

Carlos J. Bustamante

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EDUCATION:

1973 B.S. Universidad Peruana Cayetano Heredia, Biology
1975 M.S. Universidad Nacional Mayor de San Marcos, Biochemistry
1981 Ph.D. University of California, Berkeley, Biophysics,
Advisor: Ignacio Tinoco

HONORS AND/OR PROFESSIONAL EXPERIENCE:

1973-1975 Kellogg Foundation Scholarship during the Magister in Biochemistry
1975-1976 Fullbright Commission and Institute of International Education Fellow
1975-1976 Abraham Rosenberg Scholarship, University of California, Berkeley
1976-1981 Research Assistant, University of California, Berkeley
1981-1982 Postdoctoral Fellow, Lawrence Berkeley Laboratory, University of California, Berkeley
1982-1986 Assistant Professor, Dept. of Chemistry, University of New Mexico
1984 Searle Scholar
1985 Alfred P. Sloan Fellow
1986-1989 Associate Professor, Department of Chemistry, University of New Mexico
1986 Presidential Lecturer in Chemistry, University of New Mexico
1989 State of New Mexico Eminent Scholar
1989-1990 Professor of Chemistry, Dept. of Chemistry, University of New Mexico
1991-1998 Professor of Chemistry and Member of the Institute of Molecular
Biology, University of Oregon, Eugene, Oregon
1994-1998 Howard Hughes Medical Institute Investigator
1995 Elected Fellow of the American Physical Society
1997 - present Member of the Science Advisory Board of the Searle Scholars Program
1998 - present Director, Advance Microscopies Department, Physical Biosciences Division, LBNL
1998 - present Professor of Molecular and Cell Biology and Physics, University of California, Berkeley
2000 - present Howard Hughes Medical Institute Investigator
2001 Honorary Professor, Universidad Nacional Mayor de San Marcos, Lima, Peru
2001- present Member of the Science Advisory Committee of the Burroughs-Wellcome Fund
2001 Nominated for America's Best in Time Magazine
2002 Recipient of the Biological Physics Prize of the American Physical Society
2002 - present Elected member of the National Academy of Sciences
2002 Doctor *Honoris Causa* by the Universidad Nacional de Ingenieria, Lima, Peru
2003 Elected Member of the Board of Directors of the Burroughs-Wellcome Fund
2003 Doctor *Honoris Causa* by the Universidad Peruana Cayetano Heredia, Peru
2004 Alexander Hollaender Award in Biophysics of the National Academy of Sciences
2004 Hans Neurath Prize of the Protein Society
2004 Founders Award of the Biophysical Society Meeting
2004 Southern Peru Copper Corporation Prize (Peru's National Science Prize)
2005 Richtmyer Memorial Lecture Award, American Association of Physics Teachers
2005 Doctor Honris Causa by the University of Chicago

PROFESSIONAL SOCIETIES:

American Association for the Advancement of Science
American Chemical Society
American Physical Society
Biophysical Society
National Academy of Science

RECENT PUBLICATIONS

1. Tang M., Cecconi C., Kim H., Bustamante C., and Rio D., "Guanosine triphosphate acts as a cofactor to promote assembly of initial P-element transposase-DNA synaptic complexes," *Genes & Development*, **19**, 1422-1425 (2005).
2. Chemla, Y.R., Karunakaran, A., Michaelis, J., Grimes, S., Jardine P.J., Anderson, D.L., Bustamante, C., "Mechanism of force generation of a viral DNA packaging motor," *Cell*, **122**, 683-692 (2005).
3. Collin, D., Ritort, F., Jarzynski, C., Smith, S.B., Tinoco, I., Bustamante, C., "Verification of the Crooks fluctuation theorem and recovery of RNA folding free energies," *Nature*, **437**, 231-234 (2005).
4. Cecconi, C., Shank, E.A., Bustamante, C., Marqusee, S., "Direct observation of the three-state of a single protein molecule," *Science*, **309**, 2057-2060, (2005).
5. Bustamante, C., Liphardt, J., Ritort, F., "The nonequilibrium thermodynamics of small systems," *Physics Today* **58**, 43-48 (2005).
6. Mao, H.B., Arias-Gonzalez, J.R., Smith, S.B., Tinoco, I., and Bustamante, C., "Temperature control methods in a laser tweezers system," *Biophysical Journal* **89**, 1308-1316 (2005).
7. Brown, T.A., Cecconi, C., Tkachuk, A.N., Bustamante, C., and Clayton, D.A., "Replication of mitochondrial DNA occurs by strand displacement with alternative light-strand origins, not via a strand-coupled mechanism," *Genes & Development* **19**, 2466-2476 (2005).
8. Wilcox, A.J., Choy, J., Bustamante, C., and Matouschek, A., "Effect of protein structure on mitochondrial import," *PNAS* **102**, 15435 - 15440 (2005).
9. Martinez J, Yuzvinsky T.D., Fennimore A.M., Zettl, A., Garcia R., and Bustamante, C., "Length control and sharpening of atomic force microscope carbon nanotube tips assisted by an electron beam," *Nanotechnology* **16**, 2493-2496, (2005).
10. Gorostiza, P., Tombola, F., Verdaguer, A., Smith, S.B., Bustamante, C., Isacoff, E.Y., "Molecular handles for the mechanical manipulation of single-membrane proteins in living cells," *IEEE Trans Nanobioscience* **4**, 269-76 (2005).
11. Levy, O., Ptacin, J.L., Pease, P.J., Gore, J., Eisen, M.B., Bustamante, C., and Cozzarelli, N.R., "Identification of oligonucleotide sequences that direct the movement of the *Escherichia coli* FtsK translocase," *PNAS*, **102**, 17618 – 17623 (2005).
12. Li, P.T., Collin, D., Smith, S.B., Bustamante, C, Tinoco, I. Jr., "Probing the mechanical folding kinetics of TAR RNA by hopping, force-jump, and force-ramp methods," *Biophys Journal*, **90**(1), 250-60 (2006).
13. Dumont, S., Cheng, W., Serebrov, V., Beran, R.K., Tinoco, I Jr., Pyle, A.M., and Bustamante, C., "RNA translocation and unwinding mechanism of HCV NS3 helicase and its coordination by ATP," *Nature* **439**, 105-108 (2006).
14. Gore, J., Bryant, Z., Stone, M.D., Nollmann, M., Cozzarelli, N.R., and Bustamante, C., "Mechanochemical analysis of DNA gyrase using rotor bead tracking," *Nature* **439**, 100-104 (2006).

15. Ritort, F., Mihadja S., Smith, S.B., Bustamante, C., "Condensation transition in DNA-polyaminoamide dendrimer fibers studied using optical tweezers," *Phys. Rev. Lett.* **96** (11), 118301-1 – 118301-4, (2006).
16. Moffitt, J.R., Chemla, Y.R., Izhaky, D., Bustamante, C., "Differential detection of dual traps improves the spatial resolution of optical tweezers," *PNAS* **103** (24), 9006-11 (2006).
17. Bustamante, C., "Unfolding single RNA molecules: bridging the gap between equilibrium and non-equilibrium statistical thermodynamics," *Q. Rev. Biophys.*: 1-11 (2006).
18. Gore, J., Bryant, Z., Nöllmann, M., Le, M.U., Cozzarelli, N.R., Bustamante, C., "DNA overwinds when stretched," *Nature* **442**, 836-839 (2006).
19. Li, P.X.T., Bustamante, C., Tinoco, I., "Unusual mechanical stability of a minimal RNA kissing complex," *PNAS*, **103**: 15847-15852 (2006).
20. Mihadja, S., Spakowitz A., Zhang, Y., Bustamante, C., "Effect of force on mononucleosomal dynamics," *PNAS* **103** (43): 15871-15876 (2006).
21. Yongli Zhang, Corey L. Smith, Anjanabha Saha, Stephan W. Grill, Shirley Mihadja, Steven B. Smith, Bradley R. Cairns, Craig L. Peterson, and Carlos Bustamante. "DNA Translocation and Loop Formation Mechanism of Chromatin Remodeling by SWI/SNF and RSC," *Molecular Cell* **24** (4): 559-568, (Nov. 17 2006).
22. Jeffrey R. Moffitt, Yann R. Chemla, David Izhaky, and Carlos Bustamante, "Differential detection of dual traps improves the spatial resolution of optical tweezers," *PNAS*, **103**: 9006-9011 (2006).
23. Jerod L Ptacin, Marcelo Nöllmann, Carlos Bustamante & Nicholas R Cozzarelli, "Identification of the FtsK sequence-recognition domain," *Nature Structural & Molecular Biology*, **13**: 1023 - 1025 (November, 2006).
24. Jessica M. Walter, Derek. Greenfield, Carlos Bustamante, and Jan Liphardt, "Light-powering *Escherichia coli* with proteorhodopsin," *PNAS*, **104**: 2408–2412 (2007)
25. Thorsten Hugel, Jens Michaelis, Craig L. Hetherington, Paul J. Jardine, Shelley Grimes, Jessica M. Walter, Wayne Falk, Dwight L. Anderson and Carlos Bustamante Experimental Test of Connector Rotation during DNA Packaging into Bacteriophage phi29 Capsids *PLoS Biology*, (4 March 2007)
26. Leschziner AE, Saha A, Wittmeyer J, Zhang Y, Bustamante C, Cairns BR, Nogales E. Conformational flexibility in the chromatin remodeler RSC observed by electron microscopy and the orthogonal tilt reconstruction method. *PNAS* **104**(12): 4913-4918 (March 20, 2007)
27. Marcelo Nöllmann, Michael D Stone, Zev Bryant, Jeff Gore, Nancy J Crisona, Seok-Cheol Hong, Sylvain Mittelheiser, Anthony Maxwell, Carlos Bustamante and Nicholas R Cozzarelli, "Multiple modes of *Escherichia coli* DNA gyrase activity revealed by force and torque" *Nature Structural and Molecular Biology*, **14**(4), 264-271 (April 2007)
28. E.A. Galburt, S. W. Grill, A. Wiedmann, L. Lubkowska, J. Choy, E. Nogales, M. Kashlev, and C. Bustamante, "Backtracking determines the force sensitivity of RNAP II in a factor-dependent manner," *Nature*, **446**:7137, 820-823 (April 12, 2007: advance online publication March 14, 2007).

29. Wen JD, Manosas M, Li P, Smith S, Bustamante C, Ritort F, Tinoco Jr I. "Force unfolding kinetics of RNA using optical tweezers. I. Effects of experimental variables on measured results," *Biophys J.*, 92:2996-3009, published online Feb. 9 (May 2007)
30. Manosas M, Wen JD, Li P, Smith S, Bustamante C, Tinoco Jr I, Ritort F. "Force unfolding kinetics of RNA using optical tweezers. II. Modeling experiments," *Biophys J.* 92:3010-3021, published online Feb. 9 (May 2007).
31. Pan T. X. Li, Carlos Bustamante, and Ignacio Tinoco, Jr., "Real-time control of the energy landscape by force directs the folding of RNA molecules," *PNAS*, 104(17):7039-7044 (April 24, 2007, published online April 16, 2007).

RECENT SPEAKING ENGAGEMENTS

- Invited Plenary Speaker: XXX Brazilian National Meeting of Condensed Matter Physics, São Lourenço Brazil, May 10th, 2007, "Grabbing the cat by the tail: Packaging of DNA by single particles of bacteriophage phi 29 using optical tweezers"
- Invited Speaker: University of California, Santa Cruz, April 16, 2007, "Signposts along the chromosomal highway: How FtsK finds its target."
- Invited Speaker: Case Western Reserve University, annual Wood lecture, April 11, 2007, "Grabbing the Cat by the Tail: Following the packaging of DNA inside the capsid of bacteriophage phi 29 one molecule at a time and at base-pair resolution"
- Invited Speaker, "Grabbing the Cat by the Tail: Following the packaging of DNA inside the capsid of bacteriophage phi 29 one molecule at a time and at base-pair resolution," Dean's Proteins Symposium, University of California, San Diego, April 6, 2007,
- Invited Speaker: Scripps Research Institute, Structure and Affinity Group Series, March 22, 2007,
- Invited Speaker, "Following the packaging of DNA by single particles of bacteriophage phi29, using optical tweezers" McGill University, Department of Chemistry Purves Lecture, March 9, 2007, "Grabbing the cat by the tail: Packaging of DNA by single particles of bacteriophage phi 29 using optical tweezers"
- Invited Speaker, "Grabbing the Cat by the Tail: Following the packaging of DNA inside the capsid of bacteriophage phi 29 one molecule at a time and at base-pair resolution" Harvard University, Department of Chemistry and Chemical Biology, March 1, 2007.
- Invited Speaker, "Signposts along the Chromosomal Highway: How FtsK finds its Target," University of California, Santa Barbara, Biomolecular Science and Engineering Program Seminar Series, Feb. 16, 2007.
- Invited Speaker, "Recent Advances in Single Molecule Manipulation Biophysics," Molecular Frontiers Symposium, The Royal Swedish Academy of Sciences, February 2, 2007.
- Invited Speaker, "Recent Advances in Single Molecule Manipulation Biophysics" Trieste, Italy, Jan. 30, 2007.
- Invited Speaker, "Recent Advances in Single Molecule Manipulation Biophysics," XI School of Biophysics, Palazzo Franchetti, Istituto di Scienze Lettere e Arti (IVSLA), Venice, Italy, January 29, 2007.
- Invited Speaker, "How FtsK finds its target: Signposts along the chromosomal highway" University of Texas Medical Branch, January 24, 2007.
- Invited Speaker, "How FtsK finds its target: Signposts along the chromosomal highway" University of Texas Southwestern, Molecular Biophysics Graduate Program Discussion Group, January 23, 2007.
- Invited Speaker, "Grabbing the Cat by the Tail: Studies of DNA Packaging by Single f29 Bacteriophage Particles Using Optical Tweezers," Chalmers University of Technology, Gothenburg, Sweden, December 14, 2006.
- Invited Speaker, "Recent Advances in Single Molecule Manipulation Biophysics," Weizmann Inst. of Science Minisymposium on *Soft Matter and Biological Physics*, Rehovot, Israel, Nov. 5, 2006.
- Colloquium Speaker, "Recent Developments in the Biophysics of Single Molecules," Emory University Physics Colloquium, Atlanta, Georgia, October 27, 2006.
- Invited Speaker, "Sign posts along the chromosomal highway: How FtsK finds its target," Extraordinary Thursday Seminar, Max Planck Institute CBG, Dresden, Germany, October 5, 2006.

- Colloquium Speaker, “Sign posts along the chromosomal highway: How FtsK finds its target,” Müncher Physik Kolloquium, Ludwig-Maximilians-Universität, Munich, Germany, October 4, 2006.
- Invited lecturer, “Sign posts along the chromosomal highway: How FtsK finds its target”, Leonardo Lecture, San Raffaele Scientific Institute (DiBiT), Milan, Italy, October 2, 2006.
- Invited speaker, “Recent advances in single molecule manipulation biophysics,” BergamoScienza, Bergamo, Italy, September 30, 2006.
- Plenary speaker, “Recent advances in the manipulation of single molecules,” Congreso Ibero-Americano de Biofísica, Madrid, Spain, September 24, 2006.
- Invited speaker, “Sign posts along the chromosomal highway: How FtsK finds its target,” Dept. of Biochemistry and Biophysics Seminar, UC San Francisco, September 19, 2006.
- Invited speaker, “Sign posts along the chromosomal highway: How FtsK finds its target,” Alumni Distinguished Lecture, Michigan State University East Lansing, September 14, 2006.
- Invited speaker, “Sign posts along the chromosomal highway: How FtsK finds its target,” HHMI Science Meeting, Janelia Farm Research Center, Ashburn, VA, September 12, 2006.
- Invited speaker, “Direct observation of the three-state folding of single molecules of RNase H using optical tweezers”, International Conference on Bioengineering, UC Santa Barbara, Wednesday Sept. 6, 2006.
- Invited lecturer, “Recent Advances in Single Molecule Biophysics,” at the Universidad de Buenos Aires Escuela Giambiagi.
- Keynote speaker for the Center for Biophotonics Annual Retreat, Olympic Valley, CA, July 10, 2006.
- Invited speaker for “Recent Advances in Single Molecule Biophysics,” at the Gordon Research Conference on Single Molecule Approaches to Biology, Colby-Sawyer College, New London, NH, June 22, 2006.
- Invited speaker for “Single molecule studies of FtsK, a fast, sequence-directed DNA translocase”, at the Tri-Institutional Structural Biology Seminar Series, Weill Medical College of Cornell University/Rockefeller University/Memorial Sloan-Kettering Cancer Center, New York, June 8, 2006.
- Invited speaker for “Single molecule manipulation in biophysics”, and “The unwinding mechanism of an RNA Helicase” at the 2006 H.L. Welsh Lectures in Physics, University of Toronto, Canada, April 27 & 28, 2006.
- Invited speaker for “Direct Observation of Substeps Reveals the RNA Unwinding Mechanism of HCV NS3 Helicase” at the CSBI Seminar Series, MIT, Cambridge MA, April 20, 2006.
- Invited speaker for “Grabbing the Cat by the Tail: Studies of DNA Packaging by Single ϕ 29 Bacteriophage Particles Using Optical Tweezers” at the Microbiology and Molecular Genetics Seminar Series, Harvard Medical School, Boston, MA, April 18, 2006.
- Colloquium speaker, “Packaging of DNA by Single Bacteriophage Particles Using Optical Tweezers” at the Kavli Nanoscience Institute Colloquia Series, Caltech Institute for Technology, March 13, 2006.
- Colloquium speaker, “Grabbing the Cat by the Tail: Studies of DNA Packaging by Single ϕ 29 Bacteriophage Particles Using Optical Tweezers,” UC Riverside Physics Colloquia Series, Riverside, CA, Mar. 2, ‘06.
- Plenary Speaker for “Direct Observation of Substeps Reveals the RNA Unwinding Mechanism of HCV NS3 Helicase” at the Joint Annual Conference of the National Societies of Black and Hispanic Physicists, San Jose, CA, February 16, 2006.