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Serial Femtosecond Crystallography at the SwissFEL X-Ray Free Electron Laser

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We describe the possibility of performing serial femtosecond crystallography experiments at the SwissFEL X-Ray Free Electron Laser (FEL).
Single crystal X-ray diffraction snapshots can be collected from a stream of microcrystals flowing in a water jet using femtosecond pulses from a hard X-ray FEL (1).
Diffraction from ultra-short (<70 fs) pulses can be collected before significant changes occur to the sample (2). The recorded diffraction patterns can be indexed and merged in order to get accurate structure factors and then to calculate the electron density map (3). Serial crystallography can therefore be a novel way to determine the structure of proteins that do not grow into crystals of sufficient size for standard synchrotron radiation measurements or are particularly sensitive to radiation damage.
Serial crystallography also opens up the possibility for time resolved structural studies of irreversible processes. Optical pump lasers synchronized to FEL pulses (4) can be used to obtain X-ray diffraction snapshots from the excited states of proteins in nanocrystals, thus allowing the study of reaction dynamics in biological systems.
In the poster we show that these experiments can be performed at SwissFEL X-Ray FEL and we give details on beam, detectors and sample environment requirements.

1. H.N.Chapman et al. - Nature 470, 73 (2011)
2. A.Barty et al. - Nature Photonics (2011)
3. U. Weierstall, R. B. Doak, and J. C. H. Spence. Rev. Sci. Instr. Submitted (http://arxiv.org/abs/1105.2104)(2011)
4. R. A. Kirian et al. Acta Cryst A 67, 131 (2011)

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