

Seminar in Ultrafast Science and Technology

- Speaker:** Dr. Andreas Galler, European XFEL GmbH, 22869 Schenefeld, Germany
- Title:** Exploring Ultrafast Molecular Dynamics:
The Femtosecond X-ray Experiments Instrument
- Date&Time:** Thursday, 20 October 2016, 11:15
- Location:** **Lecture room B116**, Building Exakte Wissenschaften, Sidlerstrasse 5, Bern, Switzerland

Understanding the initial steps during ultrafast molecular reactions is a vital goal in structural dynamics research. While pico- and femtosecond x-ray absorption (XAS) as well as x-ray emission (XES) techniques have now matured for geometric structure and oxidation state changes (XAS) [1], and electronic structure changes (XES) [2], we seek to exploit complementary x-ray techniques like x-ray diffuse scattering (XRD) to unravel the complete dynamic sequence(s), which include electronic structure changes (via XES and XAS) next to often concomitant geometric structure changes (via XRD and XAS). These studies represent key experiments that will become readily feasible at the Femtosecond X-ray Experiments (FXE) instrument, permitting simultaneous (or quasi-simultaneous) studies of the same sample with these different tools, down to the shortest time scales available. As state of the art the formation of a high-valent Fe(V) containing complex at biologically compatible conditions, i.e. at room in solution phase is investigated, using the above mentioned x-ray techniques. The European XFEL facility will deliver a remarkably different pulse pattern than any other femtosecond hard X-ray source. It will support 6 Scientific Instruments in the initial configuration with 3 SASE beamlines. The FXE station located at the SASE 1 beamline will make use of the 5-20 keV range for dynamical pump-probe studies offering a highly versatile sample environment setting allowing for gaseous as well as condensed matter experiments. Next to the complete FXE instrument specifications we present benchmark experiments which make use of the FXE built in x-ray techniques at highest time resolution.

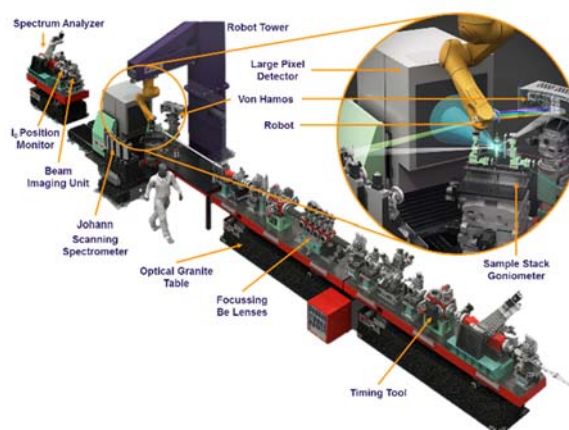


Figure 1: Artist view of the FXE instrument showing a detailed setup of optics and available x-ray techniques.

References:

- [1] C. Bressler, C. Milne, V. T. Pham, A. El Nahhas, R. M. van der Veen, W. Gawelda, S. Johnson, P. Beaud, D. Grolimund, M. Kaiser, C. N. Borca, G. Ingold, R. Abela, and M. Chergui, *Science* **323**, 489 (2009).
- [2] W. Zhang, R. Alonso-Mori, U. Bergmann, C. Bressler, M. Chollet, A. Galler, W. Gawelda, R. G. Hadt, R. W. Hartsock, T. Kroll, K. S. Kjær, K. Kubiček, H. T. Lemke, H. W. Liang, D. A. Meyer, M. M. Nielsen, C. Purser, J. S. Robinson, E. I. Solomon, Z. Sun, D. Sokaras, T. B. van Driel, G. Vankó, T.-C. Weng, D. Zhu, and K. J. Gaffney, *Nature* **509**, 345 (2014).