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Wednesday, 15.06., 15⁴⁰ - 16²⁰

Scientific opportunities and challenges for time-resolved studies using X-ray Free Electron Lasers

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With the advent of soft- and hard X-ray Free Electron Lasers (XFEL) sources, entirely new scientific opportunities and prospects have been become available in the field of time-resolved X-ray spectroscopy and X-ray scattering. One of the most unprecedented features of XFELs is their ability to produce high intensity pulsed X-ray beams with single pulse duration well below 100 femtoseconds ($1 \text{ fs} = 10^{-15} \text{ s}$). This property allows dynamical studies of light-matter interactions virtually in any medium on the very fundamental timescales of interatomic motions, i.e. intra- and intermolecular vibrations, from gas-phase to complex strongly correlated solids, i.e. high-temperature superconductors, and biomolecules. However, this unique feature of XFEL beams permits also to snapshot static structures of nanometer-sized protein crystals before the ionization and electrostatic forces “destroy” the crystal. These developments led to establishing new methodologies in structural biology, such as serial femtosecond crystallography (SFX) and very rapid development of new sample delivery methods.

In this talk I will present a state-of-the-art overview of the abovementioned research venues, which highly benefit from the progress in the field of XFEL technology, and in particular, I will focus on those aspects, which profit most from the temporal properties of the XFEL beams.

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Preparing for First Science Experiments at European XFEL

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The European X-Ray Free-Electron Laser (European XFEL) in the Hamburg area, Germany, is presently entering its commissioning phase and prepares for first scientific user experiments. Following successful first commissioning of the main electron accelerator, the first undulator, and the x-ray beam transport and instrumentation at the Femtosecond X-ray Experiments (FXE) and (SPB/SFX) instruments an early user experiment program shall start in summer 2017. In the talk I will briefly summarize the status of the European XFEL project and provide details about the start of user operation. Using examples of recent scientific applications, using other x-ray FEL facilities, and the available instrumentation at the science instruments at European XFEL then will be used to discuss classes of experiments that will be possible to be conducted in the early user program.