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Mitigating radiation damage in x-ray macromolecular crystallography at synchrotron sources Y. ZOU FINFROCK, EDWARD STERN, RANDY ALKIRE, YIZHAK YACOBY, KENNETH EVANS-LUTTERODT, AARON STEIN, NORMA DUKE, GERALD SEIDLER, ANDRZEJ JOACHIMIAK, UNIVERSITY OF WASHINGTON TEAM, ARGONNE NATIONAL LABORATORY COLLABORATION, BROOKHAVEN NATIONAL LABORATORY COLLABORATION, HEBREW UNIVERSITY COLLABORATION — A new strategy is presented to reduce primary x-ray damage in macromolecular crystallography using synchrotron radiation. The basic principle was to separate as much as possible the x-ray irradiated region, where the diffracted signal originates, from the region where damage accumulates. This is possible since, by far, most of the damage is caused by the photo-electrons (PE's) excited as an x-ray photon is absorbed, and distributes its damage typically over several μm's. The optimum method to accomplish this was to focus the x-rays to a vertical line of sub-μm width. Diffraction experiments performed recently at the Advanced Photon Source, with a 0.83x60μm vertical line focus, allowed us to directly measure the spatial dependence of radiation damage in lysozyme crystals. The PE's caused radiation damage to accumulate predominatly outside the irradiateded region of the crystal exposed with line focused beam leading to a 4.5 factor (450%) decease of radiation damage in the focused diffraction signal.

Y. Zou Finfrock

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