

Ultrafast material dynamics studies at the European XFEL

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The European X-ray Free-Electron Laser (FEL) is a high-repetition-rate X-ray user facility delivering soft and hard X-ray femtosecond pulses of unprecedented peak brilliance for studies in physics, chemistry, life sciences, and other disciplines.

Since fall 2017, six scientific instruments are in operation providing a diverse set of x-ray methodologies, and sample environments to address ultrafast processes in atoms, complex molecules, clusters or condensed matter. This talk will focus on out-of-equilibrium dynamics of complex materials and nanostructures in their fundamental space-time dimensions revealing the interplay of charge, spin, orbital and lattice couplings.

An overview of the employed X-ray techniques and capabilities in the soft and hard X-ray photon energy ranges will be given along with recent scientific examples of laser-driven phase transitions and magnetization dynamics of strong spin-lattice-coupled nanostructures. The presentation will conclude with a brief outlook to new capabilities of the XFEL and the instruments.