

Jörn Dunkel

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Employment:

MathWorks Professor of Mathematics, MIT, 07/2023–
Professor, Applied Mathematics, MIT, 07/2022–
Associate professor with tenure, Applied Mathematics, MIT, 07/2020-06/2022
Associate professor, Applied Mathematics, MIT, 07/2018–06/2020
Assistant professor, Applied Mathematics, MIT, 09/2013–06/2018
Postdoctoral research associate, DAMTP, University of Cambridge, 09/2010-08/2013
Postdoctoral research assistant, Rudolf Peierls Centre, University of Oxford, 09/2008-08/2010

Degrees:

Dr. rer. nat. (Ph.D.), Physics, University of Augsburg, 2008, Advisor: Peter Hänggi
Mathematics diploma (M.Math.), Humboldt-Universität zu Berlin, 2005
Physics diploma (M.Phys.), Humboldt-Universität zu Berlin, 2004

Honors:

Schmidt Science Polymath Award, Schmidt Futures, 2023
Robert E. Collins Distinguished Scholar, MIT Mathematics Department, 2020-2023
Gallery of Fluid Motion Award¹, APS/DFD, 2017
Outstanding Referee, American Physical Society, 2017
Complex Systems Scholar Award, James S. McDonnell Foundation, 2016–2022
Alfred P. Sloan Research Fellowship, 2015–2017
Edmund F. Kelly Research Award, MIT Mathematics Department, 2015-2018
Research Fellow, Murray Edwards College, University of Cambridge, 2011–2013
Gustav Hertz Prize, German Physical Society (DPG), 2011
Junior Research Fellow, Mansfield College, University of Oxford, 2008–2010
Erich Krautz Prize, Universität Augsburg, 2008
SCOR Actuarial Award, SCOR Group & Universität Ulm, 2005
Humboldt Prize, Humboldt-Universität zu Berlin, 2004
Lise Meitner Prize, Institute for Physics, Humboldt-Universität zu Berlin, 2004
Scholarship, German National Academic Foundation (Studienstiftung), 2001–2003

¹with Pedro Saenz, Giuseppe Pucci, Alexis Goujon, Tudor Cristea-Platon, John Bush

UROP/SPUR Students Supervised:

Rothbaum, Adam (SB Math & Physics, Class '26). Winter 2025–
Finlay, Mikaela (SB Math & CS, Class '26). Summer 2024–
Mikulevica, Anna (SB Math, Class '25). Fall 2023–Spring 2024
Liu, Elaine (SB Math & EECS major, Class '24). Summer 2023–Fall 2023
Next position: PhD Student, Stanford University
Miner, Katherine (SB Math, Class '24). Fall 2022–Spring 2024
Next position: PhD Student, University of Chicago
Brattley, Allison (SB Physics major, Class '24). Summer 2022–Spring 2024
Next position: MD-PhD Candidate, Yale School of Medicine
Goel, Gopal (SB Math major, Class '25). Summer 2022–Spring 2023
Ji, Catherine (SB Math '23). Fall 2019–Fall 2021
Next position: PhD Student, Princeton University
Garcia Andrade, Agustin (SB Math '21). Spring 2021
Next position: Algorithm Developer, Hudson River Trading
Srinisivan, Anand (SB Math '21). Summer 2020–Fall 2020
Next position: PhD Student, Cambridge University
Naveen, Venkaat (SB Math major, class of '23). Summer 2020
Shin, Tristan (SB Math & Music major, class of '23). Summer 2020
Li, Jovita (SB Math major, class of '23). Spring 2020
Reilly, Sonia (SB Math & CS '21). Fall 2019–Spring 2021
Next position: PhD Student, Courant Institute of Mathematical Sciences
Allen, Keita (SB Math major, Class '23). Fall 2019–Spring 2020
Moseley, Fischer (SB Physics major, Class '21). Fall 2018–Spring 2020
Next position: Electrical Engineer, Electric Era
Yu, Josephine (SB Physics '20). Spring 2018–Fall 2018
Next position: PhD Student, Applied Physics, Stanford University
Hastewell, Alasdair (SB Physics '18). Fall 2016–Spring 2018
Next position: PhD Student, MIT Mathematics
Heisser, Ronald H. (SB MechE '16). Fall 2015–Spring 2016
Next position: PhD Student, School of Mechanical and Aerospace Engineering, Cornell University
Runnels, Wesley (SB Math '18, MEng CS '20). Summer 2015
Next position: Software Engineer, Einblick
Kavle, Henry (SB Math '17). Summer 2015
Next position: PhD Student, Department of Applied Mathematics, University of Washington
Shin, Dong-Gil (Math major, Class '19). Fall 2014–Spring 2015
Vachharajani, Vipul (SB Math & BE '16). Fall 2014–Spring 2015
Next position: MD-PhD Student, Stanford Medical School

SB Students Senior Thesis Supervised:

Hastewell, Alasdair.

Influence of Gene Expression Gradients on Positional Information Content in Fly Embryos.

MIT Physics, 2018

Next position: PhD Student, MIT Math

Jeckel, Hannah.

Mathematical Modeling of Bacterial Swarming.

Visiting MSc Student from Philipps University of Marburg, 2017

Next position: PhD Student, Max-Planck Institute for Terrestrial Microbiology

Heisser, Ronald.

Design, Development, and Characterization of an Experimental Device to Test Torsion-Controlled Fracture of Thin Brittle Rods. MIT MechE, 2016

Next position: PhD Student, School of Mechanical and Aerospace Engineering, Cornell University

PhD Students Thesis Supervised:

Huang, Rosalind.

In progress, MIT Physics, since 2022

Walden, Harry.

In progress, MIT Math, since 2024

Harry was awarded a MathWorks Science Fellowship, 2024-2025.

Zhang, Shijie.

In progress, MIT CSE-Math, since 2022

Reyes, Jorge.

In progress, MIT Computational & Systems Biology, since 2022

Jorge was awarded a MathWorks Science Fellowship, MIT School of Science, 2022-2023

He was awarded an NSF Graduate Research Fellowship, 2023-.

Cohen, Alexander (jointly with Martin Bazant).

In progress, MIT ChemE, since 2021

Alex was awarded an NDSEG Fellowship, 2022-2025.

Stepaniants, George (jointly with Philippe Rigollet).

Inference from Limited Observations in Statistical, Dynamical, and Functional Problems, MIT Math, PhD 2024

George was awarded an NSF Graduate Research Fellowship, 2021-2024.

George was awarded an NSF Postdoctoral Fellowship, 2024-2027.

Next position: Postdoc, California Institute of Technology

Hastewell, Alasdair.

Robust spectral representations and model inference for biological dynamics, MIT Math, PhD 2024

Alasdair was awarded a MathWorks Science Fellowship, MIT School of Science, 2021-2022.

He received the inaugural David J. Benney Prize, MIT Mathematics, 2023.

Alasdair was awarded an NITMB Postdoctoral Fellowship, 2024-2027.

Next position: Postdoc, NSF-Simons National Institute for Theory and Mathematics in Biology, Northwestern University and University of Chicago

Romeo, Nicolas.

Geometry and transport in development, MIT Physics, PhD 2023

Nico received the Robert B. Guenassia Award of the MIT Office of Graduate Education, 2020.

He was awarded a MathWorks Science Fellowship, MIT School of Science, 2021-2022.

He was awarded the Biological Physics Postdoctoral Fellowship at University of Chicago, 2023-2026.

Next position: Postdoc, University of Chicago

Skinner, Dominic.

Topological order and entropy production in living systems, MIT Math, PhD 2022

Dominic was selected for an NSF Mathematical Sciences Graduate Internship at ANL, 2020.

He received a MathWorks Science Fellowship, MIT School of Science, 2020-2021.

He was awarded an NSF-Simons Postdoctoral Fellowship at Northwestern University, 2022-2025.

Next position: Postdoc, Northwestern University

Current position: Associate Research Scientist, Flatiron Institute

Supekar, Rohit.

Learning and investigating phenomenological models for active matter, MIT MechE, PhD 2021

Rohit was awarded a MathWorks Engineering Fellowship, MIT School of Engineering, 2020-2021.

Next position: New York Times, Data Scientist

Patil, Vishal.

Topology, geometry and mechanics of elastic rods and fibers, MIT Math, PhD 2021

Vishal was the recipient of a MathWorks Science Fellowship, MIT School of Science, 2020-2021.

He was awarded a Stanford Science Fellowship, 2021-2024.

Next position: Postdoc, Stanford University

Current position: Assistant Professor of Mathematics, UCSD

Song, Boya.

Computational modeling of bacterial biofilms, MIT Math, PhD 2021

Boya was awarded the Graduate Student Appreciation Fellowship, MIT Math, 2020-2021.

Next position: System Developer, InterSystems

Miller, Pearson.

Pattern formation on active chemo-mechanical surfaces, MIT Physics, PhD 2020

Pearson was the recipient of a NDSEG Fellowship, Office of Naval Research, 2014-2018.

He was awarded Flatiron Research Fellowship by the Simons Foundation, 2020-2022.

Next position: Postdoc, Flatiron Institute

Current position: Assistant Professor of Mathematics, UCSD

Mok, Rachel.

Individual-based GPU simulation framework for collective bacterial dynamics in swarms and biofilms, MIT MechE, PhD 2019

Rachel was awarded the Chyn Duog Shiah Memorial Fellowship, MIT OGE, 2018-2019.

Next position: Lecturer, MIT

Forrow, Aden.

Active flows and networks, MIT Math, PhD 2018

Aden was awarded a Royal Commission for the Exhibition of 1851 Research Fellowship, 2018-2020.

Next position: Postdoc, Broad Institute & University of Oxford

Current position: Assistant Professor, University of Maine

Słomka, Jonasz.

Generalized Navier-Stokes equations for active turbulence, MIT Math, PhD 2018

Jonasz received both the MIT Mathematics Department's 2017 Housman Award for Undergraduate Teaching, and the 2018 Johnson Prize for a co-authored paper published in a major journal.

He was awarded an ETH Fellowship, 2018-2020.

Next position: Postdoc, ETH Zürich

Current position: Junior Group Leader (SNF Ambizione Fellow), ETH Zürich

Postdoctoral Researchers/Instructors Supervised/Mentored:

Berleant, Joseph.

Postdoc, MIT Math, 2024–present

Bacik, Karol.

Instructor, MIT Math, 2023–present

Bryde, Petur.

Postdoc / Instructor, MIT Math, 2023–present

Fei, Chenyi.

Postdoc / Instructor, MIT Math, 2023–present

Choi, Gary.

NSF Fellow & Instructor, MIT Math, 2020–2023

Next position: Vice-Chancellor Assistant Professor, Chinese University of Hong Kong

Kodio, Ousmane.

Instructor, MIT Math, 2019–2023

Next position: Assistant Professor, UC Santa Barbara

Burns, Keaton.

Instructor, MIT Math, 2019–2023

Next position: Research Scientist, MIT

Totz, Jan.

Postdoc, MIT MechE (jointly with Mathias Kolle), 2019–2023

Recipient of a Feodor Lynen Fellowship by the Alexander von Humboldt Foundation, 2019-2021

Kos, Žiga.

Postdoc, MIT Math, 2019–2021

Recipient of an ARRS Seal of Excellence Postdoctoral Fellowship, 2019-2022

Next position: ARRS Fellow, University of Ljubljana

Current position: Assistant Professor, University of Ljubljana

Mietke, Alexander.

Postdoc, MIT Math, 2019–2022

Recipient of an EMBO Longterm Fellowship and a DFG Postdoctoral Fellowship, 2019-2021

Next position: Lecturer, University of Bristol

Current position: Associate Professor, University of Oxford

Heinonen, Vili.

Postdoc, MIT Math, 2017–2019; Instructor, MIT Math, 2019–2021

Recipient of the Säätiöiden postdoc -pooli Fellowship, 2017-2019

Next position: Researcher, University of Helsinki

Ronellenfitsch, Henrik.

Instructor, MIT Math, 2017–2020

Next position: Assistant Professor, Williams College

Current position: Systems Engineer, ZEISS

Pearce, Philip.

Instructor, MIT Math, 2016–2019

Next position: Independent Theory Fellow, Harvard Medical School

Current position: Associate Professor, University College London

Stoop, Norbert.

Postdoc MIT Math 2013-2014; Instructor, MIT Math, 2014-2017; Postdoc, MIT Math, 2017

Recipient of a Swiss National Foundation Fellowship, 2013-2014

Next position: Research Affiliate, ETH Zürich

Current position: Data Scientist, QuantCo

Teaching:

Courses at MIT:

18.03 Differential equations (Fall 2015, Fall 2016, Fall 2018, Fall 2019, Fall 2021, Fall 2022, Fall 2023)

18.04 Complex Analysis with Applications (Spring 2019)

18.354J Nonlinear Dynamics II: Continuum Systems, MIT (Spring 2014, Spring 2015, Spring 2020)

18.S995 Mathematical Concepts in Biology and Biological Physics (Fall 2013, Fall 2014, Spring 2016, Fall 2017)

18.S996 Introduction to Geometric Algebra (Spring 2022)

Guest lectures: **18.353** (Fall 2014), **20.416** (Fall 2013, Fall 2014)

Supervisions at University of Cambridge:

Quantum physics. Murray Edwards College (LT 2012)

Statistical & thermal physics. Murray Edwards College (MT 2011)

Quantum mechanics. Murray Edwards College (MT 2011 & MT 2012)

Dynamics & relativity. Murray Edwards College (LT 2011 & LT 2012)

Dynamics & relativity. Fitzwilliam College (LT 2011)

Tutorials at University of Oxford:

Quantum mechanics. Mansfield College (MT 2009 - HT 2010)

Mathematical methods. Lincoln College (MT 2009)

Mathematical methods. Mansfield College, University of Oxford (MT 2009)

M. Phys. Option C6: Statistical & quantum field theory. Class tutor (2008-2009)

Service:

Internal:

PhD Committee (with John Bush, Ruben Rosales): Davis Evans, MIT Math, 2025
MIT Commencement Committee, 2024-present
School of Science Postdoctoral Fellowship Steering Committee, 2024-present
Foundational Working Group on the SME Requirements, 2023-24
SPUR Faculty Mentor, MIT Math, June-August 2023
Member, MIT Summer Research Program (MSRP) Application Review Committee (ARC), 2023
Member, MIT CSB Graduate Student Selection Committee, 2023-present
Faculty Postdoc Officer, MIT Math, 09/2022-present
IAP coordinator, MIT Math, 09/2022-present
SPUR/RSI Summer Lecture, July 2022
Faculty Mentor, MIT Summer Research Program (MSRP): Gabriel Rodriguez-Roig, June-August 2022
Member, MIT Summer Research Program (MSRP) Application Review Committee (ARC), 2022
MIT Freshman Advisor, 2021-22
PhD Committee (with Ming Guo, Roger Kamm): Wenhui Tang, MIT MechE, 2021–2024
PhD Committee (with Adam Martin, Daniel Needleman, Ethan Garner): Jonathan Jackson,
MIT Biology/Harvard, 2021–2023
PhD Committee (with Peko Hosoi, Ali Jadbabaie): Juncal Arbelaiz Mugica, MIT Math, 2021–2022
PhD Committee (with Nikta Fakhri, Mehran Kardar): Jinghui Li, MIT Physics, 2021–2022
PhD Committee (with Martin Bazant): Pedro de Souza, MIT ChemE, 2020–2022
PhD Committee (with Ken Kamrin, Gareth McKinley): Saviz Mowlavi, MIT MechE, 2020–2022
PhD Committee (with Jeremy England, John Bush): Jacob Mitchell Gold, MIT Math, 2020
Commencement Exercises 2019
Investiture of Doctoral Hoods 2019
Reviewer, Sagol Weizmann-MIT Bridge Program, 2019
Mentor, MIT-Imperial Exchange Program, 2019
PhD Committee (with Nikta Fakhri, Jeff Gore, Leonid Levitov): Melis Tekant, MIT Physics, 2019–2021
PhD Committee (with James Swan, Alfredo Alexander-Katz): Andrew Fiore, MIT ChemE, 2016-2019
MISTI GSF Scientific Review Committee, 2018
PhD Committee (with Ruben Rosales, Esteban Tabak): Andrew Rzeznik, MIT Math, 2018
Commencement Exercises 2018
Investiture of Doctoral Hoods 2018
18.032x Reviewer 2017
MIT International Science and Technology Initiatives (MISTI) Faculty Committee, 2015 & 2017

PhD Committee (with Bonnie Berger, Peter Shor): Yun William Yu, MIT Math, 2017
18.095 IAP Mathematics Lecture Series, 2014, 2015, 2016, 2017, 2018, 2022 & 2024
 Math Language Examiner (German), Spring 2014 & Spring 2017, Spring 2018
 MIT Freshman Advisor, 2016-17
 MISTI Selection Committee, 2016
 Organizer, MIT Biophysics Retreat, North Falmouth, Sep 13-14 (90+ participants), Fall 2015
 PRIMES & RSI project advisor, 2015-present (Meena Jagadeesan, RSI Student 2015: Semifinalist at the 2015 Siemens Competition)
 Organizer, Lunch Seminar for MIT Math Grad Students, 2014-2015
 MIT Program Committee for the Biophysics Initiative, 2014-present
 Organizer, MIT Biophysics Retreat, Chatham, Sep 14-15 (90+ participants), Fall 2014
 MSRP Faculty Mentor, Summer 2014 (Grace Lim, MSRP Student 2014: Cal Poly Pomona President's Special Travel Award to present project at SIAM CSE15)
 Co-Organizer, MIT Physical Mathematics Seminar (with John Bush and Ruben Rosales), 2013-present

External:

CCB Review Committee, Flatiron Institute, Simons Foundation, 2025
 PhD Committee (with Daniel Goldman, David Hu, Emily Weigel, Saad Bhamla):
 Harry Tuazon, Georgia Tech, 2024
 Tenure Promotion Case Reviewer, Arizona State University, 2024
 Habilitation Committee: Pierre Ronceray, Université Aix-Marseille, 2024
 NSF Panel, 2023
 Direct Submission Editor, PNAS, 2023
 Reviewer, Research Fellowship Competition, Gonville & Caius College (Cambridge University), 2022
 Reviewer, Research Fellowship Competition, Jesus College (Cambridge University), 2022
 PhD Committee (with Teresa Lopez Leon, Denis Bartolo, Tyler Shendruk and Juan de Pablo):
 Claire Doré, ESPCI, 2022
 PhD Committee (with Ivo Sbalzarini): Karl Hoffmann, TU Dresden, 2022
 Reviewer, Israel Science Foundation, 2022
 Reviewer, Junior Faculty Hiring Committee, TU Dresden, 2022
 Direct Submission Editor, PNAS, 2022
 External Member, Tenure Board, Universität Leipzig, 2022-2026
 Reviewer, Department of Energy (DOE) Office of Science, 2022
 PhD Committee (with Anand Oza and Travis Askham): Connor Robertson, NJIT, 2021-2023
 Reviewer, Department of Energy (DOE) Office of Science, 2021
 PhD Committee (with Ivo Sbalzarini): Suryanarayana Maddu, TU Dresden, 2021
 PhD Committee (with Jeff Guasto): Amin Dehkharghani, Tufts University, 2021

NSF Panel, 2020
Reviewer, Department of Energy (DOE) Office of Science, 2020
Reviewer, SISSA faculty hiring committee, 2020
Reviewer, Emmy Noether Programm, Deutsche Forschungsgemeinschaft (DFG), 2020
Reviewer, European Research Council (ERC), 2020
Reviewer, NSF Faculty Early Career Development Program (CAREER), 2019
Advising on book proposals, Cambridge University Press, 2016 & 2019
Reviewer, European Research Council (ERC), 2019
Organizer, GSOF Invited Session ‘Towards Soft Active Metamaterials’, APS March Meeting, Boston, 2019 (with Francis G. Woodhouse)
PhD Committee (with Axel Voigt): Sebastian Reuther, TU Dresden, 2019
Reviewer, Ohio Supercomputer Center, 2018
Reviewer, Fulbright-Cottrell Award, 2018
Reviewer, Junior Research Fellowship Competition, Trinity College (Cambridge University), 2018
Correspondent, Journal Club of Condensed Matter Physics, www.condmatjclub.org, 2018
Referee, Centre Européen de Calcul Atomique et Moléculaire (CECAM), 2017
Reviewer for Israel Science Foundation (ISF), 2017
Reviewer, US-Israel Binational Science Foundation (BSF), 2017
Reviewer, German Research Foundation (DFG), 2015-2019
Member, Local Organizing Committee, APS DFD Meeting Boston, 2015
Organizer, Boston Area Physics of Living Systems Hangout, Dec 11 (40+ participants), Fall 2014
Organizer, Minisymposium ‘Collective Dynamics in Active Suspensions’, SIAM Annual Meeting, Chicago, 2014 (with E. Lushi and D. Saintillan)
Reviewer, German Academic Exchange Service (DAAD), 2014
Reviewer, Adams Prize, University of Cambridge, 2014
Reviewer, W. M. Keck Foundation, 2014
Reviewer, German-Israeli Foundation for Scientific Research and Development, 2014
Investment Committee, Murray Edwards College, University of Cambridge, 2011–2013
Reviewer, South African National Research Foundation, 2008
Referee for 40+ journals (incl. Nature, Nature Physics, Nature Materials, Nature Communications, Science Advances, PNAS, PRL, Rev Mod Phys, PRX, eLife, Cell Systems, Langmuir, Soft Matter, JFM), since 2005

Preprints:²

- K. A. Bacik, J. Ondras, A. Rudkin, J. Dunkel and I. S. Kim
Submitted
- Y.-C. Chao, S. Gokhale, L. Lin, A. D. Hastewell, A. Bacanu, Y. Chen, J. Li, J. Liu, H. Lee, J. Dunkel and N. Fakhri
Submitted
- S. Zhang, C. Fei and J. Dunkel
Nonlinear memory in cell division dynamics across species
arXiv:2408.14564, submitted

C. Meng, J.-S. Wu, Ž. Kos, J. Dunkel, C. Nisoli and I. I. Smalyukh
Submitted
- V. Heinonen, A. J. Abraham, J. Słomka, K. J. Burns, P. J. Saenz and J. Dunkel
Emergent universal statistics in non-equilibrium systems with dynamical scale selection
arXiv:2205.01627, submitted

Publications:

- G. Stepaniants, A. D. Hastewell, D. J. Skinner, J. F. Tutz and J. Dunkel
Discovering dynamics and parameters of nonlinear oscillatory and chaotic systems from partial observations
Phys Rev Research, 6: 043062, 2024
- V. P. Patil, Ž. Kos and J. Dunkel
Harmonic flow field representations of quantum bits and gates
Phys Rev Research, 6: 043039, 2024
- J. F. Tutz, A. D. McDougal, L. Wagner, S. Kang, P.T.C. So, J. Dunkel, B.D. Wilts and M. Kolle
Cell membrane buckling governs early-stage ridge formation in butterfly wing scales
Cell Reports Physical Science, 5(7): 102063, 2024
- T. Ohmura, D. J. Skinner, K. Neuhaus, G. P. T. Choi, J. Dunkel and K. Drescher
In vivo microrheology reveals local elastic and plastic responses inside three-dimensional bacterial biofilms
Advanced Materials, 36(29): 2314059, 2024
Selected as *Editor's Choice*
- M. Salvalaglio, D. J. Skinner, J. Dunkel and A. Voigt
Persistent homology and topological statistics of hyperuniform point clouds
Phys Rev Research, 6: 023107, 2024
- N. Romeo, J. Słomka, J. Dunkel and K. J. Burns
Vortex line entanglement in active Beltrami flows
J. Fluid Mech., 982: A12, 2024

²•arising from a supervised PhD thesis; ◦joint work with MIT Math instructor/postdoc; +with undergraduate student

- H. Jeckel, K. Noshou, K. Neuhaus, A. D. Hastewell, D. J. Skinner, D. Saha, N. Netter, N. Paczia, J. Dunkel and K. Drescher
Spatio-temporal transcriptomes of bacterial swarms reveal supra-generational cooperation during multicellular development
Nature Microbiology, 8: 2378-2391, 2023
- J. A. Jackson, N. Romeo, A. Mietke, K. J. Burns, J. F. Tetz, A. C. Martin, J. Dunkel and J. Imran Alsous
Scaling behavior and control of nuclear wrinkling
Nature Physics, 19:1927-1935, 2023
Selected as *Cover Article*
- D. J. Skinner, H. Jeckel, A. C. Martin, K. Drescher and J. Dunkel
Topological packing statistics distinguish living and non-living matter
Science Advances, 9: eadg1261, 2023
- A. E. Cohen, A. D. Hastewell, S. Pradhan, S. W. Flavell and J. Dunkel
Schrödinger dynamics and Berry phase of undulatory locomotion
Physical Review Letters, 130: 258402, 2023
O. Hallatschek, S. S. Datta, K. Drescher, J. Dunkel, J. Elgeti, B. Waclaw and N. S. Wingreen
Proliferating active matter
Nature Reviews Physics, 5: 407-419, 2023
- V. P. Patil, H. Tuazon, E. Kaufman, T. Chakraborty, D. Qin, J. Dunkel and M. S. Bhamla
Ultrafast reversible self-assembly of living tangled matter
Science, 380: 392-398, 2023
Selected for *Science Perspective*
- R. Supekar, B. Song, A. D. Hastewell, G. P. T. Choi, A. Mietke and J. Dunkel
Learning hydrodynamic equations for active matter from particle simulations and experiments
Proc. Natl. Acad. Sci. U.S.A., 120(7): e2206994120, 2023
- H. Jeckel, F. Diaz-Pascual, D. J. Skinner, B. Song, E. Jimenez Sibert, E. Jelli, S. Vaidya, J. Dunkel and K. Drescher
Shared biophysical mechanisms determine early biofilm architecture development across different bacterial species
PLoS Biol., 20(10): e3001846, 2022
- Ž. Kos and J. Dunkel
Nematics bits and universal logic gates
Science Advances, 8: eabp8371, 2022
- H. Kim, D. J. Skinner, D. S. Glass, A. E. Hamby, B. A. R. Stuart, J. Dunkel and I. H. Riedel-Kruse
Synthetic 4-bit adhesion logic and universal multicellular interface patterning
Nature, 608: 324-329, 2022
Selected as *Cover Article* and for *Nature News & Views*

- T. H. Tan, A. Mietke, J. Li, Y. Chen, H. Higinbotham, P. J. Foster, S. Gokhale, J. Dunkel and N. Fakhri
Odd dynamics of living chiral crystals
Nature, 607: 287-293, 2022
Selected for *Nature News & Views*
- A. Mietke and J. Dunkel
Anyonic defect braiding and spontaneous chiral symmetry breaking in dihedral liquid crystals
Phys. Rev. X, 12: 011027, 2022
- N. Romeo, A. Hastewell, A. Mietke and J. Dunkel
Learning developmental mode dynamics from single-cell trajectories
eLife, 10: e68679, 2021
- D. J. Skinner and J. Dunkel
Estimating entropy production from waiting time distributions
Phys. Rev. Lett., 127: 198101, 2021
Selected as *Editors' Suggestion* and *Physics Viewpoint*
- M. James, D. A. Suchla, J. Dunkel and M. Wilczek
Emergence and melting of active vortex crystals
Nature Communications, 12: 5630, 2021
- J. Liu, J. F. Tetz, P. W. Miller, A. Hastewell, J. Dunkel and N. Fakhri
Topological braiding and virtual particles on the cell membrane
Proc. Natl. Acad. Sci. U.S.A., 118(34): e2104191118, 2021
- P. J. Saenz, G. Pucci, S. E. Turton, A. Goujon, R. R. Rosales, J. Dunkel and J. W. M. Bush
Emergent order in hydrodynamic spin lattices
Nature, 596: 58-62, 2021
- + T. Kotwal, F. Moseley, A. Stegmaier, S. Imhof, H. Brand, T. Kiessling, R. Thomale, H. Ronellenfitsch and J. Dunkel
Active topoelectrical circuits
Proc. Natl. Acad. Sci. U.S.A., 118(32): e2106411118, 2021
- V. P. Patil and J. Dunkel
Chiral edge modes in Helmholtz-Onsager vortex systems
Phys. Rev. Fluids, 6: 064702, 2021
- K. Drescher and J. Dunkel
Learning principles of bacterial biofilm dynamics from the behavior of single cells
In *Roadmap on emerging concepts in the physical biology of bacterial biofilms*
Phys. Biol., 18: 051501, 2021
- M. Denk-Lobnig, J. F. Tetz, N. C. Heer, J. Dunkel and A. C. Martin
Combinatorial patterns of graded RhoA activation and uniform F-actin depletion promote tissue curvature
Development, 148(11): dev199232, 2021

- D. J. Skinner and J. Dunkel
Improved bounds on entropy production in living systems
Proc. Natl. Acad. Sci. U.S.A., 118(18): e2024300118, 2021
- J. Imran Alsous, N. Romeo, J. Jackson, F. M. Mason, J. Dunkel and A. C. Martin
Dynamics of hydraulic and contractile wave-mediated fluid transport during *Drosophila* oogenesis
Proc. Natl. Acad. Sci. U.S.A., 118(10): e2019749118, 2021
- D. J. Skinner, B. Song, H. Jeckel, E. Jelli, K. Drescher and J. Dunkel
Topological metric detects hidden order in disordered media
Phys. Rev. Lett., 126: 0438101, 2021
Selected as *Editors' Suggestion* and *Physics Viewpoint*
- V. P. Patil, Ž. Kos, M. Ravnik and J. Dunkel
Discharging dynamics of topological batteries
Phys. Rev. Research, 2: 043196, 2020
- H. Ronellenfitsch and J. Dunkel
Spectral design of active mechanical and electrical metamaterials
Fourteenth International Congress on Artificial Materials for Novel Wave Phenomena (Metamaterials),
IEEE, 270-272, 2020
- T. H. Tan, J. Liu, P. W. Miller, M. Tekant, J. Dunkel and N. Fakhri
Topological turbulence in the membrane of a living cell
Nature Physics, 16: 657-662, 2020
Selected as *Cover Article* and *Nature Research Highlight*
- P. W. Miller and J. Dunkel
Gait-optimized locomotion of wave-driven soft sheets
Soft Matter, 16: 3991-3999, 2020
- R. Supekar, V. Heinonen, K. J. Burns and J. Dunkel
Linearly forced fluid flow on a rotating sphere
J. Fluid Mech., 892: A20, 2020
- V. P. Patil, J. D. Sandt, M. Kolle and J. Dunkel
Topological mechanics of knots and tangles
Science, 367: 71-75, 2020
- P. Pearce, B. Song, D. J. Skinner, R. Mok, R. Hartmann, P. K. Singh, J. S. Oishi,
K. Drescher and J. Dunkel
Flow-induced symmetry breaking in growing bacterial biofilms
Phys. Rev. Lett., 123: 258101, 2019
- F. Diaz-Pascual, R. Hartmann, M. Müller, L. Vidakovic, B. Song, H. Jeckel, K. M. Thormann,
F. H. Yildiz, J. Dunkel, H. Link, C. D. Nadell and K. Drescher
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Nature Microbiology, 4: 2136-2145, 2019

- P. Pearce, F. G. Woodhouse, A. Forrow, A. Kelly, H. Kusumaatmaja and J. Dunkel
Learning dynamical information from static protein and sequencing data
Nature Communications, 10: 5368, 2019
- H. Ronellenfitsch and J. Dunkel
Chiral topological phases in designed mechanical networks
Front. Phys., 7: 178, 2019
Selected as *Frontiers in Physics – 2019 Editor’s Choice*
- + H. Ronellenfitsch, N. Stoop, J. Yu, A. Forrow and J. Dunkel
Inverse design of discrete mechanical metamaterials
Phys. Rev. Materials, 3: 095201, 2019
Selected as *Editors’ Suggestion*
- H. G. Yevick, P. W. Miller, J. Dunkel and A. C. Martin
Structural redundancy in supracellular actomyosin networks enables robust tissue folding
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- V. Heinonen, K. J. Burns and J. Dunkel
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Bacterial scattering in microfluidic crystal flows reveals giant active Taylor-Aris dispersion
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Anomalous percolation flow transition of yield stress fluids in porous media
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- R. Mok, J. Dunkel and V. Kantsler
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- N. Stoop, N. Waisboard, V. Kantsler, V. Heinonen, J. S. Guasto and J. Dunkel
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- A. Forrow, F. G. Woodhouse and J. Dunkel
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- H. Ronellenfitsch, J. Dunkel and M. Wilczek
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- F. G. Woodhouse, H. Ronellenfitsch and J. Dunkel
Autonomous actuation of zero modes in mechanical networks far from equilibrium
Phys. Rev. Lett., 121: 178001, 2018
- J. Słomka, A. Townsend and J. Dunkel
Stokes' second problem and reduction of inertia in active fluids
Phys. Rev. Fluids, 3: 103304, 2018
- P. J. Sáenz, G. Pucci, A. Goujon, T. Cristea-Platon, J. Dunkel, and J. W. M. Bush
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APS/DFD Gallery of Fluid Motion Award Winner
- J. Imran Alsous, P. Villoutreix, N. Stoop, S. Y. Shvartsman, and J. Dunkel
Entropic effects in cell lineage tree packings
Nature Physics, 14: 1016–1021, 2018
Selected as *Cover Article* and *Nature Physics News & Views*
- + R. H. Heisser, V. P. Patil, N. Stoop, E. Villermaux, and J. Dunkel
Controlling fracture cascades through twisting and quenching
Proc. Natl. Acad. Sci. U.S.A., 115(35): 8665–8670, 2018

J. Dunkel
Active fluids: Rolling sound waves
Nature Materials, 17: 759–760, 2018
Invited *News & Views* article
- P. W. Miller, N. Stoop and J. Dunkel
Geometry of wave propagation on active deformable surfaces
Phys. Rev. Lett., 120: 268001, 2018
Selected as *Cover Article*
- O. Mickelin, J. Słomka, K. J. Burns, D. Lecoanet, G. M. Vasil, L. M. Faria and J. Dunkel
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F. G. Woodhouse, J. B. Fawcett and J. Dunkel
Information transmission and signal permutation in active flow networks
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- N. Stoop and J. Dunkel
Defect formation dynamics in curved elastic surface crystals
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- J. Słomka, P. Suwara and J. Dunkel
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J. Fluid Mech., 841: 701–731, 2018
- A. Forrow, F. G. Woodhouse and J. Dunkel
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- F. G. Woodhouse and J. Dunkel
Active matter logic for autonomous microfluidics
Nature Communications, 8: 15169, 2017
- J. Słomka and J. Dunkel
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- J. Słomka and J. Dunkel
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- N. C. Heer, P. W. Miller, S. Chanet, N. Stoop, J. Dunkel, and A. C. Martin
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- F. G. Woodhouse, A. Forrow, J. B. Fawcett, and J. Dunkel
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- S. Heidenreich, J. Dunkel, S. H. L. Klapp, and M. Bär
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- F. Lopez-Jimenez, N. Stoop, R. Lagrange, J. Dunkel and P. M. Reis
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- P. Hänggi, S. Hilbert, and J. Dunkel
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- K. Drescher, J. Dunkel, C. D. Nadell, S. van Teeffelen, I. Grnja, N. S. Wingreen, H. A. Stone, and B. L. Bassler. Architectural transitions in vibrio cholerae biofilms at single-cell resolution
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- A. Bukatin, I. Kukhtevich, N. Stoop, J. Dunkel and V. Kantsler
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 - N. Stoop, R. Lagrange, D. Terwagne, P. M. Reis, and J. Dunkel
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 - J. Słomka and J. Dunkel
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- S. Hilbert, P. Hänggi, and J. Dunkel
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- J. Dunkel
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Nature Physics, 10: 409–410, 2014
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- J. Dunkel and S. Hilbert
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- H. Wioland, F. G. Woodhouse, J. Dunkel, J. O. Kessler, and R. E. Goldstein
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- J. Dunkel Effiziente Monte-Carlo-Methoden für konvexe Risikomaße
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W. Ebeling, U. Erdmann, J. Dunkel, and M. Jenssen

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Invited talks (past and forthcoming):

Workshop ‘Recent challenges in the mathematical design of new materials’,
Isaac Newton Institute, Cambridge (UK), August 2025

Invited Plenary Talk, SIAM Conference on Applications of Dynamical Systems (DS 25),
Denver (USA), May 2025

APS Global Physics Summit, Focus Session ‘Machine learning for small-scale fluid flow and transport
phenomena’, Anaheim (USA), March 2025

Model inference for active matter
Colloquium, Northeastern University, Boston (USA), March 2025

Spectral representations and model inference for multi-scale biological dynamics
Physics Colloquium, UC San Diego, La Jolla (USA), March 2025

Spectral dynamics of living matter
Conference ‘The Many Faces of Active Mechanics’, KITP / UC Santa Barbara (USA), October 2024

Mechanics of knotted and chiral living matter
WPI-SKCM² Summer School & joint WPI-ICReDD Research Symposium,
Hokkaido University, Sapporo (Japan), July 2024

Quantitative Model Inference for Living Matter
Center for Studies in Physics and Biology Seminar, Rockefeller University, New York (USA), May 2024

Programmable living materials and quantitative model inference for active matter
Physics Colloquium, Ohio University, Athens (USA), April 2024

Quantitative model inference for living matter
Janelia Computation & Theory Seminar, HHMI Janelia Research Campus, Virginia (USA), April 2024

Anti-diffusive pattern formation in quantum and active fluids
Workshop ‘Mathematical and Computational Modelling of Anti-Diffusive Phenomena’,
Isaac Newton Institute, Cambridge (UK), March 2024

Quantitative model inference for living matter
Soft Matter Seminar, DAMTP, Cambridge (UK), March 2024

Topological packing statistics of living and non-living matter
Seminar GEOTOP-A, Online, March 2024

Symmetry-informed model inference for active matter
Applied Math Colloquium, University of Arizona (USA), February 2024

Topological packing statistics of living and non-living matter
School of Mathematical and Statistical Sciences, Arizona State University (USA), January 2024

Topological packing statistics of living and non-living matter
Berkeley Statistical Mechanics Meeting
UC Berkeley (USA), January 2024

Model inference for living matter: from biological data to dynamical equations
EMBO-EMBL Symposium: Theory and Concepts in Biology
Heidelberg (Germany), July 2023

Topological statistics of living and non-living matter
Workshop ‘New statistical physics in living matter: non equilibrium states under adaptive control’,
Isaac Newton Institute, Cambridge (UK), July 2023

Control of non-equilibrium pattern formation in multicellular systems
Active Matter at Surfaces and in Complex Environments
MPI for the Physics of Complex Systems, Dresden (Germany), June 2023

Active Networks
Network Science Institute, Northeastern University, Boston (USA), June 2023

Spectral representations and model inference for multicellular dynamics
Theory Lunch, Department of Systems Biology, Harvard Medical School, Boston (USA), May 2023

Programmable living materials and quantitative models of active matter
Soft Matter and Biological Physics Seminar, Syracuse University, Syracuse (USA), April 2023

Topological statistics and model inference for active matter
Guest lecture, Active Matter Graduate Course, Harvard, Cambridge (USA), April 2023

Braiding in Biological and Soft Matter
WPI Kickoff- Symposium, Hiroshima (Japan), March 2023

Symmetry-informed model inference for living matter
Symposium: Data-driven Dynamical Systems in Biology and Soft Matter
APS March Meeting, Las Vegas (USA), March 2023

Towards programmable living materials and quantitative models of active matter
CMSA Active Matter Seminar, Harvard, Cambridge (USA), February 2023

Model inference for synthetic & living active matter
Common Task Framework (CTF) for Science and Engineering, NSF AI Institute in Dynamic Systems
(Virtual, USA), February 2023

Topological mechanics of passive and active tangles
WPI Seminar, Hiroshima University, Hiroshima (Japan), January 2023

Inferring hydrodynamic models for multicellular dynamics from live-imaging data
AMS Special Session on Modeling Collective Behavior in Biology,
2023 Joint Mathematics Meeting, Boston (USA), January 2023

Symmetry-informed model inference for active matter
AMS Special Session on Dynamics of PDEs on Heterogeneous Domains: Theory & Applications,
2023 Joint Mathematics Meeting, Boston (USA), January 2023

Control of non-equilibrium pattern formation in multicellular systems
Conference on Control of Self-Organizing Nonlinear Systems, Sonderforschungsbereich 910,
Potsdam (Germany), November 2022

Towards programmable living materials and quantitative models of active matter
School of Physics Colloquium, Georgia Tech (USA), October 2022

Towards programmable living materials and quantitative models of active matter
Physics Colloquium, Brandeis University (USA), October 2022

Topological statistics and symmetry-informed model inference for active matter
Condensed Matter Seminar, University of Minnesota (USA), September 2022

Towards programmable living materials and quantitative models of active matter
Current and Future Themes in Soft and Biological Active Matter, Nordita, Stockholm (Sweden),
August 2022

Symmetry-informed model inference for active matter
Colloquium, SFB 1294 Data Assimilation, University of Potsdam (Germany), July 2022

Estimating entropy production from waiting time distributions
Symposium in remembrance of Lutz Schimansky-Geier, Humboldt University Berlin (Germany),
July 2022

Learning biophysical models from live-imaging data
Seminar Series: Current research in Bioinformatics, Biozentrum, University of Basel (Switzerland), June
2022

Symmetry-informed model inference for active matter
Data-Driven Modeling Seminar, University of Washington (USA), June 2022

Learning hydrodynamic models for multicellular dynamics from live-imaging data
Mechanics of Life, Flatiron Institute (USA), May 2022

Symmetry-informed model inference for active matter
Theory of Living Matter Group Online Seminar, University of Cambridge (UK), May 2022

Symmetry-informed model inference for active matter
Theoretical Physics Colloquium, University of Oxford (UK), January 2022

Understanding complex systems dynamics through symmetry-informed model inference
Joint Colloquium, CASUS/Helmholtz Zentrum Dresden-Rossendorf and TU Dresden (Germany)
Online, January 2022

Altruistic fluid transport during fly egg development
METANANO 2021, Online / Tbilisi (Georgia), September 2021

Altruistic fluid transport during fly egg development
SMB 2021 Mini-symposium ‘Complex Fluids and Flows in Mathematical Biology’
Online, June 2021

Physics-informed model learning for active and living matter
EMBO Conference ‘Physics of Living Systems - From Molecules to Tissues’
Online, June 2021

Spectral design of active mechanical and electrical metamaterials
SIAM MS 21 Mini-symposium ‘At the intersection of geometry, elasticity and meta-materials’
Online, May 2021

Topological statistics of bacterial swarms and biofilms
The Physics of Living Matter, PCTS Workshop, Princeton (USA), January 2021

Early-stage bacterial biofilms – experiment & modeling
IWA Biofilms 2020 Virtual Conference: Time Scaling in Biofilm Experiments Workshop, December 2020

Topological statistics and defects in biological matter
Applied Mathematics Seminar, University of Birmingham (UK), November 2020

Topological statistics and defects in biological matter
Friday Seminar, Courant Institute (USA), November 2020

Spectral design of active mechanical and electrical metamaterials
Metamaterials, CUNY (USA), Physical Review Symposium I, September 2020
Invited session presenting outstanding papers from APS journals in 2019
Article selected by APS editors : H. Ronellenfitsch *et al.*, Phys. Rev. Materials 3: 095201

Symmetry breaking and pattern formation in soft matter and active fluids
ESAM Seminar, Northwestern, Evanston (USA), January 2020

Generalized Navier-Stokes equations for active fluids: from bacterial turbulence to planetary waves
Universality: Turbulence Across Vast Scales, Flatiron Institute, New York (USA), December 2019

Symmetry breaking in active and quantum fluids
Physics Colloquium, UMBC, Maryland (USA), November 2019

Spontaneous symmetry breaking in active fluids
Fluid Physics of Life, MPI for the Physics of Complex Systems (Germany), October 2019

Understanding & controlling bacterial dynamics: from swimming and swarming to biofilm formation
University of Luxembourg (Luxembourg), October 2019

Understanding & controlling bacterial dynamics: from swimming and swarming to biofilm formation
IGM Colloquium, EPFL, Lausanne (Switzerland), October 2019

Learning dynamical information from static data
Active Matter and Artificial Intelligence, CECAM, Lausanne (Switzerland), September/October 2019

Bacterial swimming, swarming and biofilm formation
Joint CIRCS & Physics Seminar, Northeastern University, Boston (USA), September 2019

Spontaneous symmetry breaking in soft matter and active fluids
Applied Mathematics Colloquium, MIT, Cambridge (USA), September 2019

Towards the inverse design of active metamaterials

Out-of-Equilibrium Soft Matter in Complex Media, CECAM, Lausanne (Switzerland), July 2019

Symmetry breaking in active and quantum fluids

Universität Marburg (Germany), June 2019

Symmetry breaking in active and quantum fluids

Theoretical Condensed Matter Seminar, Rudolf Peierls Centre, Oxford (UK), June 2019

Wrinkles, spaghetti & knots

Workshop ‘Mathematical Design of New Materials’, Isaac Newton Institute, Cambridge (UK), June 2019

Symmetry breaking in active and quantum fluids

CMSA Fluid Dynamics Seminar, Harvard, Cambridge (USA), May 2019

Inverse design of discrete mechanical meta-materials

16th Annual Conference on Frontiers in Applied and Computational Mathematics, jointly with 11th Northeastern Complex Fluids & Soft Matter Workshop, NJIT, Newark (USA), May 2019

Towards rationally designed active metamaterials

Workshop ‘Optimal design of soft matter’, Isaac Newton Institute, Cambridge (UK), May 2019

Wrinkles, spaghetti & knots

Mechanical Engineering and Applied Mechanics Colloquium, UPenn, Philadelphia (USA), April 2019

Discrete and continuous active matter: from bacterial biofilms to autonomous materials

‘Physics of Life’ Minisymposium, TU Dresden (Germany), April 2019

Wrinkles, spaghetti & knots

Applied Mathematics Colloquium, NJIT, Newark (USA), April 2019

Spontaneous chiral symmetry breaking in active fluids

APS March Meeting, Focus Session ‘Physics and hydrodynamics of microswimmer suspensions’ Boston (USA), March 2019

Symmetry breaking and pattern formation in soft matter and active fluids

PACM Colloquium, Princeton (USA), February 2019

Wrinkles & spaghetti

Computations in Science Seminar, University of Chicago (USA), February 2019

Wrinkles & spaghetti

Physics Colloquium, Clark College (USA), January 2019

Higher-order hydrodynamics for active and quantum fluids

Condensed Matter Seminar, UMass Amherst (USA), January 2019

Higher-order hydrodynamics for active and quantum fluids

NIM Conference ‘The Future of Nanoscience’, Tutzing (Germany), September 2018

1st lecture: Hydrodynamics & control of microbial swimming
2nd lecture: Learning dynamical information from static data
Physical approaches to understanding microbial life, Gif-sur-Yvette/Paris (France), August 2018

Spontaneous chiral symmetry breaking in active fluids
Complex Fluids in Biological Systems, BIRS Banff (Canada), July 2018

Defect Formation Dynamics in Curved Elastic Surface Crystals
SIAM Annual Meeting (AN18), Minisymposium ‘Defects and Inhomogeneities in Pattern Forming Systems’, Portland, Oregon (USA), July 2018

Controlling Fracture of Thin Brittle Rods Through Twisting and Quenching
SIAM Conference on Mathematical Aspects of Materials Science (MS 18), Minisymposium ‘Thin structures: defects, pattern and bifurcations’, Portland, Oregon (USA), July 2018

Geometric control of pattern formation in soft matter and active fluids
Physik Kolloquium, Universität Leipzig (Germany), July 2018

Mathematische Modellierung komplexer Systeme
Schule-MIT-Wissenschaft, Hamburg (Germany), June 2018

Spontaneous chiral symmetry breaking in active fluids
MPIDS Colloquium, Max Planck Institute for Dynamics and Self-Organization, Göttingen (Germany), June 2018

Chiral symmetry breaking in active fluids
Topology in Complex Fluids, Lorentz Center, Leiden (Netherlands), May 2018

Spontaneous chiral symmetry breaking in active fluids
Keynote talk, Brown/Boston University Seminar in PDE & Dynamics, Providence (USA), April 2018

Spontaneous chiral symmetry breaking in active fluids
Hauptvortrag, Symposium ‘Physics of Biological and Synthetic Active Matter’, DPG Spring Meeting, Berlin (Germany), March 2018

Entropic effects in cell lineage tree packings
Mechanics in Morphogenesis, Princeton Center for Theoretical Science, Princeton (USA), February 2018

Surface pattern formation in soft bilayer materials, embryos and oocytes
Center for Computational Biology, Flatiron Institute, New York (USA), December 2017

Symmetry breaking and mode selection in soft and active matter systems
Physics Colloquium, Boston University (USA), November 2017

Geometric control of microbial fluids: From bacterial spin lattices to active matter logic
Physics Colloquium, Lehigh University (USA), November 2017

Geometric control of microbial fluids: From bacterial spin lattices to active matter logic
Greater Boston Statistical Mechanics Meeting, MIT (USA), October 2017

Geometric control of microbial fluids: From bacterial spin lattices to active matter logic
Design and Control of NanoSystems, Venice (Italy), September 2017

Geometric control of microbial fluids: from bacterial spin lattices to active matter logic
XXVI. International Materials Research Congress, Cancun (Mexico), August 2017

Geometric control of microbial fluids: from bacterial spin lattices to active matter logic
SES 2017, 54th Annual Meeting, Boston (USA), July 2017

From bacterial spin lattices to active matter logic
Plenary talk, Nonlinear Dynamics in Electronic Systems, Zernez (Switzerland), June 2017

Spontaneous mirror-symmetry breaking and inverse energy transport in 3D active fluids
Fluids and Structures: Interaction and Modeling, Naples (Italy), May 2017

Geometric control of pattern formation in elastic materials and active fluids
Quantum Science and Technology Seminar, Department of Physics, University of Massachusetts, Boston (USA), May 2017

Geometric control of pattern formation in elastic materials and active fluids
Condensed Matter and Surface Science (CMSS) Colloquium, Ohio University, Athens (USA), April 2017

Phenomenological higher-order PDE models for active suspensions
APS March Meeting, New Orleans (USA), March 2017

Geometry-dependent viscosity reduction in sheared active fluids
SIAM CSE, Atlanta (USA), February 2017

Geometric control of pattern formation in elastic materials and active fluids
Joint Colloquium, Applied Mathematics Department and Department of Applied Physical Sciences, UNC-Chapel Hill (USA), January 2017

Mathematische Modellierung weicher and biologischer Materie
Schule-MIT-Wissenschaft, Hamburg (Germany), November 2016

Active flow networks
Colloquium 'Irreversible Processes and Selforganization', Berlin Center for Studies of Complex Chemical Systems, Humboldt University, Berlin (Germany), October 2016

Geometric control of pattern formation in soft elastic materials and active fluids
Eugene Wigner Colloquium, Institute of Physics, Technical University, Berlin (Germany), October 2016

Geometric control of pattern formation in elastic materials and active fluids
Widely Applied Math Seminar, SEAS, Harvard (USA), October 2016

Pattern formation in soft and biological matter
Department of Physics, Durham University (UK), July 2016

Controlling directional fluctuations in collective bacterial swimming
ECMTB, Minisymposium on Stochasticity in Collective Behaviour of Cells, Nottingham (UK), July 2016

Controlling collective bacterial swimming

SIAM Life Sciences Conference, Minisymposium on Large-Scale Consequences of Microbial Interactions, Boston (USA), July 2016

Pattern formation in soft and biological matter

Physics Colloquium, Institute of Physics, University of Bayreuth (Germany), June 2016

Wrinkling transitions in curved soft bilayer materials

Plenary Talk, COSMINNOV, Orleans (France), May 2016

Bacterial spin lattices

Statistical Mechanics Conference, Rutgers University (USA), May 2016

Pattern formation in soft and biological matter

Lefschetz Center for Dynamical Systems Seminar, Brown University (USA), April 2016

Pattern formation in soft and biological matter

Applied & Computational Math Seminar, Department of Mathematics, UW Madison (USA), April 2016

Pattern formation in soft and biological matter

MMEC Seminar Series, Department of Mechanical Engineering, MIT (USA), March 2016

Bacterial sheets, Geometry, Elasticity, Fluctuations and Order in 2D Soft Matter KITP / UC Santa Barbara (USA), January 2016

Pattern formation in soft and biological matter

Martin Weiner Lecture Series, Department of Physics Colloquium, Brandeis University (USA), December 2015

Hydrodynamics and control of microbial swimming

Bioengineering Colloquium, Stanford University (USA), June 2015

Surface interactions and rheotaxis of swimming cells

Small meets large: connecting microfluidics with oceanography, OIST, Okinawa (Japan), May 2015

Quantifying and controlling microbial swimming

APS March Meeting, San Antonio (USA), March 2015

Hydrodynamics and control of microbial swimming

Condensed Matter & Biological Physics Seminar, Brown University (USA), October 2014

Hydrodynamics and control of microbial swimming

New England Complex Fluids Workshop, Brandeis University (USA), September 2014

Hydrodynamics and control of microbial swimming

Statistical Physics of Self-Propelled Particles: Theory and Experiment, 565th Wilhelm and Else Heraeus Seminar, Bad Honnef (Germany), June 2014

Thermodynamic laws of isolated systems

Department of Physics, Humboldt-Universität zu Berlin (Germany), June 2014

Control of microbial locomotion by boundaries and flow gradients
Mechanical Engineering Departmental Seminar, Tufts (USA), April 2014

Hydrodynamics and control of microbial swimming
SIAM & CCE Invited Faculty Seminar, MIT (USA), April 2014

Control of microbial locomotion by boundaries and flow gradients
Active Processes in Living and Nonliving Matter, KITP UC Santa Barbara (USA), February 2014

Hydrodynamics and control of microbial locomotion
Applied Mathematics Seminar, Harvard (USA), January 2014

Hydrodynamics and control of bacterial swimming
MIT Biophysics Retreat, Falmouth (USA), September 2013

Bacterial Turbulence
Workshop 'Dynamics of Suspensions, Gels, Cells and Tissues', Isaac Newton Institute, Cambridge (UK), June 2013

Inconsistent thermodynamics and negative absolute temperature
Condensed Matter Theory Seminar, Goethe University, Frankfurt (Germany), June 2013

Meso-scale turbulence and symmetry-breaking in microbial fluids
Berlin Center for Studies of Complex Chemical Systems Seminar, PTB/Max-Planck-Society, Berlin (Germany), October 2012

Microbial swimming lessons: hydrodynamics and transport in living fluids
Biophysics Seminar, UC Berkeley (USA), April 2012

Microbial swimming lessons: hydrodynamics and transport in living fluids
Applied Mathematics Seminar, Massachusetts Institute of Technology (USA), March 2012

Statistical physics and hydrodynamics of microbial fluids
DAMTP Fluid Mechanics Seminar, University of Cambridge (UK), January 2012

Brownian motion and thermodynamics in relativity
FKFI RMKI, Hungarian Academy of Sciences, Budapest (Hungary), December 2011

Hydrodynamics of bacteria and algae
OCCAM, University of Oxford (UK), December 2011

Hydrodynamics of bacteria and algae
Complexity Forum, University of Warwick (UK), November 2011

Hydrodynamics of bacteria and algae
Nanosciences: From molecular systems to functional materials, CeNS, Venice (Italy), September 2011

Hydrodynamics of bacteria and algae
Individual & collective dynamics in active suspensions, Institut Henri Poincaré, Paris (France), June 2011

Hydrodynamics of microorganisms
Soft Matter & Biophysics Seminar, Ludwig-Maximilians-Universität, München (Germany), May 2011

Hydrodynamics of microorganisms

Eugene Wigner Kolloquium, Technische Universität Berlin, Berlin (Germany), April 2011

Thermodynamics and Brownian motion in special relativity

Plenary Talk, Gustav Hertz Prize, DPG Frühjahrstagung, Dresden (Germany), March 2011

Fluid dynamics and Levy fluctuations in dilute suspensions of algae and bacteria

Condensed Matter Seminar, Max-Planck-Institut für Metallforschung (Germany), December 2010

Levy diffusion and mixing in dilute suspensions of bacteria and algae

Theoretical Physics Seminar, University of Manchester (UK), November 2010

Thermodynamics and Brownian motion in special relativity

Hauptvortrag, GR1: Moderne Aspekte der Relativitätstheorie, 74. Jahrestagung der DPG und DPG Frühjahrstagung, Bonn (Germany), March 2010

Nonlocal observables and lightcone-averaging in relativistic thermodynamics

School of Mathematical Sciences, Queen Mary, University of London (UK), December 2009

Brownsche Bewegung und Thermodynamik in der Relativitätstheorie

Augsburger Physikalisches Kolloquium, Universität Augsburg (Germany), October 2009

Nonlocal observables and lightcone-averaging in relativistic thermodynamics

22nd Marian Smoluchowski Symposium on Statistical Physics, Zakopane (Poland), September 2009

Relativistic Brownian motion and thermodynamics

SKM Prize Symposium, DPG Conference, Dresden (Germany), March 2009

Diffusion processes and thermostatics in special relativity

Plenary talk, Klausurtagung, Collaborative Research Center Sfb 484, Kloster Irsee (Germany), April 2008

Haar measures, relative entropy and relativistic canonical velocity distributions

Medyfinol '06, XV. Conference on Nonequilibrium Statistical Mechanics and Nonlinear Physics, Mar del Plata (Argentina), December 2006

States of Aggregation of Ensembles of Particles Interacting via Morse Potentials

VII. Research Workshop Nucleation Theory and Applications, Bogoliubov Laboratory of Theoretical Physics, JINR, Dubna (Russia), April 2003

Research Contracts and Grants:

MIT SHASS+Connectivity Fund

‘Mathematical Analysis of Inequality in U.S. Legislative and Lobbying Networks’

01/2025–12/2026, USD 193,529

(with In Song Kim, MIT Political Science)

MIT Schwarzman College of Computing SERC Seed Grant Award

‘The Mathematics of Law-Making in the U.S.’

08/01/2024–07/31/2026, USD 99,763

(with In Song Kim, MIT Political Science)

Schmidt Science Polymath Award

08/01/2023–07/31/2028, USD 2,500,000

NSF Award DMR-2214021

‘Collaborative Research: Foundations of programmable living materials through synthetic biofilm engineering and quantitative computational modeling’

01/15/2023–12/31/2025, USD 211,846

Alfred P. Sloan Foundation Award G-2021-16758

‘Nonequilibrium dynamics and structure of biological systems across scales’

10/01/2021–03/01/2024, USD 1,500,000

(with Jeff Gore and Nikta Fakhri, MIT Physics)

MIT John W. Jarve (1978) Seed Fund for Science Innovation

‘New quantitative approaches to determine the mechanical basis of a human birth defect’

09/01/2021–08/31/2022, USD 136,364

(with Adam Martin, MIT Biology)

NSF Award DMS-1952706

‘Collaborative Research: Optimal-Complexity Spectral Methods for Complex Fluids’

07/01/2020–06/30/2023, USD 120,000

MIT Solomon Buchsbaum Fund

‘Geometry & design of active metamaterials’

07/1/2018–06/30/2020, USD 75,000

Royal Society International Exchange Grant

‘Translating Sequencing Data Into Representative And Predictive Fitness Landscape’

03/2017–02/2019, GBP 10,000 (\$12,689.50 USD)

(with Halim Kusumaatmaja, University of Durham, UK)

James S. McDonnell Foundation Complex Systems Scholar Award

‘Evolution of topological features in complex biological systems’

10/1/2016–09/30/2020, USD 450,000

MISTI MIT-Germany Seed Fund

‘Spatial Order and Collective Cell Behavior in Bacterial Biofilms’

12/31/2015–10/31/2018, USD 25,403.87

(with Knut Drescher, MPI for Terrestrial Microbiology, Germany)

NSF Award CBET-1510768
'Transport and Chemotaxis of Swimming Cells in Porous Media Flows'
09/1/2015-08/31/2018, USD 281,377.38

Alfred P. Sloan Foundation
09/1/2015-09/14/2017, USD 50,000

MIT Solomon Buchsbaum Fund
'Pattern formation and biological fluid flow on curved surfaces'
07/1/2014-06/30/2015, USD 75,000

Contributions to the Educational Commons not listed in the Service Section above:

Presentations and exhibitions

- Guest Speaker, MIT Undergraduate Math Association, 2022
- Guest Speaker, MIT Student Colloquium for Undergraduates in Mathematics, 2016
- Mini-presentation, Meet the MIT Mathematicians, Spring 2016
- Discussion Leader, Broad – MIT Math lunch (with A. Regev, P. Rigollet, B. Cleary), June 2015
- Short talk, MIT Math Department Family Weekend, 10/24/2014
- MIT UROP EXPO (with Ruben Rosales and Anna Ferrigno), Spring 2014
- *Nature's Raincoats* exhibit (co-presenter as part Julia Yeomans' group): Summer Science Exhibition of the Royal Society 2009, London (UK), Oxford Science Festival 2010 (UK) & Techfest 2010, IIT Bombay (India)

Academic advising at MIT (course registration/approval, etc.)

- MIT freshman advisees: Emily A. Berzolla (2016–2017), Eric R. Chen (2016–2017), Yehoon Chris Lee (2016–2017), Sebastien X. Wah (2016–2017), Gopal M. Goel (2021–2022), Thomas Guo (2021–2022), Daniel X. Hong (2021–2022), Sean J. Li (2021–2022), Andrei T. Marginean (2021–2022)
- MIT undergraduate advisees: Neil Gurram (2014), Qinru Shi (2014), Ka Yu Tam (2014), David C. Barnes (2014–2018), Suyaesh P. Fulay (2014), Wickham R. Egan (2014–2015), Andrew Xia (2014–2017), Dong-Gil Shin (2014–2015), Vipul T. Vachharajani (2014–2016), Xavier K. Mwangi (2015–2016), Kelly N. Petersen (2015–2016), Cali H. Gallardo (2015–2018), Dimitrios Konstantellos (2016–2019), Marcus Powell (2016–2018), Ulyana Pitarberg (2018–2021), Joseph M. Mastrandrea (2018–2021), Anna R. Osofsky (2018–2021), Du'aa H. Sharif (2018–2019), Julia Yu (2018–2021), Kate E. Yuan (2018–2020), Agustin E. Garcia (2018–2021), Jack-William Barotta (2018–2021), Maritza Gallegos (2019–2023), Zion Hadley (2019–2022), Kenneth L. Cox (2019–2022), Edwin C. Song (2020–2022), Nicholas S. Baginski (2021–2022), Kevin J. Liu (2021–2022), Ritaank Tiwari (2021–2022), Kevin Z. Shao (2021–2023), Veronica Khim (2021–), Maxwell S. Turner (2021–), Alexis V. Zitzmann (2021–), Anna Mikulevica (2022–), Julianne E. Flusche (2022–), Gregory Pypovych (2022–), Natnael A. Asegdew (2022–), Isabella L. Quan (2023–), Christine S. Huang (2023–), Maanasi A. Limaye (2023–), Yaman B. Otuzbir (2023–), Joshua R. Guo (2023–)
- MIT graduate advisees: Jonasz Slomka (2013–2018), Sam Hopkins (2013–2015), Rachel Mok (2014–2019), Aden Forrow (2014–2018), Jacob M. Gold (2015–2021), Vishal P. Patil (2016–2021), Boya Song (2017–2021), Dominic J. Skinner (2017–2022), Alasdair Hastewell (2018–), George Stepaniants (2019–2020), Nicolas Romeo (2019–), Alexander E. Cohen (2020–), Daniel Lazarev (2021–2023), Shijie Zhang (2022–), Andrey Bryutkin (2023–), Harry James Walden (2023–)