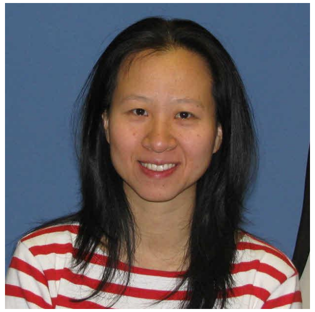
LCLS Run 23 Users Town Hall

January 30th 2024

SLAC NATIONAL ACCELERATOR LABORATORY

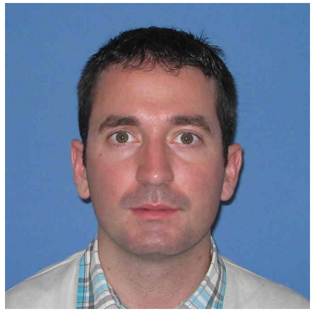
Stanford University | U.S. DEPARTMENT OF ENERGY

CXI – In Vacuum, Forward Scattering, High Power Density



Meng Liang

Matt Hayes
Area Manager



Serge Guillet
Engineer

Divya Thanasekaran
Controls

Joe Robinson
Laser

Kirk Larsen
Laser

Raymond Sierra
Sample Delivery

Gas Phase Photochemistry

Xinxin Cheng

Mike Minitti

Non-linear X-ray Science Nanofocus

Andy Aquila

Serial Femtosecond Crystallography

Sandra Mous

Mark Hunter

Short Proposal Program

Sample Testing Program (STP)

- STP, formerly PCS, best mechanism for new users
- Exploring decoupling the short proposal program from the full proposal call

Data Set Collection (DSC)

- Primarily for finishing data collection or testing on mature projects
- 1-2 shifts max allows for short proposals and faster turn around

Rapid Access

- Started in response to the COVID Pandemic
- Sample must be available within 3 weeks

- Short Proposal Program is expanding to include more science areas.
  - A submission form for each science area that will be more accessible for new Users to fill out

Serial Femtosecond Crystallography

LCLS

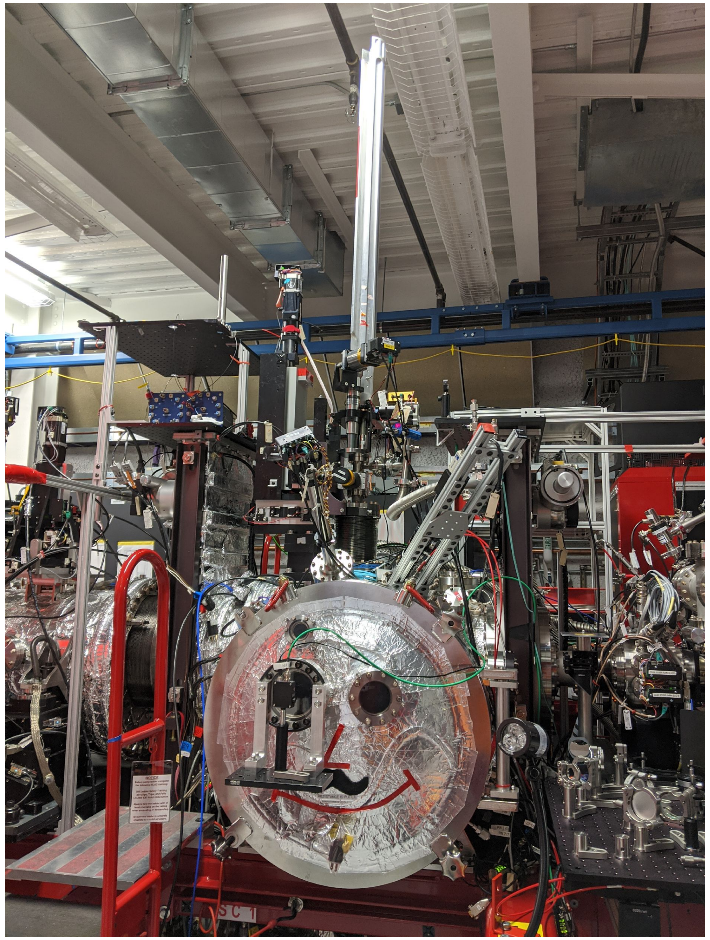
[CXI - Coherent X-ray Imaging | Linac Coherent Light Source (stanford.edu)]

- Liquid jet – GDVN, high viscosity, MESH, mixing injectors

- Fixed target scanning – nano and microfocus

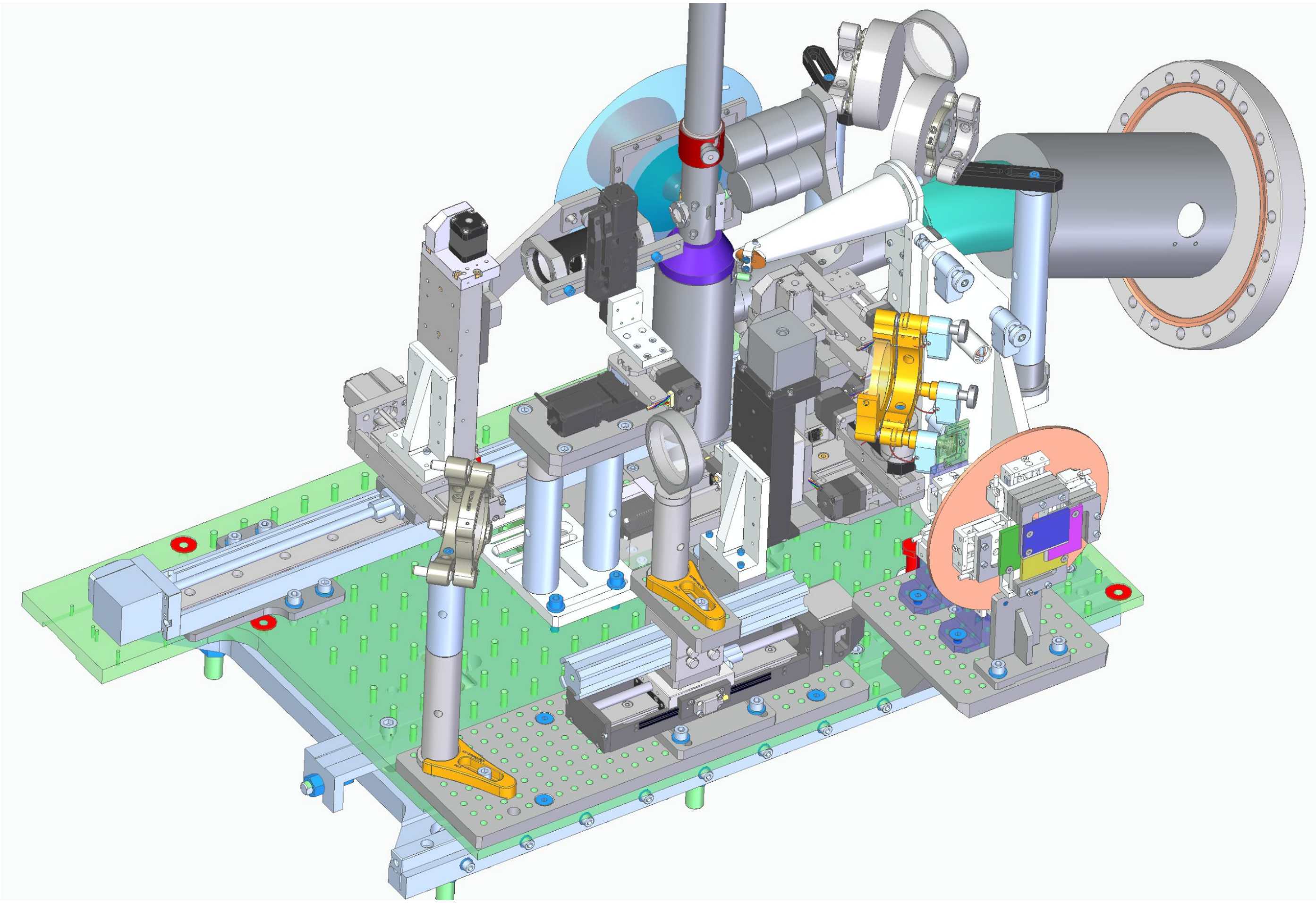
- Photon energy
- 7keV-10.5keV (1 µm or 100nm focal spot) – KB mirrors (reflective optics)
- 10.5keV-20keV (2-3µm – 50µm focal spot) – CRL (in line optics)

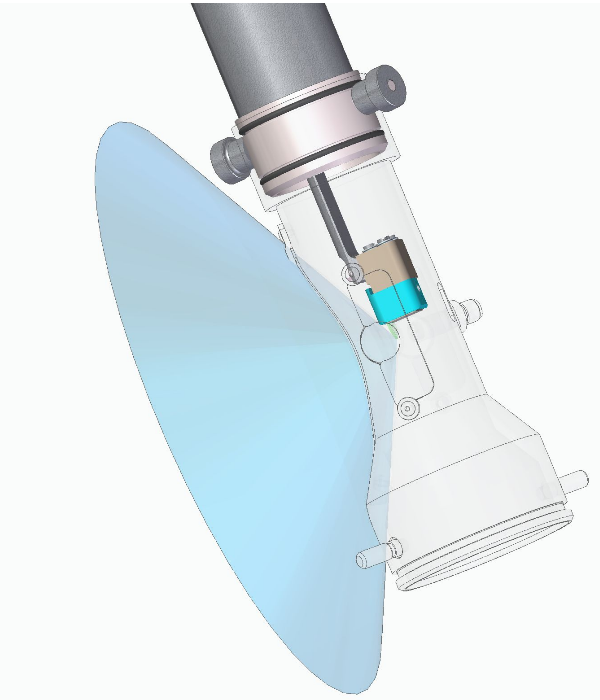
- 0.75A resolution with 18keV (previously used)
- In-vacuum background gives excellent signal to noise beyond the solvent ring
- Caveat: Quantum Efficiency of the Jungfrau drops to ~30% in the 20keV range

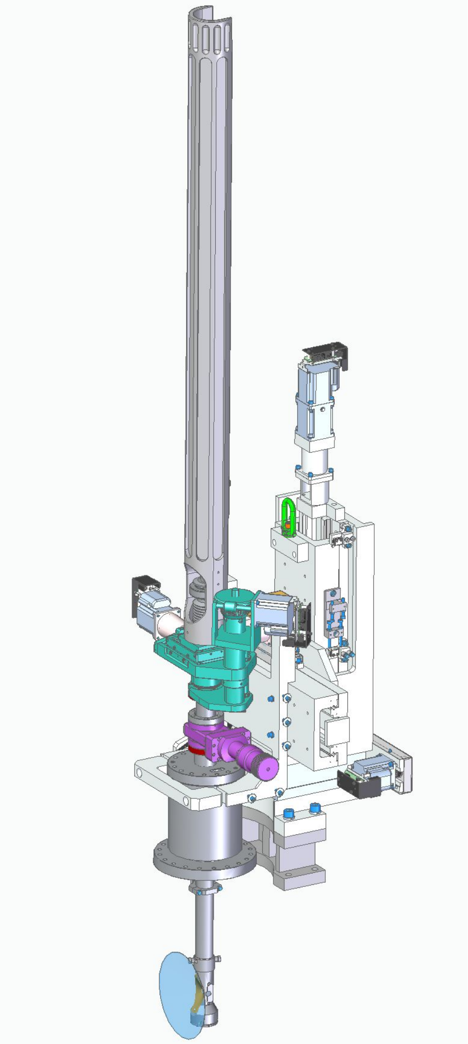


SFX liquid injector standard configuration

- Standard Configuration – liquid jet with option of laser excitation in the micron focus chamber

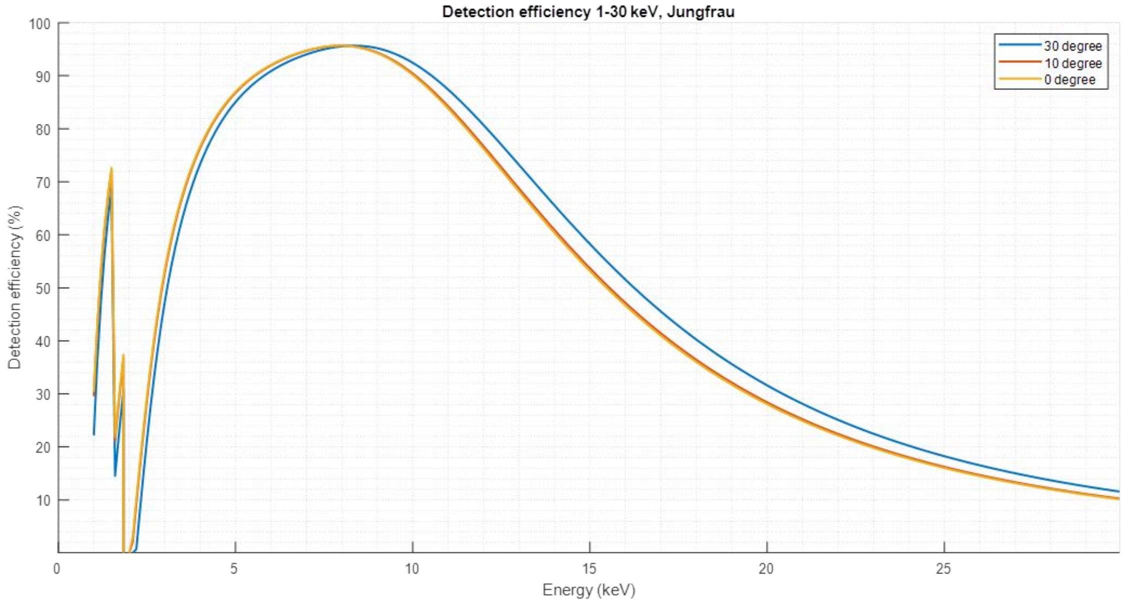






Serial Femtosecond Crystallography

- Detector – 4M Jungfrau detector
  [Jungfrau | Linac Coherent Light Source (stanford.edu)]
  - Adaptive gain
  - Dynamic Range – up to 10k 12keV photons/pulse/pixel
- in-line X-ray spectrometer available as needed
- Downstream SAXS detector (CSPAD) as needed for simultaneous SAXS/WAXS



Gas Phase Photochemistry at CXI

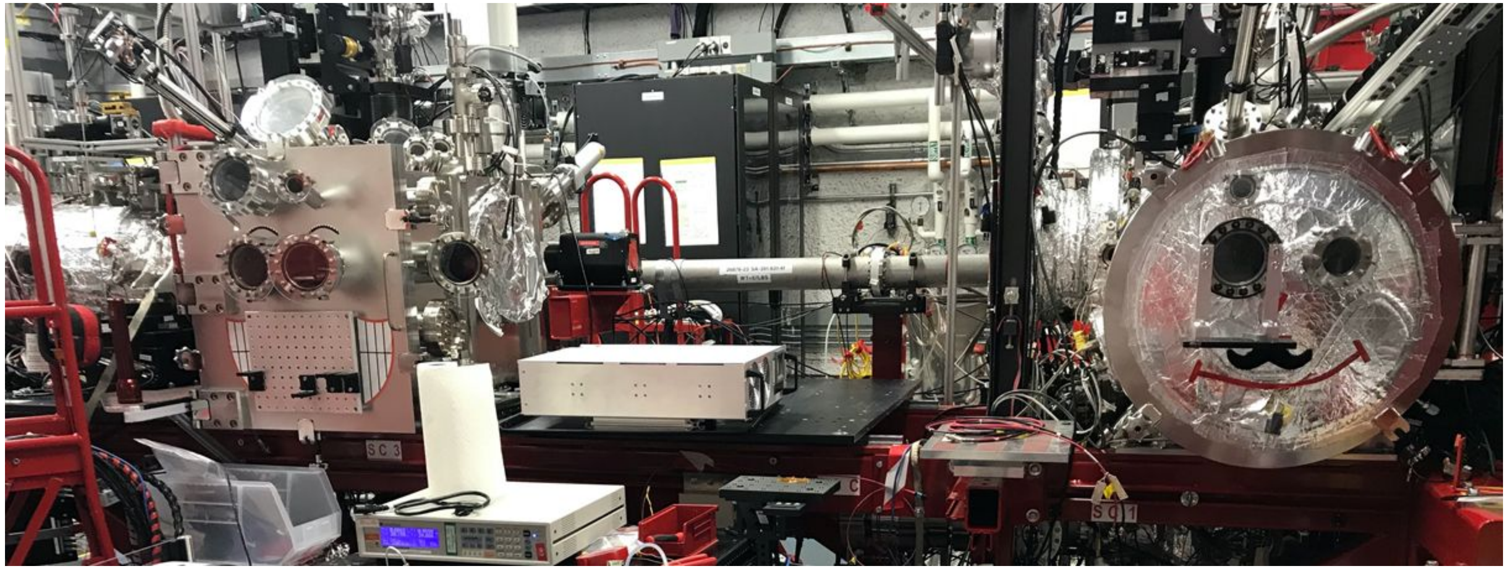
[CXI - Coherent X-ray Imaging | Linac Coherent Light Source (stanford.edu)]

Primary considerations:

- Low background scatter – Vacuum environment at hard X-ray energies with numerous slits for a clean focal spot
- Short Pulse UV capabilities

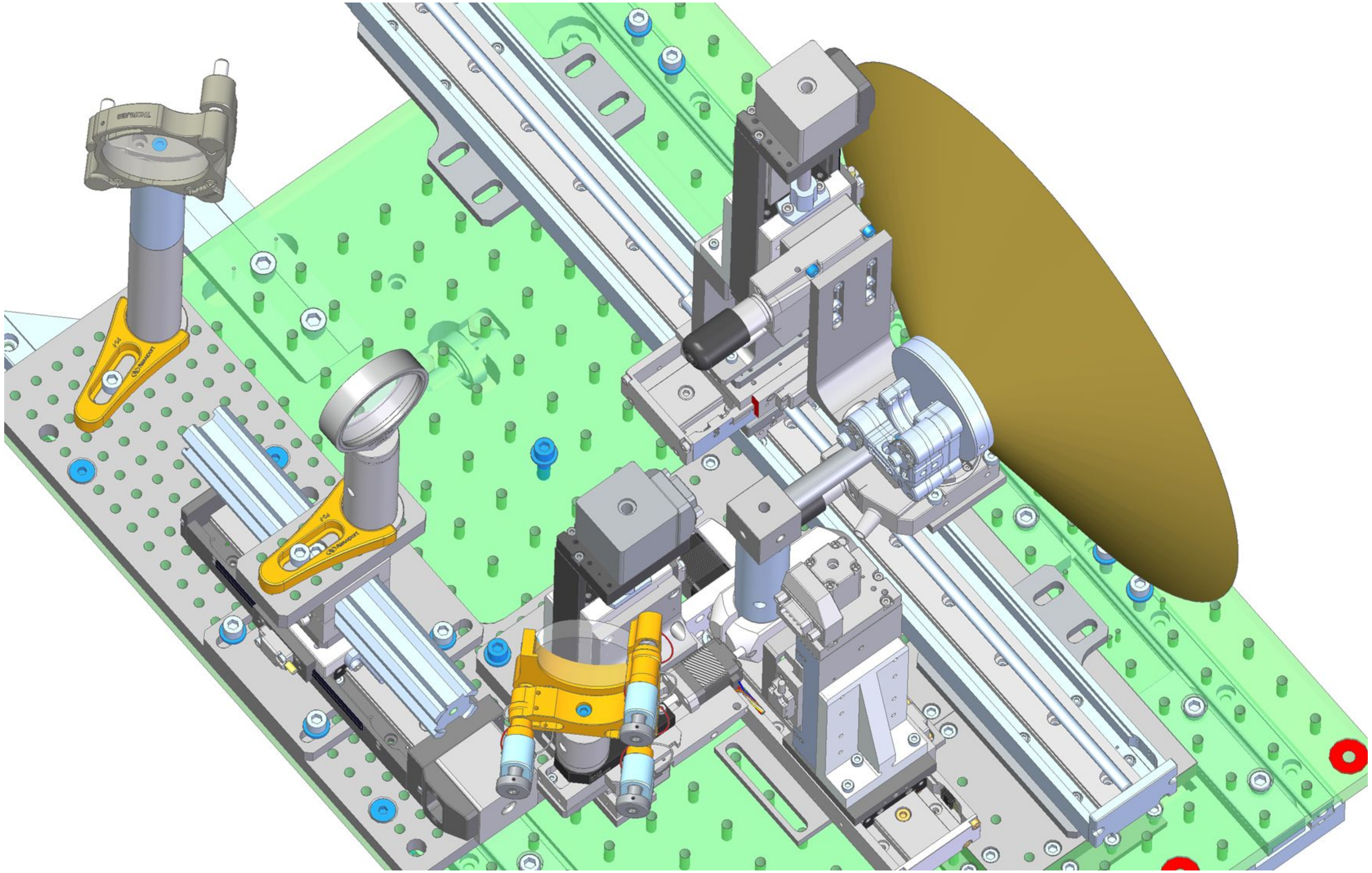
Standard configuration for gas phase chemistry:
[CXI Standard Configuration | Linac Coherent Light Source (stanford.edu)]

- Photon energy
    - 7keV-11keV (1 µm focal spot) – KB mirrors (reflective optics)
    - 11keV-20keV (5µm – 50µm focal spot) – CRLs

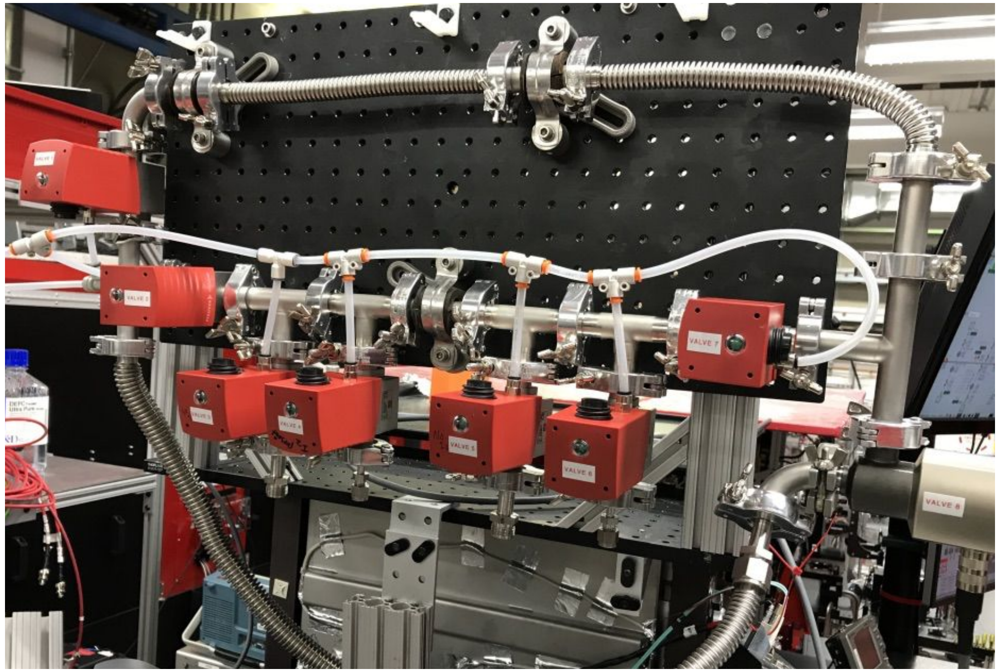


Standard Configuration

- Gas cell
- Be exit window downstream
- Pt pinhole entrance
- Additional Pt pinhole upstream – holder accommodates 4 pinholes
- Scattering cone
- UV pump propagates in-line with the X-rays
- Fully controllable sample delivery manifold

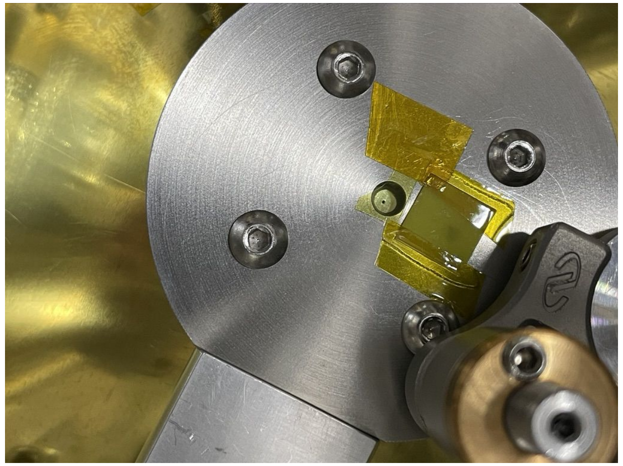


Standard Configuration



gas manifold - accommodates 4 samples

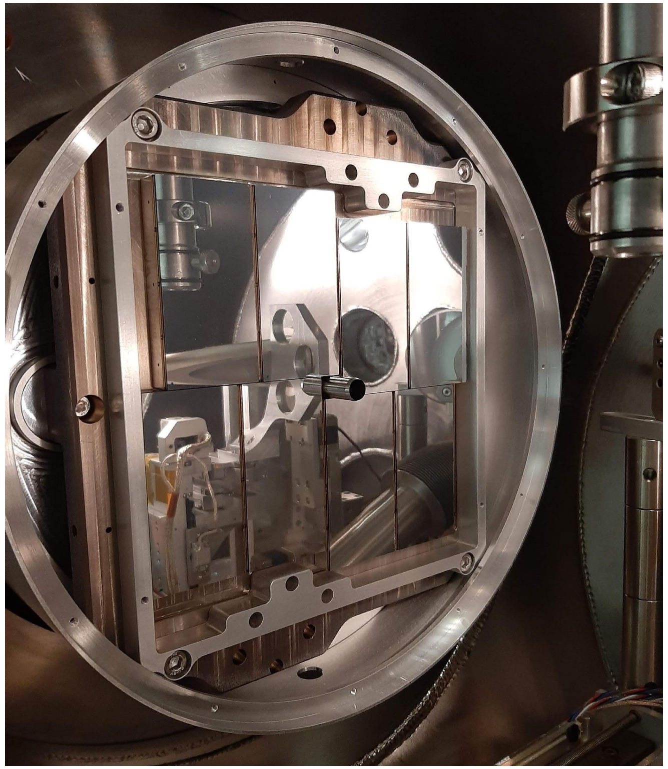
Gas cell, pinhole, scattering cone



gas cell, entrance pinhole and frosted YAG for spatial overlap

Standard Configuration

- Detector – 4M Jungfrau detector
  Jungfrau | Linac Coherent Light Source (stanford.edu)
  - Adaptive gain
  - background is <1 photon / image with proper alignment @ 10keV
- in-line X-ray spectrometer available as needed
- Downstream laser power monitor – camera and diode

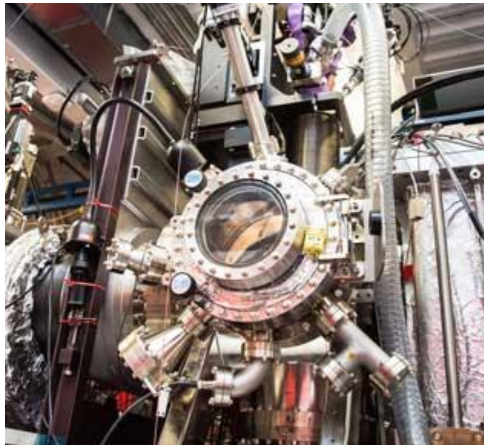


Short Pulse UV capabilities are under development – please contact a laser team member for current capabilities
CXI Specifications | Linac Coherent Light Source (stanford.edu)

High field physics / Non-linear X-ray Science

- 100 nm focus
- Power densities of 10^{20} Watts

Nano-focus chamber can host liquid jet and fixed target samples



Flexible in-air breadboard can host a variety of endstations and sample environments

Talbot interferometer for focus characterization

- Compatible with in air or in-vacuum experiments