

Physikalisches Kolloquium



Thursday, 11.12.14, 17:15, HS 100
 Reception with coffee & cookies 16:45

Prof. Claus Ropers, Georg-August-Universität Göttingen

Strong-field interactions of electrons with optical near-fields at Nanostructures: Classical and quantum phenomena

Abstract

The spatial confinement of light using metallic nanostructures enables the enhancement of a multitude of different nonlinear optical phenomena, including harmonic generation, atomic ionization, and nonlinear photoemission. This talk will discuss the nonlinear and field-driven interaction of electrons with localized optical near-fields at nanostructures over a broad range of physical parameters, with an emphasis on several examples of our recent and ongoing work. Specifically, the characteristics of ultrafast photoelectron emission from nanoscopic cathodes is studied, alongside strategies to control this photoemission and utilize it in time-resolved electron imaging and diffraction applications.

In one set of measurements, photoemission spectra from electrochemically etched metal nanotips are investigated controlled using intense near- and mid-infrared laser pulses as well as THz radiation. In an application of nanotip photoemission, the enhanced brightness of these electron sources can be used to implement Ultrafast Low-Energy Electron Diffraction (ULEED) and Ultrafast Transmission Electron Microscopy (UTEM). In UTEM, the spectroscopic study of fast electrons scattered in nanostructure near-fields can be used to both quantitatively characterize the underlying field distributions with high spatial resolution, and to quantum-coherently manipulate the momentum distribution of ultrashort electron pulses.

References

- [1] M. Sivilis, M. Duwe, B. Abel and C. Ropers, "Extreme-ultraviolet light generation in plasmonic nanostructures", *Nature Physics* **9**, 304(2013)
- [2] M. Sivilis and C. Ropers, "Generation and Bistability of a Waveguide Nanoplasma Observed by Enhanced Extreme-Ultraviolet Fluorescence", *Phys. Rev. Lett.* **111**, 085001 (2013)
- [3] R. Bormann, M. Gulde, A. Weismann, S. V. Yalunin, and C. Ropers, "Tip-enhanced strong-field photoemission" *Phys. Rev. Lett.*, **105**, 147601 (2010).
- [4] G. Herink, D. R. Solli, M. Gulde, and C. Ropers, "Field-driven photoemission from nanostructures quenches the quiver motion", *Nature* **483**, 190 (2012).
- [5] L. Wimmer, G. Herink, D. R. Solli, S. V. Yalunin, K. E. Echternkamp, and C. Ropers, "Terahertz control of nanotip photoemission", *Nature Physics* **10**, 432 (2014).
- [6] A. Paarmann, M. Gulde, M. Müller, S. Schäfer, S. Schweda, M. Maiti, C. Xu, T. Hohage, F. Schenk, C. Ropers and R. Ernstorfer, "Coherent femtosecond low-energy single-electron pulses for time-resolved diffraction and imaging: A numerical study", *Journal of Applied Physics* **112**, 113109 (2012)
- [7] M. Gulde, S. Schweda, G. Storeck, M. Maiti, H. K. Yu, A. M. Wodtke, S. Schäfer, and C. Ropers, "Ultrafast low-energy electron diffraction in transmission resolves polymer/graphene superstructure dynamics", *Science* **345**, 200 (2014).

All of you interested in physics are cordially invited!

Contact: Prof. T. Baumert, More Information: uni-kassel.de/go/physikalisches_kolloquium

