



ICFO Colloquium STEVEN BLOCK 'Optical Tweezers: Gene Regulation, Studied One Molecule at a Time'

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June 06, 2014

Friday, June 6th, 12:00, ICFO's Auditorium

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S.W. Ascherman Professor of the Sciences, Departments of Biology and Applied Physics at Stanford University. Steven M. Block is the Stanford W. Ascherman, M.D. Professor of Applied Physics and of Biology. He is a pioneer in the area of single-molecule biophysics, studying the nanomachines of life. Nature's own nanoscale machines, which include proteins and nucleic acids, are complex macromolecules that are exquisitely "designed" to carry out a multitude of sophisticated functions. Using modern laser-based approaches, which include optical traps, single-molecule fluorescence/FRET, and advanced microscopies, Block lab at Stanford University has been able to develop instruments that can measure the nanometer-scale displacements and piconewton-scale forces associated with individual biomolecules. Work in his lab has led to the direct observation of the 8 nm steps taken by

molecular motor kinesin and the sub-nanometer stepping motions of RNA polymerase on a DNA template.

Prof. Block has been selected to the U.S. National Academy of Sciences (2007) and the American Academy of Arts and Sciences (2000), and is a winner of the Max Delbruck Prize of the American Physical Society (2008) as well as the Single Molecule Biophysics Prize of the Biophysical Society (2007). He served as the President of the Biophysical Society during 2005-6. He has also consulted the U.S. government on bioterrorism through the advisory group JASON and he is an amateur bluegrass musician.

Technical advances have led to the birth of a new field, dubbed "single molecule biophysics." Single-molecule methods can record characteristics that are otherwise obscured by traditional, ensemble-based approaches, revealing rich new behaviors in biomolecules. An entire arsenal of techniques with single-molecule sensitivity has now been developed. Prominent among these technologies is the optical trap, or "optical tweezers," which is based upon radiation pressure. When combined with in vitro bioassays, optical trapping microscopes can measure molecular properties with unprecedented precision, down the atomic level-currently achieving a resolution of ~1 angstrom in a bandwidth of ~100 Hz-all while exerting exquisitely controlled forces in the piconewton (pN) range. Ultrasensitive systems for measuring force and displacement permit the nanomechanical properties of single molecules to be explored noninvasively. Among the notable successes for optical traps have been measurements of the fundamental steps generated by motor proteins and by processive nucleic acid enzymes, as well as the strengths of noncovalent bonds between proteins and the energetics and kinetics of folding in biopolymers, such as DNA and RNA. This talk will give special attention to our recent success in following the co-transcriptional folding of RNA in real time as it gets synthesized by RNA polymerase, and how that folding directly regulates genes.

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