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X-ray Diffuse Scattering from Ultrafast Laser Excited Solids MARIANO TRIGO, YU-MIIN SHEU, JIAN CHEN, DAVID REIS, University of Michigan, STEPHEN FAHY, EAMONN MURRAY, University College, Cork, Ireland, TIMOTHY GRABER, ROBERT HENNING, University of Chicago — Intense, ultrashort laser pulses can be used to excite and detect coherent phonons in solids. However, optical experiments can only probe a reduced fraction of the Brillouin zone and hence most of the decay channels of such coherent phonons become invisible. In contrast, time-resolved x-ray diffuse scattering (TRXDS) has the potential to be the ultimate tool to study these phonon decay processes throughout the Brillouin-zone of the crystal. In our work, performed at the BioCARS beamline at the Advanced Photon Source, we use synchrotron time-resolved diffuse x-ray scattering to study Si and Bi under intense laser excitation with 100 ps resolution. We show that reasonable signal levels can be achieved with incident flux of 10^{12} photons comparable to the flux that will be available at future 4th generation sources such as the LCLS in a single pulse. These sources will also provide three orders of magnitude shorter pulses; thus, this experiment serves as a test of the feasibility of time-resolved X-ray diffuse scattering as a tool for studying nonequilibrium phonon dynamics in solids.

> Mariano Trigo University of Michigan

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