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Picosecond Time-Resolved Small- and Wide-Angle X-ray Scattering of Proteins in Solution: A New Method for Tracking Protein Structural Changes NARANBAATAR DASHDORJ, HYUN SUN CHO, FRIEDRICH SCHOTTE, PHILIP ANFINRUD, Laboratory of Chemical Physics, NIDDK, National Institutes of Health, Bethesda, MD 20892 — A detailed mechanistic understanding of protein function requires knowledge of structural change on ultrafast time scales. Small- and wide-angle X-ray scattering (SAXS/WAXS) of proteins in solution exhibit a radial intensity distribution that is sensitive to protein size, shape, and structure. When acquired in a time-resolved fashion, these scattering patterns unveil conformational changes that occur as a protein executes its designed function. We recently developed the infrastructure required to record SAXS/WAXS scattering snapshots with 100-ps time resolution on the BioCARS beamline at the Advanced Photon Source in Argonne, IL. This methodology was used to probe structural changes in several proteins following laser excitation. In all systems studied thus far, the time-resolved scattering fingerprints reveal an unresolvably fast (<100 ps) structure change that presumably corresponds to tertiary motions. Subsequent structure changes occur on time scales that can span more than 8 decades. By characterizing the nature of protein structural changes in solution over a broad range of time scales, we aim to assess their biomechanics and probe the origins of the forces that drive allosteric structure transitions in multi-subunit proteins.

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