CFEL SCIENCE

# Colloquium

**06th December 2013 – 14:00**

CFEL, Building 99, seminar rooms I-III

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## Recent developments in measuring few- to sub-femtosecond dynamics in molecules

In this seminar I will look at several approaches that are using new types of light source or new methodologies to extract few to sub-femtosecond dynamics in molecules triggered by sudden photoionization. I will begin by reviewing some of the motivations for pursuing these questions and why it is important to find techniques that offer, not only extreme time resolution, but that are also suitable for application to problems in molecules larger than those hitherto investigated by attosecond methods.

The potential of HHG spectroscopy to overcome the signal limits of conventional attosecond pump-probe spectroscopy, whilst offering sub-femtosecond temporal resolution, will be discussed. Early successes of this technique will be reprised. The steps currently being taken to extend HHG spectroscopy to a wider range of small to medium sized organic molecules, e.g. through the use of custom designed sample handling methods and few-cycle pulses in the 1200-2000nm wavelength range, will be briefly commented upon. Steps to overcome intrinsic limitations on HHG spectroscopy will be discussed. In particular I will present some recent theoretical calculations that demonstrate how by using a single-photon ionization step within the HHG process methods to measure attosecond domain exponential and non-exponential Auger decay in atoms and molecules may be realised.

I will briefly report recent work in our laboratory to generated sub-femtosecond VUV (15-25 eV) isolated pulses with high power so as to ameliorate the usual limits in the pump step efficiency in attosecond pump-probe spectroscopy. A possible scheme to perform pump-probe spectroscopy using a VUV pump and single-photon induced laser enabled Auger decay (spLEAD) to measure Auger inactive inner valence holes will be introduced.

Finally I will explain how few femtosecond dynamics have been measured in X-ray photoionised $O_2$ at LCLS using a two-pulse method and how this technique might be extended to measuring charge migration in larger molecules in the near future.

Host: Robin Santra - CFEL Theory Division