

Abstract Submitted  
for the DAMOP20 Meeting of  
The American Physical Society

**Probing dynamics in molecular iodine using ultrafast XUV transient spectroscopy** SONIA MARGGI POUILLAIN, KRISTINA F. CHANG, YUKI KOBAYASHI, STEPHEN R. LEONE, University of California, Berkeley — Attosecond probing of core-level electronic transitions provides a sensitive tool for real-time observation of chemical dynamics. Here, we employ ultrafast XUV transient absorption spectroscopy to investigate the electronic and nuclear dynamics in a prototype molecule, molecular iodine ( $I_2$ ). A few-femtosecond pulse ranging between 500 and 900 nm is employed to excite the  $I_2$  molecule while an attosecond extreme-ultraviolet pulse is used to probe the dynamics through the  $4d$  iodine core-to-valence transition. Different processes are unraveled involving one-photon excitation and dissociation producing I atoms as well as multiphoton dissociative ionization leading to the formation of  $I^+$  ions. Vibrational coherences are observed in both the  $I_2$  ( $X^1\Sigma_g^+$ ) ground electronic state and the  $I_2$  ( $B^3\Pi_{0u+}$ ) excited state, which exhibit different behaviors. While an exponential decay is observed in the excited state mainly attributed to rotational dephasing, long-lived ( $>1$  ps) coherences in the ground state are retrieved. The presented results demonstrate the ability of XUV transient absorption to directly map the potential energy curves of the molecule and resolve molecular dynamics with a few-femtosecond resolution.

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Date submitted: 30 Jan 2020

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