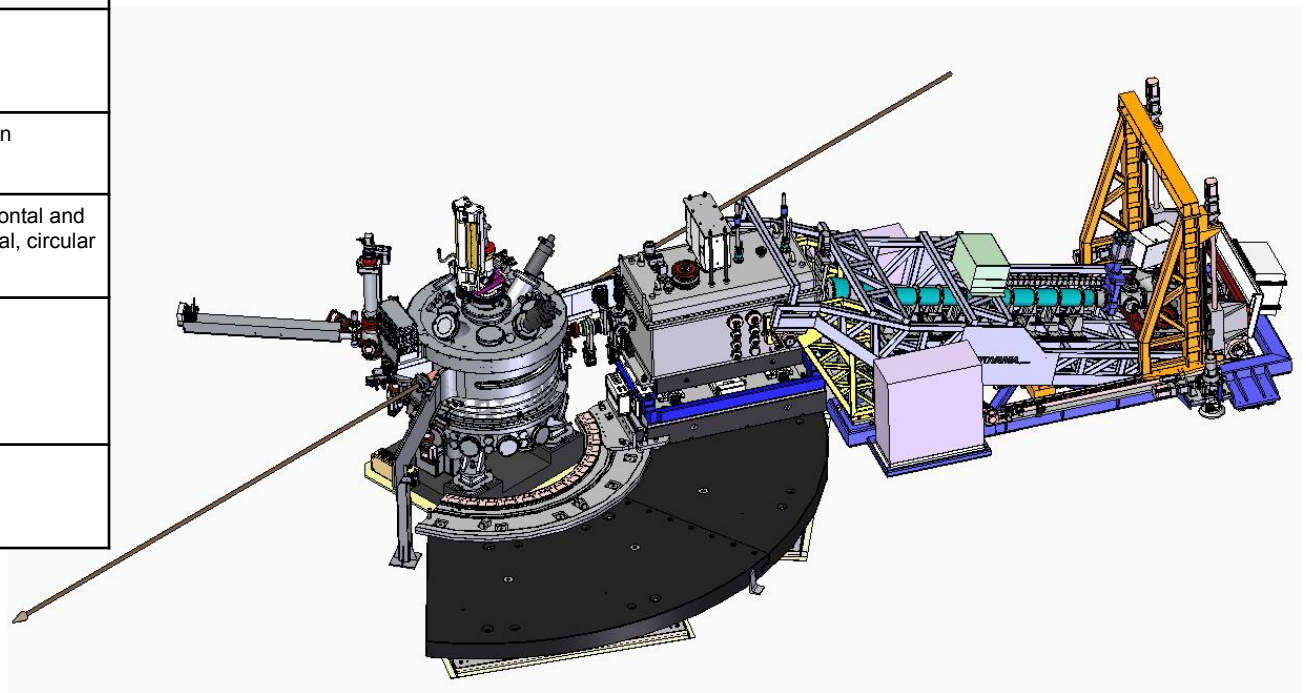
qRIXS Instrument: Sample Chamber + Spectrometer Arm

X-ray Parameters			Laser Parameters	
Repetition rate (kHz)	33		Repetition rate (kHz)	33
Energy Range (eV)	250 - 1100		Wavelength (nm)	800
Spot Size (um), H x V	10 x 10, min 1000 max		Pulse Duration (fs)	<40 @ 800 nm
Energy per pulse (nJ)	>10		Energy per pulse (μJ)	300
Pulse Duration (fs)	<200		Spot size (μm)	50 min
Beamline Resolving Power	>20,000		Polarization control	Horizontal and vertical, circular
Combined Spectrometer resolving power	10,000 @ 931 eV		Arrival time monitor precision (fs)	<20
Polarization	Linear horiz.			

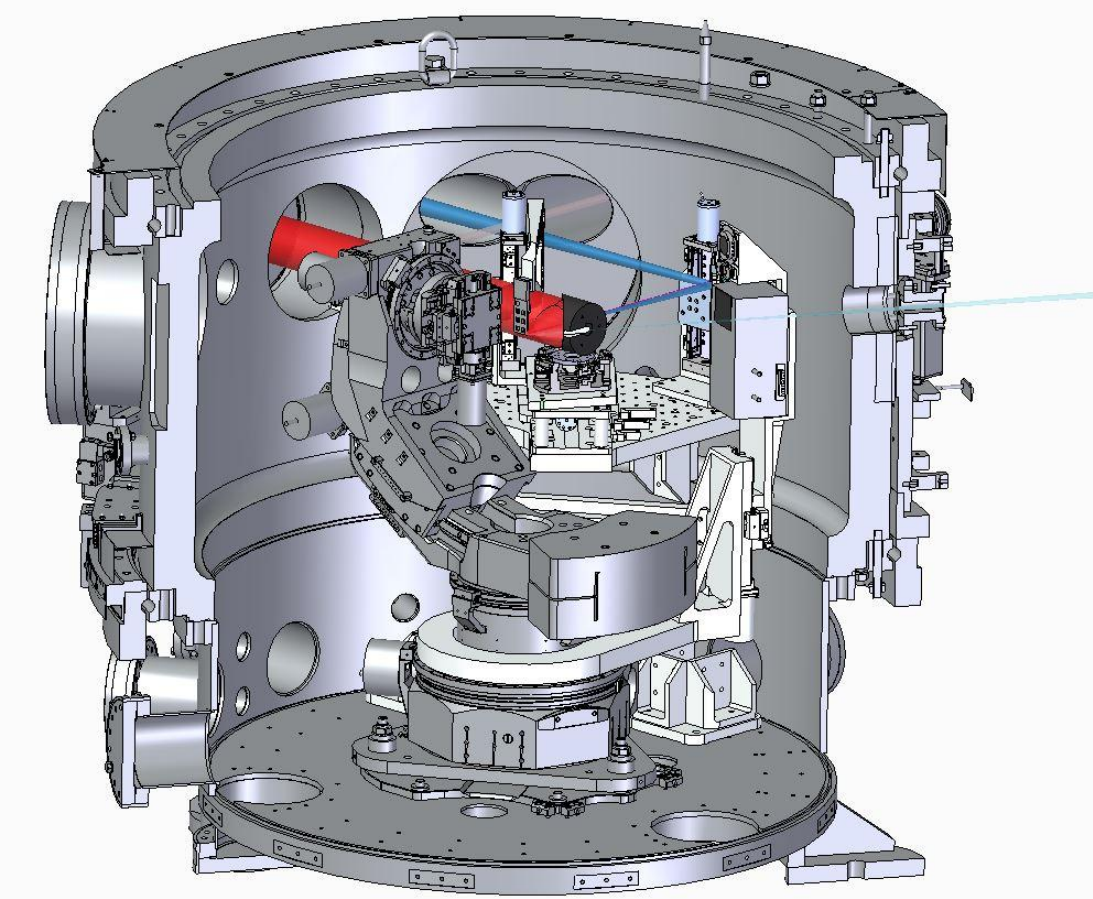
For more details:

https://lcls.slac.stanford.edu/instruments/neh-2-2/neh-2-2-Capabilities



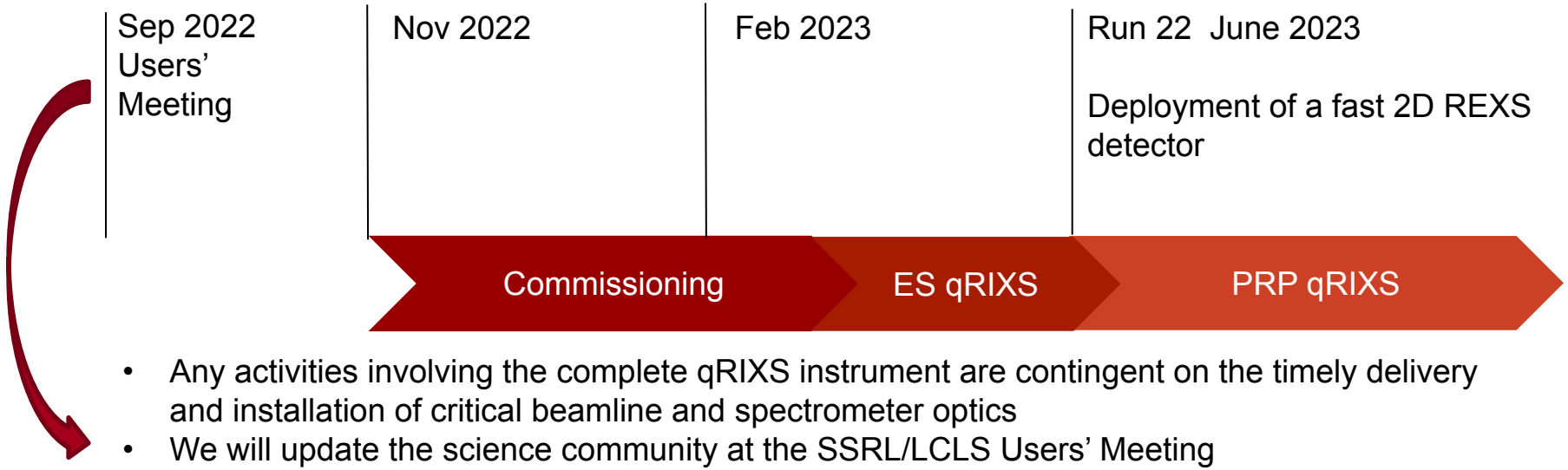
qRIXS Instrument: Sample Chamber capabilities

Techniques: XRD, REXS, XRR, XAS



- In-vacuum diffractometer, 6 degrees of freedom
- Bulk samples and thin films on substrates
- Load-lock chamber
- Sample cooling, ~ 25 K
- Diagnostic paddle for calibration targets, spatio-temporal overlap, etc.
- Laser in- and out- coupling
- Avalanche photodiode detectors for x-ray absorption and diffraction
- Arrival time monitor
- Lasers: 800 nm
- Overall temporal resolution: ~60 fs

qRIXS Instrument: Notional timeline



- Any activities involving the complete qRIXS instrument are contingent on the timely delivery and installation of critical beamline and spectrometer optics
- We will update the science community at the SSRL/LCLS Users' Meeting
- If optics are significantly delayed, we will prioritize low energy resolution experiments in the qRIXS Sample Chamber.

Users involvement in Early Science, 1 to 2-page summary:

- What is the science case?
- Why is LCLS needed?
- Crucial performance parameters:

X-ray energy, scanning
Optical wavelength, timing
Detectors, diagnostics, sample, etc.

- Signal levels?
- Who needs to participate and what can they contribute?
- Is there theoretical support, what would make the experiment a "success"?

Materials Science Capabilities: XCS Update

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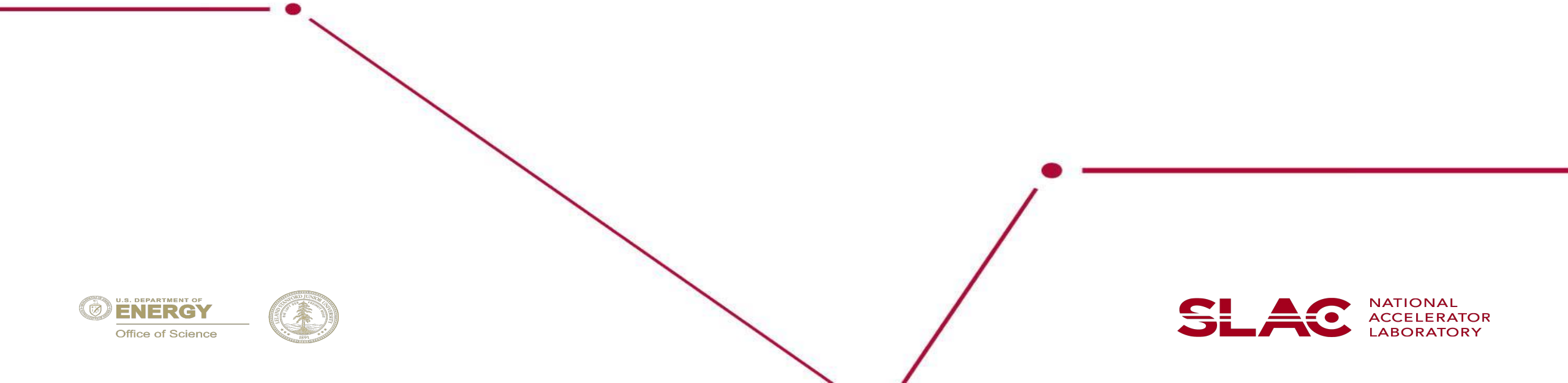

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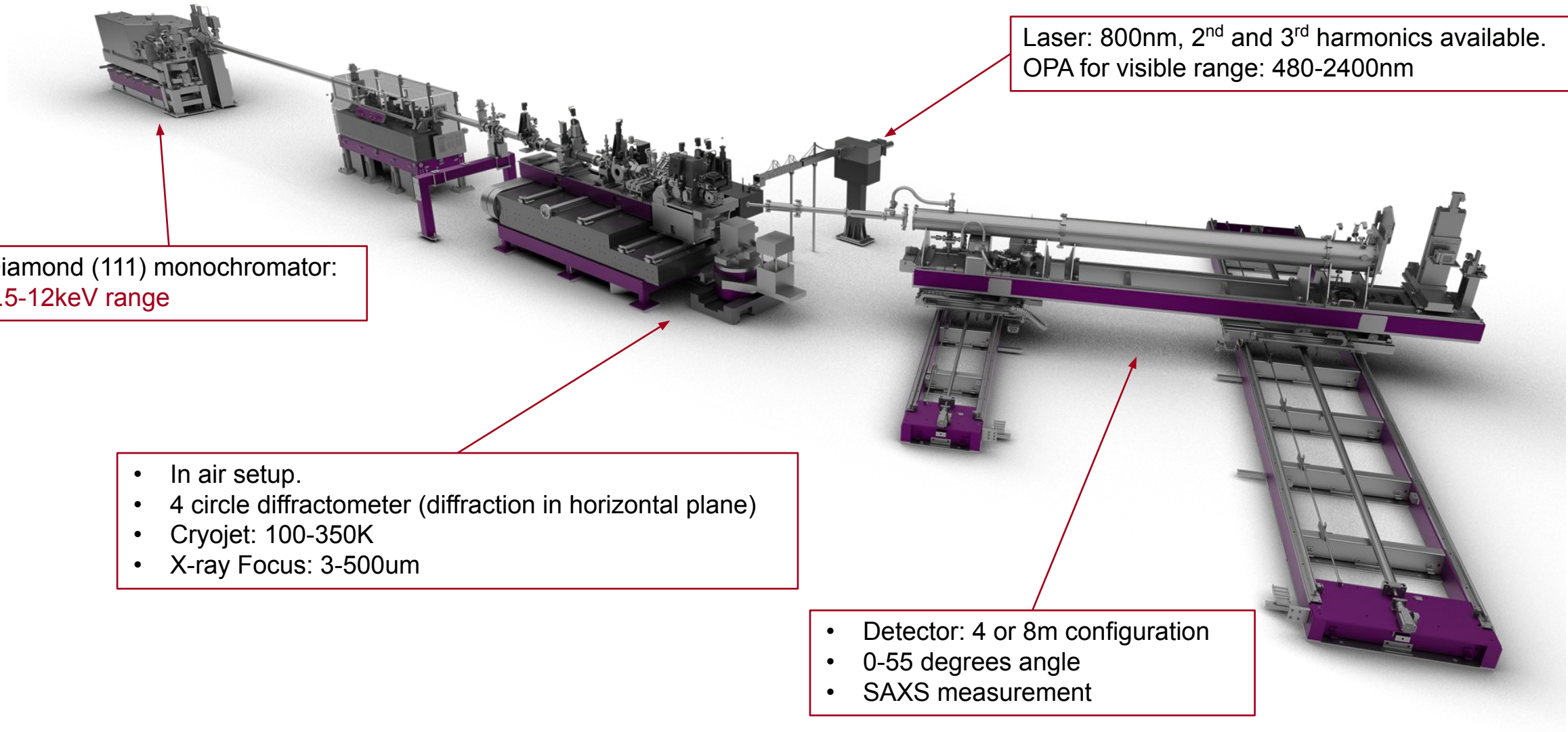
Time-resolved hard X-ray coherent scattering and small angle scattering on condensed matter systems in air.



Laser: 800nm, 2nd and 3rd harmonics available.
OPA for visible range: 480-2400nm

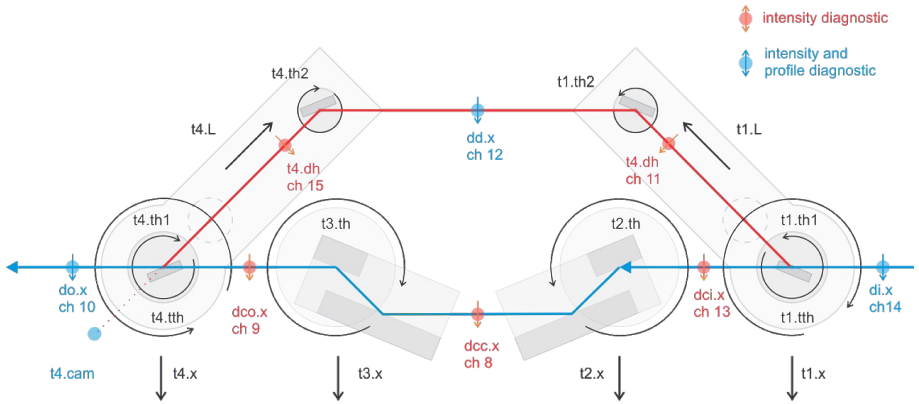
Diamond (111) monochromator:
7.5-12keV range

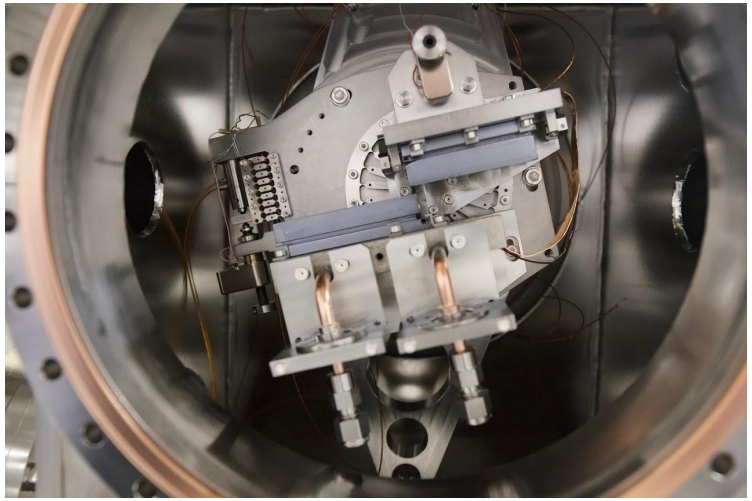
- In air setup.
- 4 circle diffractometer (diffraction in horizontal plane)
- Cryojet: 100-350K
- X-ray Focus: 3-500um

- Detector: 4 or 8m configuration
- 0-55 degrees angle
- SAXS measurement

Other capabilities:

- Split & Delay for XPCS: Wavefront splitting design. Energy range 6.5 to 13keV with a delay range from -50ps to 550ps.
- Up to 25keV X-ray
- Scannable Channel Cut Monochromator (CCM): Si(111) crystals. Energy range 7-25keV for XAS
- X-ray Pulse picker for single shot or non 120Hz operations.





Detectors:

- Epix10k and epix10k-2m: 135k pixels and 2M pixels with100um pixel size
- Epix100: 50um pixel size
- Jungfrau 0.5M and 1M: 75um pixel size