PAUL SCHERRER INSTITUT

Extra
Photon Science Seminar

Ultrashort and ultrabright x-ray free electron laser pulses for studies of correlated materials

Simon Gerber

Stanford Institute for Materials and Energy Sciences, SLAC National Accelerator Laboratory and Stanford University, USA

DATE: Monday, August 31st, 2015

TIME: ~~11:00~~ **NEW AT 11:15**

ROOM: WBGB/019

Abstract

X-ray free electron lasers (FEL) provide coherent femtosecond x-ray pulses with unprecedented brilliance, enabling x-ray scattering measurements that are extremely challenging at synchrotron lightsources. In my talk, I will discuss two of our recent experiments at the Linac Coherent Light Source (LCLS) to demonstrate how an x-ray FEL can be employed to study the properties of matter in the time domain and at very high magnetic fields.

The shortness of the x-ray FEL pulses results in an outstanding time-resolution in, so-called, pump-probe experiments. I will describe how time-resolved x-ray scattering can quantify the lattice dynamics in iron-based compounds upon coherent excitation of an optical phonon. This direct quantification of the coherent lattice dynamics reveals that even a small photo-induced lattice distortion can induce notable changes in the electronic and magnetic properties.

The second example employs the peak brilliance of an FEL. Synchronization of a pulsed magnet with the x-ray FEL pulses reveals that a three-dimensional charge density wave emerges in the superconducting cuprate $YBa_2Cu_3O_{6.67}$ beyond 15 Tesla. This approach enables x-ray scattering at magnetic field strengths up to 28 Tesla, comparable to those used in other high-field techniques, such as nuclear magnetic resonance. Our results imply that charge order and high-temperature superconductivity are not simply competing in the cuprates, but rather intimately linked.

Contact: G. Aeppli (4232)