Jörn Dunkel

Curriculum Vitae

Department of Mathematics
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Cambridge, MA 02139

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Married, 2 children

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

Employment:

Assistant professor, Physical Applied Mathematics, MIT, 09/2013–present
Postdoctoral research associate, DAMTP, University of Cambridge, 09/2010-08/2013
Postdoctoral research assistant, Rudolf Peierls Centre, University of Oxford, 09/2008-08/2010

Honors:

Gallery of Fluid Motion Award[1], APS/DFD, 2017
Outstanding Referee, American Physical Society, 2017
Complex Systems Scholar Award, James S. McDonnell Foundation, 2016–2022
Edmund F. Kelly Research Award, MIT Mathematics Department, 2015-2018
Research Fellow, Alfred P. Sloan Foundation, 2015–2017
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 Prize, 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

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

UROP Students Supervised:

Hastewell, Alasdair (Physics major, Class '18). Fall 2016–present.

Heisser, Ronald H. (B.S. MechE '16). Fall 2015–Spring 2016.
Current position: School of Mechanical and Aerospace Engineering, Cornell University

Runnels, Wesley (Math major, Class '18). Fall 2015.

Kavle, Henry (B.S. Math '17). Summer 2015.
Current position: Counselor, Epsilon Camp

Shin, Dong-Gil (Math major, Class '18). Fall 2014–Spring 2015

Vachharajani, Vipul (B.S. Math & BE '16). Fall 2014–Spring 2015.
Current position: MD/PhD student at Stanford Medical School

B.S. Students Thesis Supervised:

Hastewell, Alasdair. MIT Physics, Fall 2017- present

Heisser, Ronald. *Design, Development, and Characterization of an Experimental Device to Test Torsion-Controlled Fracture of Thin Brittle Rods*, MIT MechE, 2016.
Current position: School of Mechanical and Aerospace Engineering, Cornell University

Ph.D. Students Thesis Supervised:

Słomka, Jonasz. *Active turbulence*, MIT Math, in progress, will graduate in 2018

Forrow, Aden. *Active networks*, MIT Math, in progress, will graduate in 2018

Patil, Vishal. *Knotted structures in complex fluids*, MIT Math, in progress

Miller, Pearson. *Tissue folding*, MIT Physics, in progress

Mok, Rachel. *Bacterial biofilms*, MIT MechE, in progress

Postdoctoral Researchers/Instructors Supervised:

Heinonen, Vili. Postdoc, MIT Math, 2017–present

Pearce, Philip. Instructor, MIT Math, 2016–present

Ronellenfitsch, Henrik. Instructor, MIT Math, 2017–present

Stoop, Norbert. Postdoc/Swiss National Foundation Fellow, MIT Math 2013-2014
Instructor, MIT Math, 2014-2017
Postdoc, MIT Math, 2017-

Teaching Experience:

Courses at MIT:

18.03 Differential equations (Fall 2015, Fall 2016)

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

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

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:

18.032x Reviewer 2017

MIT International Science and Technology Initiatives (MISTI) Faculty Committee, 2015 & 2017

Thesis Committee (with Bonnie Berger, Peter Shor): Yun William Yu, MIT Math, 2017

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

18.095 IAP Mathematics Lecture Series, Spring 2014, Spring 2015, Spring 2016 & Spring 2017

Math Language Examiner (German), Spring 2014 & Spring 2017

MISTI Selection Committee, 2016

Organizer, MIT Biophysics Retreat, North Falmouth, Sep 13-14 (90+ participants), Fall 2015

PRIMES & RSI project advisor, 2015-present

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

Co-Organizer, MIT Physical Mathematics Seminar (with John Bush and Ruben Rosales), 2013–present

External:

Reviewer, Junior Research Fellowship Competition, Trinity College (Cambridge University), 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), 2015-2017

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 30+ journals (incl. Nature, Nature Physics, Nature Communications, PNAS, PRL, Review of Modern Physics, PRX, Cell Systems, Langmuir, Soft Matter, Phys. Fluids), since 2005

Publications:[2]

* 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. USA*, 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. Stochastic cycle selection in active flow networks. *Proc. Natl. Acad. Sci. USA*, 113(29):8200–8205, 2016.

H. Wioland, F. G. Woodhouse, J. Dunkel, and R. E. Goldstein. Ferromagnetic and antiferromagnetic order in bacterial vortex lattices. *Nature Physics*, 12(4):341–345, 2016.

A. U. Oza and J. Dunkel. Antipolar ordering of topological defects in active liquid crystals. *New J. Phys.*, 18:093006, 2016.

[2]Asterisks indicate papers arising from a supervised PhD thesis

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.

P. Hänggi, S. Hilbert, and J. Dunkel. Meaning of temperature in different thermostatistical 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. *Proc. Natl. Acad. Sci. USA*, 113(14):E2066–E2072, 2016.

A. Bukatin, I. Kukhtevich, N. Stoop, J. Dunkel and V. Kantsler. Bimodal rheotactic behavior reflects flagellar beat asymmetry in human sperm cells. *Proc. Natl. Acad. Sci. USA*, 1112(52): 15904–15909, 2015.

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.

* 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. *eLife*, 4:e06088, 2015.

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 and S. Hilbert. Consistent thermostatistics forbids negative absolute temperatures. *Nature Physics*, 10:67–72, 2014.

J. Dunkel. Thermodynamics: Engines and demons. *Nature Physics*, 10:409–410, 2014.

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. USA*, 110(4):1187–1192, 2013.

J. Dunkel and S. Weber. Reliable quantification and efficient estimation of credit risk. In *Risk Measures and Attitudes*, EAA Lecture Notes, pages 35–43. Springer-Verlag London, 2013.

J. Dunkel, S. Heidenreich, K. Drescher, H. H. Wensink, M. Bär, and R. E. Goldstein. Fluid dynamics of bacterial turbulence. *Phys. Rev. Lett.*, 110:228102, 2013.

J. Dunkel, S. Heidenreich, M Bär, and R. E. Goldstein. Minimal continuum theories of structure formation in dense active fluids. *New J. Phys.*, 15:045016, 2013.

H. H. Wensink, J. Dunkel, S. Heidenreich, K. Drescher, R. E. Goldstein, H. Löwen, and J. M. Yeomans. Meso-scale turbulence in living fluids. *Proc. Natl. Acad. Sci. USA*, 109(36):14308–14313, 2012.

J. Dunkel and S. Weber. Improving risk assessment for biodiversity conservation. *Proc. Natl. Acad. Sci. USA*, 109(35):E2304, 2012.

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. The more the merrier? - Entropy and statistics of asexual reproduction in freshwater planarians. *J. Stat. Phys.*, 142(6):1324–1336, 2011.

J. Dunkel, J. Talbot, and E. M. Schötz. Memory and obesity affect the population dynamics of asexual freshwater planarians. *Physical Biology*, 8:026003, 2011.

K. Drescher, J. Dunkel, L. H. Cisneros, S. Ganguly, and R. E. Goldstein. Fluid dynamics and noise in bacterial cell-cell and cell-surface scattering. *Proc. Natl. Acad. Sci. USA*, 109(27):10940–10945, 2011.

V. B. Putz, J. Dunkel, and J. M. Yeomans. CUDA simulations of active dumbbell suspensions. *Chem. Phys.*, 375(2-3):557–567, 2010.

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. Swimmer-tracer scattering at low reynolds number. *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.

J. Dunkel, P. Hänggi, and S. Weber. Time parameters and Lorentz transformations of relativistic stochastic processes. *Phys. Rev. E*, 79:010101(R), 2009.

J. Dunkel, P. Hänggi, and S. Hilbert. Nonlocal observables and lightcone averaging in relativistic thermodynamics. *Nature Physics*, 5:741–747, 2009.

J. Dunkel and P. Hänggi. Relativistic Brownian motion. *Physics Reports*, 471(1):1–73, 2009.

D. Cubero and J. Dunkel. Stationarity, soft ergodicity, and entropy in relativistic systems. *EPL*, 87(3):30005, 2009.

J. Dunkel. *Relativistic Brownian Motion and Diffusion Processes*. Ph.D. thesis, Universität Augsburg, July 2008.

J. Dunkel and S. Weber. Efficient Monte Carlo Methods for Convex Risk Measures in Portfolio Credit Risk Models. In *Proceedings of the 2007 Winter Simulation Conference*, Washington, D.C., 2007. IEEE (Piscataway, NJ).

J. Dunkel, P. Talkner, and P. Hänggi. Relativistic diffusion processes and random walk models. *Phys. Rev. D*, 75:043001, 2007.

J. Dunkel, P. Talkner, and P. Hänggi. Relative entropy, Haar measures and relativistic canonical velocity distributions. *New J. Phys.*, 9:144, 2007.

J. Dunkel and P. Hänggi. One-dimensional nonrelativistic and relativistic Brownian motions: A microscopic collision model. *Physica A*, 374(2):559–572, 2007.

D. Cubero, J. Casado-Pascual, J. Dunkel, P. Talkner, and P. Hänggi. Thermal equilibrium and statistical thermometers in special relativity. *Phys. Rev. Lett.*, 99:170601, 2007.

S. Hilbert and J. Dunkel. Nonanalytic microscopic phase transitions and temperature oscillations in the microcanonical ensemble: An exactly solvable $1d$-model for evaporation. *Phys. Rev. E*, 74:011120, 2006.

J. Dunkel, S. Hilbert, and P. Hänggi. Langevin-Gleichungen mit nichtlinearer Reibung. In T. Pöschel, H. Malchow, and L. Schimansky-Geier, editors, *Irreversible Prozesse und Selbstorganisation*, pages 11–21. Logos-Verlag, Berlin, 2006. ISBN 3-8325-1350-7.

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.

J. Dunkel, J. Chluba, and R. A. Sunyaev. Accretion of helium and metal-rich gas onto neutron stars and black holes at high luminosities. *Astron. Lett.*, 32(4):257 – 262, 2006. Russian translation in *Pis'ma v Astronomicheskii Zhurnal*, 32(4):288-294, 2006.

W. Ebeling, J. Dunkel, U. Erdmann, and S. A. Trigger. Klimontovich's contributions to the kinetic theory of nonlinear Brownian motion and new developments. *J. Phys.: Conf. Ser.*, 11:89–98, 2005.

J. Dunkel and S. Trigger. Time-dependent entropy of simple quantum model systems. *Phys. Rev. A*, 71:052102, 2005.

J. Dunkel and P. Hänggi. Theory of the relativistic Brownian motion: The (1+3)-dimensional case. *Phys. Rev. E*, 72:036106, 2005.

J. Dunkel and P. Hänggi. 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 eingereichter Arbeiten*, volume 4 of *Schriftenreihe der SCOR Deutschland Rückversicherungs-AG*, pages 41–48. Verlag Versicherungswirtschaft, Karlsruhe, 2005. ISBN 3-89952-232-X.

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.

J. Dunkel, W. Ebeling, J. W. P. Schmelzer, and G. Röpke. 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. ISBN 5-9530-0005-7.

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, Heidelberg/Berlin, 2000. Springer. ISBN 3540670912.

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):

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

Complex Fluids in Biological Systems, BIRS Banff (Canada), July 2018

SIAM Annual Meeting 2018, Minisymposium 'Defects and Inhomogeneities in Pattern Forming Systems', Portland, Oregon (USA), July 2018

Schule-MIT-Wissenschaft, Hamburg (Germany), June 2018

Max Planck Institute for Dynamics and Self-Organization, Göttingen (Germany), June 2018

Topology in Complex Fluids, Lorentz Center, Leiden (Netherlands), May 2018

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

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 Poncairé, 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 (Gemany), March 2009

Diffusion processes and thermostatistics 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:

Royal Society International Exchange Grant
'Translating Sequencing Data Into Representative And Predictive Fitness Landscape'
03/2017–02/2019, GBP 10k (with Halim Kusumaatmaja, University of Durham, UK)

James S. McDonnell Foundation Complex Systems Scholar Award
'Evolution of topological features in complex biological systems'
10/2016–09/2020, USD 450k

MISTI MIT-Germany Seed Fund
'Spatial Order and Collective Cell Behavior in Bacterial Biofilms'
12/2015–08/2017, USD 26k (with Knut Drescher, MPI for Terrestrial Microbiology, Germany)

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

Alfred P. Sloan Foundation
09/2015-08/2017, USD 50k

MIT Solomon Buchsbaum Fund Award
'Pattern formation and biological fluid flow on curved surfaces'
07/2014–06/2015, USD 75k

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)

Summer program mentoring

- Faculty Mentor for Meena Jagadeesan, RSI Summer Student 2015 (Graduate Mentor: A. Rzeznik), Semifinalist at the 2015 Siemens Competition
- Faculty Mentor for Grace Lim, MSRP Summer Student 2014 (Graduate Mentor: A. Forrow), Cal Poly Pomona President's Special Travel Award to present project at SIAM CSE15

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)
- MIT undergraduate advisees: Neil Gurram (2014), Qinru Shi (2014), Ka Yu Tam (2014), David C. Barnes (2014–), 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–), Dimitrios Konstantellos (2016–), Marcus Powell (2016–)
- MIT graduate advisees: Jonasz Slomka (2013–), Sam Hopkins (2013–2015), Rachel Mok (2014–), Aden Forrow (2014–), Jacob M. Gold (2015–)