European XFEL Theory Seminar

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Imaging and controlling electron dynamics in molecules and solids

Attosecond and few femtosecond light pulses allow one to probe the inner workings of atoms, molecules and solids on the timescale of the electronic motion. In molecules, sudden ionization by such pulses is followed by charge redistribution on a time scale ranging from a few-femtoseconds down to hundreds attoseconds, and usually leads to fragmentation of the remaining molecular cation. Such complex dynamics arises from the coherent superposition of electronic states populated by the broadband attosecond pulse and from rearrangements in the electronic structure of the molecular cation due to electron correlation. To investigate these ultrafast processes, attosecond pump-probe spectroscopy has been shown to be a very valuable tool. In solids, a considerable effort is currently devoted to understand high harmonic generation processes induced by strong few-femtosecond IR pulses. The aim is to get insight on the dynamics of electrons in the conduction bands of such systems and eventually to exert some control by taking advantage of specific properties of the materials [1]. In this talk I will present the results of recent attosecond pump-probe simulations in which several molecules, from hydrogen to the amino acid tryptophan, are ionized with a single attosecond pulse and are subsequently probed by an infrared or an XUV pulse. I will also discuss how high harmonic generation can be tuned in a solid system by the controlled deposition of monolayers of a second material [2].

[1] M. Nisoli, P. Decleva, F. Calegari, A. Palacios, and F. Martín, Chem. Rev. 117, 10760 (2017).
[2] N. F. Aguirre and F. Martín, Phys. Rev. B 94, 245423 (2016).

Host: Evgeny Gorelov