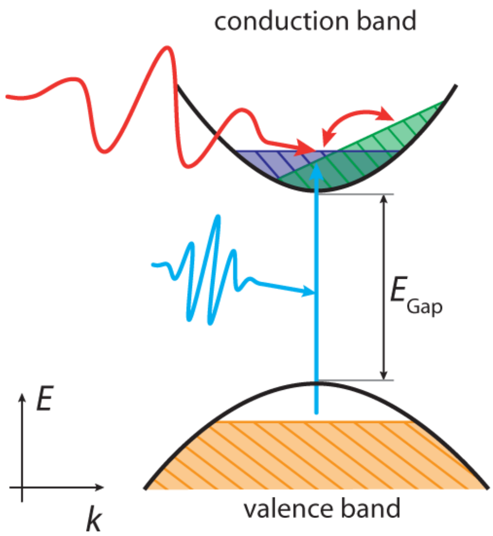
Seminar : Martin Schultze

Institute of Experimental Physics, Graz University of Technology, Austria

Monday, February, 11st 2026 at 10 AM
IJL R+4 (N° 4-A014)

Attosecond electron and spin dynamics

Professor Martin Schultze uses the toolobox of attosecond spectroscopy to explore the microscopic origin of how light interacts with matter. Atfer studying in Zurich, Munich and Berkeley he is now at the Technical University in Graz, Austria trying to find out how intense laser pulses can change the optical, electronic and magnetic properties of matter at ultimate timescales



Abstract The enormous electric field strength of ultrafast laser waveforms allows to steer electronic motion and control electronic excitation so fast, that secondary processes disrupting coherence and striving for an equilibrium have hard time catching up – even in condensed phase systems. We investigate the opportunities this temporal segregation offers to transfer coherent control ideas as demonstrated in atomic and molecular ensembles to solids.
This talk will discuss two experiments demonstrating that ultrafast optical fields can manipulate electronic and spin degrees of freedom in solid state systems at clock rates possibly faster than de-coherence.
Photodoping the band-structure of wide-gap dielectrics (as sketched in the figure) with ultrafast ultraviolet light-fields creates coherent electronic wavepackets that, at early times, can be manipulated by optical gate fields. Before the onset of dissipative processes, this manipulation is entirely reversible, suggesting novel ultrafast, coherent optoelectronic applications. We believe that this speed-up could yield optoelectronic operation up to the Petahertz frontier, which poses the ultimate limit of optoelectronic signal manipulation[1].
As a corollary of this ultrafast coherent modification of the electronic system, in suitably chosen heterostructures also the spin system can be manipulated coherently. Optically induced spin transfer is demonstrated as a route to the direct, all-optical manipulation of macroscopic magnetic moments on previously inaccessible attosecond timescales[2].

1. *The speed limit of optoelectronics. Nat. Commun. (2022). doi:10.1038/s41467-022-29252-1*

2. *Light-wave dynamic control of magnetism. Nature 571, 240–244 (2019)*

Séminaire organisé dans le cadre du programme interdisciplinaire MAT-PULSE (*Materials and Physics @ Ultimate Scale: Nanotech for a sustainable digital world*)