CFEL SCIENCE

Colloquium

20th June 2014 - 14:00

CFEL Seminar rooms I-III (DESY Bldg. 99)

Claus Ropers

University of Göttingen

Nanoscopic photoelectron sources for the study of ultrafast structural dynamics

The spatial confinement of optical near-fields 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 introduce photoelectron emission from nanoscopic emitters over a broad range of physical parameters, focusing on several examples of our recent work. Specifically, we study the characteristics of ultrafast photoelectron emission from metallic nanocathodes as well as strategies to actively control this photoemission and utilize it in electron imaging and diffraction applications.

Specifically, photoemission spectra from metal nanotips are investigated using intense near- and mid-infrared laser pulses with wavelengths ranging from 400 nm to 10 µm. The results demonstrate localized electron emission and ponderomotive acceleration up to energies of hundreds of eV. The measurements lead to the identification of a sub-cycle field-driven regime, in which the near-field decay length plays a crucial role in the electron dynamics.

In a related geometry, we employ single-cycle terahertz (THz) transients to further control the nanotip photoemission. Based on large enhancements of the THz field at the tip apex, we demonstrate gating and spectral streaking of the photoemission process, including stretching or compression of the photoemission spectrum.

In a first application, we use the enhanced brightness of nanotip photoemission in an electrostatic lens geometry to implement ultrafast low-energy electron diffraction (ULEED). This new technique allows for the study of structural dynamics with high temporal resolution and ultimate surface sensitivity.

Hosts: Krishna Murari/ Kemal Ahmed, IMPRS