

PANKAJ MEHTA

590 Commonwealth Ave
Boston, MA 02215
United States

Phone: +1 617 358 6303
email: pankajm@bu.edu
<http://physics.bu.edu/~pankajm>

Professional Employment

- 2015- *Associate Professor*, Dept. of Physics, Boston University
- 2015- *Associate Professor*, Dept. of Bioengineering, Boston University
- 2015- *Member*, BU Biological Design Center, Boston University
- 2011- *Member*, Graduate Program in Bioinformatics, Boston University
- 2013- *Member*, Center for Regenerative Medicine, Boston University Medical Center
- 2010-2015 *Assistant Professor*, Dept. of Physics, Boston University

Education

- 2006-2010 *Postdoctoral Scholar*, Molecular Biology and Physics, Princeton University (Mentor: Ned Wingreen)
- 2006 *Ph.D.* in Physics, Condensed Matter Theory, Rutgers University (Mentor: Natan Andrei)
- 2000 *B.S.* in Mathematics (with honors), California Institute of Technology

Honors & Awards

- 2016 NIH R35 MIRA Outstanding Investigator Award (NIGMS)
- 2014 Simons Investigator in the Mathematical Modeling of Living Systems
- 2014 Scialog Fellow, Molecules Come to Life
- 2014 Gerald and Deanne Gitner Family Innovation in Teaching with Technology Award
- 2013 Hariri Institute for Computing Junior Faculty Fellow
- 2011 Sloan Research Fellowship (in Physics)
- 2008 NIH K25 Quantitative Research Career Development Award

Grants

- 2016-2021 NIH R35 MIRA Outstanding Investigator Award: Modeling emergent behaviors in systems biology: a biophysical approach (Total Cost: \$1,581,850)
- 2016-2018 Scialog Grant from Simons Foundation and Research Corporation: Deriving new ecological principles for the microbial world (Total Cost: \$75,000)

- 2015-2016 Scialog Grant from Research Corporation and Moore Foundation: Rethinking the idea of cell type (Total Cost: \$50,000)
- 2014-2019 Simons Investigator in the Mathematical Modeling of Living Systems (Total Cost: \$600,000)
- 2011-2015 Sloan Research Fellowship (Total Cost: \$50,000)
- 2008-2013 NIH K25 Award: A Quantitative Study of Cell-to-Cell Communication in Bacteria (Total Cost: \$643,644)

Professional Service

Workshops and Meetings:

- 2019 Scientific Advisor, Machine Learning for Quantum Many-Body Physics, KITP, UCSB 2019
- 2018-2015 Founder and organizer, Annual BU Theory in Biology Meeting, Boston MA May 2018, 2019
- 2015 Organizer, ICTS and ICTP, Winter School on Quantitative Systems Biology, Dec 2015
- 2013 Organizer of APS March Meeting session on Excitable Systems in Biology, March 2013
- 2011 Organizer, Aspen Center for Physics Workshop: Computation and Collective Behavior in Biological Systems, June 2011
- 2009 Co-organizer of APS March Meeting session on Information Theory, March 2009

Miscellaneous:

- 2018 Reviewer, NIH R35 MIRA Award, NIH
- 2014- External Reviewer (multiple times), Modeling and Analysis of Biological Systems Study Section, NIH
- 2012-2013 Organizer, Boston University Systems/Synthetic Biology Journal Club
- 2013- Organizer, Boston University Biophysics Journal Club
- 2007-2010 Founder/Principal Organizer of Biophysics Journal Club, Princeton University

Referee for various Journals: Biophysical Journal, BMC Systems Biology, Cell, Cell Systems, Ecology Letters, eLife, Entropy, Journal of the Royal Society Interface, Journal of Statistical Mechanics: Theory and Experiment, Journal of Statistical Physics, Nature Communication, Neural Computation, Physical Review Letters, Physics Review B, Physical Review E, Physical Biology, PLoS Computational Biology, PLoS One, Proceedings of National Academy of Science, Scientific Reports.

Teaching & Mentoring

Courses taught:

- 2010-2013 *Mathematical Physics* (graduate) - Designed and taught core-graduate math methods course. Topics covered include Complex Analysis, Dynamical Systems, and Partial Differential Equations.
- 2011,2018 *Systems Biology for Physicists and Engineers* (graduate) - Designed and taught new course on systems biology for physicists and engineers.
- 2012-2013 *Introductory Physics without Calculus* (undergraduate) - Taught and helped to design materials for a new studio format course that emphasizes active learning (PY105-106).

- 2014,2015 *Methods and Logic in Quantitative Biology* (graduate) - New course cross-listed in Physics and Biomedical Engineering. The main focus of this course is the close reading of published papers illustrating the principles, achievements, and difficulties that lie at the interface of theory and experiment in biology.
- 2015-2017 *Thermal Physics* (undergraduate) - This is an undergraduate course that teaches Statistical Physics to undergraduate Physics majors. An emphasis was placed on integrating numerical methods such as Monte Carlo using Python notebooks.
- 2016, 2018 *Machine Learning for Physicists* (graduate) - A new special topics class for advanced graduate students that I developed to learn Machine Learning.

Mentoring:

Current:

Graduate Students: Wenping Cui, Alexandre Day, Ching-hao Wang

Postdocs: Robert Marsland III, Alex Golden

Alumni: (with position)

Postdoctoral Scholars: Charles K. Fisher (CEO and founder, unLearn.ai)

Graduate Students: Alex H Lang (Deep Learning Scientist, Nutonomy), Javad Noorbakhsh (Research Scientist, Jackson Laboratory)

Undergraduate Students: Joseph Evans-Sarmiego (graduate student at CU Physics), Ania Baetica (graduate student at Caltech), Wooseok (Steven) Ahn (working at MIT), Benjamin Dickens (graduate student at Berkeley)

Publications and Preprints

- 2018 J. E. Goldford, N. Lu, D. Bajić, S. Estrela, M. Tikhonov, A. Sanchez-Gorostiaga, D. Segrè, P. Mehta*, and A. Sanchez*. Emergent simplicity in microbial community assembly. *Science*, 361(6401):469–474, 2018.
- 2018 M. Bukov, A. G. Day, D. Sels, P. Weinberg, A. Polkovnikov, and P. Mehta. Reinforcement learning in different phases of quantum control. *Physical Review X*, 8(3):031086, 2018.
- 2018 W. Cui and P. Mehta. Identifying feasible operating regimes for early t-cell recognition: The speed, energy, accuracy trade-off in kinetic proofreading and adaptive sorting. *PloS one*, 13(8):e0202331, 2018.
- 2018 M. Advani, G. Bunin, and P. Mehta. Statistical physics of community ecology: a cavity solution to macarthur's consumer resource model. *Journal of Statistical Mechanics: Theory and Experiment*, 2018(3):033406, 2018.
- 2018 M. Bukov, A. G. Day, P. Weinberg, A. Polkovnikov, P. Mehta, and D. Sels. Broken symmetry in a two-qubit quantum control landscape. *Physical Review A*, 97(5):052114, 2018.
- 2018 P. Mehta, M. Bukov, C.-H. Wang, A. G. Day, C. Richardson, C. K. Fisher, and D. J. Schwab. A high-bias, low-variance introduction to machine learning for physicists. *arXiv preprint arXiv:1803.08823*, 2018.

- 2018 A. G. Day, M. Bukov, P. Weinberg, P. Mehta, and D. Sels. The glassy phase of optimal quantum control. *arXiv preprint arXiv:1803.10856*, 2018.
- 2017 M. Kolodrubetz, D. Sels, P. Mehta, and A. Polkovnikov. Geometry and non-adiabatic response in quantum and classical systems. *Physics Reports*, 697:1–87, 2017.
- 2017 S. T. Pusuluri, A. H. Lang, P. Mehta, and H. E. Castillo. Cellular reprogramming dynamics follow a simple 1d reaction coordinate. *Physical biology*, 15(1):016001, 2017.
- 2017 C.-H. Wang, P. Mehta, and M. Elbaum. Thermodynamic paradigm for solution demixing inspired by nuclear transport in living cells. *Physical Review Letters*, 118(15):158101, 2017.
- 2017 K. Dame, S. Cincotta, A. H. Lang, R. M. Sanghrajka, L. Zhang, J. Choi, L. Kwok, T. Wilson, M. M. Kańduła, S. Monti, et al. Thyroid progenitors are robustly derived from embryonic stem cells through transient, developmental stage-specific overexpression of nkx2-1. *Stem Cell Reports*, 8(2):216–225, 2017.
- 2016 B. Dickens, C. K. Fisher, and P. Mehta. Analytically tractable model for community ecology with many species. *Physical Review E*, 94(2):022423, 2016.
- 2016 P. Mehta, A. H. Lang, and D. J. Schwab. Landauer in the age of synthetic biology: energy consumption and information processing in biochemical networks. *Journal of Statistical Physics*, pages 1–14.
- 2015 C. K. Fisher and P. Mehta. Bayesian feature selection with strongly regularizing priors maps to the ising model. *Neural computation*, 27(11):2411–2422, 2015.
- 2015 J. Noorbakhsh, D. J. Schwab, A. E. Sgro, T. Gregor, and P. Mehta. Modeling oscillations and spiral waves in dictyostelium populations. *Physical Review E*, 91(6):062711, 2015.
- 2015 A. A. Wilson, L. Ying, M. Liesa, C.-P. Segeritz, J. A. Mills, S. S. Shen, J. Jean, G. C. Lonza, D. C. Liberti, A. H. Lang, et al. Emergence of a stage-dependent human liver disease signature with directed differentiation of alpha-1 antitrypsin-deficient ips cells. *Stem cell reports*, 4(5):873–885, 2015.
- 2015 A. E. Sgro, D. J. Schwab, J. Noorbakhsh, T. Mestler, P. Mehta, and T. Gregor. From intracellular signaling to population oscillations: Bridging scales in collective behavior. *Molecular Systems Biology*, 11(799), 2015.
- 2015 C. K. Fisher and P. Mehta. Bayesian feature selection for high-dimensional linear regression via the ising approximation with applications to genomics. *Bioinformatics*, page btv037, 2015.
- 2014 P. Mehta and D. J. Schwab. An exact mapping between the variational renormalization group and deep learning. *arXiv:1410.3831*.
- 2014 L. Chen, J. Noorbakhsh, R. M. Adams, J. Samaniego-Evans, G. Agollah, D. Nevozhay, J. Kuzdzal-Fick, P. Mehta, and G. Balázsi. Two-dimensionality of yeast colony expansion accompanied by pattern formation. *PLOS Computational Biology*, 10(12):e1003979, 2014.
- 2014 A. H. Lang, C. Fisher, T. Mora, and P. Mehta. Thermodynamics of statistical inference by cells. *Physical review letters*, 113:148103, 2014.
- 2014 C. K. Fisher and P. Mehta. On the transition between the niche and neutral regimes in ecology. *Proceedings of the National Academy of Sciences*, page e102451, 2014.
- 2014 D. J. Schwab, I. Nemenman, and P. Mehta. Zipf’s law and criticality in multivariate data without fine-tuning. *Physical review letters*, 113:68102, 2014.
- 2014 A. H. Lang, H. Li, J. J. Collins, and P. Mehta. Epigenetic landscapes explain partially reprogrammed cells and identify key reprogramming genes. *PLoS computational biology*, 10(8):e1003734, 2014.
- 2014

- C. K. Fisher and P. Mehta. Identifying keystone species in the human gut microbiome from metagenomic timeseries using sparse linear regression. *PLoS one*, 9(7):e102451, 2014.
- 2014 W. R. Harcombe, W. J. Riehl, I. Dukovski, B. R. Granger, A. Betts, A. H. Lang, G. Bonilla, A. Kar, N. Leiby, P. Mehta, et al. Metabolic resource allocation in individual microbes determines ecosystem interactions and spatial dynamics. *Cell reports*, 7(4):1104–1115, 2014.
- 2014 A. Mertiri, H. Altug, M. K. Hong, P. Mehta, J. C. Mertz, L. D. Ziegler, and S. Erramilli. Nonlinear mid-infrared photothermal spectroscopy using zharov splitting and quantum cascade lasers. *ACS Photonics*, 2014.
- 2013 J. Noorbakhsh, A. H. Lang, and P. Mehta. Intrinsic noise of microrna-regulated genes and the cerna hypothesis. *PLoS one*, 8(8):e72676, 2013.
- 2013 E. Reznik, P. Mehta, and D. Segrè. Flux imbalance analysis and the sensitivity of cellular growth to changes in metabolite pools. *PLoS computational biology*, 9(8):e1003195, 2013.
- 2012 P. Mehta and D. J. Schwab. Energetic costs of cellular computation. *Proceedings of the National Academy of Sciences*, 109(44):17978–17982, 2012.
- 2012 P. Mehta and A. Polkovnikov. Efficiency bounds for nonequilibrium heat engines. *Annals of Physics*, 332:110–126, 2012.
- 2012 D. J. Schwab, G. G. Plunk, and P. Mehta. Kuramoto model with coupling through an external medium. *Chaos: An Interdisciplinary Journal of Nonlinear Science*, 22(4):043139, 2012.
- 2012 D. J. Schwab, A. Baetica, and P. Mehta. Dynamical quorum-sensing in oscillators coupled through an external medium. *Physica D: Nonlinear Phenomena*, 241(21):1782–1788, 2012.
- 2011 P. Mehta, D. J. Schwab, and A. M. Sengupta. Statistical mechanics of transcription-factor binding site discovery using hidden markov models. *Journal of statistical physics*, 142(6):1187–1205, 2011.
- 2011 S.-W. Teng, J. N. Schaffer, K. C. Tu, P. Mehta, W. Lu, N. Ong, B. L. Bassler, and N. S. Wingreen. Active regulation of receptor ratios controls integration of quorum-sensing signals in vibrio harveyi. *Molecular systems biology*, 7(1), 2011.
- 2010 P. Mehta and T. Gregor. Approaching the molecular origins of collective dynamics in oscillating cell populations. *Current opinion in genetics & development*, 20(6):574–580, 2010.
- 2010 S.-W. Teng, Y. Wang, K. C. Tu, T. Long, P. Mehta, N. S. Wingreen, B. L. Bassler, and N. Ong. Measurement of the copy number of the master quorum-sensing regulator of a bacterial cell. *Biophysical journal*, 98(9):2024–2031, 2010.
- 2009 P. Mehta, S. Goyal, T. Long, B. L. Bassler, and N. S. Wingreen. Information processing and signal integration in bacterial quorum sensing. *Molecular systems biology*, 5(1), 2009.
- 2009 T. Long, K. C. Tu, Y. Wang, P. Mehta, N. Ong, B. L. Bassler, and N. S. Wingreen. Quantifying the integration of quorum-sensing signals with single-cell resolution. *PLoS biology*, 7(3):e1000068, 2009.
- 2008 P. Mehta and N. Andrei. Nonequilibrium quantum impurities: From entropy production to information theory. *Physical review letters*, 100(8):086804, 2008.
- 2008 P. Mehta, R. Mukhopadhyay, and N. S. Wingreen. Exponential sensitivity of noise-driven switching in genetic networks. *Physical biology*, 5(2):026005, 2008.
- 2008 P. Mehta, S. Goyal, and N. S. Wingreen. A quantitative comparison of srna-based and protein-based gene regulation. *Molecular systems biology*, 4(1), 2008.
- 2007 E. Boulat, P. Mehta, N. Andrei, E. Shimshoni, and A. Rosch. Heat transport properties of clean spin ladders coupled to phonons: Umklapp scattering and drag. *Physical Review B*, 76(21):214411, 2007.

- 2006 P. Mehta and N. Andrei. Nonequilibrium transport in quantum impurity models: The bethe ansatz for open systems. *Physical review letters*, 96(21):216802, 2006.
- 2005 P. Mehta, N. Andrei, P. Coleman, L. Borda, and G. Zarand. Regular and singular fermi-liquid fixed points in quantum impurity models. *Physical Review B*, 72(1):014430, 2005.

Invited Talks

- 3/2019 Invited Talk, APS March Meeting, Boston MA
- 2/2019 Invited Talk, Statistical Physics Approaches to Systems Biology, Havana, Cuba
- 1/2019 Invited Talk, Theoretical Biophysics Workshop at Emory University, Atlanta, GA
- 12/2018 Invited Talk, PCTS Bridging Theory and Experiment in Microbial Communities, Princeton, NJ
- 11/2018 Invited Talk, Quantitative Biology Initiative, Harvard University, Cambridge MA
- 10/2018 Invited Talk, PhysicsNext Workshop (organized by Physical Review Editors), Long Island, NY
- 5/2018 Chemical Engineering Seminar, CSU, Fort Collins, CO
- 4/2018 Invited Talk, Stochastic Models in Ecology and Evolutionary Biology, Venice, Italy
- 2/2018 Bioinformatics Seminar, UNC, Chapel Hill, NC
- 12/2017 Invited Talk, Physics and Machine Learning, CUNY, New York, NY
- 10/2017 Invited Talk, Harnessing Work from Noise Workshop, UMass Amherst, Amherst, MA
- 9/2017 Keynote Address, MIT Biophysics Retreat, Cape Cod, MA
- 9/2017 "Science at the Edge" Seminar, Michigan State, East, Lansing, MI
- 8/2017 Invited Talk, KITP Workshop on Eco-Evolutionary Dynamics, KITP, Santa Barbara, CA
- 7/2017 Invited Talk, Q-bio Conference, Rutgers University, New Brunswick, NJ
- 7/2017 Invited Talk, ICTP Workshop: Microbial Economy of Microbial Communities, Trieste, Italy
- 5/2017 Condensed Matter Seminar, Syracuse, Syracuse, NY
- 4/2017 Invited Talk, SCIALOG: Molecules Meet Life, Tuscon, AZ
- 3/2017 Invited Talk, APS March Meeting, New Orleans, LA
- 2/2017 Condensed Matter Seminar, Rutgers University, Piscataway, NJ
- 11/2016 Ecology and Evolutionary Biology Seminar, Yale University, New Haven, CT
- 9/2016 Computational Neuroscience Seminar, University of Pennsylvania, Philadelphia, PA
- 9/2016 Physical Mathematics Seminar, MIT, Cambridge, MA
- 7/2016 Annual Meeting of the International Physics of Living Systems (iPoLS) Network, Cambridge, MA
- 5/2016 Physics Colloquium, Rensselaer Polytechnic Institute, Troy, NY
- 4/2016 Scialog: Molecules come to Life, Tuscon, MA
- 3/2016 Scientific Computing Seminar, Applied Mathematics, Brown University, Providence, RI
- 2/2016 Channing Network Science Seminar, Brigham Young Hospital, Boston, MA
- 1/2016 MIT Meeting on Quantitative Biology, Cambridge, MA
- 1/2016 Physics Inspired Machine Learning Conference, Los Alamos, NM
- 12/2015 ICTS Winter School on Quantitative Systems Biology, Bangalore, India
- 11/2015 CIRCS Seminar, Northeastern, Boston, MA

11/2015 Physics Colloquium, UMass Boston, Boston, MA
 11/2015 Harvard Widely Applied Math Seminar, Cambridge, MA
 9/2015 Purdue Center for Cancer Research, Purdue, IN
 8/2015 Biological Distributed Algorithms (BDA) 2015, Cambridge, MA
 7/2015 META Symposium on Host-Microbe interactions, Eugene, OR
 4/2015 Simon's Conference on Theory in Biology, New York, NY
 4/2015 Biological Physics Seminar, UCLA, Los Angeles, CA
 3/2015 Presentation, Scialog: Molecules Come to Life, Tucson, AZ
 3/2015 Chez Pierre Condensed Matter Theory Seminar, MIT, Cambridge, MA
 2/2015 Theory Lunch, Dept. of Systems Biology, Harvard Medical School, Boston, MA
 2/2015 BMSE/Qbio Seminar, UCSB, Santa Barbara, CA
 1/2015 Biomedical Engineering Seminar, Boston University, Boston, MA
 1/2015 Invited Talk, Dynamics Days, Houston, TX
 12/2014 Physics Colloquium, Boston University, Boston, MA
 11/2014 Dynamics Seminar, Dept. of Mathematics, Boston University, Boston, MA
 11/2014 Hariri Institute for Computing, Boston University, Boston, MA
 11/2014 Dynamics Seminar, Dept. of Mathematics, Boston University, Boston, MA
 10/2014 Condensed Matter Seminar, Brown University, Providence, RI
 10/2014 Invited Talk, BIOMS Workshop "Modeling Cellular Systems", Heidelberg, Germany
 6/2014 Invited Talk, ICTP Workshop of Cellular Economics, Trieste, Italy
 3/2014 Invited Talk, American Physical Society March Meeting Denver, CO
 10/2013 Biophysics Seminar, Princeton University, Princeton, NJ
 9/2013 Invited Talk, BANFF Workshop on Stochasticity in Biochemical Networks, Banff, AB, Canada
 4/2013 MIT/BU Biophysics Theory Supergroup, MIT, Cambridge, MA
 4/2013 Seminar at Center for Physics and Biology, Rockefeller University, New York, NY
 11/2012 Physics Colloquium, Brandeis University, Waltham, MA
 10/2012 Physics Colloquium, University of Massachusetts Boston, Boston, MA
 5/2012 Condensed Matter Seminar, McGill University, Montreal, QC, Canada
 2/2012 Networks Seminar, University of Houston, Houston, TX
 11/2011 Molecular and Cell Biology Seminar, Boston University, Boston, MA
 11/2011 Mathematical Physics Seminar, MIT, Cambridge, MA
 5/2011 Bauer Forum, Bauer Center for Systems Biology, Cambridge, MA
 1/2011 Systems Biology Seminar, Boston University, Boston, MA
 12/2010 MRSEC/Biophysics Joint Seminar, Brandeis, Waltham, MA
 11/2010 CSBi Seminar Series, MIT, Cambridge, MA
 2/2010 Center for Physics and Biology, Rockefeller University, New York, NY
 1/2010 Condensed Matter Seminar, Boston University, Boston, MA
 1/2010 Physics Colloquium, Vanderbilt University, Nashville, TN
 11/2009 Molecular and Cell Biology Colloquium, University of Arizona, Tucson, AZ

10/2009 Biophysics Seminar, University of Pennsylvania, Philadelphia, PA
3/2009 Invited Talk, American Physical Society March Meeting, Pittsburg, PA
2/2009 Condensed Matter Seminar, MIT, Cambridge, MA
3/2007 Invited Talk, American Physical Society March Meeting Denver, CO