

DIESE WOCH

PHYSIKALISCHES KOLLOQUIUM

des Fachbereichs Physik
der Johann Wolfgang Goethe-Universität Frankfurt

Mittwoch, den 08.02.2012, 17 Uhr c.t.
Großer Hörsaal, Raum _0.111,
Max-von-Laue-Str. 1

Prof. Dr. Matthias Kling
Max-Planck Institut für Quantenoptik, Garching

„Attosecond electron dynamics in nanoparticles in strong laser fields“

Collective electron motion can unfold on attosecond time scales in nanoplasmonic systems, as defined by the inverse spectral bandwidth of the plasmonic resonant region [1]. Similarly, in dielectrics or semiconductors, the laser-driven collective motion of electrons can occur on this characteristic time scale [2]. The realization of electronics operating at Petahertz frequencies may be feasible by applying waveform controlled laser fields to nanoscale systems, where the nanolocalized near-fields enable for ultimate temporal and spatial control of the relevant electron transport processes. We have recently demonstrated the emission and directional control of highly energetic electrons from isolated nanoparticles in few-cycle laser fields [3]. Comparison of the experimental results to quasi-classical simulations reveals that the electron acceleration mechanism is based on rescattering in the enhanced near-field of the nanoparticles. Experiments, where such enhanced near-fields in plasmonic waveguides were utilized to generate high-order harmonics from a Ti:sapphire oscillator, comprising the most compact extreme ultraviolet light source [4], will be highlighted. Our aim is to measure the collective electron motion in nanostructures in strong laser fields in real-time. Theoretical [1,5] and experimental progress in this direction will be presented.

References:

- [1] M.I. Stockman, M.F. Kling, U. Kleineberg, F. Krausz, Attosecond nanoplasmonic field microscope, *Nature Photonics* 1, 539 (2007).
- [2] M. Durach, A. Rusina, M.F. Kling, M.I. Stockman, Predicted ultrafast dynamic metallization of dielectric nanofilms by strong single-cycle optical fields, *Phys. Rev. Lett.* 107, 086602 (2011).
- [3] S. Zharebtsov, Th. Fennel, J. Plenge, E. Antonsson, I. Znakovskaya, A. Wirth, O. Herrwerth, F. Süßmann, C. Peltz, I. Ahmad, S. A. Trushin, V. Pervak, S. Karsch, M.J.J. Vrakking, B. Langer, C. Graf, M.I. Stockman, F. Krausz, E. Rühl, M.F. Kling, Controlled near-field enhanced electron acceleration from dielectric nanospheres with intense few-cycle laser fields, *Nature Physics* 7, 656 (2011).
- [4] I.-Y. Park, S. Kim, J. Choi, M.F. Kling, M.I. Stockman, S.-W. Kim, Plasmonic generation of ultrashort extreme-ultraviolet light pulses, *Nature Photonics*, DOI:10.1038/nphoton.2011.258 (2011).
- [5] F. Süßmann, M.F. Kling, Attosecond nanoplasmonic streaking of localized fields near metal nanospheres, *Phys. Rev. B* 84, 121406 (2011).

Die Dozenten der Physik

Kolloquium

<http://www.uni-frankfurt.de/fb/fb13/Termine/index.html>