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Discerning Molecular Dynamics using Time Resolved X-ray Scattering JAMES GLOWNIA, Linac Coherent Light Source - SLAC National Accelerator Laboratory, MATTHEW WARE, NOOR AL-SAYYAD, JORDAN O'NEAL, PULSE Institute, Stanford University, PHILIP BUCKSBAUM, PULSE Institute, Stanford University, SLAC National Accelerator Lab — Time Resolved X-ray Scattering (TRXS) has emerged as an important tool to observe ultrafast time resolved molecular motion. Two of the large challenges associated with this technique are inverting the scattered image from scattering space to real space and to resolve dynamics that occur simultaneously on multiple electronic states. Here, we show a TRXS experiment performed with 520 nm photoexcited molecular iodine at the Linac Coherent Light Source. We use the method of Frequency Resolved X-ray Scattering (FRXS) to extract and identify the sources of molecular motion. With this technique, the analysis is performed in the x-ray scattering, Q, domain and a temporal Fourier transform is performed on the pump-probe delay dimension. The well-known bound B-electronic state vibrational wavepackets are observed in addition to single photon and multi-photon induced molecular dissociation. This analysis resolves the equilibrium position, amplitude of motion, and vibrational period information for the bound states, and the initial position and velocities of dissociation for the unbound states, allowing for the precise determination of the origins of coherent motion in the molecule.

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