Adventures in Scarcity: Collecting, Processing, and Understanding Sparse Data in Serial Microcrystallography

There is a growing interest in pursuing serial microcrystallography (SMX) experiments at existing storage ring (SR) sources. For very small crystals, radiation damage occurs before sufficient diffraction is recorded to determine the orientation of the crystal. The challenge is to merge data from a large number of such “sparse” frames in order to measure the full reciprocal space intensity. With the EMC algorithm, we show that the diffracted intensity of a crystal can still be reconstructed even without knowledge of the orientation of the crystal in any sparse frame. Recent results show that EMC-based SMX experiments should be feasible
at SR sources.

Meanwhile at CHESS, we focus on providing a clean, bright microbeam for serial microcrystallography together with advances in low-background sample delivery. In collaboration with the Dwayne Miller Group from the University of Toronto, we've developed a sample delivery system which allows for one degree of oscillation per crystal over thousands of positions within a micro-fabricated chip. In conjunction with a fast framing detector, this establishes the feasibility of rapid oscillation data collection in serial protein microcrystallography.

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