

Ultrafast science using X-ray free-electron lasers

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X-ray free-electron lasers (XFELs) offer exciting research opportunities for revealing ultrafast dynamics in matter in real time; measuring the atomically-resolved structure of complex molecules and molecular assemblies; and creating and probing astrophysically relevant, extreme states of matter. In my presentation, I will first introduce the basic physical interaction mechanisms that underlie and accompany applications of X-rays. I will then explain the principles characterizing the operation of XFELs. Numerous insightful investigations have already been performed using XFELs. In my presentation, I will focus on two recent studies in ultrafast science: the first x-ray attosecond pump and x-ray attosecond probe measurement on a condensed-phase sample, and the first direct observation of the collective properties of structural quantum fluctuations in a high-dimensional nuclear configuration space.