

Curriculum Vitae  
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

Languages English (fluent), Italian (fluent), and Spanish (native-speaker)

Post-doctoral Training

- 1975-1976 Fulbright Commission and Institute of International Education Fellow  
1976-1981 Research Assistant, University of California, Berkeley  
1981-1982 Postdoctoral Fellow, Lawrence Berkeley Laboratory, University of California, Berkeley

Academic Administration

- 1982-1986 Assistant Professor, Department of Chemistry, University of New Mexico, Albuquerque, NM  
1986-1989 Associate Professor, Department of Chemistry, University of New Mexico  
1989-1990 Professor of Chemistry, Department of Chemistry, University of New Mexico, Albuquerque, NM  
1991-1998 Professor of Chemistry, Department of Chemistry, University of Oregon, Eugene, OR  
1998- present Professor of Molecular and Cell Biology, Professor of Physics, Professor of Chemistry, University of California, Berkeley, CA  
2005-2012 Luis Alvarez Chair of Experimental Physics  
2012- present Raymond and Beverly Sackler Chair of Biophysics

Honors

- 1973-1975 Kellogg Foundation Scholarship during the Magister in Biochemistry  
1975-1976 Abraham Rosenberg Scholarship, University of California, Berkeley  
1984 Searle Scholar  
1985 Alfred P. Sloan Fellow  
1986 Presidential Lecturer in Chemistry, University of New Mexico  
1989 State of New Mexico Eminent Scholar  
1995 Elected Fellow of the American Physical Society  
2001 Honorary Professor, Universidad Nacional Mayor de San Marcos, Lima, Peru  
2001 Nominated for America's Best in Time Magazine  
2002 Recipient of the Biological Physics Prize of the American Physical Society

- 2002 Doctor *Honoris Causa* by the Universidad Nacional de Ingenieria, Lima, Peru
- 2002 - present Elected member of the National Academy of Science
- 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 National Science Prize of Peru: Southern Peru Copper Corporation Prize
- 2005 Richtmyer Memorial Lecture Award, American Association of Physics Teachers
- 2005 Doctor *Honoris Causa* by the University of Chicago
- 2009 Honorary Member of the Royal Spanish Biochemistry Society
- 2010 Honorary Member of the Spanish Biophysical Society
- 2012 Fellows of the Biophysical Society Award
- 2012 Vilcek Prize
- 2012 Doctor Honoris Causa from the Universidad Nacional Mayor de San Marcos, Lima, Peru
- 2012 Doctor *Honoris Causa* from the Universidad Peruana Ricardo Palma, Lima, Peru
- 2012 The Raymond and Beverly Sackler International Prize in Biophysics
- 2013 Elected Member Academy of Science of Chile
- 2013 Doctor *Honoris Causa* by Jiaotong University, China
- 2015 Elected Member of the American Academy of Arts and Sciences

#### Appointments

- 1991-1998 Member of the Institute of Molecular Biology
- 1994 -1998 Howard Hughes Medical Institute Investigator
- 1997 - 2000 Member of the Science Advisory Board of the Searle Scholars Program
- 1998 - 2005 Director, Advance Microscopies Department, Physical Biosciences Division, LBNL
- 2000 - present Howard Hughes Medical Institute Investigator
- 2001 - 2003 Member of the Science Advisory Committee of the Burroughs-Wellcome Fund
- 2002 - present Elected member of the National Academy of Sciences
- 2003 - 2013 Member of the Board of Directors of the Burroughs-Wellcome Fund
- 2006 - present Member of the California Institute of Quantitative Biosciences, University of California, Berkeley, CA
- 2014 - 2018 Member of the Board of Directors of the American Association for the Advancement of Science
- 2014 – present Member of the of the American Association for the Advancement of Science
- 2014 - present Member of the Advisory Board, University of New Mexico, Dept. of Chemistry and Biological Chemistry
- 2014 - 2017 Member of the Executive Council, Protein Society
- 2014 - present Member of the Kavli Energy NanoSciences Institute, University of California, Berkeley
- 2015 Elected Member of the American Academy of Arts and Sciences
- 2016 – present Member of the External Advisory Board of the GRHD (Gene Regulation in Health & Disease of Cleveland State University
- 2017 – present Member of the Peruvian Society of Biochemistry and Molecular Biology
- 2017 – present Member of the Advisory Committee, Pew Latin American Fellows Program
- 2018 – present Member of the Budget Committee, University of California, Berkeley

2019 – present Member of the Chancellor's Advisory Committee on Physical Sciences

### Professional Society Memberships

American Association for the Advancement of Science

American Chemical Society

American Physical Society

Biophysical Society

American Academy of Microbiology

### Publications

1. Lizárraga B, Sánchez D, Bustamante C, Melgar E. 1975. pH and Ca<sup>++</sup> Induced Conformational Changes in Bovine Pancreatic DNase. Fed Proc. 34:700.
2. Lizárraga B, Bustamante C, Gil A, Melgar E. Multiple Conformation of Deoxyribonuclease A. 1979. Their Separation at Alkaline pH & Low Ionic Strength in the Presence of Ca<sup>2+</sup>. Biochim. Biophys. Acta 579(2):298-302.
3. Melgar E, Lizárraga B, Gil A, Bustamante C, Sanchez RD. 1979. Role of Metals on the Activity of Pancreatic Deoxyribonuclease. Archivos De Biologia Y Medicina Experimentales 12(2):236-237.
4. Tinoco I Jr, Bustamante C, Maestre MF. 1980. The Optical Activity of Nucleic Acids and their Aggregates. Ann. Rev. Biophys. Bioeng. 9:107-14.
5. Bustamante C, Maestre, MF, Tinoco I Jr. 1980. Circular Intensity Differential Scattering of Helical Structures. I. Theory", J. Chem. Phys. 73:4273-4281.
6. Bustamante C, Maestre MF, Tinoco I Jr. 1980. Circular Intensity Differential Scattering of Helical Structures. II. Applications. J. Chem. Phys. 73(12):6046-6055.
7. Bustamante C, Tinoco I Jr, Maestre MF. 1981. Circular Intensity Differential Scattering of Helical Structures. III. A General Polarizability and Anomalous Scattering, J. Chem. Phys. 74(9):4839-4850.
8. Bustamante C. 1981. Circular Intensity Differential Scattering of Chiral Molecules [dissertation]. [Berkeley, (CA)]: University of California, Berkeley.
9. Maestre MF, Bustamante, C, Hayes T, Subirana, J, Tinoco I Jr. 1982. Differential Scattering of Circularly Polarized Light by the Helical Sperm Head of Octopus Eledone cirrhosa. Nature 298: 773-774.
10. Maestre MF, Bustamante C, Hayes T, Subirana J, Tinoco I Jr. 1982. Differential Scattering of Circularly Polarized Light by the Helical Sperm Head of Octopus Eledone cirrhosa. Nature 298: 773-774.
11. Bustamante C, Tinoco I Jr, Maestre MF. 1982. Circular Intensity Differential Scattering. IV. Randomly Oriented Species. J. Chem. Phys. 76(7):3440-3446.
12. Tinoco I Jr, Bustamante C, Maestre MF. 1982. Methods in Structural Molecular Biology, New York (NY): Plenum Press. Book Chapter. Chiroptical Methods and Their Applications to Biomolecular Systems; p. 260-303.
13. Tinoco I Jr, Maestre MF, Bustamante, C. 1983. Differential Scattering of Circularly Polarized Light: Its Effects on Measurements of Circular Dichroism. Emerging Techniques of Trends in Biochemical Sciences 8:41-44.
14. Bustamante C, Tinoco I Jr, Maestre MF. 1983. Circular Differential Scattering Can Be an Important

- Part of the Circular Dichroism of Macromolecules. *Proc. Natl. Acad. Sci. USA* 80: 3568-3572.
15. Bustamante C, Stigter D. 1984. Intercalation of Cationic Dyes in the DNA Double Helix. *Introductory Theory. Biopolymers.* 23:629-645.
  16. Bustamante C, Keller D, Maestre MF, Tinoco I Jr. 1984. Circular Intensity Differential Scattering of Dense Particles. *J. Chem. Phys.* 80:4817-4823.
  17. Keller D, Bustamante C, Tinoco I Jr. 1984. Quantum Mechanical Treatment of Circular Intensity Differential Scattering: The Elastic Process. *J. Chem. Phys.* 81:1643-1649.
  18. Bustamante C, Wells KS, Keller D, Samorí B, Maestre MF, Tinoco I Jr. 1984. Circular Intensity Differential Scattering of Cholesteric & Blue Mesophases. *Mol. Cryst. Liq. Cryst.* 111: 79-102.
  19. Katz JE, Wells KS, Ussery D, Maestre MF, Bustamante C. 1984. Design and Construction of a Circular Intensity Differential Scattering Instrument. *Rev. Sci. Instr.* 55:1574-1579.
  20. Tinoco I Jr, Maestre MF, Bustamante C, Keller D. 1984. Use of Circularly Polarized Light to Study Biological Macromolecules. *Pure Appl. Chem.* 56:1423-1428.
  21. Bustamante C. 1984. The Contribution of Differential Scattering of Circularly Polarized Light to the Optical Rotatory Dispersion of a Sample. *J. Opt. Soc. Am.* 1:1114.
  22. Keller D, Bustamante C, Maestre MF, Tinoco I Jr. 1985. Model Computations on the Differential Scattering of Circularly Polarized Light (CIDS) by Dense Macromolecular Particles. *Biopolymers* 24:783-797.
  23. Keller D, Bustamante C, Maestre MF, Tinoco I Jr. 1985. Imaging of Optically Active Biological Structures Using Circularly Polarized Light. *Proc. Natl. Acad. Sci. USA* 82:401-405.
  24. Bustamante C, Maestre MF, Keller D. 1985. Expressions for the Interpretation of Circular Intensity Differential Scattering of Chiral Aggregates. *Biopolymers* 24:1595-1612.
  25. Hall K, Wells KS, Keller D, Samorí B, Maestre MF, Tinoco I Jr, Bustamante C. 1985. Applications of Circularly Polarized Radiation. New York (NY): Plenum Press. Book Chapter, Circular Intensity Differential Scattering of Planar and Focal Conic Orientations of Cholesteric Liquid Crystals.
  26. Maestre MF, Keller D, Tinoco I Jr, Bustamante C. 1985. Applications of Circularly Polarized Radiation. New York (NY): Plenum Press. Book Chapter, Circular Differential Imaging of Chiral Objects.
  27. Maestre MF, Salzman GS, Tobey R, Bustamante C. 1985. Circular Dichroism Studies on Single Chinese Hamster Cells. *Biochemistry* 24:5152-5157.
  28. Keller D, Bustamante C, 1985. Applications of Circularly Polarized Radiation. New York (NY): Plenum Press. Book Chapter, CIDS Calculations on Quartz at Hard X-Ray Wavelengths.
  29. Allen FS, Bustamante C. 1985. Applications of Circularly Polarized Radiation. New York (NY): Plenum Press.
  30. Mickols W, Katz JE, Maestre MF, Tinoco I Jr, Bustamante C. 1985. An Imaging Differential Polarization Microscope with Electronic Readout. *Rev. Sci. Instr.* 56:2228-2236.
  31. Bustamante C, Mickols W, Maestre MF, Tinoco I Jr. 1985. Circular Differential Imaging. *Biotech.* 3:711-714.
  32. Wells KS, Beach DA, Keller D, Bustamante C. 1986. The Measurement of the Circular Intensity Differential Scattering of Chiral Aggregates: Studies on the Sperm Cell of *Eledone cirrhosa*. *Biopolymers* 25:2043-2064.
  33. Keller D, Bustamante C. 1986. Theory of the Interaction of Light with Large Inhomogeneous Molecular Aggregates. I. Absorption. *J. Chem. Phys.* 84:2961-2971.
  34. Keller D, Bustamante C. 1986. Theory of the Interaction of Light with Large Inhomogeneous

- Molecular Aggregates. II. Psi-type Circular Dichroism. *J. Chem. Phys.* 84:2972-2980.
35. Kim MH, Ulibarri L, Keller, D, Maestre MF, Bustamante C. 1986. The Psi-Type Circular Dichroism of Large Molecular Aggregates. III. Calculations. *J. Chem. Phys.* 84:2981-2989.
  36. Bustamante C, Maestre MF, Wells KS. 1986. Recent Advances in Polarization Spectroscopy: Perspectives of the Extension to the Soft X-Ray Region. *J. Photochem. Photobio.* 44: 331-341.
  37. Patterson CW, Singham SB, Salzman, GC, Bustamante C. 1986. Circular Intensity Differential Scattering of Light by Hierarchical Molecular Structures. *J. Chem. Phys.* 84:1916-1921.
  38. Kim MH, Ulibarri L, Keller D, Bustamante C. 1987. Differential Polarization Imaging. I. Theory. *Biophys. J.* 52:911-927.
  39. Kim MH, Ulibarri L, Bustamante C. 1987. Differential Polarization Imaging. II. Symmetry Properties of the Mueller Images and Calculations. *Biophys. J.* 52:928-946.
  40. Beach DA, Wells, SW, Foucar K, Bustamante C. 1987. Differential Polarization Imaging. III. Experimental Studies on Red Blood Sickle Cells. *Biophys. J.* 52:947-954.
  41. Keller D, Bustamante C. 1985. CIDS Calculations on Quartz at Hard X-Ray Wavelengths. In *Applications of Circularly Polarized Radiation*. Allen FS & Bustamante C, eds. New York, NY: Plenum Press.
  42. Allen FS, Bustamante C. 1985. eds. *Applications of Circularly Polarized Radiation*. New York, NY: Plenum Press.
  43. Mickols W, Katz JE, Maestre MF, Tinoco I Jr, Bustamante C. 1985. An Imaging Differential Polarization Microscope with Electronic Readout. *Rev. Sci. Inst.* 56:2228-2236.
  44. Bustamante C, Mickols W, Maestre MF, Tinoco I Jr. 1985. Circular Differential Imaging. *Biotech.* 3:711-714.
  45. Wells KS, Beach DA, Keller D, Bustamante C. 1986. The Measurement of the Circular Intensity Differential Scattering of Chiral Aggregates: Studies on the Sperm Cell of *Eledone cirrhosa*. *Biopolymers.* 25:2043-2064.
  46. Keller D, Bustamante C. 1986. Theory of the Interaction of Light with Large Inhomogeneous Molecular Aggregates. I. Absorption. *J. Chem. Phys.* 84:2961-2971.
  47. Keller D, Bustamante C. 1986. Theory of the Interaction of Light with Large Inhomogeneous Molecular Aggregates. II. Psi-type Circular Dichroism. *J. Chem. Phys.* 84:2972-2980.
  48. Kim M-H, Ulibarri L, Keller D, Maestre MF, Bustamante C. 1986. The Psi-Type Circular Dichroism of Large Molecular Aggregates. III. Calculations. *J. Chem. Phys.* 84:2981-2989.
  49. Bustamante C, Maestre MF, Wells KS. 1986. Recent Advances in Polarization Spectroscopy: Perspectives of the Extension to the Soft X-Ray Region. *J. Photochem. Photobio.* 44:331-341.
  50. Patterson CW, Singham SB, Salzman GC, Bustamante C. 1986. Circular Intensity Differential Scattering of Light by Hierarchical Molecular Structures. *J. Chem. Phys.* 84:1916-1921.
  51. Kim M-H, Ulibarri L, Keller D, Bustamante C. 1987. Differential Polarization Imaging. I. Theory, *Biophys. J.* 52:911-927.
  52. Kim M-H, Ulibarri L, Bustamante C. 1987. Differential Polarization Imaging. II. Symmetry Properties of the Mueller Images and Calculations. *Biophys. J.* 52:928-946.
  53. Beach DA, Wells SW, Foucar K, Bustamante C. 1987. Differential Polarization Imaging. III. Experimental Studies on Red Blood Sickle Cells, *Biophys. J.* 52:947-954.
  54. Beach DA, Wells SW, Bustamante C. 1987. Differential Polarization Microscope Using an Image Dissector Camera & Phase-Lock Detection. *Rev. Sci. Inst.* 58:1987-1995.
  55. Tinoco I Jr, Mickols W, Maestre MF, Bustamante C. 1987. Absorption, Scattering and Imaging of

- Biomolecular Structures with Polarized Light. *Ann. Rev. Biophys. Chem.* 16:319-349.
56. Spada GP, Gottarelli G, Samorì B, Bustamante C, Wells KS. 1988. A Study of Some Lyotropic Cholesteric Mesophases by Circular and Linear Dichroism and by Circular Intensity Differential Scattering. *Liq. Cryst.* 3:101-103.
  57. Bustamante C, Kim M, Beach DA. 1988. Differential Polarization Imaging: Theory and Applications, In *Polarized Spectroscopy of Ordered Systems*, a NATO Advanced Studies Series (Samorì B & Thulstrup E, eds.). Vol. 242. Kluwer Academic Publishers: Dordrecht.
  58. Bustamante C, Keller D. 1988. Theory of Absorption and Circular Dichroism of Large Inhomogeneous Molecular Aggregates. In *Polarized Spectroscopy of Ordered Systems*, a NATO Advanced Studies Institute Series (Samorì B and Thulstrup E, eds.). Vol. 242. Kluwer Academic Publishers, Dordrecht.
  59. Dunlap D, Bustamante C, Samorì B. 1988. Why Does Sinusoidally Modulated Polarization Introduce a Systematic Error in Linear Dichroism Measurements? Analytical and Instrumental Solutions. In *Polarized Spectroscopy of Ordered Systems*, a NATO Advanced Studies Institute Series (Samorì B & Thulstrup E, eds.). Vol. 242. Kluwer Academic Publishers, Dordrecht.
  60. Bustamante C, Maestre MF. 1988. Statistical Effects in the Absorption and Optical Activity of Particulate Suspensions. *Proc. Natl. Acad. Sci. USA* 85:8482-8486.
  61. Juang Ch-B, Finzi L, Bustamante C. 1988. Design and Building of a Computer Controlled Confocal Scanning Differential Polarization Microscope. *Rev. Sci. Inst.* 59:2399-2408.
  62. Garab G, Wells KS, Finzi L, Bustamante C. 1988. Helically Organized Macroaggregates of Pigment-Protein Complexes in Chloroplasts: Evidence from Circular Intensity Differential Scattering. *Biochemistry.* 27:5839-5843.
  63. Finzi L, Beach D, Bustamante C, Garab G. 1988. Differential Polarization Microscopy: Theory & Applications. In *Proceedings of the Electron Microscope Society of America* (Bailey GW, ed.), pp. 60-61.
  64. Houseal T, Bustamante C, Stump R, Maestre MF. 1989. Imaging of the Motions of Single DNA Molecules in Solution, Using Fluorescence Microscopy. *Biophys. J.* 56:507-516.
  65. García R, Keller D, Panitz J, Bustamante C. 1989. Imaging of Metal-Coated Biological Samples by Scanning Tunneling Microscopy. *Ultramicroscopy.* 27:367-374.
  66. Keller D, Bustamante C, Keller RW. 1989. Imaging of Single DNA Molecules by Scanning Tunneling Microscopy. *Proc. Natl. Acad. Sci. USA.* 86:5356-5360.
  67. Finzi L, Bustamante C, Garab G. 1989. Direct Observation of Large Chiral Domains in Chloroplast Thylakoid Membranes by Differential Polarization Microscopy. *Proc. Natl. Acad. Sci. USA* 86:8748-8752.
  68. Dunlap D, Bustamante C. 1989. Imaging of Single Stranded Nucleic Acids by Scanning Tunneling Microscopy. *Nature* 342:204-206.
  69. Bustamante C. 1989. From molecules to cells: Development of Advanced Microscopies, In *Proceedings of the III Balkan Conference in Electron Microscopy*, (I. Margaritis, ed.), pp. 213-216.
  70. Bustamante C, Houseal T, Beach D, Maestre MF. 1990. Fluorescence Microscopy Studies of the Supercoiling, Folding and Condensation of Bacterial Chromosomes Induced by Acridine Orange. *J. Biomol. Struct. Dyn.* 8:643-655.
  71. Ulibarri L, Bustamante C. 1990. The Superposition Principle in Circular Differential Scattering of Hierarchical Chiral Structures. *J. Chem. Phys.* 92:875.
  72. Gurrieri S, Rizzarelli E, Beach D, Bustamante C. 1990. Imaging of Kinked Configurations of DNA

- Molecules Undergoing OFAGE Using Fluorescence Microscopy. *Biochemistry*. 29:3396-3401.
73. Garab G, Finzi L, Bustamante, C. 1990. Differential Polarization Imaging of Chloroplasts. Microscopic and Macroscopic Linear and Circular Dichroism. In *Light in Biology and Medicine*. Vol. II (R.H. Douglas, ed.). Plenum Press: New York.
  74. Bustamante C, Keller RW, García R, Gray C, Maestre MF. 1990. STM Images of Metal-Coated and Un-Coated Biological Samples. In *Proceedings of the IV International Conference on Scanning Tunneling Microscopy*. Oarai, Japan (1989) *J. of Vacuum Science and Technology A-Vacuum Surfaces and Films*. 8(1):706-712.
  75. Bustamante C, Smith S, Gurrieri S. 1990. Fluorescence Microscopy & Computer Simulation. Studies of the Mechanisms of Reorientation of DNA Molecules Undergoing Pulsed Field Gel Electrophoresis. In *Proceedings of the SPIE Symposium on Bioimaging and Two-Dimensional Spectroscopy*. 1205:190-202.
  76. Wang F, Juang CB, Bustamante C, Wu AY. 1990. Electro-Optic Properties of (Pb, La) (Zr, Ti)O<sub>3</sub>, BaTiO<sub>3</sub> (Sr, Ba)Nb<sub>2</sub>O<sub>6</sub> and Ba<sub>2</sub>NaNb<sub>5</sub>O<sub>15</sub>, Thin Films by a Confocal Scanning Differential Polarization Microscope, In *The 4th International SAMPE Conference*, Vol. 4. *Electronic Materials-Our Future*, pp. 712-721 (Allred RE, Martinez RJ, & Wischmann KB, eds.). Society for the Advancement of Material and Process Engineering.
  77. Bustamante C. 1990. Recent Applications of Scanning Tunneling Microscopy to the Imaging of Biological Systems. In *Proceedings of the Twenty-Seventh Annual Electron Microscopy Colloquium*. Bethesda, Maryland. June, pp. 1-3.
  78. Smith S, Gurrieri S, Bustamante C. 1990. Fluorescence Microscopy and Computer Simulations of DNA Molecules in Conventional and Pulsed Field Gel Electrophoresis. In *Current Communications in Molecular Biology, DNA Electrophoresis*. Cold Spring Harbor, New York (L. Lerman, ed.), pp. 55-79.
  79. Wu AY, Wang F, Juang CB, Bustamante C. 1990. Electro-Optic and Non-Linear Optical Coefficients of (Pb, La)(Zr, Ti)O<sub>3</sub>, BaTiO<sub>3</sub>, (Sr, Ba)Nb<sub>2</sub>O<sub>6</sub>, and Ba<sub>2</sub>NaNb<sub>5</sub>O<sub>15</sub> Thin Films, In *The Symposium on Ferroelectric Thin Films, Spring Meeting, Materials Research Society Symposium Proceedings Vol. 200*, Pp. 261, Myers ER, ed: San Francisco, California.
  80. Bustamante C, Gurrieri S, Smith SB. 1990. Observation of Single DNA Molecules during Pulsed-Field Gel Electrophoresis by Fluorescence Microscopy, In *Methods: A Companion in Methods in Enzymology*, San Diego, California (E. Lai & B. Birren, eds.), Academic Press, pp. 151-159.
  81. Wu AY, Wang F, Juang C-B, Bustamante C, Yeh CY, Diels J-C. 1990. 2-D High Definition and High Resolution PLZT Thin Film Spatial Light Modulators. In *The Seventh International Symposium on the Applications of Ferroelectrics*, University of Illinois. Urbana, Illinois.
  82. Wu AY, Wang F, Juang, C-B, Bustamante C, Yeh C-Y, Diels J-C. 1990. Electro-optic and Non-Linear Optical Properties of (Pb, La)(Zr, Ti)O<sub>3</sub>, BaTiO<sub>3</sub>, (Sr, Ba)Nb<sub>2</sub>O<sub>6</sub>, Ba<sub>2</sub>NaNb<sub>5</sub>O<sub>15</sub>, and  $\beta$ -BaB<sub>2</sub>O<sub>4</sub>. In *The Seventh International Symposium on the Applications of Ferroelectrics*, University of Illinois. Urbana, Illinois.
  83. Kim M-H, Bustamante C. 1991. Differential Polarization Imaging IV: Images in Higher Born Approximations. *Biophys. J.* 59:1171-1182.
  84. Finzi L, Bustamante C, Ulibarri L. 1991. Differential Polarization Imaging V: Separation of Preferential Scattering and Preferential Absorption Contributions to the CD Image. *Biophys. J.* 59:1183-1193.
  85. Keller RW, Bustamante C, Bear DG. 1992. Scanning Tunneling Microscopy of E. coli RNA

- Polymerase Electrochemically Deposited onto an Au Substrate, American Institute of Physics Proceedings on Scanned Probe Microscopy 166-175 Santa Barbara, California.
86. Keller RW, Bear DG, Bustamante C. 1991. Method for Imaging *E. coli* RNA Polymerase Holoenzyme with the Scanning Tunneling Microscope in an Aqueous Environment. *J. Vac. Sci. Technol. B*(9):1291-1297.
  87. Bustamante C, Samorí B, Builes E. 1991. Daunomycin Inverts the Long Range Chirality of DNA Condensed States. *Biochemistry*. 30:5661-5666.
  88. Bustamante C. 1991. Direct Observation and Manipulation of Single DNA Molecules Using Fluorescence Microscopy. *Ann. Rev. Biophys. Biophys. Chem.* 20:415-446.
  89. Smith SB, Heller C, Bustamante C. 1991. Model and Computer Simulations of the Motion of DNA Molecules During Pulse Field Gel Electrophoresis. *Biochemistry*. 30:5264-5274.
  90. Garab G, Kieleczawa J, Sutherland JC, Bustamante C, Hind G. 1991. Organization of Pigment Complexes into Macrod domains in the Thylakoid Membranes of Wild-Type and Chlorophyll B-less Mutant of Barley as Revealed by Circular Dichroism. *Photochem, Photobiol.* 54:273-282.
  91. Bustamante C, Finzi L, Sebring PE, Smith SB. 1991. Manipulation of Single DNA Molecules and Measurement of Their Elastic Properties under an Optical Microscope. In *Optical Methods for Ultrasensitive Detection and Analysis: Techniques and Applications*, SPIE Proceedings Series Vol. 1435, 179-187.
  92. Keller RW, Bustamante C, Bear D. 1991. Scanning Tunneling Microscopy of *E. coli* RNA Polymerase Deposited onto an Au Substrate by an Electrochemical Process, Proceedings of the 49th Annual Meeting EMSA, San Jose, California, 378-379.
  93. Dunlap D, Bustamante C. 1991. Applications of Scanning Tunneling Microscopy to Structural Biology. In *Seminars in Cell Biology. New Ways of Looking within Cells*, Singer R ed., pps 179-185. Saunders Scientific Publication: London, England.
  94. Maestre MF, Bustamante C, Snyder P, Rowe E, Hansen R. 1991. Circular Intensity Differential Scattering (CIDS) Measurements in the Soft X-ray Region of the Spectrum (~16eV to 500 eV), SPIE 1548:179-187.
  95. Yuqiu J, Ching-Bo J, Keller D, Bustamante C, Beach D, Houseal T, Builes E, Maestre MF. 1992. Mechanical, Electrical, and Chemical Manipulation of Single DNA Molecules, *Nanotechnology* 3:16-20.
  96. Bustamante C, Vesenka J, Tang C, Rees W, Guthold M, Keller R. 1992. Circular DNA Molecules Imaged in Air by Scanning Force Microscopy. *Biochemistry*. 31:22-26.
  97. García R, Jiang Y, Dunlap D, Bustamante C. 1992. Scanning Tunneling Microscopy of Metal-coated Biomolecules. SPIE. 1639:118-126.
  98. García R, Jiang Y, Schabtach E, Bustamante C. 1992. Deposition and Images of Metal-coated DNA with the Scanning Tunneling Microscope. *Ultramicroscopy*. 42-44:1250-1254.
  99. Kenkre VM, Biscarini F, Bustamante C. 1992. A Theoretical Framework for the Interpretation of STM Images of Adsorbates. *Ultramicroscopy*. 42-44:122-127.
  100. Biscarini F, Bustamante C, Kenkre VM. 1992. Scanning Tunneling Microscopy of Adsorbed Molecules: Theoretical Considerations. SPIE. 1639:111-116.
  101. Vesenka J, Hansma HG, Siegerist C, Siligardi G, Schabtach E, Bustamante C. 1992. Scanning Force Microscopy of Circular DNA and Chromatin in Air and Propanol, SPIE. 1639:127-137.
  102. Vesenka J, Guthold M, Tang C, Keller D, Delaine E, Bustamante C. 1992. A Substrate Preparation for Reliable Imaging of DNA Molecules with Scanning Force Microscope, *Ultramicroscopy* 42-



- 44:1243-1249.
103. Keller R, Keller D, Bear D, Vesenka J, Bustamante C. 1992. Electro-deposition Procedure of E. coli RNA Polymerase onto Au and Deposition of E. coli RNA Polymerase onto Mica for Observation with Scanning Force Microscopy. *Ultramicroscopy*. 42-44:1173-1180.
  104. Hansma HG, Vesenka J, Kelderman G, Morrett H, Sinsheimer R, Elings V, Bustamante C, Hansma PK. 1992. Reproducible Imaging and Dissection of Plasmid DNA under Liquid with the Atomic Force Microscopy. *Science*. 256:1180-1184.
  105. \*Smith SB, Finzi L, Bustamante C. 1992. Direct Mechanical Measurements of the Elasticity of Single DNA Molecules Using Magnetic Bead. *Science*. 258:1122-1126.
  106. Bustamante C, Gurrieri S, Smith SB. 1993. Towards a Molecular Description of Pulsed Field Gel Electrophoresis. *Trends in Biotechnology*. 11(1):23-30.
  107. Samorí B, Siligardi G, Quagliariello C, Weisenhorn AL, Vesenka J, Bustamante C. 1993. Chirality of DNA Supercoiling Assigned by Scanning Force Microscopy. *Proc. Natl. Acad. Sci. USA* 90:3598-3601.
  108. Rees WA, Keller RW, Vesenka JP, Yang G, Bustamante C. 1993. Evidence of Bending in Open Promoter and Elongation Complexes of RNA Polymerase by Scanning Force Microscopy. *Science* 260:1646-1649.
  109. Bustamante C, Keller D, Yang G. Scanning Force Microscopy of Nucleic Acids and Nucleo-Protein Assemblies. *Current Opinion in Structural Biology*. 3:363-372.
  110. Dunla, DD, García R, Schabtach E, Bustamante C. 1993. Masking Generates Contiguous Segments of Metal-coated and Bare DNA for STM Imaging. *Proc. Natl. Acad. Sci. USA*. 90:7652-7655.
  111. Pasternack RF, Bustamante C, Collings PJ, Giannetto A, Gibbs EJ. 1993. Porphyrin Assemblies on DNA as Studied by a Resonance Light-Scattering Technique, *J. of the American Chem. Soc.* 115:5393-5399.
  112. Bezanilla M, Bustamante C, Hansma HG. 1993. Improved Visualization of DNA in Aqueous Buffer with the Atomic Force Microscope. *Scanning Microscopy*. 7(4):1145-1148.
  113. Vesenka J, Manne S, Yang G, Bustamante C, Henderson E. 1993. Humidity Effects on Atomic Force Microscopy of Gold-labeled DNA on Mica. *Scanning Microscopy*. 7(3):781-788.
  114. Zlatanova J, Leuba SH, Yang G, Bustamante C, van Holde K. 1994. Linker DNA Accessibility in Chromatin Fibers of Different Conformations: A Re-evaluation. *Proc. Natl. Acad. Sci. USA* 91:5277-5280.
  115. Bustamante C, Gurrieri S, Pasternack RF, Purrello R, Rizzarelli E. 1994. Interaction of Water-Soluble Porphyrins with Single- and Double-Stranded Polyribonucleotides. *Biopolymers*. 34:1099-1104.
  116. \*Bustamante C, Marko JF, Siggia ED, Smith SB. 1994. Entropic Elasticity of  $\lambda$ -phage DNA. *Science*. 265:1599-1600.
  117. Guthold M, Bezanilla M, Erie DA, Jenkins B, Hansma H, Bustamante C. 1994. Following the Assembly of RNA Polymerase-DNA Complexes in Aqueous Solutions with the Scanning Force Microscope. *Proc. Natl. Acad. Sci. USA* 91:12927-12931.
  118. Erie DA, Yang G, Schultz HC, Bustamante C. 1994. DNA Bending by Cro Protein in Specific & Nonspecific Complexes: Implications for Protein Site Recognition and Specificity. *Science* 266:1562-1566.
  119. Leuba S, Yang G, Robert C, Samorí B, van Holde K, Zlatanova J, Bustamante C. 1994. Three-dimensional Structure of Extended Chromatin Fibers as Revealed by Tapping-mode Scanning Force

- Microscopy. Proc. Natl. Acad. Sci. USA 91:11621-11625.
120. Bustamante C, Erie DA, Keller D. 1994. Biochemical and Structural Applications of Scanning Force Microscopy. *Current Opinion in Structural Biology*. 4:750-760.
  121. Yang G, Leuba S, Zlatanova J, van Holde K, Bustamante C. 1994. Role of Linker Histones in Extended Chromatin Fibre Structure: Modelling and Scanning Force Microscopy Studies. *Nature Structural Biology*. 1(11):761-763.
  122. Erie D, Bustamante C. 1995. DNA Bending by Cro Protein in Specific & Nonspecific Complexes: Implications for Protein Site Recognition and Specificity Technical Comment. *Science*. 269:989-990.
  123. Wyman, C, Grotkopp E, Bustamante C, Nelson CM H. 1995. Determination of HSF2 Stoichiometry at Looped DNA Complexes using Scanning Force Microscopy. *EMBO*. 14(1):117-23.
  124. Yang G, Leuba SH, Bustamante C. 1995. Scanning Force Microscopy Study of Native and Linker Histone Depleted Chromatin Fibers. *SPIE* 2384:13-21.
  125. Zlatanova J, Leuba SH, Bustamante C, van Holde K. 1995. Role of the Structural Domains of the Linker Histones and Histone H3 in the Chromatin Fiber Structure at Low-ionic Strength: Scanning Force Microscopy (SFM) Studies on Partially Trypsinized Chromatin. *SPIE*. 2384:22-32.
  126. Leuba SH, Yang G, Robert C, van Holde K, Zlatanova J, Bustamante CJ. 1995. Extended Chromatin Fibers: Evidence from Scanning Force Microscopy Studies. *SPIE*. 2384:33-44.
  127. García R, Tamayo J, Soler JM, Bustamante C. 1995. Physical Parameters that Control the Imaging of Purple Membranes with the Scanning Tunneling Microscope. *Langmuir*. 11:2109-2114.
  128. Bustamante C, Keller D. 1995. Scanning Force Microscopy in Biology. *Physics Today*. 48(12):32-38.
  129. Dunlap D, Smith S, Bustamante C, Tamayo J, Garcia R.A. 1995. A Very Low Current Scanning Tunneling Microscope. *Review of Scientific Instruments*. 66(10):4876-9.
  130. Kenkre VM, Biscarini F, Bustamante C. 1995. Scanning Tunneling Microscopy. I. Theoretical Framework and Coherence Effects. *Physical Review B (Condensed Matter)*. 51(16):11074-88.
  131. Biscarini F, Bustamante C, Kenkre VM. 1995. Scanning Tunneling Microscopy. II. Calculation of Images of Atomic and Molecular Adsorbates. *Physical Review B (Condensed Matter)*. 51(16): 11089-102.
  132. \*Smith SB, Cui Y, Bustamante C. 1996. Overstretching B-DNA: The Elastic Response of Individual Double Stranded and Single Stranded DNA Molecules. *Science*. 271:795.
  133. Wheeler CJ, Sukhu L, Yang G, Tsai Y, Bustamante C, Felgner P, Norman, J, Manthorpe M. 1996. Converting an Alcohol to an Amine in a Cationic Lipid Dramatically Alters the Co-lipid Requirement, Cellular Transfection Activity and the Ultrastructure of DNA-cytoskeleton Complexes. *Biochimica et Biophysica Acta*. 1280:1-11.
  134. Bustamante C, Rivetti C. 1996. Visualizing Protein-Nucleic Acid Interactions on a Large Scale with the Scanning Force Microscope. *Ann. Rev. Biophys. Biomol. Struc.* 25:395-429.
  135. Bustamante C, Erie DA, Yang G. 1996. Scanning Force Microscopy of Biological Macromolecules: Present & Future. In *Nanofabrication and Biosystems* (Hoch HC, Jelinski LW & Craighead HG, Ed.). New York: Cambridge University Press. 159-179.
  136. Yang G, Leuba SH, Bustamante C. 1996. Scanning Force Microscopy of Chromatin Fibers: A New Approach to an Old Problem. In *Journal of Biological Structure and Dynamics* (Sarma RH & Sarma MH, Ed.). New York: Adenine Press. 1:155-172.
  137. Yang G, Vesenska JP, Bustamante C. 1996. Effects of Tip-sample Forces and Humidity on the

- Imaging of DNA with a Scanning Force Microscope. *Scanning*. 18:344-350.
138. Garcia RA, Bustamante C, Reich N.O. 1996. Sequence-specific Recognition by Cytosine C5 and Adenine N6 DNA Methyltransferases Requires Different Deformations of DNA. *Proc. Natl. Acad. Sci. USA*. 93:7618-7622.
  139. Singh S, Turina P, Bustamante C, Keller D, Capaldi R. 1996. "Topographical Structure of Membrane-bound Escherichia coli F1F0 ATP Synthase in Aqueous Buffer. *FEBS Letters*. 397:30-34.
  140. Rivetti C, Guthold M, Bustamante C. 1996. Scanning Force Microscopy of DNA Deposited onto Mica: Equilibration vs. Molecular Trapping Studied by Statistical Polymer Chain Analysis. *J. of Molecular Biology*. 264(5):919-932.
  141. Gurrieri S, Smith SB, Wells KS, Johnson ID, Bustamante C. 1996. Real-time Imaging of the Reorientation Mechanisms of YOYO-labeled DNA Molecules during 90o and 120o Pulsed Field Gel Electrophoresis, *Nucl. Acids Res*. 24(23):4759-4767.
  142. Bustamante C, García R. 1997. El Microscopio de Fuerzas y sus Aplicaciones Biológicas. *Investigación y Ciencia*, (Scientific American Edition in Spanish) Barcelona, No. 246, 76 – 82.
  143. Wyman C, Rombel I, North AK, Bustamante C, Kustu S. 1997. Unusual Oligomerization Required for Activity of NtrC, a Bacterial Enhancer-binding Protein, *Science* 275:1658 - 1662.
  144. Bustamante C, Zuccheri G, Leuba, SH, Yang G, Samori B. 1997, Visualization and Analysis of Chromatin by Scanning Force Microscopy, *Methods: A Companion to Methods in Enzymology* 12:73-83.
  145. \*Kellermeyer MZ, Smith SB, Granzier HL, Bustamante C. 1997. Folding-Unfolding Transitions in Single Titin Molecules Characterized by Force-Measuring Laser Tweezers. *Science*. 276:1112-1116.
  146. Baumann CG, Smith SB, Bloomfield VA, Bustamante C. 1997. Ionic Effects on the Elasticity of Single DNA Molecules. *Proc. Natl. Acad. Sci. USA*. 94:6185-6190.
  147. Rippe K, Guthold M, Von Hippel, C, Bustamante C. 1997. Transcriptional Activation via DNA-looping: Visualization of Intermediates in the Activation Pathway of E. coli RNA Polymerase.  $\sigma^{54}$  Holoenzyme by Scanning Force Microscopy. *Journal of Molecular Biology*. 270:125-138.
  148. Bustamante C, Godsey, M Yang, G Guthold, M, Rivetti C. 1997. Facilitated Targeting and Transcription Imaged in Real Time with the Scanning Force Microscope. *Proceedings of the 1996 Welch Conference*, Houston. Welch Foundation Press.
  149. García R, Tamayo J, Bustamante C. 1997. Scanning Tunneling Microscopy Imaging and Selective Modification of Purple Membranes. *Intl. J. of Imaging Systems and Technology*. 8:168-174.
  150. Bustamante C, Rivetti C, Keller D. 1997. Scanning Force Microscopy Under Aqueous Solutions. *Current Opinion in Structural Biology*. 7(5):709-716.
  151. Kasas S, Thomson, NH, Smith BL, Hansma HG, Zhu X, Guthold M, Bustamante C, Kool ET, Kashlev M, Hansma P. 1997. Escherichia coli RNA Polymerase Activity Observed Using Atomic Force Microscopy. *Biochemistry*. 36:461-468.
  152. Gurrieri S, Bustamante C. 1997. Purification and Staining of Intact Yeast DNA Chromosomes and Real-time Observation of their Migration during Gel Electrophoresis. *Biochem. J*. 326:131-138.
  153. Stigter D, Bustamante C. 1998. Theory for the Hydrodynamic and Electrophoretic Stretch of Tethered B-DNA. *Biophys. J*. 75:1197-1210.
  154. Leuba, SH, Bustamante C, Zlatanova, J, Holde KV. 1998. Contributions of Linker Histones and Histone H3 to Chromatin Structure: Scanning Force Microscopy Studies on Trypsinized Fiber.

- Biophys. J. 74:2823-2829.
155. Leuba, SH, Bustamante C, Holde KV, Zlatanova J. 1998. Linker Histones Tails and N-tails of Histone H3 are Redundant: Scanning Force Microscopy Studies of Reconstituted Fibers. *Biophys. J.* 74:2830-2839.
  156. Rivetti, C, Walker, C, Bustamante, C. 1998. Polymer Chain Statistics and Conformational Analysis of DNA Molecules with Bends or Sections of Different Flexibility. *J. Mol. Biol.* 280:41-59.
  157. Kellermayer MS, Smith SB, Bustamante C, Granzier HL. 1998. Complete Unfolding of the Titin Molecule Under External Force. *J. Struct. Biol.* 121:197-205.
  158. Gurrieri S, Smith SB, Bustamante C. 1999. Trapping of Megabase-sized DNA Molecules During Agarose Gel Electrophoresis. *Proc. Natl. Acad. Sci. USA* 96:453-459.
  159. Bustamante C, Guthold M, Yang Z. 1999. Facilitated Target Location on DNA by Individual *Escherichia coli* RNA Polymerase Molecules Observed with the Scanning Force Microscope Operating in Liquid. *J. Biol. Chem.* 274:16665-16668.
  160. \*Tinoco I Jr, Bustamante C. 1999. How RNA Folds. *J. Mol. Biol.* 293:271-281.
  161. Rivetti C, Guthold M, Bustamante C. 1999. DNA Wrapping in *E. coli* RNA Polymerase Open Promoter Complexes Revealed by Scanning Force Microscopy. *EMBO Journal.* 18:4464-4475.
  162. Katriitch V Olson W, Bustamante C. 2000. Analysis of Force-Extension Curves of Single Chromatin Fibers Using by Monte Carlo Simulations. *J. Mol. Biol.* 295:29-40.
  163. Leuba S, Bustamante C. 2000. Analysis of chromatin by Scanning Force Microscopy. ch.10 in *Chromatin Protocols. Methods in Molecular Biology.* 119:143-160. P.B. Becker, ed. Humana Press Inc: Totowa, NJ.
  164. Hegner M, Smith SB, Bustamante C. 2000. Polymerization and Mechanical Properties of Single RecA-DNA Filaments. *Proc. Natl. Acad. Sci. USA.* 96:10109 – 101114.
  165. Keller D, Bustamante C. 2000. The Mechanochemistry of Molecular Motors. *Biophys. J.* 78: 541-456.
  166. Cui Y, Bustamante C. 2000. Pulling a Chromatin Fiber Reveals the Forces that Maintain its Higher Order Structure. *Proc. Natl. Acad. Sci. USA* 97: 127-132.
  167. Wuite GL, Davenport RJ, Rappaport A, Bustamante C. 2000. An Integrated Laser Trap/Flow Control Video Microscope for the Study of Single Biomolecules. *Biophys. J.* 79:1155-1167.
  168. Yang G, Cecconi C, Baase WA, Vetter IR, Bryer WA, Haack JA, Matthews BW, Dahlquist FW, Bustamante C. 2000. Solid-State Synthesis and Mechanical Unfolding of Polymers of T4 Lysozyme. *Proc. Natl. Acad. Sci. USA* 97:139-142.
  169. Davenport JR, Wuite G, Landick RA, Bustamante C. 2000. Single-Molecule Study of Transcriptional Pausing and Arrest by *E. coli* RNA Polymerase. *Science.* 287:2497-2500.
  170. Wuite G, Smith SB, Young M, Keller D, Bustamante C. 2000. Single-Molecule Studies of the Effect of Template Tension on T7 DNA Polymerase Activity. *Nature.* 404:103-106.
  171. Guthold M, Zhu X, Rivetti C, Yang G, Thomson NH, Kasas S, Hansma HG, Smith SB, Hansma PK, Bustamante C. 2000. Direct Observation of One-Dimensional Diffusion and Transcription by *Escherichia coli* RNA Polymerase. *Biophys. J.* 77: 2284-2294.
  172. Bustamante C, Smith SB, Liphardt J, Smith D. 2000. Single Molecule Studies of DNA Mechanics. *Current Opinion in Molecular Biology* 10:279-285.
  173. Baumann CB, Bloomfield VA, Smith SB, Bustamante C, Wang MD, Block SM. 2000. Stretching of Single Collapse DNA Molecules. *Biophys. J.* 78:1965-1978.
  174. Rivetti C, Guthold M, Bustamante C. 2000. DNA wrapping in *Escherichia coli* RNA polymerase

- open promoter complexes revealed by scanning force microscopy in DNA-Protein Interactions. Ch .8 in DNA-Protein Interactions: A Practical Approach. A. Travers & M. Buckle eds. Oxford University Press: Oxford.
175. Bustamante, C, Macosko, JC, Wuite GJL. 2000. Grabbing the Cat by the Tail: Manipulating Molecules One by One. *Nature Reviews Molecular and Cell Biology*. 1:130 – 136.
  176. Kellermayer MSZ, Smith SB, Bustamante C, Granzier HL. 2000. Mechanical manipulation of single titin molecules with laser tweezers. *Adv. Exp. Med. Biol.* 481:111-26.
  177. Kellermayer MK, Smith SB, Bustamante C, Granzier HL. 2001. Mechanical Fatigue in Repetitively Stretched Single Molecules of Titin. *Biophys. J.* 80:852-863.
  178. Postov L, Ullsperberger C, Keller RW, Bustamante C, Vologodskii A V, N R Cozzarelli. 2001. Positive Torsional Strain Causes the Formation of a Four-way Junction in Replication Forks. *J. Biol. Chem.* 276:2790-2796.
  179. Bustamante C, Keller D, Oster G. 2001. The Physics of Molecular Motors. *Acc. Chem. Res.* 34: 412-420.
  180. \*Liphardt J, Onoa B, Smith SB, Tinoco I Jr, Bustamante C. 2001. Reversible Unfolding of Single RNA Molecule by Force. *Science*. 292:733-737.
  181. \*Smith DE, Tans SI, Smith SB, Grimes S, Anderson DE, Bustamante C. 2001. The Bacteriophage phi29 Portal Motor can Package DNA Against a Large Internal Force. *Nature*. 413:748.
  182. D'Erme M, Bustamante C. 2001. The Effect of Poly(ADP-ribosyl)ation & Mg<sup>++</sup> Ions on Chromatin Structure Revealed by Scanning Force Microscopy. *Biochemistry*. 40:10047-10955.
  183. Park WJ, Gerion D, Zanchet D, Woerz, AS, Pellegrino T, Micheel C, Williams SC, Seitz M, Bruehl RE, Bryant Z, Bustamante C, Bertozzi CR, Alivisatos PL. 2002. Conjugation of DNA to Silanized Colloidal Semiconductor Nanocrystalline Quantum Dots. *Chemistry of Materials*. 14: 2113-2119.
  184. Tinoco I Jr, Bustamante C. 2002. The effect of Force on Thermodynamics and Kinetics of Single Molecule Reactions. *Biophys. Chem.* 101-102:513-533.
  185. \*Liphardt J, Dumont S, Smith SB, Tinoco I Jr, Bustamante C. 2002. Equilibrium Information from Nonequilibrium Measurements in an Experimental test of Jarzynski's Equality. *Science*. 296: 1832-1835.
  186. Forde NR, Izhaky D, Woodcock GR, Wuite GJL, Bustamante C. 2002. Using Mechanical Force to Probe the Mechanism of Pausing and Arrest During Continuous Elongation by Escherichia coli RNA Polymerase. *Proc. Natl. Acad. Sci. USA* 99:11682-11687.
  187. Ritort F, Bustamante C, I Tinoco Jr. 2002. A Two-state Kinetic Model for the Unfolding of Single Molecules by Mechanical Force. *Proc. Natl. Acad. Sci. USA*. 99:13544-13548.
  188. \*Bustamante C, Bryant Z, Smith SB. 2003. Ten Years of Tension; Single-Molecule DNA Mechanics. *Nature*. 421:423-427.
  189. Keller D, Swigon D, Bustamante C. 2003. Relating single molecule measurements to thermodynamics. *Biophys. J.* 84:733-738.
  190. Rivetti C, Codeluppi S, Dieci G, Bustamante C. 2003. Visualizing RNA Extrusion and DNA Wrapping in Transcription Elongation Complexes of Bacterial and Eukaryotic RNA Polymerases J. *Mol. Bio.* 326:1413-1426.
  191. Onoa B, Dumont S, Liphardt J, Smith SB, Tinoco I Jr, Bustamante C. 2003. Identifying the kinetic barriers to mechanical unfolding of the T. thermophila ribozyme. *Science*. 299:1892-1895.
  192. Smith SB, Cui Y, Bustamante C. 2003. An Optical Trap An Optical-Trap Force Transducer that Operates By Direct Measurement of Light Momentum. *Methods in Enzymology*. 361:134-162.

193. Stone MD, Bryant Z, Crisona NJ, Smith SB, Vologodskii A, Bustamante C, Cozzarelli NR. 2003. Chirality sensing by *Escherichia coli* topoisomerase IV and the mechanism of type II topoisomerases. *Proc. Natl. Acad. Sci. USA.* 100:8654-8659.
194. Kellermayer M, Bustamante C, Granzier H. 2003. Mechanics and Structure of Titin Oligomers explored with Atomic Force Microscopy. *Biochim. et Biophys. Acta.* 1604:105-114.
195. Bryant Z, Stone MD, Gore J, Smith SB, Cozzarelli NR, Bustamante, C. 2003. Structural Transitions and Elasticity from Torque Measurements on DNA. *Nature.* 424:338-341.
196. Matouschek A, Bustamante C. 2003. Finding a protein's Achilles Heel. *Nature Structural Biology.* 10-9: j674-676.
197. Gore J, Ritort F, Bustamante C. 2003. Bias and error in estimates of equilibrium free-energy differences from nonequilibrium measurements. *Proc. Natl. Acad. Sci. USA.* 100:12564-12569.
198. Bustamante C, Chemla YR, Forde NR, Izhaky D. 2004. Mechanical Process in Biochemistry Annual Review of Biochemistry. 73:705-748.
199. Goedken ER, Levitus M, Johnson A, Bustamante C, O'Donnell M, Kuriyan J. 2004. Fluorescence Measurements on the *E. coli* DNA Polymerase Clamp Loader: Implications for Conformational Changes during ATP and Clamp Binding. *J. Mol. Bio.* 5:1047-1059.
200. Trepagnier EH, Jarzynski C, Ritort F, Crooks GE, Bustamante C, Liphardt J. 2004. Experimental Test of Hatano and Sasa's Nonequilibrium Steady-state Equality. *Proc. Natl. Acad. Sci. USA.* 101(42):15038-15041.
201. Li G, Levitus M, Bustamante C, Widom J. 2005. Rapid Spontaneous Accessibility of Nucleosomal DNA. *Nature Structural and Molecular Biology* 12:46-53.
202. Pease PJ, Levy O, Cost GJ, Gore J, Ptacin J, Sherratt D, Bustamante C, Cozzarelli N. 2005. Sequence-Directed DNA Translocation by Purified FtsK. *Science.* 307:586-590.
203. Tang M, Cecconi C, Kim H, Bustamante C, Rio D. 2005. Guanosine triphosphate acts as a cofactor to promote assembly of initial P-element transposase-DNA synaptic complexes. *Genes and Development.* 19:1422-1425.
204. Chemla YR, Karunakaran A, Michaelis J, Grimes S, Jardine PJ, Anderson DL, Bustamante C. 2005. Mechanism of force generation of a viral DNA packaging motor. *Cell.* 122:683-692.
205. \*Collin D, Ritort F, Jarzynski C, Smith SB, Tinoco, I Jr, Bustamante C. 2005. Verification of the Crooks fluctuation theorem and recovery of RNA folding free energies. *Nature.* 437:231-234.
206. Cecconi C, Shank EA, Bustamante C, Marqusee S. 2005. Direct observation of the three-state of a single protein molecule. *Science.* 309:2057-2060.
207. \*Bustamante C, Liphardt J, F Ritort. 2005. The nonequilibrium thermodynamics of small systems. *Physics Today.* 58:43-48.
208. Mao HB, Arias-Gonzalez JR, Smith SB, Tinoco I Jr, Bustamante C. 2005. Temperature control methods in a laser tweezers system. *Biophys. Journal.* 89:1308-1316.
209. Brown TA, Cecconi C, Tkachuk AN, Bustamante C, Clayton DA. 2005. Replication of mitochondrial DNA occurs by strand displacement with alternative light-strand origins, not via a strand-coupled mechanism. *Genes and Development.* 19:2466-2476.
210. Wilcox AJ, Choy J, Bustamante C, Matouschek A. 2005. Effect of protein structure on mitochondrial import. *Proc. Natl. Acad. Sci. USA.* 102:15435-15440.
211. Martinez J, Yuzvinsky TD, Fennimore AM, Zettl A, Garcia R, Bustamante C. 2005. Length control and sharpening of atomic force microscope carbon nanotube tips assisted by an electron beam. *Nanotechnology.* 16:2493-2496.

212. Gorostiza P, Tombola F, Verdagner A, Smith SB, Bustamante C, Isacoff EY. 2005. Molecular handles for the mechanical manipulation of single-membrane proteins in living cells. *IEEE Trans Nanobioscience*. 4:269-76.
213. Levy O, Ptacin JL, Pease PJ, Gore J, Eisen MB, Bustamante C, Cozzarelli NR. 2005. Identification of oligonucleotide sequences that direct the movement of the *Escherichia coli* FtsK translocase. *Proc. Natl. Acad. Sci. USA*. 102:17618-17623.
214. Bustamante C. 2005. Unfolding single RNA molecules: bridging the gap between equilibrium and non-equilibrium statistical thermodynamics. *Quarterly Reviews of Biophysics*. 38(4):291-301.
215. Li PT, Collin D, Smith SB, Bustamante C, Tinoco I Jr. 2006. Probing the mechanical folding kinetics of TAR RNA by hopping, force-jump, and force-ramp methods. *Biophys. Journal*. 90(1): 250-60.
216. \*Dumont S, Cheng W, Serebrov V, Beran R K, Tinoco I Jr, Pyle AM, Bustamante C. 2006. RNA translocation and unwinding mechanism of HCV NS3 helicase and its coordination by ATP. *Nature*. 439:105-108.
217. \*Gore J, Bryant Z, Stone MD, Nollmann M, Cozzarelli NR, Bustamante C. 2006. Mechanochemical analysis of DNA gyrase using rotor bead tracking. *Nature*. 439:100-104.
218. Ritort F, Mihardja S, Smith SB, Bustamante C. 2006. Condensation transition in DNA-polyaminoamide dendrimer fibers studied using optical tweezers. *Phys. Rev. Lett*. 96(11): 118301-1 – 118301-4.
219. \*Gore J, Bryant Z, Nöllmann M, Le MU, Cozzarelli NR, Bustamante C. 2006. DNA overwinds when stretched. *Nature*. 442: 836-839.
220. Li PXT, Bustamante C, Tinoco I Jr. 2006. Unusual mechanical stability of a minimal RNA kissing complex. *Proc. Natl. Acad. Sci. USA*. 103:15847-15852.
221. Mihardja, S, Spakowitz A, Zhang Y, Bustamante, C. 2006. Effect of force on mononucleosomal dynamics. *PNAS*. 103(43):15871-15876.
222. Zhang Y, Smith CL, Saha A, Grill SW, Mihardja S, Smith, SB, Cairns BR, Peterson CL, Bustamante C. 2006. DNA Translocation and Loop Formation Mechanism of Chromatin Remodeling by SWI/SNF and RSC. *Molecular Cell*. 24(4):559-568.
223. Moffitt JR, Chemla YR, Izhaky D, Bustamante C. 2006. Differential detection of dual traps improves the spatial resolution of optical tweezers. *Proc. Natl. Acad. Sci. USA*. 103:9006-9011.
224. Ptacin JL, Nöllmann M, Bustamante C, Cozzarelli NR. 2006. Identification of the FtsK sequence-recognition domain. *Nat. Struct. Mol. Biol*. 13:1023 – 1025.
225. Tinoco I Jr, Li PTX, Bustamante C. 2006. Determination of thermodynamics and kinetics of RNA reactions by force. *Quarterly Reviews of Biophysics*. 39(4):325-360.
226. Walter JM, Greenfield D, Bustamante C, Liphardt J. 2007. Light-powering *Escherichia coli* with proteorhodopsin. *Proc. Natl. Acad. Sci. USA*. 104:2408-2412.
227. Galburt, EA, Grill SW, Wiedmann A, Lubkowska L, Choy J, Nogales E, Kashlev M, Bustamante C. 2007. Backtracking determines the force sensitivity of RNAP II in a factor-dependent manner. *Nature*. 446:820-823.
228. Nöllmann M, Stone MD, Bryant Z, Gore J, Crisona NJ, Hong SC, Mittelheiser S, Maxwell A, Bustamante C, Cozzarelli NR. 2007. Multiple modes of *Escherichia coli* DNA gyrase activity revealed by force and torque. *Nat. Struct. Mol. Biol*. 14(4):264-271.
229. Hugel T, Michaelis J, Hetherington CL, Jardine PJ, Grimes S, Walter, JM, Falk W, Anderson DL, Bustamante C. 2007. Experimental Test of Connector Rotation during DNA Packaging into Bacteriophage phi29 Capsids. *PLoS Biology*. 5(3):e59.

230. Leschziner AE, Saha A, Wittmeyer J, Zhang Y, Bustamante C, Cairns BR, Nogales E. 2007. Conformational flexibility in the chromatin remodeler RSC observed by electron microscopy and the orthogonal tilt reconstruction method. *Proc. Natl. Acad. Sci. USA.* 104(12):4913-4918.
231. Wen JD, Manosas M, Li P, Smith SB, Bustamante C, Ritort F, Tinoco I Jr. 2007. Force unfolding kinetics of RNA using optical tweezers. I. Effects of experimental variables on measured results. *Biophys. J.* 92:2996-3009.
232. Manosas M, Wen JD, Li PTX, Smith SB, Bustamante C, Tinoco I Jr, Ritort F. 2007. Force unfolding kinetics of RNA using optical tweezers. II. Modeling experiments. *Biophys J.* 92:3010-3021.
233. Li PTX, Bustamante C, Tinoco I Jr. 2007. Real-time control of the energy landscape by force directs the folding of RNA molecules. *Proc. Natl. Acad. Sci. USA* 104(17): 7039-7044.
234. Choy JL, Parekh SH, Chaudhuri O, Liu A P, Bustamante C, Footer MJ, Theriot, JA, Fletcher JD. 2007. Differential force microscope for long time-scale biophysical measurements. *Rev. Sci. Instrum.* 78(4):043711.
235. Cheng W, Dumont S, Tinoco I Jr, Bustamante C. 2007. NS3 helicase actively separates RNA strands and senses sequence barriers ahead of the opening fork. *Proc. Natl. Acad. Sci. USA.* 104(35):13954-13959.
236. Tang M, Cecconi C, Bustamante C, Rio DC. Analysis of P element transposase protein-DNA interactions during early stages of transposition. 2007. *J. Biol. Chem.* 282(39):29002-12.
237. Viereggs J, Cheng W, Bustamante C, Tinoco I Jr. 2007. Measurement of the Effect of Monovalent Cations on RNA Hairpin Stability. *J. Am. Chem. Soc.* 129(48):14966- 73.
238. Cecconi C, Shank EA, Marqusee S, Bustamante C. 2007. Studying Protein Folding with Laser Tweezers. *Proceedings of the International School Enrico Fermi. Società Italiana di Fisica.* 145-160.
239. Bustamante C, Chemla YR, Moffitt JR. 2008. High-Resolution Dual-Trap Optical Tweezers with Differential Detection. Ch 14 in *Single-Molecule Techniques: A Laboratory Manual.* Selvin, P. & T. Ha, eds. CSHL.
240. Green L, Kim CH, Bustamante C, Tinoco I Jr. 2008. Characterization of the Mechanical Unfolding of RNA pseudoknots. *J. Mol. Biol.* 375(2): 511-28.
241. Downing, K, Comolli LR, Spakowitz AJ, Siegerist CE, Jardine PJ, Grimes S, Anderson DL, Bustamante C. 2008. Three-Dimensional Architecture of the Bacteriophage phi29 Packaged Genome and Elucidation of its Packaging Process. *Virology.* 371(2):267-277.
242. Moffitt JR, Chemla YR, Smith SB, Bustamante C. 2008. Recent Advances in Optical Tweezers. *Review of Biochemistry.* 77:205-228.
243. \*Wen JD, Lancaster L, Hodges C, Zeri AC, Yoshimura SH, Noller HF, Bustamante C, Tinoco I Jr. 2008. Following translation by single ribosomes one codon at a time. *Nature.* 452:598-603.
244. Ptacin JL, Nöllmann M, Becker EC, Cozzarelli NR, Pogliano K, Bustamante C. 2008. Sequence-directed DNA export guides chromosome translocation during sporulation in *Bacillus subtilis*. *Nat. Struct. Mol. Biol.* 15(5):485-493.
245. Chemla YR, Moffitt JR, Bustamante C. 2008. Exact Solutions for Kinetic Models of Macromolecular Dynamics. *Journal Phys. Chem. B* 112(19):6025 -6044.
246. Bustamante C. 2008. Physical Biology at the Crossroads. ch. 5 in *Physical Biology: From Atoms to Medicine.* Ahmed Zewail. Imperial College Press: London. 115-135.
247. Bustamante C. 2008. In *singulo Biochemistry: When Less is More.* Annual Review of Biochemistry 77: 45-50.
248. Maragakis P, Ritort F, Bustamante C, Karplus CM, Crooks GE. 2008. Bayesian estimates of free



- energies from nonequilibrium work data in the presence of instrument noise. *The Journal of Chemical Physics*. 129:024102.
249. Mejia, YX, Mao HB, Forde NR, Bustamante C. 2008. Thermal Probing of E.coli RNA Polymerase. *Journal of Molecular Biology*. 382:682.
  250. Alcaraz J, Xu R, Mor H, Nelson CM, Mroue R, Spencer VA, Brownfield D, Radisky DC, Bustamante C, Bissell MJ. 2008. Laminin and biomimetic extracellular elasticity enhance functional differentiation in mammary epithelia. *The EMBO Journal*. 9:1-10.
  251. Cecconi C, Shank EA, Dahlquist FW, Marqusee S, Bustamante C. 2008. Protein-DNA Chimeras for Single Molecule Mechanical Folding Studies with the Optical Tweezer. *European Biophysics Journal*. 37:6.
  252. Marquis KA, Burton BM, Nollmann M, Ptacin JL, Bustamante C, Ben-Yehuda S, Rudner DZ. 2008. SpoIIIE strips proteins off the DNA during chromosome translocation. *PMC*. 1;22(13):1786-95.
  253. \*Moffitt JR, Chemla YR, Aathavan K, Grimes S, Jardine PJ, Anderson DL, Bustamante C. 2009. Intersubunit coordination in a homomeric ring ATPase. *Nature*. 457: 446-450.
  254. Mangiarotti L, Cellai S, Ross W, Bustamante C, Rivetti C. 2009. Sequence-dependent upstream DNA-RNA polymerase interactions in the open complex with lambdaR and lambdaPRM promoters and implications for the mechanisms of promoter interference. *J. Mol. Biol*. 385(3): 748-60.
  255. Galburt EA, Grill S, Bustamante C. 2009. Single molecule transcription elongation. *Methods*. 48: 323-332.
  256. \*Hodges C, Bintu L, Lubkowska L, Kashlev M, Bustamante C. 2009. Nucleosomal Fluctuations Govern in the Transcription Dynamics of RNA Polymerase II. *Science*. 325:1172926.
  257. Ibarra, B, Chemla YR, Plyasunov S, Smith SB, Lazaro JM, Salas M, Bustamante C. 2009. Proofreading Dynamics of Processive DNA Polymerase. *The EMBO Journal*. 28:2794-802.
  258. Karunakaran A, Politzer A, Kaplan A, Moffitt JR, Chemla YR, Grimes S, Jardine P, Anderson D, Bustamante C. 2009. Substrate Interactions and Promiscuity in a Viral DNA packaging Motor. *Nature*. 461:669-673.
  259. Chen G, Chang KY, Chou MY, Bustamante C, Tinoco I Jr. 2009. Triplex structures in an RNA pseudoknot enhance mechanical stability and increase efficiency of -1 ribosomal frameshifting. *Proc. Natl. Acad. Sci*. 106:12706-11.
  260. \*Shank E, Cecconi E, Dill J, Marqusee S, Bustamante C. 2009. The folding cooperativity of a protein is controlled by its chain topology. *Nature*. 465:637-640.
  261. Bustamante C, Moffitt J. 2009. Past, Present, and Future of Single-molecule Studies of Transcription. *Royal Society of Chemistry: RNA Polymerases as Molecular Motors*.
  262. Yu J, Moffitt JR, Hetherington CL, Bustamante C, Oster G. 2010. Mechanochemistry of a Viral DNA Packaging Motor. *Journal of Molecular Biology*. 400:186-203.
  263. Flemming TC, Shin JY, Lee SH, Becker E, Huang KC, Bustamante C, Pogliano K. 2010 Dynamic SpoIIIE assembly mediates septal membrane fission during *Bacillus subtilis* sporulation. *Genes Dev*. 24: 1160-1172.
  264. Huguet JM, Bizarro CV, Forns N, Smith SB, Bustamante C, Ritort F. 2010. Single-molecule derivation of salt dependent base-pair free energies in DNA. *PNAS*. 107:15431-15436.
  265. Moffitt JR, Chemla YR, Bustamante C. 2010. Mechanistic constraints from the substrate concentration dependence of enzymatic fluctuations. *PNAS*. 10:15739-15744.
  266. Moffitt JR, Chemla YR, Bustamante C. 2010. Methods in Statistical Kinetics. *Methods in Enzymology*. 475:221-257.

267. Yu J, Cheng W, Bustamante, C, Oster, G. 2010. Coupling Translocation with Nucleic Acid Undwinding by NS3 Helicase. *J. Molecular Biology*. 404:439-455.
268. Zohar, H, Hetherington CL, Bustamante, C, Muller SJ. 2010. Peptide Nucleic Acids as Tools for Single- Molecule Sequence Detection and Manipulation. *American Chemical Society, Nano Lett*. 10(11): 4697-4701.
269. Bustamante, C, Moffitt JR. 2010. *Viral DNA Packaging: One Step at a Time. Single Molecule Spectroscopy in Chemistry, Physics and Biology; Springer Series in Chemical Physics*. 96(5):237-269.
270. Bustamante, C, Cheng W, Mejia Y. 2011. Revisiting the Central Dogma One Molecule at a Time. *Cell*. 144:480-491.
271. Maillard, RA, Chistol G, Sen M, Righini M, Tan J, Kaiser CM, Hodges C, Martin A, Bustamante, C. 2011. ClpX(P) Generates Mechanical Force to Unfold and Translocate Its Protein Substrates *Cell*. 145:459-469.
272. Qu, X, Wen JD, Lancaster, L, Noller, HF, Bustamante, C, Tinoco I Jr. 2011. The ribosome uses two active mechanisms to unwind messenger RNA during translation. *Nature*. 475:118-121.
273. Cheng W, Arunajadai SG, Moffitt JR, Tinoco I Jr, Bustamante C. 2011. Single-Base Pair Unwinding and Asynchronous RNA Release by the Hepatitis C Virus NS3 Helicase. *Science*. 33:1746-1749.
274. Bintu L, Kopaczynska M, Hodges C, Lubkowska L, Kashlev M, Bustamante C. 2011. The elongation rate of RNA polymerase determines the fate of transcribed nucleosomes. *Nature Structural and Molecular Biology*. 18:1394-1399.
275. \*Kaiser CM, Goldman, DM, Chodera JD, Tinoco I Jr, Bustamante C. 2011. The Ribosome Modulates Nascent Protein Folding. *Science*. 334:1723-1727.
276. Sudhanshu B, Mihardja S, Koslover EF, Mehraeen S, Bustamante C, Spakowitz AJ. 2011. Tension-dependent structural deformation alters single-molecule transition kinetics. *PNAS*. 108:1885.
277. Elms P, Chodera J, Bustamante C, Marquese S. 2012. The molten globule state is unusually deformable under mechanical force. *PNAS*. 109:3769-3801.
278. Qu X, Lancaster L, Noller HF, Bustamante C. 2012. Ribosomal protein S1 unwinds double-stranded RNA in multiple steps. *PNAS*. 109:14458-14463.
279. Bintu L, Ishibashi T, Dangkulwanich M, Yi WY, Lubkowska L, Kashlev M, Bustamante C. 2012. Nucleosomal Elements That Control the Topography of the Barrier to Transcription. *Cell*. 151:738-749.
280. Zamft B, Bintu L, Ishibashi T, Bustamante C. 2012. Nascent RNA Structure modules the transcription dynamics of RNA Polymerases. *PNAS*. 109:8949-8953.
281. Jagannathan B, Elms P, Bustamante C, Marquese S. 2012. Direct Observation of a force-induced switch in the anisotropic mechanical unfolding pathway of a protein. *PNAS*. 109(44):18820-17825.
282. Chistol G, Liu S, Hetherington CL, Moffitt JR, Grimes S, Jardine PJ, Bustamante C. 2012. High Degree of Coordination and Division of Labor Among Subunits in a Homomeric Ring ATPase. *Cell*. 151:1017-1028.
283. Hetherington CL, Moffitt JR, Jardine PJ, Bustamante C. 2012. *Viral DNA Packaging Motors in Comprehensive Biophysics*. Academic Press. 4:420-446.
284. Lee SH, Shin, JY, Lee A, Bustamante C. 2012. Counting single photoactivatable fluorescent molecules by photoactivated localization microscopy (PALM). *PNAS*. 109:17436-17441.
285. Dangkulwanich M, Ishibashi T, Liu S, Kireeva ML, Lubkowska L, Kashlev M, Bustamante C.

2013. Complete dissection of transcription elongation reveals slow translocation of RNA polymerase II in a linear ratchet mechanism. *eLife*. 2:e00971.
286. Strycharska MS, Arias-Palomo E, Lyubimov AY, Erzberger JP, O'Shea VL, Bustamante C, Berger JM. 2013. Nucleotide and partner-protein control of bacterial replicative helicase structure and function. *Mol Cell*. 52(6):844-54.
287. Sen M, Maillard RA, Nyquist K, Rodriguez-Aliaga P, Pressé S, Martin A, Bustamante C. 2013. The ClpXP protease unfolds substrates using a constant rate of pulling but different gears. *Cell*. 155(3):636-46.
288. Moffitt J, Bustamante C. 2013. Extracting signal from noise: kinetic mechanisms from a Michaelis-Menten-like expression for enzymatic fluctuations. *The FEBS Journal*. 281(2):498-517.
289. Walter NG, Bustamante C. 2014. Introduction to single molecule imaging and mechanics: seeing and touching molecules one at a time. *Chem Rev*. 2014. 114(6):3069-71.
290. Dangkulwanich M, Ishibashi T, Bintu L, Bustamante C. 2014. Molecular Mechanisms of Transcription through Single-Molecule Experiments. *Chem Rev*. 114(6):3203-23.
291. Liu S, Chistol G, Bustamante C. 2014. Mechanical Operation and Intersubunit Coordination of Ring-Shaped Molecular Motors: Insights from Single-molecule Studies. *Biophys. J*. 106:1844-1858.
292. Ishibashi T, Dangkulwanich M, Coello Y, Lionberger TA, Lubkowska L, Ponticelli AS, Kashlev M, Bustamante C. 2014. Transcription Factors IIS and IIF Enhance Transcription Efficiency by Differentially Modifying RNA Polymerase Pausing Dynamics. *PNAS*. 111:3419 – 3424.
293. Kim HK, Liu F, Fei J, Bustamante C, Gonzalez RL Jr, Tinoco I Jr. 2014. A frameshifting stimulatory stem loop destabilizes the hybrid state and impedes ribosomal translocation. *Proc Natl Acad Sci USA*. 111(15):5538-43.
294. Liu S, Chistol, G, Hetherington CL, Tafoya S, Aathavan K, Schnitzbauer J, Grimes S, Jardine P, Bustamante C. 2014. A Viral Packaging Motor Varies Its DNA Rotation and Step Size to Preserve Subunit Coordination as the Capsid Fills. *Cell*. 157(3):702-713.
295. Liu T, Kaplan A, Alexander L, Yan S, Wen JD, Lancaster L, Wickersham CE, Fredrick K, Noller H, Tinoco I Jr, Bustamante C. 2014. Direct measurement of the mechanical work during translocation by the ribosome. *eLife*. 2014(3):e03406.
296. Bustamante C, Kaiser, CM, Maillard R, Goldman D, Wilson AM. 2014. Mechanisms of Cellular Proteostasis: Insights from Single-Molecule Approaches. *Annual. Rev. Biophys*. 43:119-140.
297. Rosenbloom AB, Lee SH, To M, Lee A, Shin JY, Bustamante C. Optimized two color super resolution imaging of Drp1 during mitochondrial fission with a slow-switching Dronpa variant. *PNAS*. 111(36):13093-13098.
298. Onoa B, Schneider AR, Brooks MD, Grob P, Nogales E, Geissler P, Niyogi K, Bustamante C. 2014. Atomic Force Microscopy of Photosystem II and Its Unit Cell Clustering Quantitatively Delineate the Mesoscale Variability in Arabidopsis Thylakoids. *Plos One*. 9(7):e101470.
299. Presse S, Peterson J, Lee J, Elms P, MacCallum JL, Marqusee S, Bustamante C, Dill K 2014. Single Molecule Conformational Memory Extraction: P5ab RNA Hairpin. *J. Phys. Chem. B*. 118(24):6597-6603.
300. Llorente-Garcia I, Lenn T, Erhardt H, Harriman OL, Liu L, Robson A, Chiu SW, Matthews S, Willis NJ, Bray CD, Lee SH, Shin JY, Bustamante C, Liphardt J, Friedrich T, Mullineaux CW, Leake MC. 2014. Single-molecule in vivo imaging of bacterial respiratory complexes indicates delocalized oxidative phosphorylation. *Elsevier*. 1837:811-824.
301. Mejia Y, Nudler E, Bustamante C. 2014. Trigger loop folding determines rate of Escheriachia coli's

- RNA polymerase. *PNAS*. 111:52 (2014)
302. Riedel C, Gabizon R, Wilson CAM, Hamadani K, Tsekouras K, Marqusee S, Pressé S, Bustamante C. 2015. The heat released during catalytic turnover enhances the enzymes diffusion. *Nature* 517:227–230.
  303. Yan S, Wen JD, Bustamante C, Tinoco I Jr. 2015. Ribosome Excursions during mRNA Translocation Mediate Broad Branching of Frameshift Pathways. *Cell*. 160(5):870-881.
  304. \*Goldman DH, Kaiser CM, Milin A, Righini M, Tinoco I Jr, Bustamante C. 2015. Mechanical force releases nascent chain-mediated ribosome arrest in vitro and in vivo. *Science* 348:457-460.
  305. Doniselli N, Rodriguez PA, Amidani D, Bardales JA, Bustamante C, Guerra DG, Rivetti C. 2015. New insights into the regulatory mechanisms of ppGpp and DksaA on Escherichia coli RNA polymerase-promoter complex. *Nuc. Ac. Res.* 43:5249-5262.
  306. Shin JY, Lopez-Garrido J, Lee SH, Diaz-Celis C, Fleming T, Bustamante C, Pogliano K. 2015. Visualization and functional dissection of coaxial paired SpoIIIE channels across the sporulation septum. *eLife* 2015; 4:e06474.
  307. Kramer JR, Onoa B, Bustamante C, Bertozzi CR. 2015. Chemically tunable mucin chimeras assembled on living cells. *Proc. Nat. Acad. Sci. (USA)*, 112(41): 2574–12579.
  308. Liu N, Chistol G, Bustamante C. 2015. Two-subunit DNA escort mechanism and inactive subunit bypass in an ultra-fast ring ATPase. *eLife* 2015; 4:e09224.
  309. Rodriguez-Aliaga P, Ramirez L, Kim F, Bustamante C, Martin A. 2016. Substrate-translocating loops regulate mechanochemical coupling and power production in AAA+ protease ClpXP. *Nat Struct Mol Biol.* 2016; 23(11): 974–981.
  310. Herrera-Asmat O, Lubkowska L, Kashlev M, Bustamante CJ, Guerra DG, Kireeva ML. 2017. Production and characterization of a highly pure RNA polymerase holoenzyme from *Mycobacterium tuberculosis*. *Protein Expression and Purification* 134: 1–10.
  311. San-Martin A, Rodriguez-Aliaga P, Molina JA, Martin A, Bustamante C, Baez M. 2017. Knots can impair protein degradation by ATP-dependent proteases. *Proc. Nat. Acad. Sci. (USA)*, 114(37):9864-9869.
  312. Lee A, Tsekouras K, Calderon C, Bustamante C, Presse S. 2017. Unraveling the Thousand Word Picture: An Introduction to Super-Resolution Data Analysis. *Chemical Reviews* 117(11):7276-7330.
  313. Bustamante C. 2017. Molecular machines one molecule at time. *Protein Science* 26(7):1245-1248.
  314. Bustamante A, Sotelo-Campos J, Guerra DG, Floor M, Wilson CAM, Bustamante C, Baez M. 2017. The energy cost of polypeptide know formation and its folding consequences. *Nature Communications* 8(1):2195.
  315. Righini M, Lee A, Canari-Chumpitaz C, Lionberger T, Gabizon R, Coello Y, Tinoco I Jr, Bustamante C. 2018. Full molecular trajectories of RNA polymerase at single base-pair resolution. *Proc. Nat. Acad. Sci. (USA)*, 115(6):1286-1291.
  316. Liu N, Chistol G, Cui Y, Bustamante C. 2018. Mechanochemical coupling and bi-phasic force-velocity dependence in the ultra-fast ring ATPase SpoIIIE. *eLife* 2018;7:e32354.
  317. Tafoya S, Bustamante C. 2018. Molecular switch-like regulation in motor proteins. *Philosophical Transactions of the Royal Society B*. 19;373(1749).

318. Tafoya S, Liu S, Castillo JP, Atz R, Morais MC, Grimes S, Jardine PJ, Bustamante C. 2018. Molecular Switch-Like Regulation Enables Global Subunit Coordination in a Viral Ring ATPase. *Proc. Nat. Acad. Sci. (USA)*, 115 (31) 7961-7966.
319. Gabizon R, Lee A, Vahedian-Movahed H, Ebright RH, Bustamante C. 2018. Pause Sequences Facilitate Entry into Long-lived Pause States by Reducing the Transcription Rate of RNA Polymerase. *Nature Communications*, 9: 2930.
320. Bustamante C, Tafoya S. 2018. Biochemistry and Biophysics *in Singulo*: When Less is More. *Cell Biology and Genetics. Pontificiae Academiae Scientiarum Scripta Varia*, 137.
321. Schöneberg J, Pavlin MR, Yan S, Righini M, Lee I-H, Carlson L-A, Bahrami AH, Goldman DH, Ren X, Hummer G, Bustamante C, Hurley JH. 2018. ATP-dependent force generation and membrane scission by ESCRT-III and Vps4. *Science*, 362: 1423 – 1428.
322. Zhang H, Wang Y, Zhang H, Liu X, Lee A, Huang Q, Wang F, Chao J, Liu H, Li J, Shi J, Zuo X, Wang L, Wang L, Cao Z, Bustamante C, Tian ZQ, Fan C. 2019. Programming chain-growth copolymerization of DNA hairpin tiles for in-vitro hierarchical supramolecular organization. *Nature Communications* 10: 1006.
323. Tafoya S., Large SJ, Liu S., Bustamante C., and Sivak DA, 2019. Using a system's equilibrium behavior to reduce its energy dissipation in nonequilibrium processes. *Proc. Natl. Acad. Sci (USA)*, 116: 5920 – 5924.
324. Alexander LM, Goldman DH, Wee LM, Bustamante C. 2019. Non-equilibrium Dynamics of a Nascent Polypeptide During Translation Suppress its Misfolding. *Nature Communications*, 10: 2709.
325. Feng B., Sosa RP, Mårtensson AKF, Jiang K, Tong A., Dorfman KD, Takahashi M., Lincoln P., Bustamante CJ, Westerlund F. and Nordén B. 2019. Hydrophobic catalysis and a potential biological role of DNA unstacking induced by environment effects. *Proc.Nat. Acad. Sci. (USA)*, 116: 17169 – 17174.
326. Desai VP, Frank F., Lee A., Righini M., Lancaster L, Noller HF., Tinoco Jr. I, and Bustamante C., 2019. Co-temporal force and fluorescence measurements reveal a ribosomal gear shift mechanism of translation regulation by structured mRNAs. *Mol. Cell.*, 75(5):1007-1019.
327. Chen Z., Gabizon, R., Brown, AI, Lee, A., Song, A., Diaz, CD, Kaplan, A., Koslover, E., Yao, T., Bustamante, C., 2019. High-resolution and high-accuracy topographic and transcriptional maps of the nucleosome barrier. *eLife*.:e48281.
328. Fukuda S, Yan S, Komi Y, Sun M, Gabizon R, Bustamante C., 2019. The Biogenesis of SRP RNA Is Modulated by an RNA Folding Intermediate Attained during Transcription. *Mol Cell.*, 77(2):241-250.
329. Onoa B., Fukuda S., Iwan M., Bustamante C., Niyogi K., 2020. Atomic Force Microscopy Visualizes Mobility of Photosynthetic Proteins in Grana Thylakoid Membranes. *Biophysical Journal* 118: 1876-1886.
330. Wang, F., Hao, Y., Li, Q., Zhang, H., Zhang, X., Wang, L., Bustamante, C., Fan, C., 2020. Programing PAM antennae for efficient CRISPR-Cas9 DNA editing. *Science Adv.* 6(19) 1-11.

Speaking Engagements2019

- Biophysical Society Thematic Meeting: “ Co-temporal Force and Fluorescence Measurements Reveal a Ribosomal Gear-shift Mechanism of Translation Regulation by mRNA Secondary Structures,” UTEC – Universidad de Ingenieria y Tecnologia, July 18, 2019
- Institute for Biophysical Dynamics: “Division of Labor Among the Subunits of a Highly Coordinated Ring ATPase,” University of Chicago, June 4, 2019.
- The Harkins Lecture: “The Ribo.some Modulates Nascent Protein Folding and Nascent Protein Folding can Modulate the Ribosome Activity,” University of Chicago, June 3, 2019.
- Ribosome 2019 Conference: “Ribosomes shift to a lower ‘gear’ in response to stable mRNA secondary structures,” Merida, Mexico, January 8, 2019.

2018

- Christian B. Anfinsen Lecture: “"Co-translational protein folding, one molecule at a time," Johns Hopkins University, November 13, 2018.
- Winton Symposium: “Power at the Nanoscale: Speed, Strength and Efficiency in Biological Motors,” University of Cambridge, November 1, 2018.
- Howard Hughes Medical Institute Scientific Meeting: “Crossing the Wall: Transcription Across the Nucleosomal Barrier”, September 4-6, 2018
- Single Biomolecules Meeting: “Use of the high resolution ‘fleezers’ to study barrier crossing by individual ribosomes,” Cold Spring Harbor Laboratory, August 31, 2018.
- Gordon Research Conference on Chromatin Structure and Function: “High-resolution and High-accuracy Topographic Map of Nucleosome Barrier Crossing by Pol II,” Newry, Maine, July 22-27, 2018.
- New Horizons in Optical Trapping: Applications to Biophysics, Statistical Mechanics, and Optics, “Use of High Resolution Optical Tweezers and Single Molecule Fluorescence Detection Capability to Study Barrier Crossing Individual Ribosomes,” Neve Ilan, Israel, June 26, 2018.
- Northwestern Biophysics Symposium, “Division of Labor Among the Subunits of a Highly Coordinated Ring ATPase,” Northwestern University, June 20, 2018.
- Department of Chemistry Colloquia. “Division of Labor Among the Subunits of a Highly Coordinated Ring ATPase,” Rochester University, May 23, 2018.
- The Albrecht Lecture: “Division of Labor Among the Subunits of a Highly Coordinated Ring ATPase,” Cornell University, April 26, 2018.
- Kolthoff Lecture in Chemistry: Lecture 1 - “Use of Crooks’ Theorem to Study the Interdomain Folding Cooperativity of a Protein,” Lecture 2 - “The Ribosome Modulates Nascent Protein Folding and Nascent Protein Folding Can Modulate the Ribosome Activity”, Lecture 3 - “Division of Labor Among the Subunits of a Highly Coordinated Ring ATPase,” University of Minnesota, April 18-20, 2018.
- Festival Puerto de Ideas: “Estudiando la Maquinaria Celular una Molécula a la Vez,” Antofagasta, Chile. April 14, 2018.
- The Linus Pauling Lecture: “Division of Labor Among the Subunits of a Highly Coordinated Ring ATPase,” Stanford University, March 9, 2018.
- Peruvian Society of Biochemistry and Molecular Biology: “Division of Labor Among the Subunits of a Highly Coordinated Ring ATPase,” Lima, Peru, March 1-2, 2018.
- Learning in Retirement Series: "Biophysics, One Molecule at a Time," University of California, Berkeley,

February 13, 2018.

## 2017

- 2017 ASCB | EMBO Meeting: “Division of Labor Among the Subunits of a Highly Coordinated Ring ATPase,” Philadelphia, PA, December 2-6, 2017
- FEBS3+: 1<sup>st</sup> Joint Meeting of the French-Portuguese-Spanish Biochemical and Molecular Biology Societies: “Division of labor and allosteric regulation among the subunits of a DNA packaging ring ATPase,” Barcelona, Spain, October 26, 2017.
- Workshop on Cell Biology and Genetics – PAS: “Biophysics and Biochemistry in Singlo: When Less is More,” Rome, Italy, October 23, 2017.
- Royal Society Symposium Allostery and Molecular Machines: “Division of Labor Among the Subunits of a Highly Coordinated Ring ATPase,” London, June 19-20, 2017.
- Free University Invited Speaker “Division of Labor Among the Subunits of a Highly Coordinated Ring ATPase,” Amsterdam, Netherlands, June 19, 2017.
- Physical Biology Conference: “Division of Labor Among the Subunits of a Highly Coordinated Ring ATPase,” Mexico City, Mexico, May 17, 2017.
- Sanders Tri-Institutional Chemical Biology Seminar Series: "The Folding Cooperativity of a Protein is Controlled by the Topology of its Polypeptide Chain," Tri-Institute, May 2, 2017.
- Rockefeller University Seminar: “Division of Labor Among the Subunits of a Highly Coordinated Ring ATPase,” Rockefeller University, May 1, 2017.
- Center for Theoretical Biological Physics Lecturer: “Division of Labor Among the Subunits of a Highly Coordinated Ring ATPase,” Rice University, April 11, 2017.
- ASU Physics Colloquium: “Use of Crooks’ Theorem to Study Interdomain Folding Cooperativity of a Protein,” Arizona State University, April 6, 2017.
- 1<sup>st</sup> Biology for Physics: Is there New Physics in Living Matter: “Physical Biology or Biological Physics,” Barcelona, Spain, January 15-18, 2017.
- Centro de Biotechnologia Madrid, Spain Invited Speaker: “Division of Labor Among the Subunits of a Highly Coordinated Ring ATPase,” Madrid, Spain, Jan 13, 2017

## 2016

- Single Molecule Symposium: “Division of Labor Among the Subunits of a Highly Coordinated Ring ATPase,” Saint Louis University, December 2, 2016.
- The Technological Revolution in Structural Biology: Its Impact on Biology and Chemistry: “Division of Labor Among the Subunits of a Highly Coordinated Ring ATPase,” The Weizmann Institute of Science, November 6, 2016.
- Trends in Quantitative Biology and Biophysics Symposium: “Division of Labor Among the Subunits of a Highly Coordinated Ring ATPase.” Universidad Autonoma de San Luis Potosi, October 20-21, 2016.
- The 22<sup>nd</sup> Annual Shih-I Pai Lecture: “The folding cooperativity of a protein controlled by the topology of its polypeptide chain,” University of Maryland, October 4, 2016.
- The 2016 Biochemistry IMPACT Lecture: “Division of Labor Among the Subunits of a Highly Coordinated Ring ATPase,” University of Notre Dame, September 15, 2016.
- Nascent Chain Biology Meeting: “Mechanical Force Releases Nascent Chain-Mediated Ribosome Arrest *in vitro* and *in vivo*,” Yamanashi, Japan, September 1-3, 2016.
- Keynote Lecture of the XXV Scientific of ICNAR: “Mechanical Force Releases Nascent Chain-Mediated

Ribosome Arrest in *vitro and in vivo*,”Universidad Nacional Mayor De San Marcos, Lima, August 15, 2016.

ICFO Colloquium: “Division of Labor Among the Subunits of a Highly Coordinated Ring ATPase,” Barcelona, Spain, July 22, 2016.

Universidad de Ingeniería, Lima Invited Speaker:” Use of Crooks Fluctuation Theorem to Study the Interdomain Folding Cooperativity of a Protein,” Lima, Peru, June 7, 2016.

Tinoco Symposium Invited Lecture: “The Role Mechanical Force on the Release of Ribosome Translational Arrest at the Sec M Sequence,” UC Berkeley, March 26, 2016.

The RNA Institute Symposium on RNA Science: Epitranscriptomics: “Following Translation by Single ribosomes one column at a time,” Albany, New York, March 18, 2016.

Pennsylvania Muscle Institute Seminar: “Division of Labor Among the Subunits of a Highly Coordinated Ring ATPase,” University of Pennsylvania, March 7, 2016.

The 2015 David S. Sigman Memorial Lecture: “The Role of Mechanical Force on the Release of Ribosome Translational Arrest at the Sec M Sequence,” University of California, Los Angeles, January 14, 2016.

## 2015

Invited Lecture Shanghai Institute of Applied Physics: “Division of Labor and Coordination among the subunits Highly Coordinated Ring ATPase,” Shanghai, China, Nov 10, 2015.

Howard Hughes Medical Institute Scientific Meeting: Division of Labor and Coordination among the subunits Highly Coordinated Ring ATPase,” HHMI, November 4, 2015.

UCLA Seaborg Symposium Invited Speaker: “Division of Labor and Coordination among the subunits Highly Coordinated Ring ATPase,” UCLA, October 18-20, 2015.

The McDowell Lecture at Univ. of British Columbia, Simon Fraser Univ. & Univ. of Victoria: “Division of Labor and Coordination among the subunits Highly Coordinated Ring ATPase,” Canada, September 20-24, 2015.

Uppsala Universitet: “Division of Labor Among the Subunits of a Highly Coordinated Ring ATPase,” Stockholm, September 3, 2015.

Karolinska Institute: “Mechanical Force Release Nascent Chain-mediated Ribosome Arrest in vitro and in vivo,” Stockholm, September 1, 2015.

Instituto de Física UNAM: “Use of Crooks Fluctuation Theorem to Study the Interdomain Folding Cooperativity of a Protein,” Mexico City, August 21, 2015.

Summer School LiSci 2015: “Mechanisms of Cellular Proteostasis: Insights from Single Molecule Studies,” Mexico City, August 17, 2015.

Italian Institute of Science: Laurea Honoris Causa Lecture at (Scuola Internazionale Superiore di Studi Avanzati )SISSA: “Division of Labor Among the Subunits of a Highly Coordinated Ring ATPase,” Italy, June 22, 2015.

Janssen R&D presentation: “Use of Crooks Fluctuation Theorem to Study the Interdomain Folding Cooperativity of a Protein,” Spring House, PA, June 14-16, 2015.

41<sup>st</sup> Annual Naff Symposium: “Division of Labor and Coordination among the subunits of the Nearly Perfect Biological Machine,” University of Kentucky, March 5-7, 2015.

## 2014

Weizmann Lecturer: “Mechanisms of Cellular Proteostasis: Insights from Single Molecule Approaches,”



- Weizmann Institute, Israel, December 3, 2014.
- Weizmann Lecturer: “Division of Labor and Coordination Among the Units of a Nearly Perfect Biological Machine,” Weizmann Institute, Israel, December 2, 2014.
- Invited Speaker: “Mechanisms of Cellular Proteostasis: Insights from Single Molecule Approaches,” Technion Institute, Israel, December 1, 2014.
- Mendel Lecturer: “Grabbing the cat by the tail: How a viral molecular motor packages DNA,” Mendel Lecture, Brno, Czech Republic, October 24, 2014.
- Keynote speaker, Latin American and Peruvian Congress of Chemistry: “Q&A A Journey Through Cellular Processes: One Molecule at a Time,; Lima, Peru, October 15, 2014.
- Max Birnstiel Lecturer: “Division of Labor and Coordination Among the Subunits of a Viral Ring ATPase,” Research Institute of Molecular Pathology. Vienna, Austria, October 8, 2014.
- Speaker of the Year, Netherlands Society for Biochemistry and Molecular Biology: “The folding cooperativity of a protein is controlled by the topography of its polypeptide chain” and “Division of Labor and Coordination Among the Units of a Nearly Perfect Biological Machine,” September 14-19, 2014.
- Invited Lecturer: “Discrete Steps and Inter-Subunit Coordination of a DNA-Packaging Ring ATPase,” Pennsylvania State University, Department of Chemistry, September 11, 2014.
- Invited Lecturer: “Division of Labor and Coordination Among the Subunits of a Nearly Perfect Biological Machine,” FASEB Machines on Genes Conference, June 24, 2014
- Franklin Lecturer: “Division of Labor and Coordination Among the Subunits of a Viral Ring ATPase,” University of Missouri, May 28, 2014.
- Invited Lecturer: “Division of Labor and Coordination Among the Subunits of a Nearly Perfect Biological Machine,” NANO Conference, University of Buenos Aires, May 14, 2014.
- Invited Lecturer: “Mechanisms of Cellular Proteostasis: Insights from Single Molecule Approaches,” ASBMB Annual Meeting, San Diego, CA, April 28, 2014.
- T.Y. Shen Lecturer (Faculty Seminar): “Division of Labor and Coordination Among the Subunits of a Viral Ring ATPase,” Massachusetts Institute of Technology, April 23, 2014.
- T.Y. Shen Lecturer (Public): “Mechanisms of Cellular Proteostasis: Insights from single-molecule approaches,” Massachusetts Institute of Technology, April 22, 2014.
- Invited Lecturer: “Division of Labor and Coordination Among the Subunits of a Nearly Perfect Biological Machine,” Foundation of Nanoscience Annual Conference, Utah, April 17, 2014
- Bühl Lecturer: “Biochemistry and Biophysics One Molecule at a Time: When Less is More,” Bühl Lecture, Carnegie Mellon University, March 25, 2014.
- National Lecturer, Biophysical Society: “A Journey Through Cellular Processes: One Molecule at a Time”, BPS National Lecture, San Francisco, CA, February 18, 2014

### 2013

- Invited Speaker: “Slugging Through: When Polymerase Meets the Ribosome”, Lecture, MIT, Department of Physics, Cambridge, Massachusetts, September 15, 2013.
- Invited Speaker: “Nucleosomal Fluctuations Govern the Transcription Dynamics of RNA Polymerase II,” Lecture, Peking University Dept. of Physics, August 25, 2013.
- Invited Speaker: “Division of Labor and Coordination Among the Subunits of a Viral Ring ATPase,” Seminar, Chinese Academy of Sciences Institute of Biophysics, August 24, 2013.
- Invited Speaker: “Recent Advances in molecular bioimages,” Lecture, CSH Conference New Advances in

- Optical Imaging of Live Cells and Organisms, Suzhou, China, August 20, 2013.
- Invited Speaker: "Following Translation by single ribosomes one codon at a time," Lecture, Ribosomes Conference, Napa Valley, CA, July 11, 2013
- Invited Speaker: "Nucleosomal Fluctuations Govern the Transcription Dynamics of RNA Polymerase II", Seminar, Massachusetts General Hospital Center for Cancer Research, June 26, 2013.
- Invited Speaker: "Mechanisms of Cellular Proteostasis: Insights from single molecule approaches," Seminar, Chinese Academy of Sciences National Laboratory of Protein Science, Shanghai, China, June 10, 2013.
- Invited Speaker: "Division of Labor and Coordination Among the Subunits of a Viral Ring ATPase." Seminar, Shanghai Institute of Applied Physics, Chinese Academy of Sciences, Shanghai, China, May 29, 2013.
- Invited Speaker: "Biophysics one molecule at a time," Public Lecture, Shanghai JiaoTong University, Shanghai, China, May 27, 2013.

## 2012

- Invited Speaker: "The folding cooperativity of a protein is controlled by the topology of its polypeptide chain", specially organized seminar by the Weizmann Institute, Rehovot, Israel, December 14, 2012.
- Invited Speaker: "Mechanisms of Cellular Proteostasis: Insights from single molecule approaches", BioPhysics Seminar, Tel Aviv University, Tel Aviv, Israel, December 13, 2012.
- Laureate Speaker: "Division of Labor and Coordination Among the Subunits of a Viral Ring ATPase", The Raymond and Beverly Sackler International Prize in Biophysics Awards Ceremony, Tel Aviv University, Tel Aviv, Israel, December 12, 2012.
- Invited speaker: "Discrete Steps and Inter-Subunit Coordination of a DNA-Packaging Ring ATPase", Microbiology Seminar Series, University of Alabama, Birmingham, AB, November 12-14, 2012.
- Kistiakowsky Lecturer: "Recent Advances in Single Molecule Biophysics", Kistiakowsky Lecture, Harvard University, Cambridge, MA, November 4-6, 2012.
- Invited speaker: "Single Molecule Characterization of a DNA-packaging Nano-motor", Annual Symposium of the International Institute of Nanotechnology, Northwestern University, Evanston IL, October 17-19, 2012.
- Invited speaker: "Discrete Steps and Intersubunit Coordination in a DNA-packaging Ring ATPase", Biophysics Colloquium, Cornell University, Ithaca, NY, October 3-4, 2012.
- Invited speaker: "Discrete Steps and Intersubunit Coordination in a DNA-packaging Ring ATPase", Cell Biology Seminar, Department of Cell Biology, Yale University, New Haven, CT, October 1-2, 2012
- Invited speaker: "Discrete Steps and Intersubunit Coordination in a DNA-packaging Ring ATPase", University of Illinois Physics Colloquium, Urbana-Champaign, IL, September 25-27, 2012.
- Invited plenary lecturer: "Mechanisms of Cellular Proteostasis; Insights from single molecule approaches", 22nd IUBMB, 37th FEBS Conference, Seville, Spain, September 8, 2012.
- Invited Speaker: "Discrete Steps and Intersubunit Coordination in a DNA-packaging Ring ATPase", Kavli Prize Symposium in Nanoscience and Neuroscience, Trondheim, Norway, September 6, 2012.
- Keynote speaker: "Discrete Steps and Intersubunit Coordination in a DNA-packaging Ring ATPase", 2nd Midwest Single Molecule Workshop, University of Michigan, Ann Arbor, MI, July 16-19,

2012.

Invited speaker: "Discrete Steps by a DNA Packaging Motor and the Inter-Subunit Coordination in a Ring-ATPase", Gordon Research Conference, West Dover, VT, July 15-20, 2012.

## 2011

Plenary speaker: "Single Molecule Biophysics", Gordon Conference; Stochastic Physics in Biology, Ventura, CA, Jan 24-26, 2011.

Invited speaker: "Grabbing the Cat by the tail: Discrete Steps by a DNA Packaging Motor and the Inter-Subunit Coordination in a Ring-ATPase", Robert and A-Young Woody Lecture, Colorado State, Mar 3, 2011.

Invited speaker:" Grabbing the Cat by the tail: Discrete Steps by a DNA Packaging Motor and the Inter-Subunit Coordination in a Ring-ATPase", Institut de Science et d'Ingenierie Supramoleculaires(I.S.I.S), Strasbourg, France, Mar 30-Apr 2, 2011.

Keynote speaker: "The Role of Topology on the Folding Cooperativity of a Protein", Molecular and Cellular Biophysics Symposium, University of Denver, April 7-9, 2011.

Invited lecturer: Instituto de Fisica, Universidad Autonoma De San Luis Potosi, Mexico, May 22-28, 2011.

Keynote lecturer:" Recent Advances in Single Molecule Biophysics", Gordon Research Conference: Nucleic Acids, University of New England, ME, June 5-10, 2011.

Invited lecturer: Curso Avanzado de Microscopía Confocal 2011: "Detección y Análisis de interacciones moleculares en células", Instituto de Investigación Médica "Mercedes y Martín Ferreyra", Córdoba, Argentina, June 13-18, 2011.

Plenary lecturer: "Slugging Through: When Polymerase Meets the Nucleosome", ICBP 7th International Conference on Biological Physics, San Diego, CA, June 23, 2011.

Invited speaker:" Grabbing the Cat by the Tail:Discrete Steps by a DNA Packaging Motor and the Intersubunit Coordination of a Ring ATPase", Gordon Research Conference: Enzymes, Coenzymes and Metabolic Pathways, Waterville, NH, July 10-15, 2011.

Invited speaker: "Use of Crooks Fluctuation Theorem to Study the Interdomain Folding Cooperativity of a Protein", AFM BioMed Conference,Paris, France, Aug 21-31, 2011.

Invited speaker: "Grabbing the Cat by the Tail: Discrete Steps by a DNA Packaging Motor and the Intersubunit Coordination of a Ring ATPase", NIH WALSL Lecture Series 2011-2012, Sept. 7, 2011.

Invited speaker: "Grabbing the Cat by the Tail:Discrete Steps by a DNA Packaging Motor and the Intersubunit Coordination of a Ring ATPase", Valdivia, Chile, Sept 23-27, 2011.

Invited speaker: The Dynamic of Transcription of RNA Polymerase II through a Nucleosome", NIH/NCI Symposium, Frederick, MD, Nov 1-2, 2011.

Invited lecturer: "Principles of Single Molecule Biophysics" Phd course, Facultad de Ciencias Químicas y Farmacéuticas, Universidad de Chile, Chile, March 21-25, 2011

Invited lecturer:"Sugging Through:When Polymerase Meets the Nucleosome" Coloquios de Microbiología, Pontificia Universidad Catolica, Chile, March, 25, 2011

Invited speaker: "Grabbing the Cat by the Tail: Discrete Steps by a DNA Packaging Motor and the Inter-Subunit Coordination in a Ring-ATPase" Seminar Series Centro Interdisciplinario de Neurociencias de Valparaiso, Universidad de Valparaiso, Chile, March 25, 2011

Invited speaker: "The Role of Chain Topology in the Folding Cooperativity of a Protein", seminar Center

for Optics and Photonics, Universidad de Concepcion, Chile, September 26, 2011

## 2010

- Keynote speaker: “Grabbing the Cat by the Tail: Discrete Steps by a DNA Packaging Motor and the Intersubunit Coordination of a Ring ATPase”, Biomolecular Interactions and Methods, Gordon-Kenan Research Seminar, Galveston, TX, January 16-17, 2010.
- Invited lecturer: “Grabbing the Cat by the Tail: Studies of DNA Packaging by Single 29 Bacteriophage Particles Using Optical Tweezers”, Technion-Israel Institute of Technology and The Weizmann Institute of Science, Israel, February 14-18, 2010.
- Invited Lecture: “Doing Biochemistry *in Singulo*: When less is more”, Timothy J. O’Leary, S.J. Distinguished Scientist lecturer, Gonzaga University, March 22, 2010.
- Invited speaker: “Grabbing the Cat by the tail: Discrete Steps by a DNA Packaging Motor and the Inter-Subunit Coordination in a Ring-ATPase”, Physics Colloquium, University of Oregon, April 28, 2010.
- Invited speaker: “Grabbing the Cat by the tail: Discrete Steps by a DNA Packaging Motor and the Inter-Subunit Coordination in a Ring-ATPase”, Quad Seminar Series, Washington University in St. Louis, April 29, 2010.
- Invited speaker: “Grabbing the Cat by the tail: Discrete Steps by a DNA Packaging Motor and the Inter-Subunit Coordination in a Ring-ATPase”, Nanoengineering Seminar Series, University of San Diego, May 5, 2010.
- Invited speaker: “Grabbing the Cat by the tail: Discrete Steps by a DNA Packaging Motor and the Inter-Subunit Coordination in a Ring-ATPase”, ASM2010 Colloquium Conference, San Diego, May 25-26, 2010.
- Invited lecturer: “Grabbing the Cat by the tail: Discrete Steps by a DNA Packaging Motor and the Inter-Subunit Coordination in a Ring-ATPase”, Marine Biological Laboratory, Woods Hole on Cape Cod, MA, June 14-16, 2010.
- Invited lecturer", Single Molecule Manipulation Methods", Federal University of Rio Grande De Norte, Natal, Brazil June 28-July 5, 2010.
- Invited lecturer", The Folding Cooperatively of a Protein is Controlled by the Topology of its Polypeptide chain", 2nd International Soft Matter Conference (ISMC 2010), Granada, Spain, July 5-8, 2010.
- Invited lecturer:", Grabbing the Cat by the tail: Discrete Steps by a DNA Packaging Motor and the Inter-Subunit Coordination in a Ring-ATPase", Spanish Biophysical Society Meeting, Zaragoza, Spain, July 7-10, 2010.
- Keynote speaker: Optical Trap and Optical Micromanipulation (OTOM) conference for 24th Symposium of the Protein Society, San Diego, CA Aug 1-5, 2010.
- Invited lecturer: iBioSeminars Lecture, UCSF, Sept. 21, 2010.
- Invited speaker: “Grabbing the Cat by the tail: Discrete Steps by a DNA Packaging Motor and the Inter-Subunit Coordination in a Ring-ATPase”, Rockefeller University, Sept. 23-25, 2010.
- Invited speaker: “Grabbing the Cat by the tail: Discrete Steps by a DNA Packaging Motor and the Inter-Subunit Coordination in a Ring-ATPase”, 11th Annual James P. Holland Memorial Lecture, Indiana University, Oct. 3-5, 2010.
- Plenary lecturer: “The folding cooperativity of a protein is controlled by the topology of its polypeptide chain”, 3rd Latin America Protein Society, Salta Argentina, Oct. 13-16, 2010.

2009 and earlier

- Invited Lecture: "Grabbing the Cat by the Tail: Discrete Steps by a DNA Packaging Motor and the Inter-Subunit Coordination in a Ring-ATPase", Distinguished Lecture Series for Biological Chemistry, UCLA, March 2, 2009.
- Invited Lecture: "Grabbing the Cat by the Tail: Discrete Steps by a DNA Packaging Motor and the Inter-Subunit Coordination in a Ring-ATPase", Honors Program Lecture Series, New York University School of Medicine, March 9, 2009.
- Invited speaker: "Stepsize and intersubunit coordination of a ring ATPase", NIH NanoWeek 2009, Bethesda, Maryland, April 7, 2009.
- Invited speaker: a workshop at the Center for Advanced Microscopy, University of Buenos Aires, Argentina, May 17-22, 2009
- Invited speaker: Single Molecule Studies Seminar, Bioénergétique et Ingénierie des Protéines of the Institut Fédératif Biologie Structurale et Microbiologie, CNRS, Marseilles, France, June 19, 2009.
- Invited speaker: "Single Molecule Studies of the Stepping and Subunit Coordination in a DNA-Packaging Ring ATPase", Protein Gordon Research Conference, Manchester, NH, June 25, 2009
- Invited speaker: Optimization at A Small Scale Conference, UCSD, July 20-21, 2009.
- Invited speaker: "Grabbing the cat by the tail: Studies of DNA packaging by single phi29 bacteriophage particles using optical tweezers", St. John College, NM, Aug. 5-9, 2009.
- Invited Lectures: "Grabbing the Cat by the Tail: Discrete Steps by a DNA Packaging Motor and the Inter-Subunit Coordination in a Ring-ATPase", Falk-Plaut Lecture, Columbia University, New York, Sept 7-11, 2009.
- Invited speaker: "Grabbing the Cat by the Tail: Discrete Steps by a DNA Packaging Motor and the Inter-Subunit Coordination in a Ring-ATPase", XXXXII Congreso SEBBM Seminar, Universidad de Oviedo, Spain, Sept 22-25,2009.
- Invited speaker."Grabbing the cat the tail: DNA packaging motor", Secretariat of AtomByAtom Conference, San Sebastian, Spain, Sept 27-30,2009.
- Invited speaker "Grabbing the cat the tail:Single Molecule Studies of a Viral DNA packaging motor", University of Chicago, Chicago, Il, November 12, 2009.
- Invited speaker "Grabbing the cat the tail:Single Molecule Studies of a Viral DNA packaging motor". Argonne National Laboratory, Argone, IL, November 13, 2009.
- Invited speaker "Biological Single-Molecule Spectroscopy", Paris Interdisciplinary PhD. Symposiums, Paris, France, Dec. 7, 2009.
- Invited speaker "Grabbing the Cat by the Tail: Discrete Steps by a DNA Packaging Motor and the Inter-Subunit Coordination in a Ring-ATPase", Institute Curie Research, Paris, France, Dec. 8, 2009.
- Invited Speaker: "The Role of Topology in the Folding Cooperativity of a Protein", seminar Facultad de Ciencias, Universidad de Chile, Chile, December 17, 2009.

2008

- Invited speaker: First annual Schaeffer lecture, University of New Mexico, October 31, 2008.
- Invited speaker: 2008 Lamport Lecture, University of Washington, October 23, 2008.
- Invited speaker: Arizona State University, Distinguished lecturer, September 24-25, 2008.
- Invited speaker: University of Colorado at Denver Health Sciences Center, September 23, 2008.
- Invited speaker: "Grabbing the cat by the tail: Studies of DNA packaging by single phi29 bacteriophage particles using optical tweezers", Centennial Symposium of the Physical Division of the ACS,

Philadelphia, PA, August 18-19, 2008.

- Invited speaker: "Grabbing the cat by the tail: Studies of DNA packaging by single phi29 bacteriophage particles using optical tweezers", ISMB (Institute of Structural Molecular Biology) Symposium, University College London/Birkbeck Institute, June 20, 2008.
- Invited speaker: "Grabbing the Cat by the Tail: Discrete Steps by a DNA Packaging Motor and the Inter-Subunit Coordination in a Ring-ATPase", Nobel Symposium on Single Molecule Spectroscopy in Chemistry, Physics, and Biology, Sångå-Såby conference center, Sweden, June 1-June 6, 2008.
- Invited Lecture: "Grabbing the cat by the tail: Studies of DNA packaging by single phi29 bacteriophage particles using optical tweezers", Fox Chase Cancer Center Distinguished Lecture series, May 30th, 2008.
- Invited Lecture: "Grabbing the cat by the tail: Studies of DNA packaging by single phi29 bacteriophage particles using optical tweezers", Distinguished Lecture for Biomechanical Engineering, Stanford University, May 27, 2008.
- Invited Seminar: "Grabbing the cat by the tail: Studies of DNA packaging by single phi29 bacteriophage particles using optical tweezers", Joint seminars in Molecular and Cellular Biology speaker series, UC-Davis, May 22 2008.
- Invited Lecture: "Grabbing the cat by the tail: Studies of DNA packaging by single phi29 bacteriophage particles using optical tweezers", Sarkar Lecture 2008, Molecular Structure and Function Research Program, The Hospital for Sick Children, Toronto, May 9, 2008.
- Invited Lecture: "Grabbing the cat by the tail: Studies of DNA packaging by single phi29 bacteriophage particles using optical tweezers", Compass Project Lecture Series, University of California Berkeley, Physics Department, April 22, 2008
- Invited lecturer: "Catalyzed and uncatalyzed mechanical unfolding of single RNA molecules by force", (Wed April 16); "Studies of the torsional properties of single DNA molecules: an old problem with a new twist", (Thursday April 17); "Grabbing the cat by the tail: Following the packaging of DNA by single particles of bacteriophage phi 29 using optical tweezers", (Friday April 18); MIT Arthur D. Little Lecture Series, Boston, MA, April 16- 18, 2008.
- Invited Seminar: "Signposts along the chromosomal highway: How FtsK finds its target", UC San Diego Chemistry department (Molecular Biophysics Training Grant), April 11, 2008.
- Invited Seminar: "Grabbing the Cat by the Tail: Studies of DNA Packaging by Single phi29 Bacteriophage Particles Using Optical Tweezers", New York University, Center for Soft Matter Research, January 28th, 2008.

## 2007

- Invited Speaker: "Following Translation by Single Ribosomes One Codon at a Time", Seminar Centro de Neurociencias de Valparaiso, Universidad de Valparaiso, Chile, December 13, 2007.
- Invited Speaker: "Following Translation by Single Ribosomes One Codon at a Time ", Departmental seminar Facultad de Ciencias, Universidad de Chile, Chile, December 12, 2007.
- Invited Lecturer: "Biofísica de Manipulación de Moléculas Individuales (Biophysics and manipulation of single molecules)" Phd course, Facultad de Ciencias, Universidad de Chile, Chile, December 10-12, 2007
- Invited speaker: "Signposts along the chromosomal highway: how FtsK finds its target", BaMBA (Biology and Mathematics in the Bay Area) III, November 10, 2007.
- San Jose State University, Invited speaker: 2007 Welch Conference: "Biological Single-Molecule

- Spectroscopy", Physical Biology—from Atoms to Cells, Houston, Texas, October 22, 2007.
- Invited plenary speaker: "Proofreading and Editing by a Processive DNA Polymerase", Single Molecules and Molecular Machines Symposium, University of California Berkeley, October 20, 2007.
- Invited speaker: "Signposts along the chromosomal highway: how FtsK finds its target", Emory University, Luminaries in Science Lecture Series, October. 9, 2007.
- Invited speaker: University of Panama, October 5, 2007.
- Invited speaker: "Recent Advances in Single Molecule Manipulation in Biophysics", 21st Gibbs Conference on Biothermodynamics, Carbondale, IL, October 1, 2007.
- Invited speaker: "Grabbing the Cat by the Tail: Studies of DNA Packaging by Single phi29 Bacteriophage Particles Using Optical Tweezers", 6th International Conference of Biological Physics, Montevideo, Uruguay, August 29 2007.
- Invited speaker: IV Congreso Nacional de Estudiantes de Genética y Biotecnología, UNM de San Marcos, Lima Peru, August. 22, 2007.
- Invited speaker: "Signposts along the chromosomal highway: How FtsK finds its target", Gordon Research Conferences, Chromosome Dynamics, University of New England, August 12-17, 2007,
- Invited Plenary speaker: Burroughs Wellcome fund, Dana Point California, July 27, 2007
- Invited speaker: "Single Molecule Studies of FtsK", FASEB Summer Research Conferences: Helicases and NTP-Driven Nucleic Acid Motors: Structure, Function, Mechanisms and Roles in Human Disease (Indian Wells, CA), June 25, 2007.
- Invited Plenary speaker: "Recent advances of single molecule manipulation methods in biophysics", 2007 Summer Bioengineering Conference, (Keystone, CO), June 21, 2007.
- Invited speaker: "Signposts along the Chromosomal Highway: How FtsK finds its target", NIH Wednesday Afternoon Lecture Series, May 30, 2007.
- Invited Plenary speaker: "Grabbing the cat by the tail: Packaging of DNA by single particles of bacteriophage phi 29 using optical tweezers", XXX Brazilian National Meeting of Condensed Matter Physics, São Lourenço Brazil, May 10th, 2007.
- Invited speaker: "Signposts along the chromosomal highway: How FtsK finds its target", University of California, Santa Cruz, April 16, 2007.
- 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", Case Western Reserve University, annual Wood lecture, April 11, 2007.
- 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: "Following the packaging of DNA by single particles of bacteriophage phi29, using optical tweezers", Scripps Research Institute, Structure and Affinity Group Series, March 22, 2007.
- Invited speaker: "Grabbing the cat by the tail: Packaging of DNA by single particles of bacteriophage phi 29 using optical tweezers", McGill University, Department of Chemistry Purves Lecture, March 9, 2007.
- 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,

February 16, 2007,

Invited speaker: “Following the Packaging of DNA by Single Particles of Bacteriophage Phi29: An Ultra-high Resolution Optical Tweezers Study”, HHMI Science Meeting, Chevy Chase, Maryland, February 12, 2007.

Invited speaker: “Recent Advances in Single Molecule Manipulation Biophysics”, Molecular Frontiers Symposium, The Royal Swedish Academy of Sciences, February 2, 2007.

Invited Seminar: “Recent Advances in Single Molecule Manipulation Biophysics”, Trieste, Italy, January 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 Seminar: “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.

## 2006

Invited speaker: “Grabbing the Cat by the Tail: Studies of DNA Packaging by Single  $\phi$ 29 Bacteriophage Particles Using Optical Tweezers”, Chalmers University of Technology, Gothenburg, Sweden, December 14, 2006.

Invited speaker: “Recent Advances in Single Molecule Manipulation Biophysics”, Weizmann Institute of Science Minisymposium on *Soft Matter and Biological Physics*, Rehovot, Israel, November 5, 2006.

Colloquium speaker: “Recent Developments in the Biophysics of Single Molecules”, Emory University Physics Colloquium, Atlanta, Georgia, October 27, 2006.

Invited speaker: “Signposts along the chromosomal highway: How FtsK finds its target”, Extraordinary Thursday Seminar, Max Planck Institute CBG, Dresden, Germany, October 5, 2006.

Colloquium speaker: “Signposts along the chromosomal highway: How FtsK finds its target”, Müncher Physiks Kolloquium, Ludwig-Maximilians-Universität, Munich, Germany, October 4, 2006.

Invited lecturer: “Signposts 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”, at BergamoScienza, Bergamo, Italy, September 30, 2006.

Plenary speaker: “Recent advances in the manipulation of single molecules”, at the Congreso Ibero-Americano de Biofísica, Madrid, Spain, September 24, 2006.

Invited speaker: “Signposts along the chromosomal highway: How FtsK finds its target”, at the Department of Biochemistry and Biophysics Seminar, UC San Francisco, September 19, 2006.

Invited speaker: “Signposts along the chromosomal highway: How FtsK finds its target”, at the Alumni Distinguished Lecture, Michigan State University East Lansing, September 14, 2006.

Invited speaker: “Signposts 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 September 6, 2006.



- Invited lecturer: “Recent Advances in Single Molecule Biophysics”, at the Universidad de Buenos Aires Escuela Giambiagi.
- Keynote speaker: Center for Biophotonics Annual Retreat, Olympic Valley, CA, July 10, 2006.
- Invited speaker: “Recent Advances in Single Molecule Biophysics”, Gordon Research Conference on Single Molecule Approaches to Biology, Colby-Sawyer College, New London, NH, June 22, 2006.
- Invited speaker: “Single molecule studies of FtsK, a fast, sequence-directed DNA translocase”, Tri-Institutional Structural Biology Seminar Series, Weill Medical College of Cornell U./Rockefeller U./Memorial Sloan-Kettering Cancer Center, New York, June 8, 2006.
- Invited speaker: “Single molecule manipulation in biophysics”, “The unwinding mechanism of an RNA Helicase”, H.L. Welsh Lectures in Physics, University of Toronto, Canada, April 27- 28, 2006.
- Invited speaker: “Direct Observation of Substeps Reveals the RNA Unwinding Mechanism of HCV NS3 Helicase”, CSBI Seminar Series, MIT, Cambridge, MA, April 20, 2006.
- Invited speaker: “Grabbing the Cat by the Tail: Studies of DNA Packaging by Single 29 Bacteriophage Particles Using Optical Tweezers”, 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”, 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 29 Bacteriophage Particles Using Optical Tweezers”, UC Riverside Physics Colloquia Series, Riverside, CA, March 2, 2006.
- Plenary speaker: “Direct Observation of Substeps Reveals the RNA Unwinding Mechanism of HCV NS3 Helicase”, Joint Annual Conference of the National Societies of Black and Hispanic Physicists, San Jose, CA, February 16, 2006.
- Invited speaker: “Grabbing the Cat by the Tail: Packaging of DNA by Single Particles of Bacteriophage Phi29 Studied One Molecule at a Time”, Biophysics Symposium, Ohio State University, Ohio, February 8, 2006.
- Invited speaker: “Protein Unfolding”, Gordon Research Conference: Reversible Associations in Structural and Molecular Biology, Ventura, CA, January 17, 2006.
- Invited speaker: “Grabbing the Cat by the Tail: Studies of DNA Packaging by Single 29 Bacteriophage Particles Using Optical Tweezers”, Nanoscience and Quantum Physics Symposium, University of California, Berkeley, January 5, 2006.

## 2005

- Invited lecturer: “Grabbing the Cat by the Tail: Packaging of DNA by Single Particles of Bacteriophage Phi 29 Studied One Molecule at a Time”, Lehigh University, Bethlehem, PA, December 6, 2005.
- Invited speaker: “Recent Advances in Single Molecule Manipulation”, International Symposium for Protein Nanomechanics, Madrid, Spain, October 18-19, 2005.
- Invited speaker: “Recent Advances in Single Molecule Biophysics”, Federation of European Biochemical Societies - International Union, for Biochemistry and Molecular Biology, Budapest, Hungary, July 4-7, 2005.
- Invited speaker: “Recent Advances in Single Molecule Biophysics”, Institute of Plant Biology, Szeged, Hungary, July 4, 2005.
- Invited speaker: “Unfolding Single RNA Molecules: Bridging the Gap between Equilibrium and Nonequilibrium Statistical Thermodynamics”, Statistical Physics FisEs Conference in Madrid,

Spain June 27-29, 2005.

Invited speaker: "Following the Footsteps of Single Bio-Molecular Motors", Nobel Symposium on Controlled Nanoscale Motion in Biological and Artificial Systems, Backaskog Slott, Sweden, June 13-17, 2005.

Invited speaker: "Single Molecule Observation of Hepatitis C Virus RNA Helicase at Work", University of Chicago, Chicago, IL June 9-10, 2005.

Invited speaker: "Mechanism of Force Generation of a Viral DNA Packaging Motor", Gordon Nucleic Acid Research Conference, Newport, RI, June 7-9, 2005.

Invited speaker: "Unfolding Single RNA Molecules: Bridging the Gap between Equilibrium and Nonequilibrium Statistical Thermodynamics", Nobel Committee of Chemistry in Coimbra, Portugal, May 1-4, 2005.

Invited speaker: "Direct Observation of the Three-State Folding of a Single Protein Molecule by Optical Tweezers", Protein Society Meeting, Barcelona, Spain, April 30-May 4, 2005.

Davidson lecturer for "Recent Advances in Single Molecule Biophysics", University of Kansas, KS, April 21, 2005.

Invited speaker: "Direct Measurement of Torque on Single DNA Molecules: An Old Problem with a New Twist", American Physical Society Meeting, Los Angeles, CA, March 21, 2005.

Invited speaker: "Recent Advances in Single Molecule Biophysics", at the University of Arizona, Tucson, AZ, March 4, 2005.

Distinguished lecturer: "Grabbing the Cat by the Tail: Studies of DNA Packaging by Single Phi29 Bacteriophage Particles using Optical Tweezers", Indiana University, Bloomington, IN, February 16, 2005.

Invited speaker: "Gyrase", Biophysical Society Meeting, Long Beach, CA, February 12-13, 2005.

Invited speaker: "Recent Advances in Single Molecule Biophysics", University of California, Berkeley, January 25, 2005.

Invited speaker: "Recent Advances in Single Molecule Biophysics: Reversible Unfolding of a Single RNA Molecule by Force", University of New Mexico, Albuquerque, Mexico, January 21, 2005.

Distinguished lecturer: "Unfolding Single RNA by Force", University of Texas, Austin, TX, January 19, 2005.

## 2004

Trailblazers Distinguished lecturer: "Mechanical unfolding of a single RNA molecule by force", University of Missouri, Kansas City, MI, Nov 3-4, 2004.

Moses Gomberg lecturer: "Grabbing the Cat by the tail: Studies of DNA Packaging by Single Phi29 Bacteriophage Particles using Optical Tweezers", University of Michigan in Ann Arbor, Michigan, October 25-26, 2004.

Invited speaker: "MukBEF a bacterial condensing organizes DNA into condense periodic and stable structure in ATP-dependent manner", Protein Society Symposium, San Diego, CA, August 14-18, 2004.

Invited speaker: "Grabbing the Cat by the tail: Studies of DNA Packaging by Single Phi29 Bacteriophage Particles using Optical Tweezers", Bioscience 2004 in Glasgow, Scotland, July 18-24, 2004.

FASEB lecturer: "Grabbing the Cat by the tail: Studies of DNA Packaging by Single Phi29 Bacteriophage Particles using Optical Tweezers", Saxton River, VT, June 12-17, 2004.

Invited speaker: "Grabbing the Cat by the tail: Studies of DNA Packaging by Single Phi29 Bacteriophage

- Particles using Optical Tweezers", University of California Irvine, Irvine, CA, May 27, 2004.
- Invited speaker: "Grabbing the Cat by the tail: Studies of DNA Packaging by Single Phi29 Bacteriophage Particles using Optical Tweezers", American Society for Microbiology, New Orleans, LA, May 24-26, 2004.
- Invited speaker: "Grabbing the Cat by the tail: Studies of DNA Packaging by Single Phi29 Bacteriophage Particles using Optical Tweezers", University of Washington, Seattle, WA, May 13-14, 2004.
- Invited speaker: "Studies of DNA Packaging by Single Phi29 Bacteriophage Particles using Optical Tweezers", American Physical Society, College Park, MD, May 1-4, 2004.
- Louis Jacob Bircher lecturer, "Unfolding of Single RNA Molecule by Force", Vanderbilt U., Nashville, TN, April 22-23, 2004.
- Ernest C. Pollard lecturer, "Grabbing the Cat by the tail: Studies of DNA Packaging by Single Phi29 Bacteriophage Particles using Optical Tweezers", Pennsylvania State University, PA, April 11-12, 2004.
- Invited Keynote/Distinguished lecturer for RECOMB 2004, "Recent Advances in Single Molecule Manipulation in Biophysics", San Diego, CA, March 27-31, 2004.
- Invited speaker: "Recent Advances in Single Molecule Manipulation in Biophysics", and "Grabbing the Cat by the tail: Studies of DNA Packaging by Single Phi29 Bacteriophage Particles using Optical Tweezers", University of North Carolina, NC, March 22-24, 2004.
- Edgar Fahs Smith lecturer for "Unfolding of Single RNA Molecule by Force", University of Pennsylvania, March 17-19, 2004.
- Invited speaker: "Grabbing the Cat by the tail: Studies of DNA Packaging by Single Phi29 Bacteriophage Particles using Optical Tweezers", UCLA Nanosystems Seminar, Los Angeles, CA, March 9-10, 2004.
- Invited speaker: "Grabbing the Cat by the tail: Studies of DNA Packaging by Single Phi29 Bacteriophage Particles using Optical Tweezers", University of Oregon, OR, March 1-3, 2004.
- Invited speaker: "Recent Advances in Single Molecule Manipulation in Biophysics", Biophysical Society, Bethesda, MD, Feb. 15-17, 2004.
- Invited speaker: "Recent Advances in Single Molecule Manipulation in Biophysics", Western Spectroscopy Association Annual Conference, Asilomar, CA, January 28-30, 2004.
- Invited speaker: "Grabbing the Cat by the tail: Studies of DNA Packaging by Single Phi29 Bacteriophage Particles using Optical Tweezers", Arizona State University, AZ, January 22-24, 2004.

## 2003

- Invited speaker: "Steps to a Career in Academia", Burroughs Wellcome Fund, San Diego, CA, December 3-5, 2003.
- Invited speaker: "Grabbing the Cat by the tail: Studies of DNA Packaging by Single Phi29 Bacteriophage Particles using Optical Tweezers", Washington University School of Medicine, MO, November 5-9, 2003.
- Invited speaker: "Recent Advances in Single Molecule Manipulation in Biophysics", University Chicago, IL October 28-31, 2003.
- Invited speaker: "Recent and Future Advances in the Manipulation of Single Molecules and its Applications to Biophysics", Frontiers Symposium, Lawrence Livermore National Laboratory, CA, October 21, 2003.
- Invited speaker: "Grabbing the Cat by the tail: Studies of DNA Packaging by Single Phi29 Bacteriophage

Particles using Optical Tweezers", Annual Biomedical Research Conference for Minority Students(ABRCMS), San Diego, October 15-18, 2003.

Invited speaker: "The Bacteriophage  $\phi$ 29 Portal Motor can Package DNA Against a Large Internal Force", ACS 226th Fall National Meeting, NY, September 8-10, 2003.

Invited speaker: "Studies of DNA Packaging by Single Phi29 Bacteriophage Particles using Optical Tweezers", Frontiers in Chemical Biology: Biomolecular Dynamics and Force Generation, Manchester, London, September 4-6, 2003.

Invited speaker: "Grabbing the Cat by the tail: Studies of DNA Packaging by Single Phi29 Bacteriophage Particles using Optical Tweezers", 2nd International ASTATPHYS-MEX 2003, Puerto Vallarta, Mexico, August 25-30, 2003.

Invited speaker: "Grabbing the Cat by the Tail: Studies of DNA Packaging by Single Phi29 Bacteriophage Particles using Optical Tweezers", The Protein Society 17th Annual Symposium, July 26-30, 2003.

Invited speaker: "Grabbing the Cat by the Tail: Studies of DNA Packaging by Single Phi29 Bacteriophage Particles using Optical Tweezers", University of Albany, NY, Jun 17-21, 2003.

Invited speaker: "Measuring the Torsional Rigidity of DNA: an old problem with a new twist", University of California, San Diego, May 22, 2003.

Invited speaker: "Grabbing the cat by the tail: Studies of DNA Packaging by Single Phi29 Bacteriophage Particles using Optical Tweezers", University of Texas, May 2-4, 2003.

Invited speaker: "Measuring the Torsional Rigidity of DNA: an old problem with a new twist", at National Academy of Sciences, April 28, 2003.

Invited speaker: "Studies of DNA Packaging by Single Phi29 Bacteriophage Particles using Optical Tweezers, Unfolding of a Single RNA Molecule by Force and Measuring of Torsional Rigidity of DNA: an old problem with a new twist", University of Maryland, April 20-23, 2003.

Invited speaker: "Studies of DNA Packaging by Single Phi29 Bacteriophage Particles using Optical Tweezers", University of Iowa, April 9-11, 2003.

Invited speaker: "Unfolding of a Single RNA Molecule by Force", John Hopkins University, March 22-23, 2003.

Invited speaker: "Studies of DNA Packaging by Single Phi29 Bacteriophage Particles using Optical Tweezers", at University of Wisconsin, March 13-14, 2003.

Invited speaker: "Studies of DNA Packaging by Single Phi29 Bacteriophage Particles using Optical Tweezers", at Sonoma State University, March 10, 2003.

Invited speaker: "Studies of DNA Packaging by Single Phi29 Bacteriophage Particles using Optical Tweezers", at Texas AandM University, February 17-19, 2003.

Invited speaker: "Studies of DNA Packaging by Single Phi29 Bacteriophage Particles using Optical Tweezers", at Institute of Physics National University of Mexico, February 2-4, 2003.

## 2002

Invited speaker: Dutch Biophysical Society Conference at Universiteit Leiden, Netherlands, October 7 –8, 2002.

Invited speaker: Center de Fisica and Center of Biotechnology at University Autonoma of Mexico City in Cuernava, July 3-7, 2002.

ELAF 2002 Conference speaker "Single Molecules Studies of DNA Packaging by Bacteriophage phi29", Universida Nacional de Ingeniera anc Countri Club El Bosque, Peru, Lima, June 23-28, 2002.

Invited speaker: "Studies of DNA Packaging by Single phi29 Bacteriophage particles using Optical Tweezers", Rockefeller University, NY, June 4-5, 2002.

Invited speaker: "Grabbing the Cat by the Tail: Studies of DNA Packaging by Single phi29 Bacteriophage Particles", Pfizer Lecture (Konrad Bloch), Harvard University, Cambridge, MA, May 30 - June 1, 2002.

Invited speaker: "Grabbing the Cat by the Tail: Studies of DNA Packaging by Single phi29 Bacteriophage Particles Using Optical Tweezers", XIV International Biophysics Congress, Buenos Aires, Argentina, April 27-May 3, 2002.

Invited speaker: "Grabbing the Cat by the Tail: Studies of DNA Packaging by Single phi29 Bacteriophage Particles Using Optical Tweezers", California Institute of Technology, California, April 7-8, 2002.

Invited speaker: "Grabbing the Cat by the Tail: Studies of DNA Packaging by Single phi29 Bacteriophage Particles Using Optical Tweezers", American Physical Society, Maryland, March 17-19, 2002.

Biophysical Society Annual Meeting speaker: "Grabbing the Cat by the Tail: Recent Advances in Single Molecule Biophysics", San Francisco, California, February 26, 2002.

Annual BMB Research Conference and Retreat speaker "Grabbing the cat by the tail: Single Molecule Studies of DNA Packaging by Bacteriophage phi29", Pacific Grove, California, Jan 13-15, 2002.

Invited speaker: "Recent advances in single molecule biophysics: reversible unfolding of single RNA molecules by force" Keystone Symposium, Colorado, January 6, 2002.

## 2001

Invited speaker: "Mecanoquímica del empaquetamiento del DNA en el bacteriófago f-29", at Universidad Autónoma de San Luis Potosí, December 6-9, 2001.

Invited speaker: "Single molecule methods and applications to the study of DNA-binding molecular motors", Universidad Autónoma de Madrid, November 30, 2001.

Invited speaker: "Grabbing the Cat by the Tail: Studies of DNA Packaging by Single 29 Bacteriophage Particles Using Optical Tweezers", at UC Santa Barbara, November, 12-13, 2001.

Invited speaker: "Recent Advances In Single Molecule", LBNL in Washington, DC office, November 4-6, 2001.

Invited speaker: "Reversible Unfolding of Single RNA Molecules by Mechanical Force", University of Colorado, Boulder, Oct 23-25, 2001.

Advisory Committee Meeting at the Burroughs Wellcome Fund, RTP, NC, October 9-10, 2001.

Invited speaker: "Recent Advances in Single Molecule Biophysics", University of Nebraska, Omaha, NE, October 2-4, 2001.

Invited speaker: "Some issues regarding the thermodynamics of Single Molecule", Touch of Nature Conference Center, Carbondale, IL, September 29-October 2, 2001.

Invited speaker: "Studies of the Packaging of DNA by Single phi29 Bacteriophages Using Optical Tweezers", Institute for Theoretical Physics, Santa Barbara, CA, August 20-24, 2001.

Invited speaker: "Following DNA Replication One Molecule at a Time", Microscopy and Microanalysis at Long Beach, CA, August 5-9, 2001.

Presented seminar: University of Chicago for the Chemistry Department, IL, May 20-22, 2001.

Presented seminar: Unitat de Biofísica i Bioenginyeria, Facultat de Medicina, Barcelona Spain, April 28-May 5, 2001.

Invited speaker: "Recent Advances in Single Molecule Biophysics", Evanston, IL, April 12-14, 2001.

Presented seminar: "Recent Advances on Single Molecule Manipulation", UCSF, San Francisco, CA, April 12, 2001.

Presented seminar: Allan Gwathmey Lectures, Charlottesville, VA, April 4-6, 2001.

Invited speaker: "DNA and RNA Polymerases", College Park, MD, March 13-15, 2001

Invited speaker: for "Following DNA Replication One Molecule at a Time", St. Louis, MO, March 6-8, 2001.

Invited speaker: "Sizing up Single Molecules", Biophysical Society, Boston, MA, February 17-21, 2001.

## 2000

Invited speaker: "Following RNA Replication One Molecule at a Time", University of California, Davis, November 27, 2000.

Invited speaker: "Following RNA Replication One Molecule at a Time", University of Washington, WA, October 5, 2000.

Keynote speaker: IV Congreso Iberoamericano de Biofisica, Alicante, Spain, October 9-16, 2000.

Member of the Washington Advisory Group Study Section Meeting, Washington D.C., October 1-3, 2000.

Presented seminar: "Following DNA Replication one Molecule at a Time", University of Pennsylvania, September 13, 2000.

Invited speaker: Protein Society Meeting, San Diego, CA, August 6-9, 2000.

Invited speaker: "Protein Folding in the Cell", section of the 2000 FASEB Summer Research Conference, Vermont Academy in Saxtons River, VT, July 22-27, 2000.

Keynote speaker, Gordon Conference in Biopolymers, PA, June 18, 2000.

Invited presenter: Colloquium in the Biochemistry and Molecular Biology Division of DuPont Corp., June 9, 2000.

Invited presenter: Biophysics seminar, Baylor College of Medicine, Houston, TX, May 22, 2000.

Invited presenter: Joint MIT-Harvard Physical Chemistry colloquium, MA, May 4, 2000.

Invited organizer: National Institute of Health, Workshop on single molecule methods in Biology, April 16-18, 2000.

Keynote speaker for the Molecular and Cell Biology Dept., Cal Day 2000 University of California, April 15, 2000.

Invited presenter: Biophysics Seminar, Brandeis University, MA, April 4, 2000.

Invited presenter: Molecular Biology Seminar, Mayo Clinic, MN, April 3, 2000.

Keynote speaker: Biophysics Group Retreat, University of California, Berkeley, March 20, 2000.

Invited speaker: Life Sciences Division, Lawrence Berkeley National Lab, CA, February 8, 2000.

Invited presenter: Molecular Biology Colloquium, Scripps Institute, La Jolla, CA, January 13, 2000.

## 1999 and previous

Invited presenter: Molecular and Cellular Biophysics Dept. Colloquium, Yale University, CT, December 6, 1999.

Attendee: DOE Advisory Committee meeting on BERAC, Washington DC, November 30-December 1, 1999.

Invited presenter: Seminar at the US Department of Agriculture, Albany, NY, October 11, 1999.

Served as an ad-hoc member in the Biophysics study section for NSF, Bethesda, MD, October 25-26,

1999.

Invited presenter: Biochemistry Dept. seminar, Mount Sinai School of Medicine, NY, October 8, 1999.

Invited speaker: Biochemistry and Molecular Biophysics Dept. Colloquium, Columbia University, NY, October 7, 1999.

Invited speaker: Physical Chemistry Colloquium, University of Illinois, Urbana-Champaign, September 8, 1999.

Chair and speaker: Single Molecule Studies Session Program in Mathematics and Molecular Biology, Santa Fe, NM, January 9–14, 1999.

Invited speaker: “Novel Developments in Biotechnology”, Cold Spring Harbor Laboratory, sponsored by J. P. Morgan, Syosset, NY, September 25-28, 1998.

speaker: Scientific Workshop on Modern Trends in Cell Biology. Howard Hughes Medical Institute Headquarters, Bethesda, MD, September 7-10, 1998.

Chair and speaker: Atomic Force Microscopy Session, XIV International Electron Microscopy Meeting, Cancún, Mexico, August 31-September 4, 1998.

speaker: Gordon Research Conference, Salve Regina University, Newport, RI, June 14-19, 1998.

Invited presenter: Seminar at the American Physics Society Meeting, Santa Fe, NM, May 27-30, 1998.

Invited presenter: "RNA Polymerase Structure and Function", Annual Meeting of the American Society for Microbiology, Atlanta, GA. “Single-molecule Observations of Transcription”, May 17-21, 1998.

Invited presenter: “Imaging Protein-nucleic Acid Complexes with a Scanning Force Microscope”, University of Miami, School of Medicine, FL, May 8, 1998.

Keynote speaker: Annual Molecular Biophysics Mini-symposium, Center for Molecular Biophysics and Biophysical Chemistry, Rutgers State University of New Jersey, May 1, 1998.

Invited presenter: “Mechanical Folding and Unfolding Transitions in Globular Proteins Using Single-molecule Manipulation Methods”, Frontiers in Biochemistry Series, Stanford University, CA, April 22, 1998.

Invited speaker: “Imaging Protein/DNA Interactions with the Scanning Force Microscope”, Keystone Symposia on Molecular and Cellular Biology, Incline Village, NV, March 28-April 3, 1998.

Invited presenter: “Recent Advancements in the Imaging Protein-nucleic Acid Complexes with the Scanning Force Microscope”, Biophysical Sciences Channel Group, State University of New York, March 30, 1998.

Member of the Searle Scholars Advisory Board Meeting in Palo Alto, CA, March 1-3, 1998.

Member of the Council of the Biophysical Society, Kansas City, MI, February 22-26, 1998.

Presenter: Scanning Force Microscopy Lecture Series, Universidad de San Marcos, Lima, Peru, December 10-16, 1997.

Invited speaker: "Major Issues in Modern Biology", University of California, Davis, November 5, 1997.

Invited presenter: “Imaging Protein Nucleic Acid Complexes with the Scanning Force Microscope”, University of Massachusetts, September 24, 1997.

Invited presenter: “Imaging Protein Nucleic Acid complexes with the Scanning Force Microscope”, University of Colorado Health Sciences Center, September 11, 1997.

Invited presenter: Molecular Biology Department Seminar, University of Cape Town, AZ, August 13, 1997.

Invited speaker: Federation of American Societies for Experimental Biology Conference, VT, July 19-23, 1997.

- Invited speaker: Protein Society Meeting, Boston, MA, July 12-16, 1997.
- BBCA Study Section, NIH, Chevy Chase, MD, June 5-6, 1997,
- Invited presenter: Department of Biology, University of California, Berkeley, April 24, 1997.
- Invited presenter: Physics Department, University of California, Berkeley April 8, 1997.
- Invited presenter: University of California at Irvine, March 11, 1997.
- Invited presenter: Johns Hopkins University, Baltimore, MD, March 5, 1997.
- Invited presenter: University of California, Los Angeles, January 28, 1997.
- Invited presenter: California Institute of Technology, January 9, 1997.
- Invited participant: Review of the Electron Microscopy Center, Texas A and M University, December 11-13, 1996.
- Invited speaker: "Facilitated target location and transcription by E. coli RNA polymerase imaged in buffer by scanning force microscopy", Biophysics Workshop, University of California, Los Angeles, December 6, 1996,
- Member: Review Board BBCA Study Section, National Institutes of Health, October 24-25, 1996.
- Invited speaker: "Real-time imaging of transcription by individual E. coli RNA polymerase molecules", Welch Foundation 40th Conference on Chemical Research, October 21-22, 1996, Houston, TX.
- Invited speaker: "Real-time imaging of a transcribing RNA polymerase in aqueous buffer", American Chemical Society Southwest Regional Meeting, Houston, TX, October 18-19, 1996.
- Invited speaker: "Force measurements and micromanipulation of single DNA molecules", International Interdisciplinary Workshop: Structure and Function of DNA, Abbaye Mt. St. Odille, France, September 30-October 5, 1996.
- Invited speaker: Chemistry Department, University of Parma, Italy, September 30, 1996.
- Invited presenter: Chemistry Department, University of Bologna, Italy, September 27, 1996.
- Invited speaker: Scanning Force Microscope, Universidad Peruana Mayor de San Marcos, Lima, Perú, August 19-22, 1996.
- Co-chair of the Biopolymers Gordon Conference, Salve Regina College, Newport, RI, June 16-21, 1996.
- Member: Review Board BBCA Study Section, National Institutes of Health, June 13-14, 1996.
- Invited presenter: Fred Hutchinson Cancer Research Center, University of Washington, Seattle, May 22-23, 1996.
- Presented seminar: "Imaging protein-nucleic acid complexes with the scanning force microscope", Structural Biology Seminar, University of California, Berkeley, April 8, 1996.
- Attendee: The Structural Analysis of Protein-Protein and Protein-Nucleic Acid Interactions, Howard Hughes Medical Institute Scientific Meeting, MD, March 17-March 20, 1996.
- Member: Review Panel for the Undergraduate Biological Sciences Education Program, Howard Hughes Medical Institute, Bethesda, MD, March 11-13, 1996.
- Member: Review Board BBCA Study Section, National Institutes of Health, March 6-7, 1996.
- Invited presenter: "The Elastic Behavior of DNA Molecules Using Single Molecule Manipulation Methods", Biophysical Society Meeting, Baltimore, MD, February 17-21, 1996.
- Presented seminar: "Mechanical Manipulation of Single DNA Molecules", Department of Molecular Biology, Princeton University, December 7, 1995.
- Member: Review Board BBCA Study Section, National Institutes of Health, October 26-27, 1995.
- Presented seminar: "Recent Developments in the Biological Application of the Scanning Force Microscopy", Laboratory of Molecular Biology National Institutes of Health, NIDDK, Bethesda, MD, October 25, 1995.



- Presented seminar: "Nano-mechanical Studies of Single Biomolecules: Present Capabilities and Future Perspectives", Department of Chemistry, Rice University, Houston, TX, October 18, 1995.
- Presented seminar: "Single-Molecule Studies of DNA Mechanics", John Schellman Celebration, Macromolecular Conformations, Interactions, and Mechanisms Symposium, University of Oregon, October 6-7, 1995.
- Presented seminar: "Imaging Protein DNA Complexes with the Scanning Force Microscope", Rockefeller University Lecture Series, New York, NY, September 29, 1995.
- Keynote speaker: "Scanning Force Microscopy of Nucleo-Protein Assemblies", Biomolecular Recognition Symposium, University of Michigan, September 21-23, 1995.
- Invited speaker: "Structure of Native and Linker Histone-Depleted Chromatin Fibers Revealed by Scanning Force Microscopy", ACS Frontiers in Biophysical Chemistry Symposium, Chicago, IL, August 20-22, 1995.
- Invited speaker: "Structure of E. coli F1Fo ATP Synthase Revealed by Scanning Force Microscopy", Protein Society Meeting, Boston, MA, July 8-12, 1995.
- Invited speaker: "Biological Applications of Scanning Force Microscopy", Ninth Conversation in Biomolecular Stereodynamics, University at Albany, NY, June 20-24, 1995.
- Invited speaker: "Scanning Force Microscopy of Biological Samples", Emerging Techniques in Atomic Force Microscopy Symposium, American Society for Biochemistry and Molecular Biology, San Francisco, CA, May 21-25, 1995.
- Invited speaker: "Scanning-Force-Microscopy Studies of RNA Polymerase Structure and Function.", RNA Polymerase Structure and Function Session of the 95th General Meeting of the American Society for Microbiology, Washington, D.C., May 21-25, 1995:
- Presented seminar: "Studies of DNA Elasticity Using Single-molecule Manipulation Methods", Physics Department Colloquium, University of California, Berkeley, May 8, 1995.
- Presented seminar: "SFM of Protein DNA Complexes", Department of Biochemistry, Albert Einstein College of Medicine, Bronx, NY, April 25, 1995.
- Invited speaker: "Studying Protein DNA Interactions using Scanning Force Microscopy", Howard Hughes Medical Institute Scientific Meeting, Bethesda, MD, March 19-22, 1995.
- Presented: "Overstretching DNA", Biophysical Society Meeting, San Francisco, CA, February 12, 1995.
- Presented seminar: "Imaging Protein DNA Complexes with a Scanning Force Microscope", University of California, Santa Cruz, January 15, 1995.
- Invited speaker: "Measurements of the elastic response of single DNA Molecules using Magnetic Beads", Condensed Matter Seminar, University of Chicago, IL, January 6, 1995.
- Invited speaker: "Studying biological systems through single-molecule manipulation methods", Physics Colloquium, University of Chicago, IL, January 5, 1995.
- Presented seminar: Galveston University, Galveston, TX, December 15, 1994.
- Presented seminar: Rice University, Houston, TX, December 14, 1994.
- Presented seminar: Yale University, New Haven, CT, December 3-6, 1994.
- Presented seminar: "Imaging Protein DNA Complexes with the Scanning Force Microscope", Oregon Health Sciences University, Portland, OR, Nov. 15, 1994.
- Presented seminar: University of Texas Health Science Center, San Antonio, TX, October 12-14, 1994.
- Invited speaker: CAM 94 Physics Meeting, Cancún, Mexico, September 26-30, 1994.
- Invited speaker: San Luis Potosí Conference on Physics and Biophysics of Complex Fluids, Mexico, July 31-August 3, 1994.

- Presented seminar: "Visualizing and Manipulating DNA molecules through an optical microscope", Department of Molecular Biology, Institute of Mathematics and Its Applications, University of Minnesota, MN, July, 1994.
- Invited speaker: Gordon Conference on Biopolymers; Nucleic Acid structures, Salve Regina College, Newport, RI, June 26-July 1, 1994.
- Invited speaker: "Experimental manipulation of single molecules", Princeton lectures on Biophysics, sponsored by NEC Research Institute, 1994.
- Member: NIH BBBCA Molecular and Cellular Biophysics Study Section, June 8-10, 1994.
- Invited speaker: Engineering Conference on Nanofabrication in Biosystems, Kona, Hawaii, May 6-12, 1994.
- Presented seminar: "Imaging Protein-DNA complexes with the Scanning Force Microscopy", North Western Ohio University, April 1994.
- Presented seminar: "Imaging Protein-DNA complexes with the Scanning Force Microscope", Case-Western Reserve Ohio University, April 1994.
- Presented seminar: "Imaging Protein DNA Complexes with the Scanning Force Microscope", University of Virginia, April 1994.
- Presented seminar: "Imaging Protein DNA Complexes with the Scanning Force Microscope", School of Biological Sciences, University of Missouri, Kansas City, MO, March 1994.
- Presented seminar: Biotechnology Center, Ohio State University, OH, March 1994.
- Member: NIH Molecular and Cellular Biophysics Study Section, BBBCA Chevy Chase, MD, February 24-26, 1994.
- Presented seminar: Department of Chemistry, University of California, Santa Barbara, CA, February 1994.
- Presented seminar: "Scanning Force Microscopy of Protein-DNA Complexes", California Technological Institute, Pasadena, CA, February 1994.
- Invited speaker: Gordon Conference on Dynamics of Macromolecular and Polyelectrolyte Solutions, Oxnard, CA, February 7-11, 1994.
- Invited speaker: Fifteenth Annual West Coast Chromatin and Chromosomes Meeting, Asilomar, CA, December 9-12, 1993.
- Presented seminar: Stanford University, CA, November 21-23, 1993.
- Member: NIH BBBCA Study Section, October 1993.
- Presented seminar: Cornell University, Ithaca, NY, September 28-30, 1993.
- Invited speaker and poster presenter: "Imaging Transcription Complexes with the Scanning Force Microscope" (talk), "Direct Measurement of the Elasticity of Single DNA Molecules through an Optical Microscope" (poster), Science Innovation, Boston, MA August 6-10, 1993.
- Invited speaker: MSA Meeting, Cincinnati, OH, August 3-8, 1993.
- Invited speaker: : 11th International Congress of Biophysics, International Union of Pure & Applied Biophysics, Budapest, Hungary, July 25-30, 1993.
- Invited speaker: 22nd Steenbock Symposium on Protein-Nucleic Acid Interactions, University of Wisconsin-Madison, WI, May 22-26, 1993.
- Presented seminar: Oregon Graduate Institute, Portland, OR, March 12, 1993.
- Invited speaker: Chemistry Department, University of Washington, WA, March 2-3, 1993.
- Invited lecturer: "Inside the Single Cell", Nalbandov Symposium, University of Illinois at Urbana-Champaign, Champaign, IL, February 18-21, 1993.

Invited speaker: Biophysics of DNA Symposium, Department of Molecular Biology, Princeton University, Princeton, NJ, February 5-6, 1993.

Invited speaker: SPIE International Symposia on Biomedical Optics, Los Angeles, CA, January 16-23, 1993.

Presented seminar: Chemistry Department, University of New Mexico, NM, December 12-14, 1992.

Invited speaker: Gordon Research Conferences on Polymer Physics, Newport, RI, August 3-8, 1992.

Invited speaker: 5th International Congress on Cell Biology, Madrid, Spain, July 26-30, 1992.

Presented seminar: Oregon Materials Science Symposium Program, Oregon State University, OR, May 9, 1992.

Invited speaker: ASTI Conference, Portland State University, Portland, OR, May 4, 1992.

Invited speaker: American Chemical Society Meeting, San Francisco, CA, April 5-10, 1992.

Presented seminar: Biology Division, Los Alamos National Laboratories, March 23, 1992.

Presented seminar: Biochemistry Department, University of Iowa, IA, March 19, 1992.

Invited speaker: Biochemistry and Molecular Biophysics Department, Medical School at the University of Washington, Seattle, WA, March 11-12, 1992.

Member: NIH BBBCA Study Section, February 26-28, 1992.

Invited speaker: Symposium on Scanning Probe Microscopy, SPIE Meeting, Los Angeles, CA, January 20-22, 1992.

Invited speaker poster presenter: Symposium on the New Scanning Probe Microscopies, Twente University, Netherlands, December, 11-14, 1991.

Invited presenter: Biophysical Chemistry Seminar, University of California, Berkeley, CA, October 20, 1991.

Presented: "Imaging of DNA Molecules", Fourth Mammoth Lakes Discussions, Mammoth Lakes, CA, September 27-28, 1991.

Invited speaker: EMSA (Electron Microscopy Society of America) San Jose, CA, August 4-11, 1991.

Site visit: NSF, Des Moines, IA, July 11, 1991.

Presented lecture at the American Society of Photobiology, San Antonio, Texas, June 24-27, 1991.

Invited speaker: to the Gordon Research Conferences on Nucleic Acids at Rhode Island, June 10-14, 1991.

Invited speaker: Canadian Seminar on Surface Science, Trent University, Ontario, Canada, May 28-30, 1991.

Invited speaker: Symposium on Characterizing the Structure of Large Molecules, American Chemical Society Meeting, Atlanta, GA, April 15-17, 1991.

Presented seminar: Naval Research Laboratory, Chemistry Division, Washington, D.C., April 13-15, 1991.

Invited speaker: ICN-UCI Symposium on the Advances in Genetic Disease, Newport Beach, California, February 28 - March 2, 1991.

Poster: Human Genome Conference, Santa Fe, NM, February 16-19, 1991.

Invited speaker: Engineering Institute Conference on Scanned Probe Microscopies, Santa Barbara, CA, January 6-11, 1991.

Presented seminar: Chemistry Department, Haverford College, Haverford, CT, November 1990.

Presented seminar: Chemistry Department, Swarthmore College, Swarthmore, PA, November 1990.

Chairman: Symposium on Scanning Tunneling Microscopy, Biotechnology Conference, Washington, D.C., Nov 27-28, 1990.

Presented seminar: American Electrochemical Society Meeting, Seattle, WA, November 17-19, 1990.

Invited speaker: Italian Conference on Chemical Physics, Maratea, Italy, October 9-12, 1990.

Invited speaker: International Conference of the Italian Chemical Society, San Benedetto del Tronto, Italy, October 2-5, 1990.

Presented seminar: Microbiology Department, Medical School of the University of Bologna, Bologna, Italy, October 1, 1990.

Presented seminar: Chemistry Department, University of Catania, Catania, Sicily, September 28, 1990.

Invited speaker: Institute of Molecular Biology Retreat, Marine Biological Laboratory, OR, September 10-13, 1990.

Invited speaker: Scripps Institute, La Jolla, CA, September 4-6, 1990.

Presented seminar: Physics Department, University of Southern Illinois, Carbondale, IL, August 3-9, 1990.

Plenary lecturer: Fifth International Conference on Scanning Tunneling Microscopy (NANO I), Baltimore, MD, July 21-25, 1990.

Invited speaker: Micro 90: Novotel Symposium on Novel Microscopies, London, England, July 1-6, 1990.

Invited speaker, site-visit session: Human Genome Project, Lawrence Berkeley Laboratory, Department of Energy, Berkeley, June 28-29, 1990.

Invited speaker: American Society of Microbiology Biotechnology Conference, Chicago, IL, June 7-10, 1990.

Invited speaker: Bi-annual Symposium on Electron Microscopy, Iowa State University, Ames, IA, May 10-13, 1990.

Invited speaker: Electron Microscopy International Conference, Bethesda, MD, May 9-13, 1990.

Presented seminar: Biology Department, University of California, Berkeley, May 1-3, 1990.

Invited speaker: Methods on Pulsed Field Gel Electrophoresis Symposium, American Physical Society Meeting, Anaheim, CA, March 13-14, 1990.

Keynote speaker: Advances in Pulsed Field Gel Electrophoresis Symposium, Bamburg Center, Cold Spring Harbor Lab, Spring Harbor, NY, March 4-8, 1990.

Presented seminar: Department of Microbiology, Universidad Autonoma de Madrid, Madrid, Spain, March 2, 1990.

Invited speaker: "Symposium on New Imaging Technologies" 50th Anniversary of the Biophysics Dept. Celebration, Johns Hopkins University, Baltimore, MD, February 22, 1990.

Invited presenter: Biophysical Society Meeting in Baltimore, MD, February 17-23, 1990.

Invited colloquium speaker: Biophysics Department in Baylor Medical Center, Dallas, TX, January 25-26, 1990.

Invited speaker: SPIE symposium, Los Angeles, CA, January 17-19, 1990.

Invited speaker: Third Berkeley Symposium on Structural and Dynamical Biology, January 9-12, Berkeley, CA, 1990.

Invited speaker: Symposium on Nucleic Acids and Ligands Interactions, American Chemical Society Regional Meeting, Baton Rouge, LA, Dec. 1989.

Invited speaker: (invitation extended by University President and Regents), Summary Laboratory Research Efforts, University of New Mexico, Albuquerque, NM, Dec. 1989.

Presented seminar: University of Oregon, Eugene, OR, October 1989.

Invited speaker: Human Genome Symposium at the Annual MBRS Symposium, Houston, TX, October

1989.

Invited speaker: III Balkan Conference in Electron Microscopy, Athens, Greece, September 1989.

Presented seminar: Universidad Autonoma de Madrid, Spain, September 1989.

Presented seminar: the Institute of Molecular Biology, University of Oregon, Eugene, OR, August 1989.

Invited presenter: IV International Meeting on Scanning Tunneling Microscopy, Oarai, Japan, July 1989.

Presented seminar: Chemistry Department, University of Catania, Sicily, May 1989.

Invited presenter: Biological Application of Scanning Tunneling Microscopy, NATO Conference of STM, Erice, Italy, May 1989.

Invited presenter: Biophysical Society Meeting in Cincinnati, OH, February 1989.

Presented seminar: University of California at San Francisco Medical Center, San Francisco, CA, January 1989.

Presented seminar: Applied Science Department, University of California, Davis, November 1988.

Invited speaker: Symposium on Modern Optical Microscopy, Meeting of the Society for Analytical Cytology, Breckenridge, CO, Sept. 1988.

Presented seminar: Chemistry Department, Arizona State University, Tempe, AZ, September 1988.

Invited speaker: 46th Meeting of the Electro Microscopic Society of America (EMSA), Milwaukee, WI, August 1988.

Presented seminar: Biochemistry Department at Oregon State University, Corvallis, OR, May 2, 1988.

Visiting professor: University of Modena, Modena, Italy, May 1988.

Presented seminar: Biophysics Department, Chemical Biodynamics Laboratory at the University of California, Berkeley, April 26, 1988.

Presented seminar: Chemistry Department of the University of Oregon, Eugene, OR, April, 1988.

Presented seminar: Differential Polarization Microscopy, Genetics group in Los Alamos National Laboratory, Los Alamos, NM, April 1988.

Presented seminar: Chemistry Department, University of California, Berkeley, January 1988.

Invited presenter: "Patterns of Polymerization in Red Blood Sickle Cells by Differential Polarization Microscopy", Biophysical Society Meeting, New Orleans, LA, 1987.

Invited presenter: "Theory of Differential Polarization Imaging", Biophysical Society Meeting, New Orleans, LA, 1987.

Invited presenter: "Differential Polarization Imaging: Theory and Applications", NATO Advanced Study Institute, Rimini, Italy, October 1987.

Keynote speaker: "Recent Developments of Polarized Spectroscopy of Ordered Systems", NATO 900th Anniversary of the University of Bologna, Italy, October 1987.

Invited speaker: NATO Advanced Studies Institute, Rimini, Italy, October 1987.

Presented seminar: "Differential Polarization Imaging", Chemistry Department of Catholic University, Lima, Peru, 1987.

Presented seminar on "Theory of Duysens Flattening" at the Chemistry Department of Catholic University, Lima, Peru, 1987.

Presented a paper on "Theory of Mueller Imaging", M.H. Kim, L. Ulibarri and Bustamante, C. at Biophysical Meeting, San Francisco, CA, 1986.

Attended the Meeting of Biomedical Engineering Society, Ft. Worth, Texas, August 1986.

Presented seminar: "Differential Polarization Imaging" at the Chemistry Department of University of Denver, Colorado, March 1986.

Invited to present seminar entitled "Differential Polarization Microscopy" at the Biochemistry

- Department, Universidad San Marcos and at the Chemistry Department of Catholic University, Lima, Peru, March 1986.
- Presented a paper "  $\pi$ -type Circular Dichroism: A New Theory" at the Biochemistry Department, Universidad San Marcos, Lima, Peru, March 1986.
- Presented a paper "Theory of Duysens Flattening" at the Biochemistry Department, Universidad San Marcos & at the Chemistry Department of Catholic University, Lima, Peru, March 1986.
- Seminar presentation "Differential Polarization Microscopy: An Emerging Technique in Biological Research" at the Polymer and Solid State Sciences Group at Los Alamos National Laboratory, February 1986.
- Presented seminar on "Polarized Light Methods: Theory and Experimental Studies" at the theoretical biology group at Los Alamos National Laboratory, February 1986.
- Invited seminar at the Biology Department at Johns Hopkins University, Baltimore, Maryland, January 1986.
- Invited speaker: "CIDS at Short Wavelengths", New Frontiers of Synchrotron Radiation Sources, Berkeley, CA, November 1985.
- Presented seminar: "Differential Polarization Imaging" at the Chemistry Department of University of Texas at Houston, November 1985.
- Invited speaker: on "Circularly Polarized Scattering in the Visible and the Prospects for Similar Experiments Using Soft X-Rays" at Japan-U.S. Seminar on Ultraviolet Photobiology and Spectroscopy Using Synchrotron Radiation, Brookhaven National Laboratories, October 1985.
- Presented a paper on "  $\pi$ -Type Circular Dichroism: A General Theory" at Gordon Conference on Liquid Crystals, Welfboro, New Hampshire, July 1985.
- Presented a paper on "Theory of  $\pi$ -Type Circular Dichroism" at Biophysical Society Meeting, Baltimore, February 1985.
- Invited presenter: "The CIDS of Oriented and Rotationally Disorder Samples", Biophysical Society Meeting, Baltimore, MD, February 1985.
- Invited speaker: "New Frontiers in Optical Activity Research", Southwest Regional Meeting, American Chemical Society, Lubbock, TX, February 1985.
- Invited presenter: "The CIDS of Planar and Focal Conic Orientations of Liquid Crystals", Biophysical Society Meeting, Albuquerque, NM, May 1984.
- Invited speaker: "CIDS of Cholesteric and Blue Mesophases", Meeting of the American Chemical Society, St. Louis, MI, May 1984.
- Invited presenter: "A New Optical Microscopy Technique Using Circularly Polarized Light", Biophysical Society Meeting, San Antonio, TX, February 1984.
- Invited presenter: "Circular Intensity Differential Scattering in the Short Wavelengths", Stanford Conference on New Ring Technology, Stanford, CA, July 28-31, 1983.
- Invited presenter: "The CIDS of Planar Cholesteric Samples", Gordon Conference on Liquid Crystals, Wolfeboro, NH, June 25-30, 1983.
- Invited presenter: "The Circular Intensity Differential Scattering of Chiral Aggregates", Biophysical Society Meeting, San Diego, CA, February, 1983.