Coherent Hard X-ray Beamline

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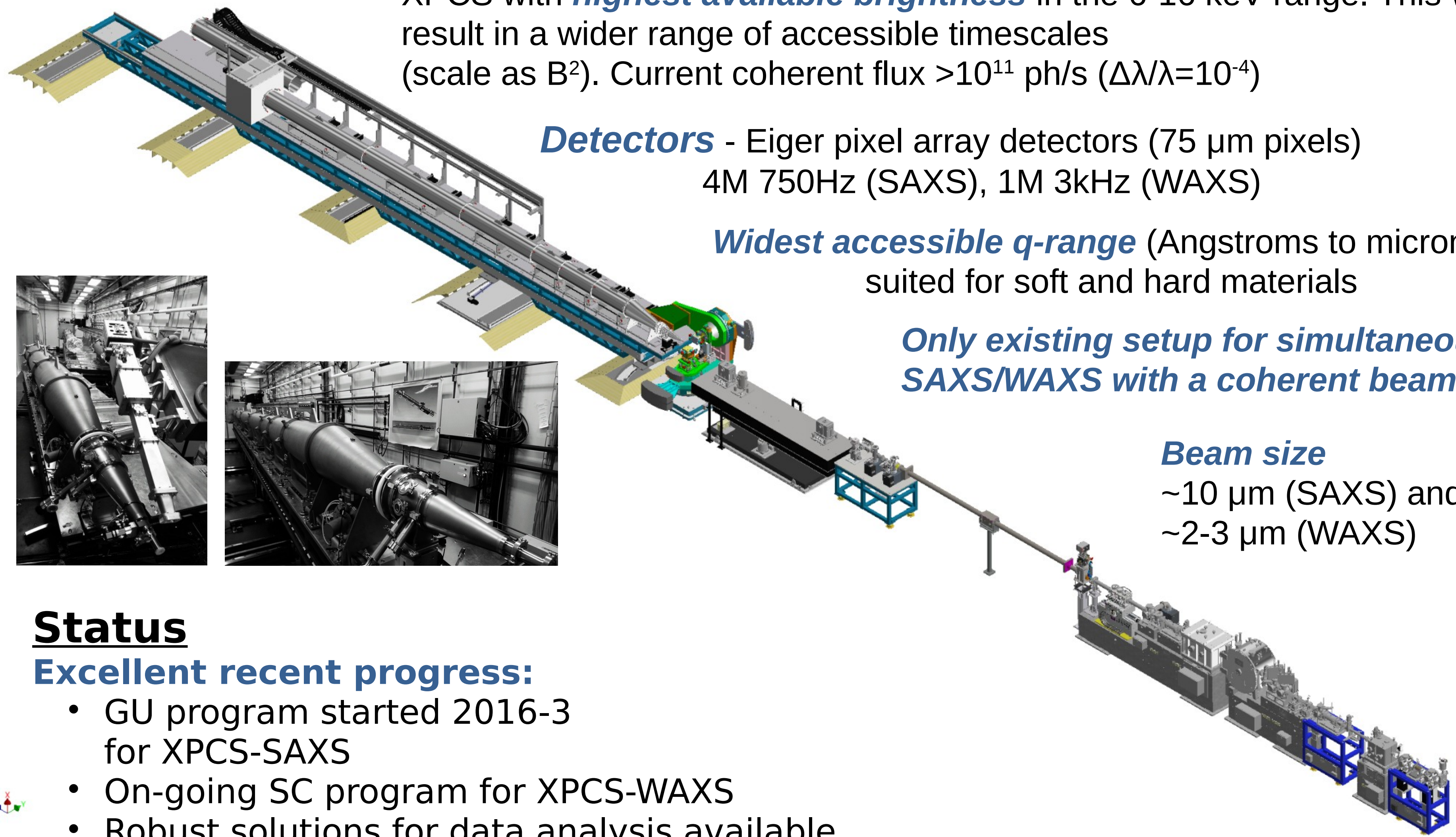
First Light: 11/14
First General User: 10/16
First Paper: Nature Comm. , 2016

First Holiday Card Feature
Dec 2016

CHX Beamline Overview



Strengths

XPCS with ***highest available brightness*** in the 6-16 keV range. This will result in a wider range of accessible timescales (scale as B^2). Current coherent flux $>10^{11}$ ph/s ($\Delta\lambda/\lambda=10^{-4}$)

Detectors - Eiger pixel array detectors (75 μm pixels)
4M 750Hz (SAXS), 1M 3kHz (WAXS)

Widest accessible q-range (Angstroms to microns) suited for soft and hard materials

Only existing setup for simultaneous SAXS/WAXS with a coherent beam.

Beam size
~10 μm (SAXS) and
~2-3 μm (WAXS)

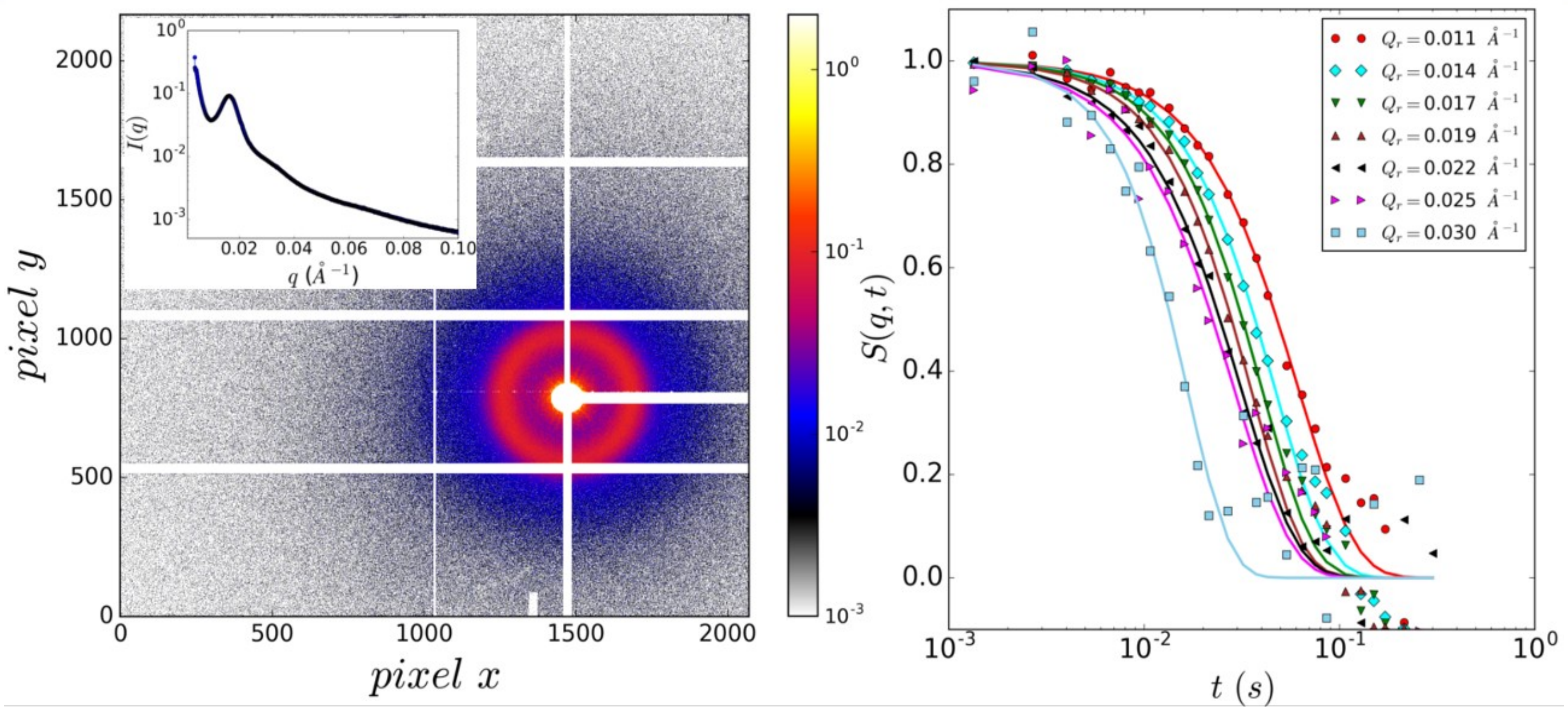
Status

Excellent recent progress:

- GU program started 2016-3 for XPCS-SAXS
- On-going SC program for XPCS-WAXS
- Robust solutions for data analysis available

Revealing the Dynamics of Polymer Gels

- The MIT group, Prof. B. Olsen (PI), used X-ray Photon Correlation Spectroscopy (XPCS) at the CHX beamline to study dynamics in transient networks of associative polymers. These materials are relevant to artificial skin and self-healing gels.

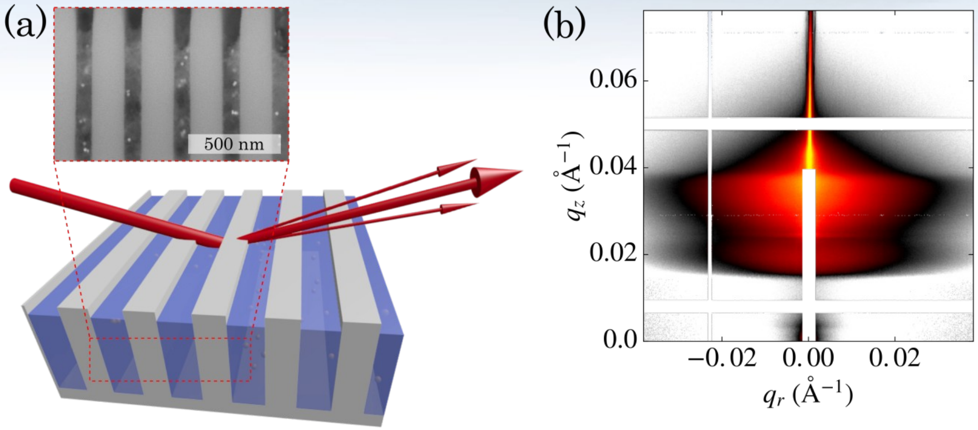


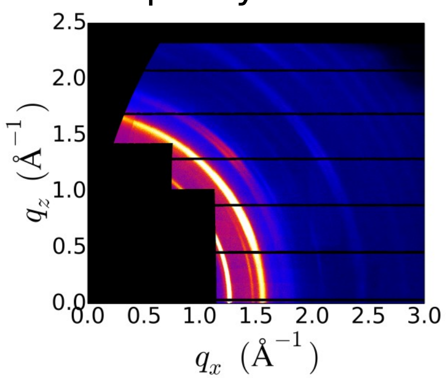
- The measurements are extremely challenging because of the low scattering contrast and (relatively) fast time scales; The Eiger 4M detector was used to record short bursts of 300 frames (=400 ms at 1.33 ms/frame) to mitigate beam damage
- The world class coherent flux at the CHX beamline allowed the MIT-CHX team to obtain the *dynamic structure factor S(q,t)* at significantly smaller length scales ($q \sim 0.03$ Å^{-1}) and shorter time scales ($t \sim 10^{-2}$s) than previously recorded with similar polymers
- CHX Data Analysis Solutions: https://github.com/NSLS-II-CHX

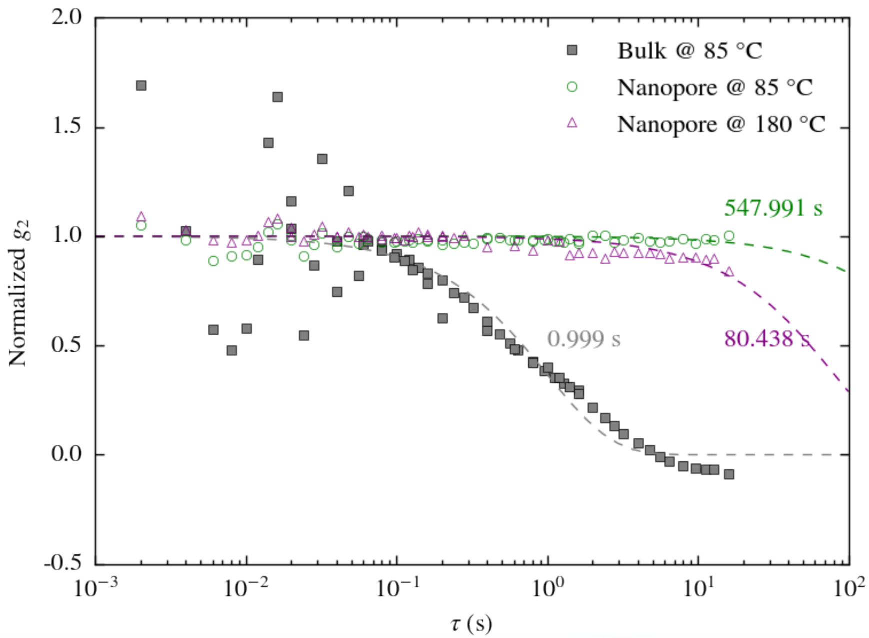
B. Olsen Gr*oup (Chem. Eng. MIT)*, unpublished

Nanoconfined Electrolytes

- **Goal:** Exploit nano-confinement for improved battery electrolytes, suppressing failure modes, and delivering a high-capacity & high-cyclability battery.
- **Strategy:** Study the structure (WAXS) and dynamics (XPCS) of polymer electrolytes under nano-confinement; measurements performed @ CHX
- **Results:**
  - Created new nano-confined polymer electrolytes
  - Observed shifts in the crystallinity of PEO when confined (orientation, melt behavior)
  - Measured dynamics of nano-confined materials, demonstrating a large (>3 orders-of-magnitude) increase in viscosity, and anisotropic dynamics







Z. Zheng *et al.*, *submitted* (2017)

Dynamics of Materials (soft- and bio-): time and length scales