



## SEMINAIRE ISMO

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### **Multi-photon processes and two-color studies in atomic and molecular systems**

The unprecedented characteristics of new XUV and X-ray Free Electron Lasers, such as FLASH and LCLS, have stimulated numerous investigations focusing on the detailed understanding of fundamental photon-matter interactions in atoms and molecules. In particular, the effect of high intensities (up to  $10^{16}$  W/cm<sup>2</sup>) giving rise to multiple ionization processes as well as the temporal evolution of ultra-fast photo-induced processes (down to a few  $10^{-15}$  s) can be studied for the first time in the short wavelength regime, i.e. at photon energies high enough to excite also the strongly bound core electrons.

In recent series of experiments, the intense XUV pulses were used to study by electron spectroscopy multi-photon processes such as sequential ionization and above-threshold ionization. These experiments serve as case studies for the non-linear response of matter to short wavelength radiation and allow for a critical comparison with theoretical predictions for this type of processes. In addition, the effect of an additional synchronized optical/IR laser was investigated. In case of resonant excitation by the XUV pulse, the intense IR field causes a strong modification of the decay dynamics, which was experimentally observed via the intensity-dependent shift of the resonance and the competition between resonant and direct Auger processes. In case of direct photo-ionization, the strong IR field can modify completely the angle-resolved Auger spectra, which reveal strong intensity modulations induced by sub-cycle interferences, i.e. by the coherent emission of electrons produced during one cycle of the superimposed optical field.

Finally, I will present some future opportunities, opened up with the start of operation of the European XFEL at the end of 2015. Special focus will be given to one of the six permanent experimental stations, the SQS (Small Quantum System) Scientific Instrument, which is dedicated to the investigation of atoms, ions, molecules and clusters in intense fields and to the study of non-linear phenomena.

**Mardi 26 mars 2013 à 11h**

**Bât. 210 – Amphi 1 (2ème étage)**

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