Set beamline to stun: High energy serial data collection at Diamond beamline I24


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Time-resolved structural biology methods took a leap forward with the advent of XFEL radiation. The coupling of tens of femtosecond duration pulses for pump-probe diffraction before destruction with serial sample delivery techniques made it possible to follow fast irreversible dynamic processes in protein structures [1]. Beyond initial rapid changes, however, a lot of interesting biology occurs on the microsecond to second time domain, which does not require an XFEL to follow [2]. Serial Synchrotron X-ray Crystallography (SSX) provides a versatile and accessible technique to fill in the gaps and measure these slower time-points.

At I24, Diamond’s microfocus macromolecular crystallography beamline, we can perform time-resolved SSX experiments on fixed targets or viscous jets, activating reactions using laser light [3], rapid mixing [4], or X-rays [5] to collect microsecond time-resolved structures. Previous serial work using the Pilatus 6M from Dectris allowed 10 ms exposure times at 12.4 keV. We are now moving towards high energy serial data collection using a cadmium telluride Eiger detector. This allows users to take advantage of higher diffraction efficiency, lower X-ray absorption, photo-electron escape from microcrystals, and reduced exposure times [6].

The ability to perform dynamic serial crystallography experiments at synchrotrons improves accessibility to time-resolved methods, reduces the burden on XFEL sources to measure slower time points, and leads to beneficial hardware and software development for both sources. We will present the latest results and developments in time-resolved high energy SSX data collection at I24.

Figure 1. The fixed target serial synchrotron crystallography setup on Diamond Light Source beamline I24.