Wide-Angle X-Ray Photon Correlation Spectroscopy and Time-Resolved Coherent X-Ray Scattering Beamline

Principal developer: Dr. Alec Sandy
Argonne National Laboratory
9700 S. Cass Ave.
Lemont, IL 60439
630-252-0281
asandy@anl.gov

Co-Developers:

Dr. Eric Dufresne
X-Ray Science Division, ANL
Lemont, IL

Prof. Oleg Shpyrko
University of California-San Diego
San Diego, CA

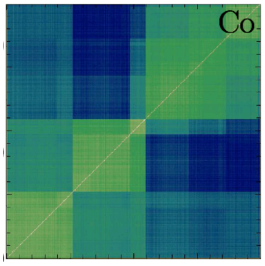
Dr. Meimei Li
Nuclear Engineering Division, ANL
Lemont, IL

Prof. Mark Sutton
McGill University
Montreal, PQ, Canada

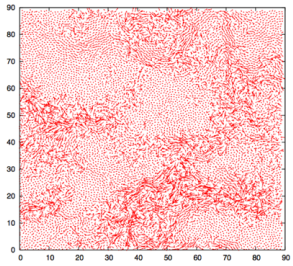
Prof. Michael Pierce
Rochester Institute of Technology,
Rochester, NY

Dr. Hoydoo You
Materials Science Division, ANL
Lemont, IL

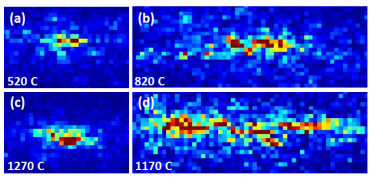
Abstract: X-ray photon correlation spectroscopy (XPCS) characterizes fluctuations in condensed matter at a combination of mesoscale length scales and timescales not otherwise accessible. Signal strengths depend on the x-ray beam coherence and minimum accessible time scales scale inversely with the square of the source brilliance so XPCS will benefit tremendously from APS-U. We propose to build a new beamline specialized in wide-angle (WA) XPCS. It will advance studies in a host of key areas in physics and materials science and engineering that include dynamic heterogeneity, structural dynamics in super-cooled liquids and fluctuations associated with competing mesoscale interactions in emergent materials. Features of the beamline include uniquely high time-averaged coherent flux, access to time delays as short as ~ 100 ns, access to higher coherent flux at energies up to ~ 20 keV for penetration into diverse samples and environments and extinction-free horizontal diffraction for increased set-up stability and flexibility.



Two-time correlation reflecting avalanches in the martensitic transition of quenched cobalt. Resolving the abrupt events requires the WA-XPCS beamline at APS-U [C. Sanborn *et al.*, PRL **107**, 015702 (2011)].



Particle displacements (simulated) occurring within a relaxation time of a supercooled liquid illustrating dynamic heterogeneity [L. Berthier, Physics **4**, 42 (2011)]. Brighter swaths are larger displacements.



Domain-sensitive speckle snapshots from multiferroic $ErMnO_3$. The dynamic behavior of competing ground states will be captured by the proposed WA-XPCS beamline [A. Barbour *et al.*, unpublished (2016)].