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New scientific opportunities for studies of non-equilibrium dynamics at the European XFEL

Dr. Sakura Pascarelli

European XFEL

In the past decade we have seen very important developments in the field of accelerator based X-ray user facilities, with the advent of 4th generation synchrotron sources and MHz rate free electron lasers. The first hard X-ray free-electron laser, LCLS (US) became operational in 2009 and over the last decade four additional hard X-ray FELs have begun user operation. Among these, the EuXFEL is the first high photon energy FEL powered by a superconducting accelerator, leading to an increase of more than 2 orders of magnitude in the number of delivered photon pulses per second to the sample. A unique feature of X-ray FELs is the combination of the extremely short (fs) photon pulses with the short (Å) wavelengths of hard x-rays produced. These relatively new user facilities are opening novel avenues in the investigation of fundamental processes in many areas of science, from physics to chemistry, biology and materials science, because they allow investigation of matter at the time scales of electron and nuclear dynamics (down to fs), with chemical selectivity and bulk sensitivity.

After many years of construction, user operation at the Eu-XFEL ramped up gradually, and between 2017 and 2019 six instruments were delivered to the user community and are now operational. In the first part of my presentation I will briefly introduce the present performance of the facility in terms of electron and photon beam characteristics and provide an overview of recent science highlights in different scientific domains. In the second part, I will focus on perspectives for studies of equilibrium and non-equilibrium dynamics exploiting MHz sequential X-ray Photocorrelation Spectroscopy. I will describe challenges encountered in first attempts to investigate fluctuation dynamics on the microsecond timescale in different systems, including water, polymers and proteins in solution. I will also show first results related to investigation of rare, stochastic events by X-ray holographic imaging, highlighting the unique advantages of high repetition rate sources for these investigations.

Für diese Zeit steht eine Kinderbetreuung nach vorheriger Anmeldung zur Verfügung.

Contact: Prof. Dr. Björn Sothmann, Faculty of Physics
Phone: +49 (203) 37-91578 / Mail: bjoerns@thp.uni-due.de