IXS Summary

Discussion between

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After XFELO Retreat

XFELO Retreat
SLAC, Stanford, July 2016

Differentiation: XFEL vs XFELO

Mostly: Spectrometer experiments limited by Photons/s/meV

Some specific issues favor XFELO:

Higher Energy

Easier Operation for Si(nnn) Non-Resonant IXS ~meV resolution (22 and 26 keV)
Access to Broader Range of resonances (Nuclear and Electronic)
Improved Penetration into Sample Environments
Reduced Radiation Damage per Scattering Event
Improved Count Rates (often)

Better Stability

For Careful/Sensitive Measurements

Broader Scientific Cases

Disordered Materials:

Mesoscale crossover from continuum to atomistic dynamics

esp. relaxation in this region ($<0.1 < Q < 10$ nm^{-1})

Probe Transverse Dynamics

Method not clear (HR-RIXS? IXS with correlation?)

All liquids, glasses (alloys?)

Combined chemical/vibration sensitivity

NIS with eV analyzers to choose specific chemical states

Nitrogen Fixation Cycle intermediate states

Sensitive probes of electron-phonon coupling

Very High (~0.1 meV) Resolution non-resonant IXS

HR-RIXS

Precision S(Q,w) in different zones

Superconductors, Correlated Materials

Extreme Conditions – especially Earth Science

Composition and viscosity of the interior center of the earth

More Methodological

Standing Waves, Layers in Total External Reflection, and Multilayers

Coherent superposition of wave fields, Brilliance limited

Extreme intensity: non-linear driven response

General properties of layer systems/interfaces are different!

Superconducting interfaces of insulators, friction, surfing

High-Resolution RIXS

Analyzers from quartz/sapphire, 20 meV now, probably 5 meV, 1 meV?

MCD with IXS?

Probe of magnetism, coupling to other (orbital, electronic) system

Complex/correlated materials

NRIXS

Medium (5-10) meV resolution, Spherical Analyzers? New Method?

d-d excitations, orbitons, gaps (band structure)

Others:

High-res phonons, low-energy gaps, pump-probe

Pump-Probe TDS (esp. small samples), Transform F(Q,t) G(r,t)

Compton?, Raman?, Emission?

TDI (diffusion)? (->NRS)

Optics Questions & Challenges

(AB Opinions)

Method for meV-resolution IXS:

Spherical Analyzers? Post-Sample Collimation (YS&+spectrograph?).

- sample clear aperture (for sample environment -> larger is better)
- required beam size (larger is easier, maybe better for rad damage)
- allowable beam projection/ sample thickness at finite Q
- resolution function -> FWHM? (PSC tail can be better)
- parallelization (Q, E-spectrograph (ys))
- absolute energy: higher is better

What about low-resolution expts:

NRIXS: Desire 5-10 meV res with sharp tail

Emission? X-Ray Raman?

Sufficiently flexible spectrometer design(s) without sacrificing capability

Development of high resolution RIXS analyzers

5 meV probably OK (work required), 1 meV maybe.

Development of ultra-high resolution non-resonant spectrometer

Mono? PSC optics? Nuclear Analyzer?

Expect incident beam optics to be LN2 cooled

Never forget the fight against radiation damage…