

Kirill S. Korolev

Assistant Professor in Physics and Bioinformatics, Boston University
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EDUCATION

Harvard University, Cambridge, MA

- **Ph.D. in theoretical condensed matter physics** May 2010
Thesis: Statistical physics of topological emulsions and expanding populations
Advisor: David R. Nelson

Moscow Institute of Physics and Technology (MIPT), Dolgoprudny, Russia

- **B.S. with highest honors in applied physics and applied mathematics** July 2005
Undergraduate thesis: Magnetization relaxation in monocrystals of YBaCuO
Advisor: L.S. Uspenskaya

APPOINTMENTS

- Assistant Professor, *Boston University* July 2013–present
- Pappalardo Postdoctoral Fellow, *MIT* 2010–2013
Advisors: Leonid A. Mirny and Jeff Gore
- Postdoctoral Fellow, *Harvard University* 2010
Advisor: David R. Nelson

AWARDS

- Cottrell Scholar Award 2017–2020
Research Corporation \$100,000 (direct)
- Simons Investigator in the Mathematical Modeling of Living Systems 2016–2021
Simons Foundation \$500,000 (direct)
- Scialog Molecules Come to Life Award 2017–2019
Moore Foundation and RCSA \$100,000 (direct)
- Hariri Research Award, co-PI with Daniel Segre, *Hariri Institute for Computing* 2017
- Junior Faculty Fellow, *Hariri Institute for Computing* 2015–2018
- Scialog Fellow, *Research Corporation for Science Advancement* 2014–2016
- Pappalardo Postdoctoral Fellowship, *MIT* 2010–2013
- Certificate of Distinction in Teaching, *Harvard University* 2009
- Goldhaber Prize to an outstanding PhD candidate, *Harvard University* 2008
- Purcell Fellowship to incoming PhD students, *Harvard University* 2005–2006
- Scholarship for academic excellence, *MIPT* 2002–2005
- Potanin Fellowship, *MIPT* 2002–2005
- Gold medal International Physics Olympiad (IPhO) XXXII, Turkey 2001

TEACHING EXPERIENCE

Boston University

- Computational and Quantitative Reasoning for Bioinformatics and Systems Biology Fall 2018
- Mathematical Physics Fall 2013–2018
- Dynamics and Evolution of Biological Networks Spring 2014–2017
- Bioinformatics Graduate Seminar Spring 2014–2017

Harvard University

- Departmental Teaching Fellow; Physics Department 2009–2010
Ran a training program in pedagogy for new Teaching Fellows
- Physical Sciences 2; Head Teaching Fellow Fall 2008
- Advanced Electromagnetism; Teaching Fellow Fall 2007
- Physical Sciences 3; Teaching Fellow Spring 2007
- Physical Sciences 2; Teaching Fellow Fall 2006
- Physics 1a; Teaching Fellow Summer 2006

ADVISING

Current

- Postdoctoral scholars: Robert Marsland, Alexander Golden
- Graduate students: Gabriel Birzu, Ashish Bino George
- Research assistants: Sakib Matin

Former

- Postdoctoral researchers: Feng Wang
- PhD students: Rajita Menon
- Master students: Michael Chernicoff
- Long-term visiting students: Kohaku So, Keisuke Ishihara, Quentin Hoarau
- Undergraduate students: Peter Freese, Ivana Cvijovic, Xiangxi Gao, Vivek Ramanan, Brianna Richardson, Michelle Patino, Daniel Varoli
- High school students: You Jin Reo, Alexander Smirnov, Luanna Ferreeira, Andrew Li, Adarsh Ramchandran, Sanjena Venkatesh, Raghav Jain, Kaitlyn Hoxha

PROFESSIONAL ACTIVITIES

- Reviewed grant applications for Simons Foundation, Research Corporation for Science Advancement, Department of Defense, National Science Foundation
- Referee for Physical Review Letters, PNAS, eLife, Cell, Current Biology, Nature Communications, PLoS Biology, PLoS Computational Biology, Evolution, Proceedings of the Royal Society B, Europhysics Letters, Reviews of Modern Physics, Oikos, Trends in Cancer, Genetics, Physical Biology, Physical Review E, PLoS ONE, JSTAT, Nonlinearity, Journal of the Royal Society Interface, Bulletin of Mathematical Biology, Journal of Mathematical Biology, Scientific Reports, ISME Journal, Cell Systems, Proceedings of the Royal Society Interface, New Journal of Physics
- Co-organized Theory of Living Systems Conference 2019
- Co-organized BU Theory in Biology Conference 2018
- Co-organized invited session at APS March meeting titled “Complex microbial communities” 2016
- Outreach lecture to 30 Boston area high school science teachers on the synergies between research in physics and biology 2014
- Organized Harvard Condensed Matter Theory Kid’s Seminar 2008–2010
- Helped organize Biannual Teaching Conference, Harvard University 2009
- Helped organize High School Physics Olympiads, Russia 2001–2004

INVITED TALKS

- Materials Research Science and Engineering seminar series, *Brandeis University* 2019
The role of space in population dynamics
- Theory & Biology conference, *Simons Foundation, NYC* 2019

- The role of space in population dynamics

2019
- Physics Colloquium, *University of Michigan*

2019
- The role of space in population dynamics

2019
- Frontiers in Quantitative and Systems Biology seminar series, *QCBio, UCLA*

2019
- The role of space in population dynamics

2019
- Joint seminar of Mathematical Modeling and Basic Biology groups, *Fred Hutch, Seattle*

2019
- The role of space in population dynamics

2018
- Physicists working on cancer, *Weizemann Institute of Science, Israel*

2018
- Population genetics and ecology of spatially growing populations

2018
- American Society for Microbiology Microbe Meeting, *Atlanta, GA*

2018
- Effects of cellular chirality on competition and cooperation in microbial colonies

2018
- Microbiome: Applications & Future, *Synthetic Biology Center, MIT*

2018
- Theory & Microbiome

2018
- American Physical Society March Meeting, *Los Angeles, CA*

2018
- Neither pulled nor pushed: A new class of reaction diffusion waves

2018
- Condensed Matter Kid's Seminar, *Harvard University*

2018
- Neither pulled nor pushed: A new class of reaction diffusion waves

2018
- Fundamental problems in active matter, *Aspen Institute of Physics*

2018
- Effects of Cellular Chirality on Competition and Cooperation in Microbial Colonies

2018
- Biomathematics Seminar, *Harvard University*

2017
- Evolution during range expansions of cooperatively growing populations

2017
- Workshop on Systems Biology and Molecular Economy of Microbial Communities, *ICTP, Italy*

2017
- The role of spatial structure in microbial interactions

2017
- BU Microbiome Day, *Boston University*

2017
- Statistical physics of microbial communities

2017
- Bioinformatics and Computational Biology Seminar, *Worcester Polytechnic Institute*

2017
- Mutations that slow down cancer

2016
- Physics Department Colloquium, *University of Massachusetts, Boston*

2016
- To grow or not to grow: From microtubules to cancer

2016
- Center for Theoretical Biological Physics Seminar, *Rice University*

2016
- Beyond the Standard Model of Growth: From Chiral Cells to Polymer Networks

2016
- Widely Applied Mathematics *Harvard University*

2016
- Survival of the chiral: Chiral microbes succeed by altering spatial structure

2016
- Squishy Physics, *Harvard University*

2016
- Assembly and control of large microtubule complexes

2016
- XXIII Summer School Nicolás Cabrera, *Madrid, Spain*

2016
- Phase transitions in populations dynamics of microbes and cancer

2016
- Channing Network Science Seminar, *Harvard Medical School*

2016
- Ecology and evolution of cancer tumors

2016
- First MIT Meeting on Quantitative Ecology, *Massachusetts Institute of Technology*

2016
- The games microbes play

2016
- Populations, Evolution, and Physics, *Aspen Institute of Physics*

2016
- Evolution during cooperative growth

2016
- Center for Genomics and Computational Biology Seminar Series, *Duke University*

2015
- The tug-of-war between deleterious and beneficial mutations in cancer

2015
- Hariri Institute for Computing and Computational Science & Engineering, *Boston, MA*

2015
- Why cancer is so rare?

2015
- American Physical Society March Meeting, *San Antonio, TX*

2015
- Diffusion-limited mutualism

2014
- Digestive Disease Week, *Chicago*

2014
- Community structure of bacteria in the human microbiome

2014
- Biology Department Seminar Series, *Boston University*

2014
- Evolutionary dynamics in cancer

2014
- Physics Department Colloquium, *Emory University*

2013

- Ecology and evolution of cancer tumors and expanding populations
• Biophysics Seminar Series, *Massachusetts Institute of Technology* 2013
- Ecology and evolution of cancer tumors and expanding populations
• Laufer Center Seminar, *University of Stony Brook* 2013
- Ecology and evolution of cancer tumors and expanding populations
• Biophysics Theory Seminar, *Purdue University* 2013
- Ecology and evolution of cancer tumors and expanding populations
• Complex Systems Seminar, *University of Michigan* 2013
- Ecology and evolution of cancer tumors and expanding populations
• Evolution Seminar, *University of Pennsylvania* 2013
- Ecology and evolution of cancer tumors and expanding populations
• Systems Biology Seminar, *Boston University* 2013
- Ecology and evolution of cancer tumors and expanding populations
• 15th Annual Greater Boston Area Statistical Mechanics Meeting, *Brandeis University* 2013
- Dynamics of evolutionary innovations in cancer
• Workshop on Selection in Population Genetics, *Radcliffe Institute* 2012
- Dangerous passengers: A closer look at deleterious mutations
in evolutionary models of cancer
• Condensed Matter Seminar, *UMass Amherst* 2012
- Statistical mechanics of genes in expanding microbial colonies
• Condensed Matter Theory Kid's Seminar, *Harvard University* 2012
- Dangerous passengers: A closer look at deleterious mutations
in evolutionary models of cancer
• Towards Unifying Concepts in the Physics of Aperiodic Systems, *Princeton University* 2011
- Space, evolution, and the Petri dish: Statistical mechanics of
stochastic demixing and deterministic mixing in microbial colonies
• Condensed Matter Seminar, *Virginia Tech* 2011
- Space, evolution, and the Petri dish
• Pappalardo Symposium; and Faculty lunch, *MIT* 2011
- Genetic demixing in bacterial colonies
• Mini Stat Mech Meeting, *UC Berkeley* 2011
- Genetic mixing and demixing in bacterial colonies
• Cells, Circuits, and Computation, *Harvard University* 2010
- Spatial assays for microbial evolution
• Center for the Physics of Living Cells, *UIUC* 2010
- Population genetics in a Petri dish
• Widely Applied Mathematics seminar, *Harvard University* 2009
- Genetic demixing and Fisher waves

PREPRINTS

- Gabriel Birzu, Sakib Matin, Oskar Hallatschek, and [Kirill S. Korolev](#), *Genetic drift in range expansions is very sensitive to density feedback in dispersal and growth* (bioRxiv).
- Maxime Deforet, Carlos Carmona Fontaine, [Kirill S. Korolev](#), and Joao B. Xavier, *Contribution of growth and dispersal to the evolution of expanding populations*, bioRxiv doi.org/10.1101/221390.
- Ching-Hao Wang, Sakib Matin, Ashish George, and [Kirill S. Korolev](#), *Pinned, locked, pushed, and pulled traveling waves in structured environments*, bioRxiv doi.org/10.1101/341222.

PEER-REVIEWED PUBLICATIONS

2019

- Robert Marsland III, Wenping Cui, Joshua Goldford, Alvaro Sanchez, [Kirill S. Korolev](#), and Pankaj

Mehta, *Available energy fluxes drive a phase transition in the diversity, stability, and functional structure of microbial communities*, **PLoS Computational Biology** 15(2), e1006793 (2019).

2018

- Gabriel Birzu, Oskar Hallatschek, and [Kirill S. Korolev](#), *Fluctuations uncover a distinct class of traveling waves*, **PNAS** 115, E3645-E3654 (2018).
- Ashish George and [Kirill S. Korolev](#), *Chirality provides a direct fitness advantage and facilitates intermixing in cellular aggregates*, **PLoS Computational Biology** 14(12), e1006645 (2018).
- Rajita Menon, Vivek Ramanan, and [Kirill S. Korolev](#), *Interactions between species introduce spurious associations in microbiome studies*, **PLoS Computational Biology** 14(1), e1005939 (2018).
- Mohammad I. El Mouzan, Harland S. Winter, Assad A. Assiri, Kirill S. Korolev, Ahmad A. Al Sarkhy, Scot E. Dowd, Mohammad A. Al Mofarreh, and Rajita Menon, *Microbiota profile in new-onset pediatric Crohn's disease: data from a non-Western population*, **BMC Pathogens** 10, 49 (2018).
- Mohammad I El Mouzan, Kirill S Korolev, Mohammad A Al Mofarreh, Rajita Menon, Harland S Winter, Ahmad A Al Sarkhy, Scot E Dowd, Ahmad M Al Barrag, and Asaad A Assiri, *Fungal dysbiosis predicts the diagnosis of pediatric Crohn's disease*, **WJG** 24(39): 4510-4516 (2018).
- Mina Nazari, Xiaoqing Li, Mohammad Amin Alibakhshi, Haojie Yang, Kathleen Souza, Christopher Gillespie, Suryaram Gummuluru, Björn M. Reinhard, [Kirill S. Korolev](#), Lawrence D. Ziegler, Qing Zhao, Meni Wanunu, Shyamsunder Erramilli, *Femtosecond Photonic Viral Inactivation Probed Using Solid-State Nanopores*, **Nano Futures** 2, 045005 (2018).

2017

- Ana B. Pavel and [Kirill S. Korolev](#), *Genetic load makes cancer cells more sensitive to common drugs: evidence from Cancer Cell Line Encyclopedia*, **Scientific Reports** 7, 1938 (2017)
- Liselotte Jauffred, Rebecca Munk-Vejborg, [Kirill S. Korolev](#), Stanley Brown, and Lene B. Oddershede, *Chirality in microbial biofilms is mediated by close interactions between the cell surface and the substratum*, **ISME Journal** 11, 1688-1701 (2017)
- Mohammad El Mouzan, Feng Wang, Mohammad Al Mofarreh, Rajita Menon, Ahmad Al Barrag, [Kirill S. Korolev](#), Ahmad Al Sarkhy, Mona Al Asmi, Yassin Hamed, Anjum Saeed, Scot Dowd, Asaad Assiri, and Harland Winter, *Fungal microbiota profile in newly-diagnosed treatment-naïve children with Crohn disease*, **Journal of Crohn's and Colitis** 11, 586-592 (2017)

2016

- Keisuke Ishihara, [Kirill S. Korolev](#), Timothy J. Mitchison, *Physical basis of large microtubule aster growth*, **eLife** e19145 (2016)
- Saurabh R. Gandhi, Eugene A. Yurtsev, [Kirill S. Korolev](#) and Jeff Gore, *Range expansions transition from pulled to pushed waves as growth becomes more cooperative in an experimental microbial population*, **PNAS** 113, 6923 (2016)
- Feng Wang, Jess L. Kaplan, Benjamin D. Gold, Manoj K. Bhasin, Naomi L. Ward, Richard Keller-mayer, Barbara S. Kirschner, Melvin B. Heyman, Scot E. Dowd, Stephen B. Cox, Haluk Dogan, Blaire Steven, George D. Ferry, Stanley A. Cohen, Robert N. Baldassano, Christopher J. Moran, Elizabeth A. Garnett, Lauren Drake, Hasan H. Otu, Leonid A. Mirny, Towia A. Libermann, Harland S. Winter, and [Kirill S. Korolev](#), *Detecting microbial dysbiosis associated with pediatric Crohn disease despite the high variability of the gut microbiota*, **Cell Reports** 14, 945 (2016)

2015

- [Kirill S. Korolev](#), *Evolution arrests invasions of cooperative populations*, **Physical Review Letters** 115, 208104 (2015)
- Rajita Menon and [Kirill S. Korolev](#), *Public good diffusion limits microbial mutualism*, **Physical Review Letters** 114, 168102 (2015)

- Lei Dai, [Kirill S. Korolev](#), and Jeff Gore, *Relation between stability and resilience determines the performance of early warning signals under different environmental drivers*, **PNAS** 112, 10056 (2015)

2014

- Christopher D. McFarland, Leonid A. Mirny, and [Kirill S. Korolev](#), *Tug-of-war between driver and passenger mutations in cancer and other adaptive processes*, **PNAS** 111, 15138 (2014)
- [Kirill S. Korolev](#), Joao B. Xavier, and Jeff Gore, *Turning ecology and evolution against cancer*, **Nature Reviews Cancer** 14, 371 (2014)
- Peter D. Freese, [Kirill S. Korolev](#), Jose I. Jimenez, and Irene A. Chen, *Genetic drift suppresses bacterial conjugation in spatially structured populations*, **Biophysical Journal** 106, 944 (2014)

2013

- Manoshi S. Datta, [Kirill S. Korolev](#), Ivana Cvijovic, Carmel Dudley, and Jeff Gore, *Range expansion promotes cooperation in an experimental microbial metapopulation*, **PNAS** 110, 7354 (2013)
- Lei Dai, [Kirill S. Korolev](#), and Jeff Gore, *Slower recovery in space before collapse of connected populations*, **Nature** 496, 355 (2013)
- [Kirill S. Korolev](#), *The fate of cooperation during range expansions*, **PLOS Computational Biology** 9, e1002994 (2013)
- Christopher D. McFarland, [Kirill S. Korolev](#), Gregory V. Kryukov, Shamil Sunyaev, and Leonid A. Mirny, *The impact of deleterious passenger mutations on cancer progression*, **PNAS** 110, 2910 (2013)
- Maxim O. Lavrentovich, [Kirill S. Korolev](#), and David R. Nelson, *Radial Domany-Kinzel models with mutation and selection*, **Physical Review E** 87, 012103 (2013)

2012

- Lei Dai, Daan Vorselen, [Kirill S. Korolev](#), Jeff Gore, *Generic indicators for loss of resilience before tipping point leading to population collapse*, **Science** 336, 1175 (2012)
- [Kirill S. Korolev](#), Melanie J.I. Müller, Nilay Karahan, Andrew W. Murray, Oskar Hallatschek, and David R. Nelson, *Selective sweeps in growing microbial colonies*, **Physical Biology** 9, 026008 (2012)

2011

- [Kirill S. Korolev](#), Joao B. Xavier, David R. Nelson, and Kevin R. Foster, *A quantitative test of population genetics using spatiogenetic patterns in bacterial colonies*, **The American Naturalist** 178, 538 (2011)
- [Kirill S. Korolev](#) and David R. Nelson, *Competition and cooperation in one-dimensional stepping-stone models*, **Physical Review Letters** 107, 088103 (2011)

2005 - 2010

- [Kirill S. Korolev](#), Mikkel Avlund, Oskar Hallatschek, and David R. Nelson, *Genetic demixing and evolution in linear stepping stone models*, **Reviews of Modern Physics** 82, 1691 (2010)
- Oskar Hallatschek and [Kirill S. Korolev](#), *Fisher waves in the strong noise limit*, **Physical Review Letters** 103, 108103 (2009)
- [Kirill S. Korolev](#) and David R. Nelson, *Defect-mediated emulsification in two dimensions*, **Physical Review E** 77, 051702 (2008)
- L.S. Uspenskaya, [Kirill S. Korolev](#), and P.N. Yarykin, *Peculiarity of magnetization relaxation in finite size superconductors*, **Physica C** 423, 181 (2005)