

Symposium Photons for Magnetism (SYPM)

jointly organized by
the Magnetism Division (MA),
the Semiconductor Physics Division (HL),
the Microprobes Division (MI), and
the Surface Science Division (O)

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Accelerator-based photon sources producing highly brilliant synchrotron radiation have played an important role in the development of magnetism and spintronics during the last 20 years. The exploitation of x-ray magnetic circular dichroism and related phenomena has enabled the advancement of sophisticated experimental techniques in spectroscopy, scattering, and imaging. This symposium brings together people from the areas of magnetism and accelerator physics in an effort to identify the chances for future magnetism research lying in the development of new accelerator-based light sources, such as free-electron lasers, or energy recovery linacs. These new sources provide improved brilliance and short light pulses in the femtosecond regime. Therefore, particular emphasis is paid to time-resolved experiments and the application of these light sources in pump-probe investigations in spin dynamics.

Overview of Invited Talks and Sessions

(Lecture Room H1)

Invited Talks

SYPM 1.1	Thu	15:00–15:30	H1	Ultrafast emergence of nanoscale ferromagnetism far from equilibrium — ●HERMANN DÜRR
SYPM 1.2	Thu	15:30–16:00	H1	Free-Electron Laser for Ultrafast Measurements in Material Science — ●SVEN REICHE
SYPM 1.3	Thu	16:00–16:30	H1	Nanomagnetism seen by Femtosecond X-rays — ●STEFAN EISEBITT
SYPM 1.4	Thu	16:30–17:00	H1	Ultrashort Radiation Pulses at Storage Rings — ●HOLGER HUCK
SYPM 1.5	Thu	17:00–17:30	H1	Every atom counts - Magnetic properties of supported metal atoms and small alloy clusters — TORBEN BEECK, IVAN BAEV, STEFFEN PALUTKE, KAI CHEN, SÖREN MEYER, KARI JÄNKÄLÄ, MICHAEL MARTINS, ●WILFRIED WURTH

Sessions

SYPM 1.1–1.5	Thu	15:00–17:30	H1	Photons in Magnetism (MA, HL, MI, O)
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SYPM 1: Photons in Magnetism (MA, HL, MI, O)

Time: Thursday 15:00–17:30

Location: H1

Invited Talk SYPM 1.1 Thu 15:00 H1
Ultrafast emergence of nanoscale ferromagnetism far from equilibrium — ●HERMANN DÜRR — SLAC National Accelerator Laboratory, Menlo Park USA

Long-range magnetic order in solids is usually ascribed to the exchange interaction between electron spins. Close to equilibrium this leads to spontaneous magnetization when the system cools below the magnetic ordering temperature. We show that the far from equilibrium flow of angular momentum via spin currents can also achieve long-range ferromagnetic order even above the ordering temperature. To reveal this process, we use ultrafast x-ray diffraction at SLAC's Linac Coherent Light Source to probe the nucleation, growth and transient existence of ferromagnetic order on the nm length and fs timescale after fs optical laser excitation has brought a metallic 3d - 4f alloy system into a highly non-equilibrium chaotic spin state. The technological exploitation of this effect could pave the way for novel ways to manipulate and transport information within the smallest space-time dimensions.

Invited Talk SYPM 1.2 Thu 15:30 H1
Free-Electron Laser for Ultrafast Measurements in Material Science — ●SVEN REICHE — Paul Scherrer Institute, Villigen, Switzerland

Free-electron Lasers provide intense and coherent photon pulses with femtosecond pulse duration down to the Angstrom wavelength level. With ability to freely adjust the resonant wavelength and polarization it became a unique instrument to study ultrafast process on the Atomic level in a broad range of research fields. This presentation gives a brief introduction on the functionality of a Free-electron LASER and possible application for material science.

Invited Talk SYPM 1.3 Thu 16:00 H1
Nanomagnetism seen by Femtosecond X-rays — ●STEFAN EISEBITT — Institut für Optik und Atomare Physik, Technische Universität Berlin

Magnetism exhibits phenomena on intrinsic timescales spanning many orders of magnitude. Femtosecond light sources have given us access to ultrafast de/remagnetization phenomena. Due to their short wavelength, novel fs X-ray sources allow us to probe such phenomena in conjunction with spatial information at the nanoscale. I will report on resonant scattering experiments at Free Electron X-ray Lasers, which allow us to observe the influence of electronic transport in the presence of magnetic domains on ultrafast demagnetization phenomena. In addition, ultrafast real space observation of magnetic domains via x-ray holography using single fs-pulses from X-ray lasers has become a reality and will be discussed.

Invited Talk SYPM 1.4 Thu 16:30 H1
Ultrashort Radiation Pulses at Storage Rings — ●HOLGER HUCK — Zentrum für Synchrotronstrahlung, Technische Universität Dortmund, Deutschland

With the advent of linac-based SASE-FELs, the investigation of ultrashort phenomena on the sub-picosecond scale is becoming a rapidly growing field of research. Synchrotron radiation sources based on storage rings offer a broad range of photon energies and higher repetition rates than linear accelerators, but have an inherently longer pulse duration of typically several ten picoseconds. However, different techniques have been developed to generate ultrashort radiation pulses ranging from the THz to the X-ray regime at storage rings. Several of these techniques will be outlined in this talk. For example in Germany, BESSY, ANKA and the MLS are regularly operated in low-alpha mode, a femto-slicing source exists at BESSY, and the CHG (coherent harmonic generation) scheme is employed by the DELTA short-pulse facility, for which EEHG (echo-enabled harmonic generation) is planned as an upgrade.

Invited Talk SYPM 1.5 Thu 17:00 H1
Every atom counts - Magnetic properties of supported metal atoms and small alloy clusters — TORBEN BEECK, IVAN BAEV, STEFFEN PALUTKE, KAI CHEN, SÖREN MEYER, KARI JÄNKÄLÄ, MICHAEL MARTINS, and ●WILFRIED WURTH — Institut für Experimentalphysik, Universität Hamburg, Luruper Chaussee 149, 22761 Hamburg

Investigation of supported metal atoms and small clusters with a well-defined number of atoms gives fundamental insights into the evolution of magnetic properties from single atoms to nanostructures. Experimental results can be compared to theoretical studies since the supported small clusters present tractable systems for sophisticated theoretical methods that explicitly include strong correlation effects. Experimentally the magnetic properties can be investigated using magnetic circular dichroism in resonant x-ray absorption (XMCD). XMCD at modern synchrotron radiation sources such as BESSY II in Berlin and PETRA III in Hamburg allows us - due to its element specificity - to investigate very dilute targets such as small particles with very few atoms even on a large background, i.e. in contact with a metal substrate. In the talk I will review results on single metal atoms as well as small alloy clusters with a defined number of atoms and composition in contact with a metal substrate which illustrate how the local properties such as spin and orbital magnetic moment strongly depend on the interaction within the cluster and with the substrate.

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