Action at the nanoscale: Single-molecule studies of protein motion

Biological systems respond to environmental and chemical perturbations with sophisticated processes that often involve conformational motions of their protein building blocks. These motions have been difficult to resolve due to limitations in sensitivity, specificity, and time resolution. We address these limitations with single-molecule methods, including advances in data analysis that resolve multiple microsecond dynamics occurring in parallel within individual proteins. We explore two processes: (1) photoprotective quenching in oxygenic photosynthesis, uncovering parallel processes that respond to slow and fast changes in sunlight; and (2) the molecular-level motions of a cancer drug target, identifying previously hidden conformational coupling between the extracellular and intracellular domains via a single transmembrane alpha-helix.