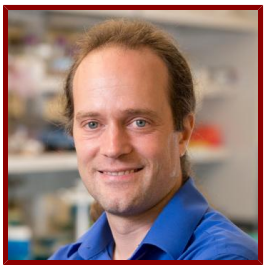
Stanford



Zev Bryant

Associate Professor of Bioengineering and, by courtesy, of Structural Biology

Bio

BIO

Molecular motors lie at the heart of biological processes from DNA replication to vesicle transport. My laboratory seeks to understand the physical mechanisms by which these nanoscale machines convert chemical energy into mechanical work. We use single molecule tracking and manipulation techniques to observe and perturb substeps in the mechanochemical cycles of individual motors. Protein engineering helps us to explore relationships between molecular structures and mechanical functions. Broad topics of current interest include torque generation by DNA-associated ATPases and mechanical adaptations of unconventional myosins.

ACADEMIC APPOINTMENTS

- Associate Professor, Bioengineering
- Associate Professor (By courtesy), Structural Biology
- Member, Bio-X
- Member, Wu Tsai Neurosciences Institute

ADMINISTRATIVE APPOINTMENTS

- Director, Stanford Biophysics, (2025- present)
- Associate Director, Stanford Biophysics, (2024-2025)
- Associate Chair of Graduate Admissions, Stanford Bioengineering, (2018-2025)

HONORS AND AWARDS

- Predoctoral Fellowship, Howard Hughes Medical Institute (1999)
- Harold M. Weintraub Award, FHCRC (2004)
- Alan Bearden Award, UC, Berkeley (2004)
- Postdoctoral Fellowship, Helen Hay Whitney Foundation (2005)
- Director's New Innovator Award, NIH (2008)
- Pew Scholars Award, Pew Charitable Trusts (2009)

BOARDS, ADVISORY COMMITTEES, PROFESSIONAL ORGANIZATIONS

- Council Member, Biophysical Society (2017 - 2020)

PROFESSIONAL EDUCATION

- B.Sc., University of Washington , Biochemistry (1998)

- Ph.D., UC, Berkeley , Molecular and Cell Biology (2003)

LINKS

- Bryant Lab: https://web.stanford.edu/group/bryant/

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

Molecular motors lie at the heart of biological processes from DNA replication to vesicle transport. My laboratory seeks to understand the physical mechanisms by which these nanoscale machines convert chemical energy into mechanical work. We use single molecule tracking and manipulation techniques to observe and perturb substeps in the mechanochemical cycles of individual motors. Protein engineering helps us to explore relationships between molecular structures and mechanical functions. Broad topics of current interest include torque generation by DNA-associated ATPases and mechanical adaptations of unconventional myosins.

Teaching

COURSES

2026-27

- SEMINAR IN BIOPHYSICS: BIOPHYS 250 (Aut)

2025-26

- Molecular Motors I: BIOE 335 (Win)

2024-25

- Introduction to Bioengineering (Engineering Living Matter): BIOE 80, ENGR 80 (Spr)
- Molecular Motors I: BIOE 335 (Spr)

2023-24

- Physical Biology: BIOE 42 (Spr)

STANFORD ADVISEES

Doctoral Dissertation Reader (AC)

Carlos Alvarado, Matt DeJong, Ian Ho, Alex Leffell, Chih-Wei Joshua Liu, Siranush Nobile

Postdoctoral Faculty Sponsor

Noor Al-Sayyad, Sebastian Coupe

Doctoral Dissertation Advisor (AC)

Joel Gates, Lauren Takiguchi

Doctoral (Program)

Joshua Gilligan, Andre Gu, Jessica Karaguesian, Sarah Sanderson, Xitong Wang, Evelyn Wong

GRADUATE AND FELLOWSHIP PROGRAM AFFILIATIONS

- Bioengineering (PhD Program)
- Biophysics (PhD Program)
- Structural Biology (PhD Program)

Publications

PUBLICATIONS

- **Stepwise DNA-unwinding gates TnpB genome-editing activity.** *Molecular cell*
  Zhou, Z., Saffarian-Deemyad, I., Shi, H., Weiss, T., Ur-Rehman, M. M., Vohra, K., Skopintsev, P., Yoon, P. H., Trinidad, M. I., Langeberg, C. J., Kamalu, M., Amerasekera, J., Zhou, et al
  2026

- **Engineering filamentous myosins for optical control of contractility.** *bioRxiv : the preprint server for biology*
  Zemsky, S., Ruijgrok, P. V., Bryant, Z.
  2025

- **Rapid two-step target capture ensures efficient CRISPR-Cas9-guided genome editing.** *Molecular cell*
  Shi, H., Al-Sayyad, N., Wasko, K. M., Trinidad, M. I., Doherty, E. E., Vohra, K., Boger, R. S., Colognori, D., Cofsky, J. C., Skopintsev, P., Bryant, Z., Doudna, J. A.
  2025

- **Optical control of fast and processive engineered myosins in vitro and in living cells.** *Nature chemical biology*
  Ruijgrok, P. V., Ghosh, R. P., Zemsky, S. n., Nakamura, M. n., Gong, R. n., Ning, L. n., Chen, R. n., Vachharajani, V. T., Chu, A. E., Anand, N. n., Eguchi, R. R., Huang, P. S., Lin, et al
  2021

- **Cas9 interrogates DNA in discrete steps modulated by mismatches and supercoiling.** *Proceedings of the National Academy of Sciences of the United States of America*
  Ivanov, I. E., Wright, A. V., Cofsky, J. C., Aris, K. D., Doudna, J. A., Bryant, Z.
  2020

- **Multimodal Measurements of Single-Molecule Dynamics Using FluoRBT.** *Biophysical journal*
  Ivanov, I. E., Lebel, P. n., Oberstrass, F. C., Starr, C. H., Parente, A. C., Ierokomos, A. n., Bryant, Z. n.
  2017

- **Controllable molecular motors engineered from myosin and RNA.** *Nature nanotechnology*
  Omabegho, T. n., Gurel, P. S., Cheng, C. Y., Kim, L. Y., Ruijgrok, P. V., Das, R. n., Alushin, G. M., Bryant, Z. n.
  2017

- **Gold rotor bead tracking for high-speed measurements of DNA twist, torque and extension.** *Nature methods*
  Lebel, P., Basu, A., Oberstrass, F. C., Tretter, E. M., Bryant, Z.
  2014; 11 (4): 456-462

- **Dynamic basis of supercoiling-dependent DNA interrogation by Cas12a via R-loop intermediates.** *Nature communications*
  Aris, K. D., Cofsky, J. C., Shi, H., Al-Sayyad, N., Ivanov, I. E., Balaji, A., Doudna, J. A., Bryant, Z.
  2025; 16 (1): 2939

- **Motor crosslinking augments elasticity in active nematics.** *Soft matter*
  Redford, S. A., Colen, J., Shivers, J. L., Zemsky, S., Molaei, M., Floyd, C., Ruijgrok, P. V., Vitelli, V., Bryant, Z., Dinner, A. R., Gardel, M. L.
  2024

- **Exploitation of Engineered Light-Switchable Myosin XI for Nanotechnological Applications.** *ACS nano*
  Salhotra, A., Rahman, M. A., Ruijgrok, P. V., Meinecke, C. R., Ušaj, M., Zemsky, S., Lindberg, F. W., Surendiran, P., Lyttleton, R. W., Linke, H., Korten, T., Bryant, Z., Månsson, et al
  2023

- **Single-molecule dynamics of DNA gyrase in evolutionarily distant bacteria Mycobacterium tuberculosis and E. coli.** *The Journal of biological chemistry*
  Galvin, C. J., Hobson, M., Meng, J. X., Ierokomos, A., Ivanov, I. E., Berger, J. M., Bryant, Z.
  2023: 103003

- **Motor processivity and speed determine structure and dynamics of microtubule-motor assemblies.** *eLife*
  Banks, R. A., Galstyan, V., Lee, H. J., Hirokawa, S., Ierokomos, A., Ross, T. D., Bryant, Z., Thomson, M., Phillips, R.

2023; 12

- **Coarse-Grained Modeling Reveals the Impact of Supercoiling and Loop Length in DNA Looping Kinetics.** *Biophysical journal*
  Starr, C. H., Bryant, Z., Spakowitz, A. J.
  2022
- **Engineering reconfigurable flow patterns via surface-driven light-controlled active matter** *PHYSICAL REVIEW FLUIDS*
  Gong, X., Mathijssen, A. M., Bryant, Z., Prakash, M.
  2021; 6 (12)
- **Machine learning active-nematic hydrodynamics.** *Proceedings of the National Academy of Sciences of the United States of America*
  Colen, J., Han, M., Zhang, R., Redford, S. A., Lemma, L. M., Morgan, L., Ruijgrok, P. V., Adkins, R., Bryant, Z., Dogic, Z., Gardel, M. L., de Pablo, J. J., Vitelli, et al
  2021; 118 (10)
- **Spatiotemporal control of liquid crystal structure and dynamics through activity patterning.** *Nature materials*
  Zhang, R. n., Redford, S. A., Ruijgrok, P. V., Kumar, N. n., Mozaffari, A. n., Zemsky, S. n., Dinner, A. R., Vitelli, V. n., Bryant, Z. n., Gardel, M. L., de Pablo, J. J.
  2021
- **Modulated control of DNA supercoiling balance by the DNA-wrapping domain of bacterial gyrase.** *Nucleic acids research*
  Hobson, M. J., Bryant, Z., Berger, J. M.
  2020
- **Introduction: Molecular Motors.** *Chemical reviews*
  Iino, R. n., Kinbara, K. n., Bryant, Z. n.
  2020; 120 (1): 1–4
- **Multi-parameter measurements of conformational dynamics in nucleic acids and nucleoprotein complexes.** *Methods (San Diego, Calif.)*
  Ivanov, I. E., Bryant, Z.
  2019
- **A Mechanosensitive RhoA Pathway that Protects Epithelia against Acute Tensile Stress.** *Developmental cell*
  Acharya, B. R., Nestor-Bergmann, A., Liang, X., Gupta, S., Duszyc, K., Gauquelin, E., Gomez, G. A., Budnar, S., Marcq, P., Jensen, O. E., Bryant, Z., Yap, A. S.
  2018
- **Dynamic coupling between conformations and nucleotide states in DNA gyrase.** *Nature chemical biology*
  Basu, A., Hobson, M., Lebel, P., Fernandes, L. E., Tretter, E. M., Berger, J. M., Bryant, Z.
  2018; 14 (6): 565–74
- **Rotation of endosomes demonstrates coordination of molecular motors during axonal transport.** *Science advances*
  Kaplan, L. n., Ierokomos, A. n., Chowdary, P. n., Bryant, Z. n., Cui, B. n.
  2018; 4 (3): e1602170
- **Cryo-EM structures reveal specialization at the myosin VI-actin interface and a mechanism of force sensitivity.** *eLife*
  Gurel, P. S., Kim, L. Y., Ruijgrok, P. V., Omabegho, T. n., Bryant, Z. n., Alushin, G. M.
  2017; 6
- **Structural Dynamics and Mechanochemical Coupling in DNA Gyrase** *JOURNAL OF MOLECULAR BIOLOGY*
  Basul, A., Parentez, A. C., Bryant, Z.
  2016; 428 (9): 1833-1845
- **Remote control of myosin and kinesin motors using light-activated gearshifting.** *Nature nanotechnology*
  Nakamura, M., Chen, L., Howes, S. C., Schindler, T. D., Nogales, E., Bryant, Z.
  2014; 9 (9): 693-697
- **Engineering myosins for long-range transport on actin filaments** *NATURE NANOTECHNOLOGY*
  Schindler, T. D., Chen, L., Lebel, P., Nakamura, M., Bryant, Z.
  2014; 9 (1): 33-38

- **Processive ATP-driven substrate disassembly by the N-ethylmaleimide-sensitive factor (NSF) molecular machine.** *journal of biological chemistry*
  Cipriano, D. J., Jung, J., Vivona, S., Fenn, T. D., Brunger, A. T., Bryant, Z.
  2013; 288 (32): 23436-23445
- **Torque Spectroscopy of DNA: Base-Pair Stability, Boundary Effects, Backbending, and Breathing Dynamics.** *Physical review letters*
  Oberstrass, F. C., Fernandes, L. E., Lebel, P., Bryant, Z.
  2013; 110 (17): 178103-?
- **Recent developments in single-molecule DNA mechanics** *CURRENT OPINION IN STRUCTURAL BIOLOGY*
  Bryant, Z., Oberstrass, F. C., Basu, A.
  2012; 22 (3): 304-312
- **ATP binding controls distinct structural transitions of Escherichia coli DNA gyrase in complex with DNA** *NATURE STRUCTURAL & MOLECULAR BIOLOGY*
  Basu, A., Schoeffler, A. J., Berger, J. M., Bryant, Z.
  2012; 19 (5): 538-U105
- **Torque measurements reveal sequence-specific cooperative transitions in supercoiled DNA** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
  Oberstrass, F. C., Fernandes, L. E., Bryant, Z.
  2012; 109 (16): 6106-6111
- **Engineering controllable bidirectional molecular motors based on myosin** *NATURE NANOTECHNOLOGY*
  Chen, L., Nakamura, M., Schindler, T. D., Parker, D., Bryant, Z.
  2012; 7 (4): 252-256
- **Detailed Tuning of Structure and Intramolecular Communication Are Dispensable for Processive Motion of Myosin VI** *BIOPHYSICAL JOURNAL*
  Elting, M. W., Bryant, Z., Liao, J., Spudich, J. A.
  2011; 100 (2): 430-439
- **Contribution of the myosin VI tail domain to processive stepping and intramolecular tension sensing** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
  Dunn, A. R., Chuan, P., Bryant, Z., Spudich, J. A.
  2010; 107 (17): 7746-7750
- **Engineered Myosin VI Motors Reveal Minimal Structural Determinants of Directionality and Processivity** *JOURNAL OF MOLECULAR BIOLOGY*
  Liao, J., Elting, M. W., Delp, S. L., Spudich, J. A., Bryant, Z.
  2009; 392 (4): 862-867
- **Coarse-Grained Structural Modeling of Molecular Motors Using Multibody Dynamics** *CELLULAR AND MOLECULAR BIOENGINEERING*
  Parker, D., Bryant, Z., Delp, S. L.
  2009; 2 (3): 366-374
- **Coarse-Grained Structural Modeling of Molecular Motors Using Multibody Dynamics.** *Cellular and molecular bioengineering*
  Parker, D., Bryant, Z., Delp, S. L.
  2009; 2 (3): 366-374
- **Multiple modes of Escherichia coli DNA gyrase activity revealed by force and torque** *NATURE STRUCTURAL & MOLECULAR BIOLOGY*
  Nollmann, M., Stone, M. D., Bryant, Z., Gore, J., Crisona, N. J., Hong, S., Mitelheiser, S., Maxwell, A., Bustamante, C., Cozzarelli, N. R.
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- **The power stroke of myosin VI and the basis of reverse directionality** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
  Bryant, Z., Altman, D., Spudich, J. A.
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- **DNA overwinds when stretched** *NATURE*
  Gore, J., Bryant, Z., Noellmann, M., Le, M. U., Cozzarelli, N. R., Bustamante, C.

2006; 442 (7104): 836-839

- **Mechanochemical analysis of DNA gyrase using rotor bead tracking** *NATURE*
  Gore, J., Bryant, Z., Stone, M. D., Nollmann, M. N., Cozzarelli, N. R., Bustamante, C.
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- **Structural transitions and elasticity from torque measurements on DNA** *NATURE*
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- **Ten years of tension: single-molecule DNA mechanics** *NATURE*
  Bustamante, C., Bryant, Z., Smith, S. B.
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- **Conjugation of DNA to silanized colloidal semiconductor nanocrystalline quantum dots** *CHEMISTRY OF MATERIALS*
  Parak, W. J., Gerion, D., Zanchet, D., Woerz, A. S., Pellegrino, T., Micheel, C., Williams, S. C., Seitz, M., Bruehl, R. E., Bryant, Z., Bustamante, C., Bertozzi, C. R., Alivisatos, et al
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- **Mechanical unfolding of a beta-hairpin using molecular dynamics** *BIOPHYSICAL JOURNAL*
  Bryant, Z., Pande, V. S., Rokhsar, D. S.
  2000; 78 (2): 584-589
- **Characterization of differentially expressed genes in purified Drosophila follicle cells: Toward a general strategy for cell type-specific developmental analysis** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
  Bryant, Z., Subrahmanyan, L., Tworoger, M., LaTray, L., Liu, C. R., Li, M. J., van den Engh, G., Ruohola-Baker, H.
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- **Mosaic analysis in the Drosophila ovary reveals a common hedgehog-inducible precursor stage for stalk and polar cells** *GENETICS*
  Tworoger, M., Larkin, M. K., Bryant, Z., Ruohola-Baker, H.
  1999; 151 (2): 739-748
- **maelstrom is required for an early step in the establishment of Drosophila oocyte polarity: posterior localization of grk mRNA** *DEVELOPMENT*
  Clegg, N. J., Frost, D. M., Larkin, M. K., Subrahmanyan, L., Bryant, Z., Ruohola-Baker, H.
  1997; 124 (22): 4661-4671