Experimentelle Physik 2

Seminar Festkörperphysik (CMP Seminar)

Aktuelle Probleme der Festkörperphysik für Studenten und Mitarbeiter
020236 Kolloquium/Seminar SS 25
Vorlesungszeit: 10.04.2025 – 24.07.2025

Monday, 19.05.2025
12:10 - CP-E0-139

Ultrafast Magnetism Across Magnetic Material Classes

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Ultrafast magnetism - studying spin dynamics on femtosecond to picosecond timescales - reveals fundamental differences between magnetic materials. Metallic ferromagnets, such as transition metals, demagnetise rapidly due to strong electron-electron and electron-phonon interactions enabled by free charge carriers. These processes drive the transfer of energy and angular momentum, allowing magnetic responses within hundreds of femtoseconds. Metallic antiferromagnets are predicted to switch even faster via spin-flip scattering between antiparallel sublattices, requiring minimal lattice interaction and offering potential for high-speed spintronics. In contrast, dielectric antiferromagnets, such as magnetic insulators, lack free electrons and rely on spin-lattice coupling, magnon excitation and spin-orbit effects. Their dynamics therefore occur on longer time scales. Our study examines representative systems - metallic ferromagnets, metallic and dielectric antiferromagnets, and emerging altermagnets - using direct optical excitation to explore characteristic timescales and mechanisms. These insights are critical for advancing ultrafast spintronic technologies and unlocking new non-equilibrium phenomena.