

POLLY M. FORDYCE

Shriram Center Room 088
443 Via Ortega
Departments of Genetics and Bioengineering
Stanford, CA 94305

pfordyce@stanford.edu
mobile: (650) 799-8131
www.fordycelab.com

EDUCATION

- Ph.D., Physics 2007
Stanford University, Stanford, CA
Thesis: "Single-molecule studies of kinesin family motor proteins"
- B.A. in Physics, B.A. in Biology (*summa cum laude*) 2000
University of Colorado at Boulder, Boulder, CO
Honors Thesis: "Determination of the form factor and branching ratio of $K_L \rightarrow e^+ e^- \gamma$ "

RESEARCH & PROFESSIONAL EXPERIENCE

- **Co-director, Microfluidics Foundry, Stanford University, Stanford, CA** 2015-present
- **Assistant Professor, Stanford University, Stanford, CA** 2014-present
Departments of Genetics and Bioengineering
Fellow, ChEM-H
- **Postdoctoral Researcher, University of California, San Francisco, CA** 2007-2014
Department of Biochemistry and Biophysics
Advisor: Professor Joseph DeRisi
Microfluidic affinity assays for characterizing transcription factor binding
Microfluidic production of spectrally encoded beads
- **Consultant, GigaGen, Inc., San Francisco, CA** 2011-2012
Microfluidic devices for deep sequencing of individual T and B cells
- **Ph.D. in Physics, Stanford University, Palo Alto, CA** 2000-2006
Departments of Physics and Biological Sciences
Advisor: Steven M. Block
Optical trapping and single-molecule fluorescence studies of kinesin proteins
- **B.A.s in Physics and Biology, University of Colorado at Boulder (*summa cum laude*)** 1996-2000
Department of Physics
Advisor: Tony R. Barker
Determination of the form factor and branching ratio of $K_L \rightarrow e^+ e^- \gamma$

FELLOWSHIPS, GRANTS, & AWARDS

- Gabilan Fellowship 2015-2017
- NIH Pathway to Independence Award (K99/R00) 2012-present
- Gordon Research Conference poster competition, first prize 2013
- W. M. Keck Foundation Grant (co-author) 2009-2012
- Helen Hay Whitney Postdoctoral Fellowship 2008-2011
- NIH Kirschstein NRSA Award (declined) 2007
- G.J. Lieberman Fellow 2003-2004
- National Science Foundation Graduate Research Fellow 2002-2005
- Centennial Teaching Award 2002
- National Science Foundation REU Grant Recipient 2001

RESEARCH FOCUS

In my research, I develop new microfluidic tools for making quantitative, systems-scale, biophysical measurements of protein binding interactions. One such tool is MITOMI 2.0, a microfluidic platform capable of measuring binding affinities and kinetics for a single transcription factor protein interacting with up to 4,000 DNA sequences in parallel. In initial validation studies, we demonstrated that this platform was able to detect both strong and weak interactions for transcription factors from a variety of different structural families, including many that had been difficult to characterize via other techniques. We have since used this tool to reveal surprising binding flexibility in structurally simple transcription factors, discover new families of DNA binding proteins, and probe how evolutionary changes in transcription factor binding specificity can rewire transcriptional networks during evolution.

In parallel with this work, I have also developed a microfluidic platform for producing spectrally encoded beads via the ratiometric incorporation of multiple different lanthanide nanophosphors. A key advantage of this approach is the ability to create potentially very large libraries for biological multiplexing, and we are currently working to use these beads as a platform to produce peptide libraries for studies of protein-protein interactions.

PATENTS

U.S. Patent Application 61/692,618. "Spectrally encoded microbeads and methods and devices for making and using same". B. Baxter, J. DeRisi, P. Fordyce, R. Gerver, R. Gomez-Sjoberg, K. Thorn. (2013).

PUBLICATIONS (PEER-REVIEWED).

1. Perez, J.C., **Fordyce, P.M.**, Lohse, M.B., Hanson-Smith, V., DeRisi, J.L., and Johnson, A.J. "How duplicated transcription regulators can diversify to govern the expression of non-overlapping sets of genes", *Genes & Development* 28:1272-7 (2014).
2. Dybbro, E., **Fordyce, P.M.**, Ponte, M., and Arron, S.T. "Hydraulic expulsion of Tumbu fly larvae", *JAMA Derm.* 150:791-2 (2014).
3. Lohse, M.B., Hernday, A.D., **Fordyce, P.M.**, Noiman, L., Sorrells, T.R., Hanson-Smith, V., Nobile, C.J., DeRisi, J.L. and Johnson, A.D. "Identification and characterization of a recently evolved, novel class of sequence-specific DNA binding domains", *PNAS* 110:7660-5 (2013).
4. Hernday, A.D., Lohse, M.B.*, **Fordyce, P.M.***, Nobile, C.J., DeRisi, J.L., and Johnson, A.D. "Structure of the transcriptional network controlling white-opaque switching in *Candida albicans*", *Molecular Microbiology* [Epub ahead of print] (2013). (* denotes equal authorship)
5. Nelson, C.S., Fuller, C.K., **Fordyce, P.M.**, Greninger, A.L., Li, H., and DeRisi, J.L. "Microfluidic affinity and ChIP-seq analyses converge on a conserved FOXP2 binding motif that enables the detection of evolutionarily novel regulatory targets", *Nucleic Acids Research*, 41:5991-6004 (2013).
6. **Fordyce, P.M.**, Pincus, D., Kimmig, P., Nelson, C., El-Samad, H., Walter, P., and DeRisi, J.L. "Basic leucine zipper transcription factor Hac1 binds DNA in two distinct modes as revealed by microfluidic analyses", *PNAS* 109:E3084-93 (2012).
7. Gerver, R.E.*, Gomez-Sjoberg, R.*, Baxter, B.C.*, Thorn, K.S.*, **Fordyce, P.M.***, Diaz-Botia, C.A., Helms, B.A., and DeRisi, J.L. "Programmable microfluidic synthesis of spectrally encoded microspheres". *Lab on a Chip* 12:4716-23 (2012). (* denotes equal authorship; author order was chosen by random draw)
8. **Fordyce, P.M.**, Diaz-Botia, C.A., Gomez-Sjoberg, R., and DeRisi, J.L. "Systematic characterization of feature dimensions and closing pressures for microfluidic valves produced via photoresist reflow". *Lab on a Chip*, 12:4287-95 (2012).
9. **Fordyce, P.M.***, Gerber, D.*, Tran, D., Zheng, J., Li, H., DeRisi, J.L., and Quake, S.R., "De novo identification and biophysical characterization of transcription factor binding with microfluidic affinity analysis", *Nature Biotechnology* 28:970-5 (2010). (* denotes equal authorship)

10. Valentine, M.T.*, **Fordyce, P.M.***, Krzysiak, T.C., Gilbert, S.P., and Block, S.M., "Individual dimers of the mitotic kinesin motor Eg5 step processively and support substantial loads *in vitro*", **Nature Cell Biology** 8:470-476 (2006). (* denotes equal authorship)
11. Lang, M.J.*, **Fordyce, P.M.***, Engh, A.M., Neuman, K.C., and Block, S.M., "Simultaneous, coincident optical trapping and single-molecule fluorescence", **Nature Methods** 1:133-139 (2004). (* denotes equal authorship)
12. Rosenfeld, S.S., **Fordyce, P.M.**, Jefferson, G.M., King, P.H., and Block, S.M., "Stepping and stretching – how kinesin uses internal strain to walk processively", **Journal of Biological Chemistry** 278:18550-18556 (2003).
13. Lang, M.J., **Fordyce, P.M.**, and Block, S.M., "Combined optical trapping and single-molecule fluorescence", **Journal of Biology** 2:6-10 (2003).
14. Alavi-Harati, A. *et al.*, "Search for the decay $K_L \rightarrow \pi^0 e^+ e^-$ ", **Physical Review Letters** 86:397-401 (2001).
15. Alavi-Harati, A., *et al.*, "Measurement of the branching ratio of $K_L \rightarrow e^+ e^- \gamma$ ", **Physical Review D** 64:1-4 (2001).

OTHER PUBLICATIONS (REVIEWS/BOOK CHAPTERS).

1. **Fordyce, P.**, and Ingolia, N. "Integrating systems biology data to yield functional genomics insights", **Genome Biology** 12:302 (2011).
2. **Fordyce, P.M.***, Valentine, M.T.*, and Block, S.M., "Advances in surface-based assays for single molecules", in "Single-Molecule Techniques: A Laboratory Manual" (Cold Spring Harbor Monograph Series, 2008). (* denotes equal authorship)
3. Valentine, M.T., **Fordyce, P.M.**, and Block, S.M., "Eg5 steps it up!", **Cell Division** 1:31-39 (2006).

EXTRAMURAL RESEARCH TALKS

1. **University of Minnesota Academic Health Center Duluth Research Seminar.** Duluth, MN (2016).
2. **Memorial Sloane Kettering Computational Biology Seminar.** New York, NY (2016).
3. **Princeton University Biophysics Seminar.** Princeton, NJ (2016).
4. **Epigenomics 2016.** San Juan, Puerto Rico (2016).
5. **EMBL Conference: Personalized Health.** Heidelberg, Germany (2015).
6. **Rice University Bioengineering Seminar.** Houston, TX (2015).
7. **BIRS Conference: Rules of Protein-DNA Recognition, Computational and Experimental Advances.** Oaxaca, Mexico (2015).
8. **University of California Santa Barbara Junior Nanotech Network Workshop.** Santa Barbara, CA (2015).
9. **University of California San Diego Department of Bioengineering Seminar.** San Diego, CA (2014).
10. **University of California San Francisco Cardiovascular Research Institute Seminar.** San Francisco, CA (2014).
11. **Princeton University Lewis-Sigler Institute Seminar.** Princeton, NJ (2014).
12. **University of Washington Department of Bioengineering Seminar.** Seattle, WA (2014).
13. **Stanford University Department of Genetics Seminar.** Stanford, CA (2014).
14. **Harvard Medical School Department of Biological Chemistry & Molecular Pharmacology Seminar.** Boston, MA (2014).
15. **Northwestern University Department of Molecular Biosciences Seminar.** Evanston, IL (2014).
16. **University of California San Diego Department of Chemistry and Biochemistry Seminar.** La Jolla, CA (2014).
17. **Harvard University FAS Center for Systems Biology Seminar.** Cambridge, MA (2014).
18. **University of Colorado at Boulder Department of Biochemistry Seminar.** Boulder, CO (2014).
19. **California Institute of Technology Department of Bioengineering Seminar.** Pasadena, CA (2014).

20. **University of California Berkeley Department of Bioengineering Seminar.** Berkeley, CA (2014).
21. **University of California Berkeley Department of Chemical Engineering Seminar.** Berkeley, CA (2014).
22. **Cornell University Department of Molecular Biology and Genetics Seminar.** Ithaca, NY (2014).
23. **Stanford University Department of Bioengineering Seminar.** Stanford, CA (2014).
24. **University of Maryland Department of Bioengineering Seminar.** College Park, MD (2014).
25. **University of Washington Genome Sciences Department Seminar.** Seattle, WA (2014).
26. **Bio-Rad Seminar.** Pleasanton, CA (2013).
27. **University of Utah: Rising Stars Symposium in Chemical Biology.** Salt Lake City, UT (2013).
28. **University of California Davis Chemistry Department Seminar.** Davis, CA (2013).
29. **University of Santa Clara Chemistry Department Seminar.** Santa Clara, CA (2013).
30. **Gordon Research Conference: Physics and Chemistry of Microfluidics.** Barga, Italy (2013).
31. **EMBL Conference: From Functional Genomics to Systems Biology.** Heidelberg, Germany (2010).
32. **Agilent Technologies Seminar.** Santa Clara, CA (2010).
33. **Lawrence Berkeley National Laboratories Molecular Foundry Seminar.** Berkeley, CA (2008).
34. **University of Colorado Optical Science and Engineering Seminar.** Boulder, CO (2006).
35. **Aspen Conference on Single-Molecule Biophysics.** Aspen, CO (2003).

SELECTED POSTER PRESENTATIONS

1. **Cold Spring Harbor Laboratory: Mechanisms of Eukaryotic Transcription.** Cold Spring Harbor, NY (2013).
2. **Gordon Research Conference: Physics and Chemistry of Microfluidics.** Barga, Italy (2013).
3. **Annual Biophysical Society Meeting.** San Francisco, CA (2010).
4. **Frontiers in Chemical Biology: Single Molecules.** Cambridge, UK (2006).
5. **Annual Biophysical Society Meeting.** San Antonio, TX (2003).

TEACHING EXPERIENCE

Founder and leader, Teaching Assistant Orientation Program <i>Department of Physics, Stanford University, Palo Alto, CA</i>	2002
Head Teaching Assistant, Physics 51 (Light and Heat) <i>Department of Physics, Stanford University, Palo Alto, CA</i>	2001
Teaching Assistant, Physics 41 (Classical Mechanics), Physics 43 (Electrostatics) <i>Department of Physics, Stanford University, Palo Alto, CA</i>	2000-2001
Guest Lecturer, Biology 211 (Biophysics of Sensory Transduction) <i>Department of Biological Sciences, Stanford University, Palo Alto, CA</i>	2002
Instructor, Geology 7 (Outdoor Education Program) <i>Department of Geological and Environmental Sciences, Stanford University, Palo Alto, CA</i>	2001-2006

SERVICE & OUTREACH

Reviewer <i>(Science, Nature Biotechnology, Nature Methods, ACS Synthetic Biology, Lab on a Chip, PNAS)</i>	2006-present
Scientific advisor, <i>X-Prize Foundation</i>	2010
Trip leader, <i>Techbridge program, Chabot Space and Science Center</i>	2008-2011
Science outreach volunteer, <i>Brandeis-Hillel Day School</i>	2009

Guest speaker, *Crystal Springs High School Science Club*
Member, *Biophysical Society, American Physical Society*

2009
2006-present