New Directions in X-ray Scattering

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Goal for the Workshop

- Identify important Scientific Directions
- Review Proposed Configuration of SSRL scattering facilities
  - Beamlines
  - Detectors
  - Other Capabilities (Ancillary Equipment)
  - Software
- A Document with Recommendations
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Agenda

♦ 10:00: Present one possible direction (to get started)
♦ 10:30 – 12:30: Talks about exciting science we would like to do in the near future

♦ Lunch – discussion of the morning sessions

♦ 1:30 – 3:30 – Plan the direction SSRL scattering program should take and the capabilities new beamlines should provide. Make a list of recommendation for the SSRL directorate and SAC
Spear 3: new opportunities

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- Flux vs Energy (keV) for different magnets:
  - SPEAR2
  - SPEAR3 new wiggler
  - 7-2

- Penetration length vs Energy (eV) for different materials:
  - water
  - CaCO$_3$
  - SiO$_2$
  - Al
  - La$_2$MnO$_4$
  - Carbon

- Flux density vs Energy (KeV) for APS Undulator A:
  - 7-2 >1mm/mrad
  - 7-2 :0.2mm/mrad

- Flux vs Energy (keV) for 500 mA current:
  - SPEAR3 new wiggler

- Penetration length vs Energy (eV) for different materials:
  - water
  - CaCO$_3$
  - SiO$_2$
  - Al
  - La$_2$MnO$_4$
  - Carbon
Science (a selection of interesting fields)

- Sample Orientation controlled
  - E.g. – single crystal, interfaces, etc..

- Time based
  - Study of chemical reactions and other time dependent processes, such as settling of colloids, etc…

- 2D diffraction pattern
  - Study of Texture
  - E.g., Deviatoric strain, IBAD/ITaN etc..

- High angular resolution
  - E.g., phase transition, structure solution, etc…
Outline: Proposed configuration

◆ **Beamlines** – accomplish the science with following BLs
  ◆ Psi/8circle
  ◆ 3 or 4 circle with a large 2D detector
  ◆ High angular resolution 2+ circle

◆ **Detectors**

◆ **Sample Capabilities:**
  ◆ Cryostats, reactors, strain rigs etc

◆ **Software**
Psi/8 circle

High Brightness – 5 – 30 keV: 7-2

- For sample alignment
  - \(\Theta, \chi, \phi, \Theta_H\)
- Detector
  - \(2\Theta + 2\Theta_H\)
- Analyzer + small 2D detector and/or fast 1D psd
- Temp: 8 – 1200 K, other reactors, sample chambers
3Circle with large Area Detector

High Flux Density – 5 – 40 keV : 10-2

◆ 2 circle – Chi and Phi for sample – theta locked
◆ Quick switch between a large 2D detector and a point detector (analyzer) on 2th arm
◆ Time based expt., study of texture, thin films.
◆ Reactors, temperature stages, environmental chambers
2+ circle diffractometer

5-14 keV : 2-1

- Small Chi arc.
- High resolution diffraction setup
  - Several different analyzers – easy setup
  - High angle monochromator
- Other detector sets
  - Soller Slits
  - Reflectivity
  - Small 2D detector/linear PSD off axis diffraction
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- Large area detector
  - > 300x300 mm
  - high dynamic range
  - Low dark current
  - fast readout (1hz or better)

- Small area detector/Linear PSD
  - Ultra-high dynamic range

- Energy sensitive point detectors
  - E resolution of ~ 150 eV at 8 keV
  - High count-rate

- High Count-rate PMTs
Other Capabilities

- Temperature stage: 8 – 300 K (displex)
- Temperature stage: 300 - 1300K.
- Temperature stage: 70 – 700K – small
- Flow reactors.
- Electrochemical cells.
- Modular sample mount for other use developed sample stages, e.g., strain rigs, high pressure cells, hydrogen cell, chamber for radioactive samples, etc...
Software

◆ **Data Collection:**
  ◆ Intuitive – easy to use
  ◆ Versatile – easy to customize for a user applications (via macros, e.g.)

◆ **Data Analysis:**
  ◆ Easy conversion of 2D images to Chi-Q space.
  ◆ Easy splicing of 2D images into a reciprocal lattice map.
  ◆ Semi-automated texture analysis from 2D diffraction images.
Goal for the Workshop

- Discuss Scientific Directions

Two Morning Science Sessions

- Feedback on proposed SSRL scattering facilities
  - Beamlines
  - Detectors
  - Other Capabilities
  - Software

After Lunch
220 Martensite Ring

Order in Interfacial Water

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