Fritz-Haber-Institut der Max-Planck-Gesellschaft

Physikalische Chemie — Direktor: Prof. Dr. Martin Wolf

MAX-PLANCK-GESELLSCHAFT

Department Seminar:

Monday, October 23, 2017, at **11:00** a.m.;
— all are invited to meet at around 10:40 for a chat and coffee —

Dr. Gerhard Ingold Femto Group,
Laboratory for Synchrotron Radiation - Condensed Matter,
Paul Scherrer Institute, Villigen PSI, Switzerland.

BERNINA Instrument at SwissFEL
Femtosecond Diffraction and Scattering in Condensed Matter

PC Seminar Room G2.06, Building G, Faradayweg 4 L. Rettig

Abstract:

The BERNINA instrument under construction at the ARAMIS hard X-ray free electron laser is designed to perform femtosecond X-ray experiments in condensed matter and material science employing photon-in and photon-out techniques in the range (2.1)4.5-12.4 keV. Such techniques combined with excitation pulses derived from a femtosecond optical laser in a pump-probe scheme allow to study the stimulated response of functional or correlated crystalline materials in the time domain with atomic resolution on a sub-ps timescale. In such materials novel electronic properties reflect a balance between several competing interactions, both of long- and short-range order, including charge and orbital ordering, magnetism, and coupling to the lattice. One way to clarify cause and effect of coupled ordering is to selectively pump and probe specific modes by tailored pulses when the system is tuned by adjusting thermodynamic variables such as temperature, magnetic field or pressure.

In the first part of my talk I will present a specific example by discussing the stimulated magneto-structural phase transition in the prototypical MSMA Ni_2MnGa. We combine trXRD to directly measure the structural dynamics and trMOKE to capture the transient magnetic order. We measure decay and recovery timescales to follow the evolution of both the structure and magnetization in time. Our latest results suggest that the photoinduced demagnetization modifies the Fermi surface in regions that couple strongly to the periodicity of the structural modulation.

In the second part I will present an overview and the status of the instrument. Its design emphasizes rapid reconfiguration capability in terms of flexible sample environment, goniometers, spectrometers, scattering and detector geometries to support a wide variety of experiments that benefit from short pulses. Based on experiments we have performed in the past, several developments are under way to enable new type of experiments, namely the improvement of the time resolution by an order of magnitude, THz-pumping, polarization-resolved resonant diffraction (trRXRD), high pulsed magnetic fields at low temperatures, and momentum resolved inelastic scattering (trRIXS).