CXI – In Vacuum, Forward Scattering, High Power Density

Meng Liang
Matt Hayes
Serge Guillet
Divya Thanasekaran
Joe Robinson
Kirk Larsen
Raymond Sierra
Area Manager
Engineer
Controls
Laser
Sample Delivery

Gas Phase Photochemistry
Non-linear X-ray Science
Serial Femtosecond Crystallography
Nanofocus

Xinxin Cheng
Mike Minitti
Andy Aquila
Sandra Mous
Mark Hunter
<table>
<thead>
<tr>
<th>Short Proposal Program</th>
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<tr>
<td><strong>Sample Testing Program (STP)</strong></td>
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<td>• STP, formerly PCS, best mechanism for new users</td>
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<td>• Exploring decoupling the short proposal program from the full proposal call</td>
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<td><strong>Data Set Collection (DSC)</strong></td>
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<td>• Primarily for finishing data collection or testing on mature projects</td>
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<td>• 1-2 shifts max allows for short proposals and faster turn around</td>
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<td><strong>Rapid Access</strong></td>
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<td>• Started in response to the COVID Pandemic</td>
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<td>• Sample must be available within 3 weeks</td>
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- 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

- 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)
- 0.75Å 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
● 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
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:
- 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

Talbot interferometer for focus characterization
• Compatible with in air or in-vacuum experiments

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

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