MeV Ultrafast Electron Diffraction for Chemical Science at SLAC

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Imaging changes in molecular geometries on their natural femtosecond timescale with sub-Angstrom spatial precision is one of the critical challenges in the chemical sciences. Ultrafast electron diffraction (UED), pioneered by Mourou, Ewbank and Zewail in 1980s is one of the most powerful tools imaging the conformational changes of nuclear structure during a chemical reaction. The temporal resolution of UED has been limited to a few picoseconds, insufficient to study many interesting chemical reactions in isolated molecular systems.

Mega-Electron-Volt (MeV) UED at SLAC is an initiative started in 2014, with the goal of demonstrating the feasibility and capability of femtosecond UED with relativistic electrons [1]. In the past two years, 10 target gas phase molecules with a wide range of photoinduced molecular dynamics have been studied, including vibration in B state I_2 [2], photodissociation of CF_3I and ring-opening reaction of 1,3-cyclohexadiene. In this poster, I will present the setup, capability and experimental program of gas phase MeV UED at SLAC. Two dissociation experiments on CF_3I and $C_2F_4I_2$ will be presented in detail.

In the near future, new capabilities including THz streaking and time-stamping, deep UV and VUV pump, and liquid phase UED will be developed, along with continuous improvement in temporal resolution and machine stability. Our program is also seeking input from chemical dynamics community and looking forward to further expand the gas phase UED user community.

References:

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