

SHIXIN LIU

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POSITION

The Rockefeller University 2016—present
Assistant Professor
Head, Laboratory of Nanoscale Biophysics and Biochemistry
Faculty Member, Tri-Institutional PhD Program in Chemical Biology
Faculty Member, Tri-Institutional MD-PhD Program

ACADEMIC TRAINING

University of California, Berkeley 2010—2015
Postdoctoral Fellow
Advisor: Carlos Bustamante

Harvard University 2003—2009
Ph.D., Chemistry
Advisor: Xiaowei Zhuang
Dissertation: "Single-molecule fluorescence studies of enzyme kinetics and protein-nucleic acid interactions"

University of Science and Technology of China 1998—2003
B.S., Biological Science

AWARDS

2018 NIH Director's New Innovator Award (DP2)
2018 Sinsheimer Scholar Award, The Alexandrine and Alexander L. Sinsheimer Foundation
2017 Kimmel Scholar, Sidney Kimmel Foundation
2017 Basil O'Connor Starter Scholar Research Award, March of Dimes Foundation
2017 Quadrivium Award for Innovative Research in Epigenetics, The Quadrivium Foundation
2016 Monique Weill-Caulier Career Scientist Award, The Hirschl/Weill-Caulier Trusts
2013 NIH Pathway to Independence Award (K99/R00)
2012 Education Travel Award, Biophysical Society
2008 Chinese Government Award for Outstanding Students Abroad

1998

Ranked #1 in the Special Class for the Gifted Young, Top Freshman Scholarship, University of Science and Technology of China

PUBLICATIONS (* denotes co-first author; # denotes corresponding author)

Publications since Joining Rockefeller:

1. L. Wang*, Z. L. Johnson*, M. R. Wasserman*, J. Levring*, J. Chen#, **S. Liu**#. Conformational dynamics of the ABC exporter multidrug resistance protein 1. Under review.
2. R. Leicher, E. J. Ge, X. Lin, M. J. Reynolds, T. Walz, B. Zhang#, T. W. Muir, **S. Liu**#. PRC2 bridges non-adjacent nucleosomes to establish heterochromatin. *bioRxiv* 795260. Under review.
3. M. R. Wasserman*, G. D. Schauer*, M. E. O'Donnell#, **S. Liu**#. (2019) Replication fork activation is enabled by a single-stranded DNA gate in CMG helicase. *Cell* 178, 600-611.
4. M. R. Wasserman, **S. Liu**#. (2019) A *tour de force* on the double helix: exploiting DNA mechanics to study DNA-based molecular machines. *Biochemistry* 58, 4667-4676. Review.
5. X. Ju, D. Li, **S. Liu**#. (2019) Full-length RNA profiling reveals pervasive bidirectional transcription terminators in bacteria. *Nat. Microbiol.* 4, 1907-1918.
6. S. Li, E. B. Zheng, L. Zhao, **S. Liu**#. (2019) Nonreciprocal and conditional cooperativity directs the pioneer activity of pluripotency transcription factors. *Cell Rep.* 28, 2689-2703.
7. L. Wang, C. Y. Mo, M. R. Wasserman, J. T. Rostøl, L. A. Marraffini, **S. Liu**#. (2019) Dynamics of Cas10 govern discrimination between self and non-self in type III CRISPR-Cas immunity. *Mol. Cell* 73, 278-290.
8. Q. Zheng, N. D. Omans, R. Leicher, A. Osunsade, A. S. Agustinus, E. Finkin-Groner, H. D'Ambrosio, B. Liu, S. Chandariapaty, **S. Liu**, Y. David. (2019) Reversible histone glycation is associated with disease-related changes in chromatin architecture. *Nat. Commun.* 10, 1289.
9. S. Tafoya*, S. J. Large*, **S. Liu**, C. Bustamante, D. A. Sivak. (2019) Using a system's equilibrium behavior to reduce its energy dissipation in nonequilibrium processes. *Proc. Natl. Acad. Sci. U. S. A.* 116, 5920-5924.
10. S. Tafoya, **S. Liu**, J. P. Castillo, R. Atz, M. C. Morais, S. Grimes, P. J. Jardine, C. Bustamante. (2018) Molecular switch-like regulation enables global subunit coordination in a viral ring ATPase. *Proc. Natl. Acad. Sci. U. S. A.* 115, 7961-7966.
11. **S. Liu**#, S. Tafoya, C. Bustamante#. (2017) Deciphering the molecular mechanism of the bacteriophage ϕ 29 DNA packaging motor. *Methods Mol. Biol.* 1486, 343-355. Protocol.

Earlier Publications:

12. B. Cheng, S. Wu, **S. Liu**, P. Rodriguez-Aliaga, J. Yu, S. Cui. (2015) Protein denaturation at a single-molecule level: the effect of nonpolar environments and its implications on the unfolding mechanism by proteases. *Nanoscale* 7, 2970-2977.
13. **S. Liu***, G. Chistol*, C. L. Hetherington*, S. Tafoya, K. Aathavan, J. Schnitzbauer, S. Grimes, P. J. Jardine, C. Bustamante. (2014) A viral packaging motor varies its DNA rotation and step size to preserve subunit coordination as the capsid fills. *Cell* 157, 702-713.

14. **S. Liu***, G. Chistol*, C. Bustamante. (2014) Mechanical operation and intersubunit coordination of ring-shaped molecular motors: insights from single-molecule studies. *Biophys. J.* 106, 1844-1858. Review.
15. M. Dangkulwanich*, T. Ishibashi*, **S. Liu***, M. L. Kireeva, L. Lubkowska, M. Kashlev, C. Bustamante. (2013) Complete dissection of transcription elongation reveals slow translocation of RNA polymerase II in a linear ratchet mechanism. *eLife* 2, e00971.
16. G. Chistol*, **S. Liu***, C. L. Hetherington, J. R. Moffitt, S. Grimes, P. J. Jardine, C. Bustamante. (2012) High degree of coordination and division of labor among subunits in a homomeric ring ATPase. *Cell* 151, 1017-1028.
17. **S. Liu***, B. T. Harada*, J. T. Miller, S. F. Le Grice, X. Zhuang. (2010) Initiation complex dynamics direct the transitions between distinct phases of early HIV reverse transcription. *Nat. Struct. Mol. Biol.* 17, 1453-1460.
18. S. Chung, M. Wendeler, J. W. Rausch, G. Beilhartz, M. Gotte, B. R. O'Keefe, A. Bermingham, J. A. Beutler, **S. Liu**, X. Zhuang, S. F. Le Grice. (2010) Structure-activity analysis of vinylogous urea inhibitors of human immunodeficiency virus-encoded ribonuclease H. *Antimicrob. Agents Chemother.* 54, 3913-3921.
19. J. W. Rausch, E. A. Abbondanzieri, **S. Liu**, X. Zhuang, S. F. Le Grice. (2010) Retrovirus replication: new perspectives on enzyme and substrate dynamics. In *Recent Advances in Human Retroviruses: Principles of Replication and Pathogenesis* (eds. A. Lever, K. T. Jeang, B. Berkhout. World Scientific), pp. 307-343. Book Chapter.
20. **S. Liu**, E. A. Abbondanzieri, J. W. Rausch, S. F. Le Grice, X. Zhuang. (2008) Slide into action: dynamic shuttling of HIV reverse transcriptase on nucleic acid substrates. *Science* 322, 1092-1097.
21. **S. Liu**, G. Bokinsky, N. G. Walter, X. Zhuang. (2007) Dissecting the multistep reaction pathway of an RNA enzyme by single-molecule kinetic "fingerprinting". *Proc. Natl. Acad. Sci. U. S. A.* 104, 12634-12639.
22. G. Bokinsky, L. G. Nivón, **S. Liu**, G. Chai, M. Hong, K. M. Weeks, X. Zhuang. (2006) Two distinct binding modes of a protein cofactor with its target RNA. *J. Mol. Biol.* 361, 771-784.
23. Z. Song, **S. Liu**, H. He, N. Hoti, Y. Wang, S. Feng, M. Wu. (2004) A single amino acid change (Asp53→Ala53) converts Survivin from anti-apoptotic to pro-apoptotic. *Mol. Biol. Cell* 15, 1287-1296.

INVITED TALKS

Feb 2020	Biophysical Society Annual Meeting, Nanoscale Biophysics Subgroup, San Diego, CA
Jul 2019	Gordon Research Conference on Mechanisms of Microbial Transcription, Lewiston, ME
Jul 2019	Biophysical Society Thematic Meeting on Single-Molecule Biology, Lima, Peru
Jun 2019	Dynamic Single-Molecule Meeting, Tianjin, China
Apr 2019	Department of Biology, Johns Hopkins University, Baltimore, MD
Mar 2019	Cell Press LabLinks on Single Molecule Technologies, New York City
Jan 2019	Molecular Biophysics Seminar Series, New York University, NY
Sep 2018	Department of Chemistry, Georgetown University, DC
Jul 2018	Telluride Workshop on Chromatin Dynamics, Telluride, CO
Jun 2018	Bionanoscience Colloquium, Delft University of Technology, Netherlands

Mar 2018 IAS Focused Program on Mechanisms of Transcription, HKUST, Hong Kong
Nov 2017 Genome Integrity Discussion Group, New York Academy of Sciences, NY
Nov 2016 Biophysics Seminar, University of Maryland, College Park, MD
Jul 2015 Peking Union Medical College, Beijing, China
Jun 2015 Tsinghua University, Beijing, China
Jun 2015 Peking University, Beijing, China
Fall 2014 - California Institute of Technology; University of California, San Diego; University of
Spring 2015 Texas Southwestern Medical Center; Massachusetts Institute of Technology; University
of Michigan; The Rockefeller University (*Job search talks*)
Jan 2013 Shanghai Jiao Tong University, Shanghai, China
Jul 2009 University of Science and Technology of China, Hefei, China

PROFESSIONAL ACTIVITIES

2005- Member, Biophysical Society
2017- Member, American Society for Biochemistry and Molecular Biology
Peer Reviewer for *Nature*, *Cell*, *Mol Cell*, *Nat Commun*, *PNAS*, *eLife*, *JACS*, *NAR*, *Sci Rep*

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