

# Matthew E. Black

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## CONTACT INFORMATION

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## EDUCATION

### **Ph.D., Quantitative and Computational Biology**

Princeton University, Princeton, NJ, USA

May 2024

Dissertation Advisor: Prof. Joshua W. Shaevitz

Dissertation Title: *Mechanics and Motility of Myxococcus xanthus*

### **M.A., Quantitative and Computational Biology**

Princeton University, Princeton, NJ, USA

May 2019

G.P.A.: 3.7/4.0

Notable coursework: Natural Algorithms, Biophysical Chemistry I, Chemical Biology II

### **B.S., Bioengineering** University of Maryland, College Park, MD, USA

June 2013

G.P.A.: 3.9/4.0 (*Magna Cum Laude*)

Capstone Project: Electronic tracheal stent with remote monitoring

Notable coursework: Bioinstrumentation, Biological Systems Control, Biofluids, Biomechanics

## RESEARCH EXPERIENCE

### **Postdoctoral Research Associate**, Lewis-Sigler Institute

Princeton University, Princeton, NJ, USA

June 2024–Present

**Nanoscale Structure of the Mitotic Spindle** Leveraged expansion microscopy and dual view light sheet imaging to construct nanoscale-resolution maps of the tubulin architecture of the vertebrate mitotic spindle.

**Expansion Microscopy Deformation Correction** Developed a novel protocol for *in situ* correction of spatial deformations that occur as a result of expansion microscopy.

### **Ph.D. Student**, Shaevitz Lab

Princeton University, Princeton, NJ, USA

September 2017–May 2024

**Bacterial Fruiting Body Rheology** (2018-2023) Created a novel atomic force microscope (AFM)-based assay for rheological characterization of live *M. xanthus* fruiting bodies. These measurements provided the first direct measurement of activity-induced viscosity reduction in an active viscoelastic material.

**Influence of Capillary Forces on Gliding Bacteria** (2021-2024) Engineered a device for controlling osmotic pressure in bio-compatible hydrogels. Used this device in combination with time-lapse surface profilometry and light microscopy to demonstrate how capillary forces influence the motion and population structure of gliding bacteria on hydrated surfaces. Programmed a neural network-based data analysis pipeline for cell segmentation and downstream statistical analysis.

**Dense, Single Cell Tracking of Gliding Bacteria** (2022-2024) Designed and implemented novel neural network architectures and algorithms for segmenting and tracking single bacteria in dense monolayers. Used this data to measure, at unprecedented time and labeling density, single- and multicellular motility of gliding bacteria when they are confined within dense, swarming monolayers.

**Research Specialist I, Bos Lab**

Princeton University, Princeton, NJ, USA

February 2016–August 2017

**Single Cell Responses to sub-MIC Antibiotics** (2016-2017) Combined time-lapse fluorescence photomicroscopy and quantitative image analysis to characterize the intracellular response of single *E. coli* cells to sub-minimum inhibitory concentrations of DNA damage-inducing antibiotics.

**Collective Motility and Antibiotic Response of Bacteria** (2016-2017) Used microfluidics and quantitative light microscopy to characterize how structured environments affect both the collective motility and emergence of antibiotic resistance in populations of free-swimming *E. coli*.

**Data Analyst I**

Memorial Sloan Kettering, New York, NY, USA

January 2015–February 2016

Programmed data collection and analysis software for clinical research projects. Designed and implemented a database schema for managing and querying internal surgical outcomes data.

**Program Manager**

Code Systems Corporation, Seattle, WA, USA

November 2013–October 2014

**Selenium Server Integration** (2014-2014) Developed a novel system for testing web browsers by integrating open source browser testing software with the company's virtual machine code. Led later product development and the product's initial rollout to customers.

**Turbo Studio Management** (2013-2014) Managed development of the company's enterprise software platform and provided technical support to clients.

**Senior Research Associate**

Children's National Hospital, Washington, DC, USA

November 2012–July 2013

**Magnesium in Sick Cell Crisis (MAGiC) Study** (2012-2013) Coordinate site activities for the MAGiC study at Children's National Hospital as part of a multi-center clinical trial.

Enrolled patients, managed, and collected study data for ongoing clinical trials in the Emergency Department.

**Research Assistant, Shapiro Lab**

University of Maryland, College Park, MD, USA

September 2011–May 2013

Instrumented electromagnets and control software for ferromagnetic drug targeting in tissue culture samples.

Implemented software for automated image analysis of microscopy data.

**Research Assistant, Akcora Lab**

Stevens Institute of Technology, Hoboken, NJ, USA

June 2012–August 2012

Synthesized and characterized the structure and ionic conductivity of polymer-iron oxide nanocomposites.

Analyzed data and performed optical microscope experiments to characterize the phase separation dynamics of drying aqueous polymer droplets.

TEACHING  
EXPERIENCE**Assistant in Instruction**, Princeton University

Graded lab reports and instructed students on scientific exposition. Demonstrated and assisted students with biological and physical laboratory techniques and mentored students in the design and execution of their own, novel experiments.

ISC234, An Integrated, Quantitative Introduction to the Natural Sciences II **Spring 2022**

ISC232, An Integrated, Quantitative Introduction to the Natural Sciences I **Fall 2021**

ISC234, An Integrated, Quantitative Introduction to the Natural Sciences II **Spring 2021**

ISC232, An Integrated, Quantitative Introduction to the Natural Sciences I **Fall 2020**

MENTORING &  
SUPERVISION**Junior Paper Mentor**, Princeton University, Department of Physics

Guided students through semester-long research projects. Mentored students in how to conduct biophysics research, analyze experimental data, and generate scientific reports.

**Viscoelastic Properties of Myxococcus xanthus Fruiting Bodies**, Kai R. Torrens

**Experimental Characterization of Hydrogel Permeability**, Trishala Kumar

**Senior Thesis Mentor**, Princeton University, Department of Molecular Biology

Supervised year-long senior thesis projects for Princeton University seniors.

**Determination of Microtubule Branching Factor Localization during Mitosis**, Christopher Martino

**Nanoscale Mapping of Heterogeneities in Superabsorbent Hydrogels**, Sarina Hasan

HONORS AND  
AWARDS**Moore Postdoctoral Fellowship**

Princeton University

2025-2026

PROFESSIONAL  
ACTIVITIES AND  
SKILLS**Journal Referee**

International Journal of Computer Vision

2025

Computer Vision and Pattern Recognition - CV4Animals

2025

**Programming Languages**

Python (PyTorch, JAX, CuPy), MATLAB, LabVIEW, C#, CUDA

**Bench Skills**

Eukaryotic & bacterial cell culture, immunofluorescence, single molecule microscopy, force microscopy, light sheet & confocal microscopy, microfluidics, signal acquisition & processing, protein purification

REFEREED  
PUBLICATIONS

8. Copenhagen, K., **Black, M. E.**, Shaevitz, J. W. (2025) *3D Agent-Based Modeling without Chemical Signaling Recreates Collective Behaviors seen in Myxococcus xanthus Colonies* PRX Life **3**, 043015
7. **Black, M. E.**, Fei, C., Alert, R., Wingreen, N. S., Shaevitz, J. W. (2025) *Capillary interactions drive the self-organization of bacterial colonies* Nat. Phys. **21**, 1444-1450
6. **Black, M. E.**, Shaevitz, J. W. (2023) *Rheological Dynamics of Active Myxococcus xanthus Populations during Development* Phys. Rev. Lett. **130**, 218402 [arXiv:2111.12623]
5. Koch, M.D., **Black, M. E.**, Han, E., Shaevitz, J.W., Gitai, Z. (2022) *Pseudomonas aeruginosa distinguishes surfaces by stiffness using retraction of type IV pili* Proc. Nat. Acad. Sci. **119**, 20
4. Phan, T.V., Morris, R., **Black, M. E.**, Do, T.K., Lin, K.C., Nagy, K., Sturm, J.C., Bos, J., Austin, R.H. (2020) *Bacterial Route Finding and Collective Escapes in Mazes and Fractals* Phys. Rev. X **10**, 031017

CONFERENCE  
PRESENTATIONS

3. Phan, T.V., Morris, R.J., Lam, H.T., Hulamm, P., **Black, M.E.**, Bos, J., Austin, R.H. (2018) *Emergence of Escherichia coli critically buckled motile helices under stress* Proc. Nat. Acad. Sci. **115**, 51
2. Morris, R., Phan, T.V., **Black, M.**, Lin, K.C., Kevrekidis, I.G., Bos, J., Austin, R.H. (2017) *Bacterial population solitary waves can defeat rings of funnels* New J. Phys. **19**, 035002
1. Senses, E., **Black, M.**, Cunningham, T., Sukhishvili, S.A., Akcora, P. (2013) *Spatial Ordering of Colloids in a Drying Aqueous Polymer Droplet* Langmuir **29**, 8
  
15. Copenhagen, K., **Black, M. E.**, Shaevitz J. W. *Defect interactions and dynamics control ordering in self-propelled rod active nematics*  
APS March Meeting March 2024
14. **Black, M. E.\***, Fei, C. F., Alert, R. A., Wingreen, N., Shaevitz, J. W. *Surface tension produces an adhesive force between Myxococcus xanthus cells*  
International Meeting on the Biology of Myxobacteria June 2023
13. Han, E., Copenhagen, K., **Black, M. E.**, Shaevitz, J. W. *Instantaneous polar order enhances cell aggregation in thin Myxococcus xanthus layers—experiment*  
APS March Meeting March 2023
12. Copenhagen, K., Han, E., **Black, M. E.**, Shaevitz, J.W. *Instantaneous polar order enhances cell aggregation in thin Myxococcus xanthus layers—theory*  
APS March Meeting March 2023
11. Ramachandran, A., Kaneelil, P., **Black, M. E.**, Gitai, Z., Shaevitz, J. W., Stone, H.A. *Surface tension regulates the morphological evolution of a growing bacterial colony at an air-solid interface*  
APS Meeting of the Division of Fluid Dynamics November 2022
10. **Black, M. E.\***, Fei, C. F., Gonzales La Corte, S., Alert, R. A., Wingreen, N., Shaevitz, J. W. *Capillary attraction structures M. xanthus collective dynamics*  
International Meeting on the Biology of Myxobacteria June 2022
9. **Black, M. E.\***, Gonzales La Corte, S., Alert, R. A., Wingreen, N., Shaevitz, J. W. *Capillary attraction facilitates bacterial collective dynamics: experiment*  
APS March Meeting March 2022
8. Fei, C. F., **Black, M. E.**, Gonzales La Corte, S., Alert, R. A., Wingreen, N., Shaevitz, J. W. *Capillary attraction facilitates bacterial collective dynamics: theory*  
APS March Meeting March 2022
7. **Black, M. E.\***, Shaevitz, J.W. *Viscoelasticity of Myxococcus xanthus fruiting bodies*  
APS March Meeting March 2021
6. Phan, T.V., Austin, R. H., Morris, R., **Black, M. E.**, Bos, J. *E. coli in mazes*  
APS March Meeting March 2019
5. Phan, T.V., Morris, R., Austin, R. H., **Black, M. E.**, Bos, J. *Emergence of E. coli critically buckled motile helices under antibiotic stress*  
APS March Meeting March 2019
4. Austin, R. H., Phan, T.V., Morris, R., Lam, H.T., **Black, M. E.**, Bos, J. *E. coli filaments doing the twist*  
APS March Meeting March 2018
3. Phan, T.V., Morris, R., **Black, M. E.**, Lin, K. C., Bos, J., Austin, R. H. *Collective creativity and survival algorithms of bacteria*  
APS March Meeting March 2018
2. Austin, R. H., Morris, R., Phan, T.V., **Black, M. E.**, Lin, K. C., Bos, J. *How bacterial populations soliton waves can defeat a funnel ring*  
APS March Meeting March 2017

1. Senses, E., **Black, M. E.**, Cunningham, T., Akcora, P. *Evaporation induced ordering in polymer-colloid suspensions*  
APS March Meeting March 2013