Contribution ID: **217** Contribution code: **FRBI2** Type: **Invited Orals**

Observation of Coherent Electronic Motion with X-Ray Free-Electron Lasers

Friday, 26 August 2022 11:30 (30 minutes)

Electron motion is a key ingredient of every chemical processes. The natural timescale for such electronic dynamics in small molecular systems is typically in the range of tens to hundreds of attoseconds. Here I will present recent experimental results using attosecond x-ray free electron laser pulses and pulse pairs to probe ultrafast electronic motion. X-ray free-electron lasers offer continuous wavelength tunability across the soft x-ray region allowing for atomic-site specific probes of the electron density in molecular systems.

I will present our first results showing isolated attosecond soft X-ray pulses from the FEL, with peak power approaching the terawatt scale. Such high power pulses open the door for nonlinear spectroscopies such as pump/probe spectroscopy, and X-ray wave mixing. We have demonstrated the preparation of a coherent electronic wavepacket by driving stimulated X-ray Raman scattering. Combing attosecond X-ray pulses with an external laser field we are able to time-resolve the photoemission dynamics of core-level electrons in molecules, observing the coherent evolution of a wavepacket of core-excited states. I will also show the first results from a x-ray pump/x-ray probe measurement of ionization induced charge motion.

Use of the Linac Coherent Light Source (LCLS), SLAC National Accelerator Laboratory, is supported by the U.S. Department of Energy (DOE), Office of Science, Office of Basic Energy Sciences (BES) under Contract No. DE-AC02-76SF00515. This work was supported by the U.S. DOE, Office of Science, Office of BES, Chemical Sciences, Geosciences, and Biosciences Division (CSGB).

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Yes

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Session Classification: End-to-end experiments (machine driven)

Track Classification: End-to-end experiments (machine driven)