AKjDPG 3: Free-Electron Lasers

Time: Sunday 16:00–17:30 Location: C 02

Tutorial AKjDPG 3.1 Sun 16:00 C 02

Opportunities for experiments on atoms, molecules and clusters at the European X-Ray Free Electron Laser — •Michael Meyer — European XFEL, Schenefeld, Germany

The unique characteristics of X-ray Free Electron Lasers (XFELs), especially the high intensity (up to $10^{19} W/cm^2$) and the short duration (down to the sub-femtosecond regime) of the generated X-ray pulses, open access to various new research opportunities for investigations of atoms, molecules, ions and nanoparticles. Using typical recent experiments as showcase, the tutorial will illustrate which novel information is obtained for example in studies of multi-photon processes in the short wavelength regime and how dynamical information can be extracted from site-specific time-resolved pump-probe experiments.

The relevant instrumentation, required experimental conditions and important photon beam parameters enabling this type of studies will be presented and discussed, taking the Small Quantum Systems (SQS) scientific instrument at the European XFEL as example. In the presentation, strong emphasis will be given to provide a basic guideline for successful experiments, addressing especially new users of FEL facilities. Practical information about the experimental infrastructure available to users as well as the operational support provided by the facility to the researchers for the preparation, execution and subsequent analysis of an experimental campaigns will be outlined.

Tutorial AKjDPG 3.2 Sun 16:45 C 02

Your first Free-Electron Laser experiment: What to know before you go — •Kirsten Schnorr — Paul Scherrer Institut, Villigen, Switzerland

X-ray Free-Electron Lasers (XFELs) have emerged as uniquely powerful light sources that enable experiments on the femtosecond time scale due to their ultrashort pulses with atomic resolution exploiting the short wavelengths or state-selectivity of X-rays. This tutorial will introduce the fundamental properties of XFEL radiation and give an overview of the current XFEL landscape.

Building on this foundation, we will survey key application areas of XFELs with a focus on atomic, molecular and optical (AMO) physics. The fundamental interaction mechanisms of X-rays and matter will be reviewed. We will discuss how a temporal resolution down to the femto- and even atto-second time scale can be achieved using the pump-probe technique. We will look into typical XFEL applications in AMO sciences either making use of the extreme X-ray intensities which result in the absorption of multiple X-ray photons within one pulse by a target and/or exploiting the high achievable temporal resolution. Finally, the tutorial will provide a practical overview of the architecture of a typical XFEL beamline and experimental station for AMO sciences.