MS06.O06

Preparing for SwissFEL: Exploring the limits of time-resolved X-ray spectroscopy

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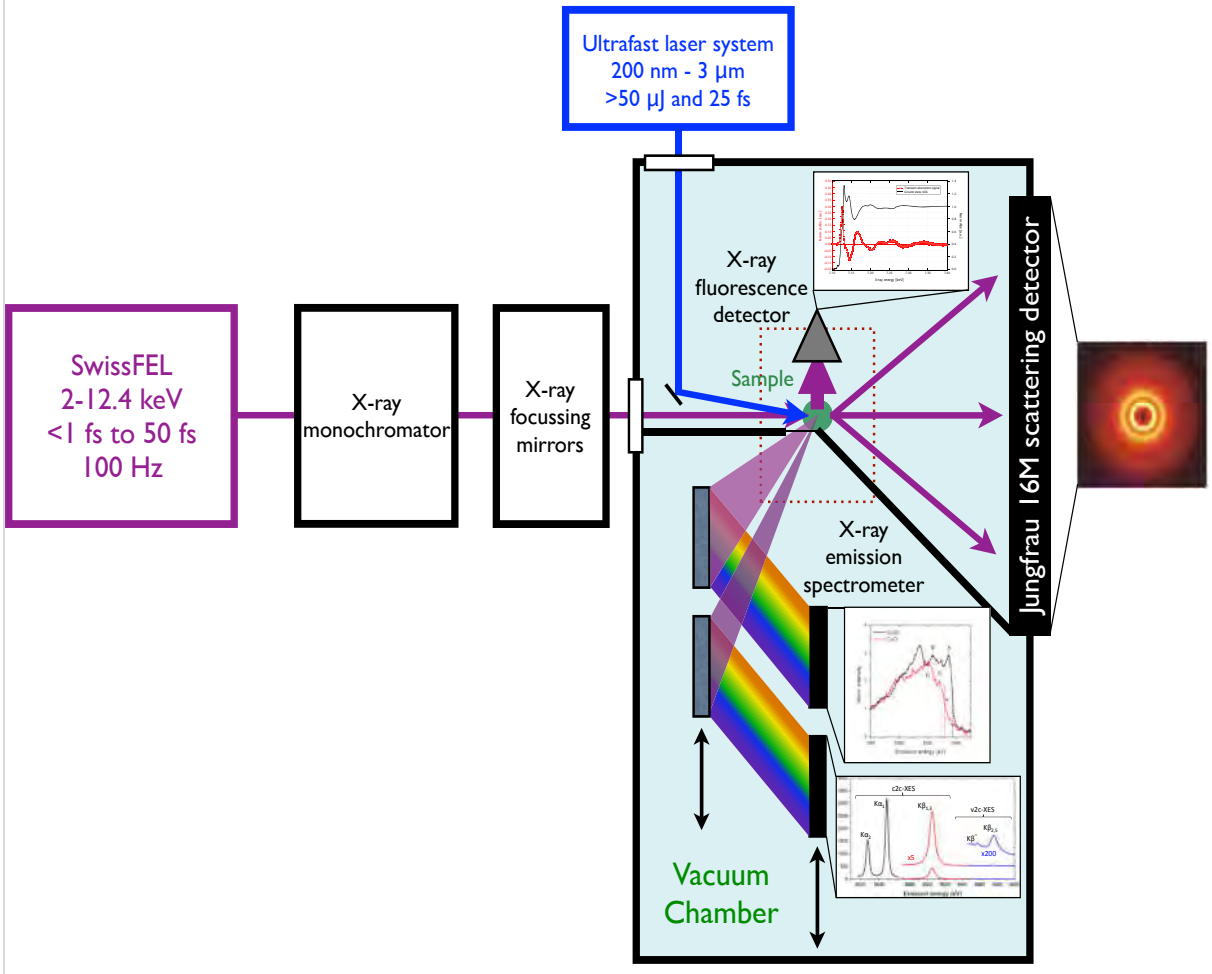
Using x-ray absorption spectroscopy (XAS) and x-ray emission spectroscopy (XES) to probe laser-excited samples we can obtain excited-state structural and electronic dynamical information not available through other techniques.[1] One of the restrictions of most synchrotron-based implementations of this technique is the three-orders of magnitude mismatch between x-ray and laser repetition rates (MHz Vs. kHz). By using a laser capable of generating significant pulse energies at MHz repetition rates we can eliminate this discrepancy, thus greatly reducing measurement times and enhancing achievable signal-to-noise ratios.[2] Several examples that demonstrate the strength of this technique will be presented, including probing the electron relaxation in photoexcited TiO2 nanoparticles in solution and resolving the dynamical structural changes associated with ligand rebinding in the protein myoglobin under physiological conditions. The ability to extend these types of measurements into the femtosecond regime at Experimental Station A[3] at the SwissFEL hard X-ray free electron laser, which is under construction at the Paul Scherrer Institute (Villigen, Switzerland), will be discussed.

[1] *T. J. Penfold, C. J. Milne, and M. Chergui, Advances in Chemical Physics 153, 1 (2013).,* ***[2]*** *F. A. Lima, C. J. Milne, D. C. V. Amarasinghe, et al., Rev Sci Instrum 82, 063111 (2011).,* ***[3]*** *http://www.psi.ch/swissfel/internal-reports*



Keywords: XFEL, photochemistry, X-ray spectroscopy