

Jörn Dunkel

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Employment:

Full professor, Applied Mathematics, MIT, from 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:

Robert E. Collins Distinguished Scholar, MIT Mathematics Department, since 07/2020
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 Students Supervised:

Brattley, Allison (SB Physics major, Class '24). Summer 2022–
Ji, Catherine (SB Math major, Class '23). Fall 2019–Fall 2021
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: Research Software Engineer, Harvard 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 at 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:

Reyes, Jorge.

In progress, MIT Computational & Systems Biology, since 2022

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

Stepaniants, George (jointly with Philippe Rigollet).

In progress, MIT Math, since 2021

George was awarded an NSF Graduate Research Fellowship.

Cohen, Alexander (jointly with Martin Bazant).

In progress, MIT ChemE, since 2021

Alex was awarded an NDSEG Fellowship, 2022-2025.

Hastewell, Alasdair.

In progress, MIT Math, since 2019

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

Romeo, Nicolas.

In progress, MIT Physics, since 2019

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.

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

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

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

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:

Choi, Gary.

NSF Fellow & Instructor, MIT Math, 2020–present

Kodio, Ousmane.

Instructor, MIT Math, 2019–present

Burns, Keaton.

Instructor, MIT Math, 2019–present

Totz, Jan.

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

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

Mietke, Alexander.

Postdoc, MIT Math, 2019–present

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

Next position: Lecturer, University of Bristol (starting 09/2022)

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: Lecturer, 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)

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:

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), June-August 2022

Member, MIT Summer Research Program (MSRP) Application Review Committee (ARC), 2022

MIT Freshman Advisor, 2021-22

PhD Committee (with Adam Martin, Daniel Needleman, Ethan Garner): Jonathan Jackson, MIT Biology/Harvard, 2021-present

PhD Committee (with Ming Guo, Roger Kamm): Wenhui Tang, MIT MechE, 2021-present

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, 2019-21

PhD Committee (with James Swan, Alfredo Alexander-Katz): Andrew Fiore, MIT ChemE, 2016-19

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

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:

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): Connor Robertson, NJIT, 2021 –

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 Math Bio CAREER 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

- 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
Submitted
 - D. J. Skinner, H. Jeckel, A. C. Martin, K. Drescher and J. Dunkel
Topological packing statistics distinguish living and non-living matter
Submitted
 - A. E. Cohen, A. D. Hastewell, S. Pradhan, S. W. Flavell and J. Dunkel
Schrödinger dynamics of undulatory locomotion
arXiv:2205.10725, submitted
 - V. Heinonen, A. J. Abraham, J. Słomka, K. J. Burns, P. J. Saenz and J. Dunkel
Emergent universal statistics in nonequilibrium systems with dynamical scale selection
Submitted, 2022
 - A. D. Hastewell and J. Dunkel
Forecasting non-equilibrium dynamics using linear orthogonal basis decompositions
Submitted, 2022
 - V. P. Patil, Ž. Kos and J. Dunkel
Harmonic flow field representations of quantum bits and gates
arXiv:2202.03941, submitted
 - R. Supekar, B. Song, A. D. Hastewell, A. Mietke and J. Dunkel
Learning hydrodynamic equations for active matter from particle simulations and experiments
arXiv:2101.06568, submitted
 - H. Jeckel, F. Diaz-Pascual, D. J. Skinner, B. Song, E. Jimenez Sibert, E. Jelli, S. Vaidya,
J. Dunkel and K. Drescher
Multispecies phase diagram reveals biophysical principles of bacterial biofilm architectures
bioRxiv:10.1101/2021.08.06.455416
- K. Drescher, P. Pearce and J. Dunkel
Multiscale physics of bacterial biofilms
Nature Reviews Physics, invited review article

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

Publications:

- 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. Higinbothom, 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. Tonz, 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. Totz, 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
Breakdown of biofilm architecture in response to antibiotics facilitates community invasion
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
Dev. Cell, 50: 568-598, 2019
Selected for *Developmental Cell Preview*
- V. Heinonen, K. J. Burns and J. Dunkel
Quantum hydrodynamics for supersolid crystals and quasicrystals
Phys. Rev. A, 99: 063621, 2019

A. Dehkharghani, N. Waisbord, J. Dunkel and J. S. Guasto
Bacterial scattering in microfluidic crystal flows reveals giant active Taylor-Aris dispersion
Proc. Natl. Acad. Sci. U.S.A., 116(23): 11119-11124, 2019
- N. Waisbord, N. Stoop, J. Dunkel and J. S. Guasto
Anomalous percolation flow transition of yield stress fluids in porous media
Phys. Rev. Fluids, 4: 063303, 2019
- R. Mok, J. Dunkel and V. Kantsler
Geometric control of bacterial surface accumulation
Phys. Rev. E, 99: 052607, 2019
- R. Hartmann, P. K. Singh, P. Pearce, R. Mok, B. Song, F. Diaz-Pascual, J. Dunkel and K. Drescher
Emergence of three-dimensional order and structure in growing biofilms
Nature Physics, 15: 251-256, 2019
Selected for *Nature Physics News & Views*

- N. Stoop, N. Waisboard, V. Kantsler, V. Heinonen, J. S. Guasto and J. Dunkel
Disorder-induced topological transition in porous media flow networks
J. Non-Newton. Fluid Mech., 268: 66-74, 2019
- H. Jeckel, E. Jelli, R. Hartmann, P. K. Singh, R. Mok, J. F. Tetz, L. Vidakovic, B. Eckhardt, J. Dunkel and K. Drescher
Learning the space-time phase diagram of bacterial swarm expansion
Proc. Natl. Acad. Sci. U.S.A., 116(5): 1489-1494, 2019
- A. Forrow, F. G. Woodhouse and J. Dunkel
Functional control of network dynamics using designed Laplacian spectra
Phys. Rev. X, 8: 041043, 2018
- H. Ronellenfitsch, J. Dunkel and M. Wilczek
Optimal noise-canceling networks
Phys. Rev. Lett., 121: 208301, 2018
Selected as *Physics Focus*
- 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
Spin lattices of walking droplets
Phys. Rev. Fluids, 3: 100508, 2018
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
Anomalous chained turbulence in actively driven flows on spheres
Phys. Rev. Lett., 120: 164503, 2018
- F. G. Woodhouse, J. B. Fawcett and J. Dunkel
Information transmission and signal permutation in active flow networks
New J. Phys., 20: 035003, 2018
- N. Stoop and J. Dunkel
Defect formation dynamics in curved elastic surface crystals
Soft Matter, 14: 2329–2338, 2018
- J. Słomka, P. Suwara and J. Dunkel
The nature of triad interactions in active turbulence
J. Fluid Mech., 841: 701–731, 2018
- A. Forrow, F. G. Woodhouse and J. Dunkel
Mode selection in compressible active flow networks
Phys. Rev. Lett., 119: 028102, 2017
- F. G. Woodhouse and J. Dunkel
Active matter logic for autonomous microfluidics
Nature Communications, 8: 15169, 2017
- J. Słomka and J. Dunkel
Geometry-dependent viscosity reduction in sheared active fluids
Phys. Rev. Fluids, 2: 043102, 2017
- J. Słomka and J. Dunkel
Spontaneous mirror-symmetry breaking induces inverse energy cascade in 3d active fluids
Proc. Natl. Acad. Sci. U.S.A., 114(9): 2119–2124, 2017
- N. C. Heer, P. W. Miller, S. Chanet, N. Stoop, J. Dunkel, and A. C. Martin
Actomyosin-based tissue folding requires a multicellular myosin gradient
Development, 144: 1876–1886, 2017
- F. G. Woodhouse, A. Forrow, J. B. Fawcett, and J. Dunkel
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Antipolar ordering of topological defects in active liquid crystals
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- S. Heidenreich, J. Dunkel, S. H. L. Klapp, and M. Bär
Hydrodynamic length-scale selection in microswimmer suspensions
Phys. Rev. E, 94: 020601(R), 2016

- F. Lopez-Jimenez, N. Stoop, R. Lagrange, J. Dunkel and P. M. Reis
Curvature-controlled defect localization in elastic surface crystals
Phys. Rev. Lett. 116: 104301, 2016
Selected as *Cover Article*

- P. Hänggi, S. Hilbert, and J. Dunkel
Meaning of temperature in different thermostistical ensembles
Phil. Trans. R. Soc. A, 374(2064), 2016

- 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
Bimodal rheotactic behavior reflects flagellar beat asymmetry in human sperm cells
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- N. Stoop, R. Lagrange, D. Terwagne, P. M. Reis, and J. Dunkel
Curvature-induced symmetry breaking determines elastic surface patterns
Nature Materials, 14: 337–342, 2015
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- J. Słomka and J. Dunkel
Generalized Navier-Stokes equations for active suspensions
EPJ-ST, 224: 1349–1358, 2015

- P. Khuc Trong, H. Doerflinger, J. Dunkel, D. St. Johnston, and R. E. Goldstein. Cortical microtubule nucleation can organise the cytoskeleton of drosophila oocytes to define the anteroposterior axis
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- H. H. Wensink, V. Kantsler, R. E. Goldstein, and J. Dunkel
Controlling active self-assembly through broken particle-shape symmetry
Phys. Rev. E, 89: 010302(R), 2014

- V. Kantsler, J. Dunkel, M. Blayney, and R. E. Goldstein
Rheotaxis facilitates upstream navigation of mammalian sperm cells
eLife, 3: 02403, 2014

- S. Hilbert, P. Hänggi, and J. Dunkel
Thermodynamic laws in isolated systems
Phys. Rev. E, 90: 062116, 2014

- J. Dunkel
Thermodynamics: Engines and demons
Nature Physics, 10: 409–410, 2014
Invited *News & Views* article

- J. Dunkel and S. Hilbert
 Consistent thermostatistics forbids negative absolute temperatures
Nature Physics, 10: 67–72, 2014
 Selected for *Nature Physics News & Views*
- H. Wioland, F. G. Woodhouse, J. Dunkel, J. O. Kessler, and R. E. Goldstein
 Confinement stabilizes a bacterial suspension into a spiral vortex
Phys. Rev. Lett., 110: 268102, 2013
- V. Kantsler, J. Dunkel, M. Polin, and R. E. Goldstein
 Ciliary contact interactions dominate surface scattering of swimming eukaryotes
Proc. Natl. Acad. Sci. U.S.A., 110(4): 1187–1192, 2013
- J. Dunkel, S. Heidenreich, K. Drescher, H. H. Wensink, M. Bär, and R. E. Goldstein
 Fluid dynamics of bacterial turbulence
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- J. Dunkel and S. Weber
 Reliable quantification and efficient estimation of credit risk
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- J. Dunkel, S. Heidenreich, M. Bär, and R. E. Goldstein
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- I. M. Zaid, J. Dunkel, and J. M. Yeomans
 Lévy fluctuations and mixing in dilute suspensions of algae and bacteria
J. R. Soc. Interface, 8: 1314–1331, 2011
- S. Quinodoz, M. Thomas, J. Dunkel, and E. M. Schötz
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J. Stat. Phys., 142(6): 1324–1336, 2011
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- V. B. Putz, J. Dunkel, and J. M. Yeomans
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- V. B. Putz and J. Dunkel
 Low Reynolds number hydrodynamics of asymmetric, oscillating dumbbell pairs
EPJ-ST, 187: 135–144, 2010
- J. Dunkel and S. Weber
 Stochastic root finding and efficient estimation of convex risk measures
Operations Research, 58(5): 1505–1521, 2010
- J. Dunkel, V. B. Putz, I. M. Zaid, and J. M. Yeomans
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Soft Matter, 6: 4268–4276, 2010
- J. Dunkel and I. M. Zaid
 Noisy swimming at low Reynolds numbers
Phys. Rev. E, 80(2): 021903, 2009
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 Time parameters and Lorentz transformations of relativistic stochastic processes
Phys. Rev. E, 79: 010101(R), 2009
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 Nonlocal observables and lightcone averaging in relativistic thermodynamics
Nature Physics, 5: 741–747, 2009
 Selected for *Nature Physics News & Views*
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 Relativistic Brownian motion
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- D. Cubero and J. Dunkel
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- J. Dunkel
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 Ph.D. thesis, Universität Augsburg, July 2008
- J. Dunkel and S. Weber
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- J. Dunkel, P. Talkner, and P. Hänggi
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Physica A, 374(2): 559–572, 2007
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Phys. Rev. Lett., 99: 170601, 2007
- S. Hilbert and J. Dunkel
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Langevin-Gleichungen mit nichtlinearer Reibung
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Irreversible Prozesse und Selbstorganisation, pages 11–21. Logos-Verlag, Berlin, 2006
- J. Dunkel and S. Hilbert
Phase transitions in small systems: Microcanonical vs. canonical ensembles
Physica A, 370(2): 390–406, 2006
- J. Dunkel and P. Hänggi
Relativistic Brownian motion: From a microscopic binary collision model to the Langevin equation
Phys. Rev. E, 74: 051106, 2006
Erratum, *Phys. Rev. E* 74: 069902(E), 2006
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Phys. Rev. A, 71: 052102, 2005
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Phys. Rev. E, 72: 036106, 2005

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Theory of the relativistic Brownian motion: The (1+1)-dimensional case
Phys. Rev. E, 71: 016124, 2005
- J. Dunkel Effiziente Monte-Carlo-Methoden für konvexe Risikomaße
In D. Zietsch, editor, *Deutscher SCOR-Preis für Aktuarwissenschaften 2005: Zusammenfassung eingereicherter Arbeiten*, volume 4 of *Schriftenreihe der SCOR Deutschland Rückversicherungs-AG*, pp. 41–48
Verlag Versicherungswirtschaft, Karlsruhe, 2005
- J. Dunkel
Effiziente Monte-Carlo-Methoden für konvexe Risikomaße
Diploma thesis, Institut für Mathematik, Humboldt-Universität zu Berlin, April 2005
- J. Dunkel, L. Schimansky-Geier, S. Hilbert, and P. Hänggi
Stochastic resonance in biological nonlinear evolution models
Phys. Rev. E, 69: 056118, 2004
- J. Dunkel, L. Schimansky-Geier, and W. Ebeling
Exact solutions for evolutionary strategies on harmonic landscapes
Evol. Comput., 12(1): 1–17, 2004.
- J. Dunkel, W. Ebeling, and S. Trigger
Active and passive Brownian motion of charged grains in dusty plasma models
Phys. Rev. E, 70: 046406, 2004
- J. Dunkel
On the Relationship between Modified Newtonian Dynamics and Dark Matter
Astrophys. J. Lett., 604(1): L37–L40, 2004
- J. Dunkel
Evolutionsmodelle mit nichtlokaler Selektion: Kramers-Problem und Stochastische Resonanz im eindimensionalen Fisher-Eigen-Modell
Diploma thesis, Institut für Physik, Humboldt-Universität zu Berlin, April 2004
- J. Dunkel, L. Schimansky-Geier, W. Ebeling, and P. Hänggi
Kramers problem in evolutionary strategies
Phys. Rev. E, 67: 061118, 2003
- J. Dunkel, W. Ebeling, J. W. P. Schmelzer, and G. Röpke
A dissipative one-dimensional collision model with intermediate energy storage
Physica D, 185(3-4): 158–174, 2003
- A. Chetverikov and J. Dunkel
Phase behavior and collective excitations of the Morse ring chain
Eur. Phys. J. B, 35(2): 239–253, 2003
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Dissipative collisions of one-dimensional Morse-clusters with intermediate energy storage
In J. W. P. Schmelzer, G. Röpke, and V. B. Priezzhev, editors, *Nucleation Theory and Applications*, pages 367–394. JINR Publishing House Dubna, 2002

J. Dunkel, W. Ebeling, U. Erdmann, and V. A. Makarov
Coherent motions and clusters in a dissipative Morse ring chain
Int. J. Bif. & Chaos, 12(11): 2359–2377, 2002

J. Dunkel, W. Ebeling, and U. Erdmann
Thermodynamics and transport in active Morse chains
Eur. Phys. J. B, 24(4): 511–524, 2001

U. Erdmann, J. Dunkel, and W. Ebeling
Nonlinear waves and moving clusters on rings

In D. Helbing, H. J. Herrmann, M. Schreckenberg, and D. E. Wolf, editors, *Traffic and Granular Flow '99: Social, Traffic and Granular Dynamics*, pages 239–244, Springer Heidelberg/Berlin, 2000

W. Ebeling, U. Erdmann, J. Dunkel, and M. Jenssen
Nonlinear dynamics and fluctuations of dissipative Toda chains
J. Stat. Phys., 101(1/2): 443–457, October 2000

Invited talks (past and forthcoming):

Active Matter at Surfaces and in Complex Environments
MPI for the Physics of Complex Systems, Dresden (Germany), June 2023

Georgia Tech (USA), October 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

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

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
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
KFKI 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:

Alfred P. Sloan Foundation Award G-2021-16758

‘Nonequilibrium dynamics and structure of biological systems across scales’

10/01/2021–09/30/2024, 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 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), Abhinav 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 (2019–2021), Zion Hadley (2019–), Kenneth L. Cox (2019–), Edwin C. Song (2020–), Nicholas S. Baginski (2021–), Veronica Khim (2021–), Kevin J. Liu (2021–), Kevin Z. Shao (2021–), Maxwell S. Turner (2021–), Alexis V. Zitzmann (2021–), Ritaank Tiwari (2021–)
- 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–), Alasdair Hastewell (2018–), George Stepaniants (2019–2020), Nicolas Romeo (2019–), Alexander E. Cohen (2020–), Daniel Lazarev (2021–)