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Simultaneous x-ray imaging of A and B state dynamics in iodine at the LCLS[1] MATTHEW WARE, ADI NATAN, JAMES CRYAN, PHIL BUCKSBAUM, Stanford University, SLAC, and PULSE Institute, JAMES GLOWNIA, SLAC and LCLS — We will discuss our most recent analysis of the nuclear dynamics of photoexcited iodine from the LCLS. At the LCLS, we pumped a gas cell of iodine with a weak 520nm, 50 fs pulse from the X state into the dissociating A and bound B electronic states, and the nuclear dynamics are then probed with 9 keV, 40 fs x-rays with variable time delay. The A and B electronic states are perpendicular and parallel electronic transitions respectively, so their time-dependent x-ray diffraction signals can be isolated from each other. This work highlights the difficulty of using x-ray diffraction to film the excited state dynamics in molecules: the diffraction signal is an incoherent sum of all populated electronic states and, when the x-ray coherence time is shorter than the electronic coherence time, the signal can potentially include coherent interference between electronic states. Thus, even for simple systems like iodine, distinguishing the nuclear dynamics on different electronic surface s becomes a difficult task. For iodine, the analysis required knowledge of the dipole selection rules between the X and the A and B electronic states as well as the bound and dissociating character of the A and B states in order to separate the total diffraction signal into its A and B state contributions.

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