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Characterization of ultrafast hard x-ray pulses for LCLS using gas phase techniques MARCUS P. HERTLEIN, Lawrence Berkeley National Laboratory (LBNL), REINHARD KIENBERGER, Stanford Linear Accelerator Center (SLAC), HIDEHITO ADANIYA, ADRIAN CAVALLIERI, BENEDICT FEINBERG, DAVID FRITZ, TIMUR Y OSIPOV, ALI BELKACEM, LBNL — The availability of ultrafast (sub-100 fs) hard x-ray pulses (E > 1000 eV) promises new experimental opportunities, but also requires new techniques for their use. The Linac Coherent Light Source (LCLS) at the Stanford Linear Accelerator Center (SLAC) is such a source that is expected to provide a high flux of 230 fs monochromatic x-ray photons with energy between 0.8 and 8 keV. Characterization methods for beams with such characteristics still need to be developed. We are presenting several techniques that show promise for the spatial and temporal characterization of ultrafast hard x-rays. They were developed and used at the Advanced Light Source (ALS), and will undergo further testing at the Sub-Picosecond Photon Source (SPPS) at SLAC. Our methods exploit effects such as ultrafast core-hole binding energy changes in atoms after laser excitation, and creation of energy sidebands on Auger electrons that are emitted in a laser field. We have demonstrated the usefulness of these effects on a picosecond time scale, but their use can be extended well into the femtosecond domain. We will also discuss time-of-flight techniques which offer the possibility of nondestructive x-ray spatial mode characterization. Our focus is on gas phase experiments, since they offer the possibility of nondestructive, transparent monitoring of the x-rays, leaving the main beam nearly undisturbed and available for experiments.

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