Discussion Questions WGI (CXDI)

Source parameters:

- energy

fundamental (12 keV) & 3rd harmonic (36 keV)

Higher harmonics???

Access to softer energies possibility ???
6 keV to 12 keV

protein crystallography (anomalous dispersion)
magnetism

- pulse pattern

different pulse patterns to avoid heating of the sample

- pulse length (time resolved experiments)

to have an option to reach shorter time scales

10 fs - 200 fs

- polarization

- …

Beamline optics:

- monochromatisity

10^{-3} - 10^{-4}

- spot size

100 nm – 1 µm - 10 µm - 50 µm - 100 µm

Variable focus spot from 1 µm and up

KB optics for 100 nm – 1 µm

Lenses Si for 15 keV and higher

Be lens as collimator

- degree of coherence

apertures upstream

- diagnostics

- …

Detector: (2 Detectors?)

- pixel size

200 µm

- number of pixels
- framerate

5 MHz (200 ns)

- atomic diffusion in material science
- movement of dislocations and defects

- accessible q-range

1K by 1K pink beam and 4K by 4K for monochromatic beam

- dynamic range (10^4)

- 10^5 is desirable
-

Detectors for 3rd harmonic (36 keV) ???

Sample environment:

- DETECTOR arm

7 m detector arm

- Diffractometer

goniometer

- Accessible scattering angles

50 deg vertical and 10 deg horizontal for 12 keV
The possibility to move detector in the forward direction geometry
Evacuated path from detector to sample

- Sample positioning

- microscope (confocal microscope)
- SEM
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- cryostate

liquid samples

vacuum

- possibility to measure with 2 detectors

- temperature

laser heating

- external fields

fs Titanium Saphire, ns lasers, high pressure (diamond anvil cells)

- pump pulses
- …

- **Type of experiments:**

Forward scattering & Bragg geometry

a. single shot
b. multiple shots (integrate pulses)
c. fast readout (5MHz)

Nucleation experiment

Liquid flow cell
Laser (ns or fs)
Structuring of solution with laser
High rep rate source (5 Mhz)
High rep rate detector (5 Mhz)
Triggered detector
Detector distance 50 cm to look at full powder (forward scattering)
Move detector to 1-2 m after initial alignment (off-axis Bragg geometry)
Focus to 1 micron, or 10 micron
Evacuated flightpath but not evacuated sample environment
1K detector (200 micron pixels OK)
No mono
Energy 12 keV for inorganic crystals

Energy 6 keV for organic crystals
Pulse length: 10-200 fs
Single shot Diagnostics: Pulse intensity

Shock waves
Laser (ns or fs) 1 Joule (ns)
Vacuum sample chamber with long stroke stages (apertures in vacuum)
VISAR
1-10Hz rep rate
Forward scattering (detector distance 50 mm -5000 mm)
Bragg geometry detector up to 1-5 m
Focus to 100 nm, 1 micron, or 10 micron
Single shot measurements
Everything in vacuum, including detector for forward
Detector in air for Bragg with exit window
1K detector (200 micron pixels OK)
No mono for forward
Mono for Bragg
Energy 12 keV for Bragg peaks (crystals)
Energy 6 keV for forward scattering (CXI)
Observables: Grain changes, lattice changes with 50 fs resolution
Pulse length: 10 fs
Single shot Diagnostics: Pulse intensity
Is this really a HEDS experiment? Not really – diagnostic is coherent scattering (CXI) and diffraction (Bragg) looking at bulk structural material changes. Easiest done using drive laser on MID endstation already equipped for this.

Ablation
Similar to shocks, except:
Laser (fs), 20 micron focus
Forward scattering
5nm – 0.2nm length scales
Not only crystalline structure – also look at void formation in bulk material without atomic resolution.
Lower energies desirable (4-12 keV)
Is this really a HEDS experiment? Not really – diagnostic is coherent scattering (CXI) and diffraction (Bragg) looking at bulk structural material changes. Easiest done using drive laser on MID endstation already equipped for this.

Bragg spots (Robinson style)

Anvil cells

Charge density waves

The detector:

CDW systems are usually beautiful cristals. The 2kf satellite reflection
gives an image of the direct beam (along the transverse direction). If I use a 10µm beam at 8keV, I get a 60µm wide satellite at 2m, with

sometimes less than 10 speckles (60µm large). I have to resolve each
speckle,
i.e. I need a 20µm pixel size detector (with those conditions) to get 3
points on each speckle.
I can NOT reduce the beam size to 1µm*1µm to be able to use the 200µm
Graafsma detector because of irradiation:
To increase the photon density by a factor of 100 would destroy the CDW.

with a fully coherent beam:
At E=12keV, source size=10µm, and the detector at 8m, speckle size =72µm
(FWHM).
At E=12keV, source size=10µm, and the detector at 16m, the speckle
size=154µm (FWHM).
I need a fast enough detector, a small area (500*500µm should be
enough), with a 50*50µm pixels size and a *16m* 2theta arm to get 3 points on each speckle.
Dynamic range: we got between 1-10 ph/s at Troika on

each speckle.

The diffractometer:
Vertical diffraction plane would be better (but...). It is important
also to be able to go out of plane (the sample environnement sometimes
does not allow to
use the chi cercle).
I would prefer a Kappa geometry (not a Huber tower which is very limited
in chi).
A diffractometer with a 1m 2theta arm would be very usefull of
pre-aligned the sample before using the long 16m arm (independant of the
goniometer).
For the pre-alignment, attenuators are necessary.