Prof. Steven M. Block
Department of Biological Sciences and Department of Applied Physics
Gilbert Hall, 371 Serra Mall, M/C 5020
Stanford University, Stanford, CA 94305-5020
sblock@stanford.edu

Single Molecule Studies on Molecular Motors with Angstrom Accuracy

Recent advances have led to a new field of scientific exploration, dubbed *single molecule biophysics*. Prominent among the enabling technologies is the laser-based optical trap, also known as 'optical tweezers.' When combined with various *in vitro* assays, optical traps can perform physiological measurements on single biomolecules. In conjunction with ultra-sensitive systems for measuring force and displacement, the nanomechanical properties of proteins and nucleic acids are today being explored with unprecedented precision, revealing rich behaviors that have heretofore been obscured by traditional, ensemble-based measurements. We recently succeeded in constructing new optical instrumentation that has broken the 'nanometer barrier,' and is thereby able to resolve displacements ***at the atomic level***, all in an aqueous buffer at ambient temperature, i.e., under physiological conditions. As a consequence, we can now measure the motions of individual RNA polymerase molecules in real time as these step from base to base along a DNA template. On the practical side, base-pair resolution makes it possible to sequence single molecules of DNA in an entirely new way, based on enzyme movements, and points to new directions in biological nanoscience.