Ran Tao

Philadelphia, PA — (470) 601-1503 — rtao21@sas.upenn.edu

Education

University of Pennsylvania — Philadelphia, PA
Ph.D. Candidate in Physics — 2021-2027 Expected
Advisor: Prof. Arnold JTM Mathijssen
Ella N. Pawling Graduate Fellow

The Wharton School — Philadelphia, PA
M.A. in Statistics and Data Science — 2024-2027 Expected

Emory University — Atlanta, GA
B.S. Physics (with Highest Honors) and B.S. Applied Mathematics — 2018-2021
Advisor: Prof. Eric R. Weeks
Cumulative GPA: 3.94/4.00
Senior Honor Thesis: The Flow and Clogging of Soft Particles in Two-Dimensional Hoppers

Research Experience

Research Assistant under Prof. Arnold JTM Mathijssen — 2021-Present
University of Pennsylvania — Philadelphia, PA

Topological Separation of Bacterial Active Matter — 2023-present

- Designed a microfluidcs device preventing bacteria contamination (patent pending)
- Developed a system that precisely controls the accumulation and depletion of microswimmers
- Utilized the topological design to sort different strains of cells (patent pending)
- Investigated the ecology of multi-species in flow network

Essential Morphological Properties for Bacterial Upstream Swimming — 2023–present

- Investigated the upstream swimming capabilities of various microswimmers
- Genetically engineered bacterial strains to systematically vary morphology
- Identified key morphological traits essential for effective upstream motility

Invasion of Bacteria Swimming Upstream into Microstructured Devices — 2022-2024

- Analyzed bacterial upstream swimming across varying confinements and microfluidic geometries
- Discovered the flow-driven bacterial invasion process under clinically relevant conditions
- Explored how upstream bacterial invasion drives biofilm formation

Enhancement of Bacterial Rheotaxis in Non-Newtonian Fluids — 2022-2023

- Simulated the swimming of bacteria in complex fluid
- Uncovered the fundamental mechanisms behind bacteria reorientation dynamics in complex fluid

Research Assistant under Prof. Eric R. Weeks — 2019-2021
Emory University — Atlanta, GA

Clogging Experiment and Simulation in Quasi Two-Dimensional Hoppers — 2019-2021

- Investigated the clogging process with varying particle softness under different gravitational conditions
- Simulated and visualized soft particle flow using IDL

Publications

1. **Ran Tao**, Georgios Gounaris, Marcelo Guzman, Eleni Katifori, Arnold J.T.M. Mathijssen. (2025). Topological separation of bacterial active matter, in preparation for submission to *Nature Physics*
2. Kailin Chen, Alexander Bolanos Campos, Mistica Lozano Perez, Erin Berlew, **Ran Tao**, Arnold J.T.M. Mathijssen, Julia Greer, Joel Boerckel, Alessandro Maggi, Ottman Tertuliano. (2025). Biphasic Mechanoregulation of Cell-Ecm Interactions in 3D Nanoarchitectures, accepted at *Biophysical Journal*
3. **Ran Tao**, Albane Théry, Suya Que, Arnold J.T.M. Mathijssen. (2025). Invasion of bacteria swimming upstream into microstructured devices, accepted at *Cell Newton*
4. Nathaniel C. Esteves†, **Ran Tao**†, Arnold J.T.M. Mathijssen, Jun Zhu. (2025). Nitric oxide and biofilm dispersal in *Vibrio cholerae*, accepted at *Proc. Natl. Acad. Sci. U.S.A.*
5. Arnold J.T.M. Mathijssen, Lauren Altman†, Talia Calazans†, M.J. Ferencz†, Michelle Fung†, Ian J. Lee†, Maciej Lisicki†, Ivy Liu†, Maggie Liu†, Ernest Park†, **Ran Tao**†, Albane Théry†, Zeyuan Wang†, Margot Young†. (2025). Emergence of collective functionalities in biomedical active matter, under review at *Annual Review of Condensed Matter Physics*
6. Qinqin Pu, Nathaniel C. Esteves, Mary R. Brockett, Elyza A. Do, Rui Liu, **Ran Tao**, Arkaprabha Banerjee, Denise Chac, Amy T. Ma, Nanditha Ravishankar, Clara Y. Zhu, Jasmin Akter, Jennifer C. Chang, Joris Beld, Rashidul Haque, Ana A. Weil, Arnold J.T.M. Mathijssen, Michael J. Federle, Ansel Hsiao, Jun Zhu. (2024). Cross-Phylum Quorum Sensing in Dysbiosis Drives Cholera Pathogenesis and Microbiota Structure, under third round review at *Nature*
7. Ding Cao, **Ran Tao**, Albane Théry, Song Liu, Arnold J.T.M. Mathijssen, Yilin Wu. (2024). Giant enhancement of bacterial upstream swimming in macromolecular flows, under second round review at *Science Advances*, arXiv:2408.13694
8. Bryan O. Torres Maldonado, Albane Théry, **Ran Tao**, Quentin Brosseau, Arnold J.T.M. Mathijssen, Paulo E. Arratia. (2024). Enhancement of bacterial rheotaxis in non-Newtonian fluids, *Proc. Natl. Acad. Sci. U.S.A.* 121 (50), e2417614121
9. **Ran Tao**, Madelyn Wilson, Eric R. Weeks. (2021). Soft particle clogging in two-dimensional hopper, Phys. Rev. E 104, 044909

Conferences

1. **Ran Tao**, Georgios Gounaris, Eleni Katifori, Arnold Mathijssen. Microbial Navigation and Ecology in Flow Networks, APS March Meeting 2025, Contributed Talk
2. **Ran Tao**, Georgios Gounaris, Eleni Katifori, Arnold Mathijssen. Microbial Navigation and Ecology in Flow Networks, APS DFD Meeting 2024, Contributed Talk
3. **Ran Tao**, Suya Que, Albane Théry, Arnold Mathijssen. Invasion of Bacteria Swimming Upstream in Structured Microchannels, APS DFD Meeting 2024, Contributed Talk
4. **Ran Tao**, Arnold Mathijssen. Enhanced upstream swimming of bacteria in complex fluids: Viscoelasticity, Biophysical Society Annual Meeting 2024, Poster Presentation
5. **Ran Tao**, Ding Cao, Albane Théry, Yilin Wu, Arnold Mathijssen. Enhanced upstream swimming of bacteria in complex fluids: part II, viscoelasticity, APS DFD Meeting 2023, Contributed Talk
6. **Ran Tao**, Eric R. Weeks. Clogging of soft particles in 2D hoppers, APS March Meeting 2022, Contributed Talk
7. **Ran Tao**, Eric R. Weeks. Clogging of soft particles in 2D hoppers, APS March Meeting 2021, Contributed Talk