SYQS 2: Quantum Control Spectroscopy II

Time: Thursday 14:00–15:30 Location: E 415

Invited Talk SYQS 2.1 Th 14:00 E 415

Efficient control of electron dynamics — •Matthias Wollenhaupt — University of Kassel, Institute of Physics, Heinrich-Plett-Str. 40, D-34132 Kassel, Germany

The ability to generate ultrashort laser pulses with controllable shape has made it possible to manipulate the dynamics of quantum systems almost at will. Quantum control has wide-ranging applications but also important implications to our basic understanding of light matter interactions. For instance, revealing physical mechanisms underlying the coherent interaction of intense tailored light fields with matter has become a central theme in quantum control. Efficient control not only implies large population transfer rates, i.e. inherently non-perturbative interactions, but also comprehensive control of the three dimensional electron wave function. In this contribution, both aspects of control are demonstrated on bound and continuum electron dynamics.

As for bound electron dynamics we demonstrate efficient non-perturbative control strategies based on tailoring the interaction of intense laser fields to the dynamics of atomic or molecular dipole with attosecond precision [1].

Coherent control of electron dynamics in the continuum exerted by polarization-shaped laser pulses is combined with direct three-dimensional detection via tomographic reconstruction [2,3].

[1] T. Bayer et al., Phys.Rev.Lett. 102, (2009) 023004-1.
[2] M. Wollenhaupt et al., Appl.Phys.B 95, (2009) 245.
[3] M. Wollenhaupt et al., Appl.Phys.B 95, (2009) 647.

Invited Talk SYQS 2.2 Th 14:30 E 415

Exploring wavepacket dynamics under strong laser fields — •Leticia Gonzalez — Institut f. Physikalische Chemie, Friedrich Schiller Universitaet Jena, Jena, Germany

Control of nuclear and electron dynamics in molecules is a hot topic in physical chemistry. In this contribution we investigate the effect of strong laser fields in two molecular systems. In the first case, a molecular switch is controlled by inducing dynamic Stark fields. Such strong laser fields alter the topology of the potential energy surface, creating a favorable situation to switch the nuclear dynamics from one minimum to the other. In the second example, the photo-dissociation dynamics and dissociative photo-ionization of dihalomethanes is presented. Pump-probe experiments demonstrate the creation and control of orbital hole electronic and vibrational wave packets created via strong field ionization [1]. Our simulations provide an interpretation for the experimental signals.

[1] Creation and control of multi-hole molecular wave packets via strong field ionization, D. Geissler, T. Rozgonyi, J. González-Vázquez, L. González, S. Nichols, T. Weinacht, submitted (2009).

Invited Talk SYQS 2.3 Th 15:00 E 415

Quantum Control Spectroscopy in Ultracold Atomic and Molecular Gases — •Matthias Weidemüller — Physikalisches Institut, Universität Heidelberg, Germany

In the past years, there has been enormous progress in the investigation and understanding of the dynamics of ultracold atomic and molecular gases. It was soon realized that methods of coherent control can be fruitfully applied to these systems, which are characterized by an extreme level of control over motional and internal degrees of freedom. After a general introduction into these recent developments, I will focus on the interaction of shaped ultrashort laser pulses with ultracold atoms and molecules and present our recent work on this subject.

The work presented has been done in collaboration with T. Mullins, R. Wester and other members of my former group at the University of Freiburg, and the groups of L. Wöste and C. Koch from FU Berlin.