Kirill S. Korolev

Physics and Bioinformatics, Boston University, 44 Cummington Mall, Boston, MA 02215
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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

- Simons Investigator in the Mathematical Modeling of Living Systems — 2016–2021
  Simons Foundation $500,000 (direct)
- Hariri Research Award, co-PI with Daniel Segre, *Hariri Institute for Computing* — 2015–2018
- 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
- Gold medal International Physics Olympiad (IPhO) XXXII, Turkey — 2001

TEACHING EXPERIENCE

Boston University
- Mathematical Physics — Fall 2013–2015
- 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

- Graduate students: Gabriel Birzu, Rajita Menon, Ashish Bino George

Former

- Postdoctoral researchers: Feng Wang
- Master students: Michael Chernicoff
- Undergraduate students: Quentin Hoarau, Peter Freese, Ivana Cvijovic, Xiangxi Gao
- High school students: You Jin Reo, Alexander Smirnov, Luanna Ferreeira, Andrew Li, Adarsh Ramchandran

PROFESSIONAL ACTIVITIES

- Referee for Physical Review Letters, PNAS, eLife, Current Biology, Evolution, PLoS Computational Biology, 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, 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 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

SELECTED INVITED TALKS

- Bioinformatics and Computational Biology Seminar, *Worcester Polytechnic Institute* 2017
  Mutations that slow down cancer
- Physics Department Colloquium, *University of Massachusetts, Boston* 2016
  To grow or not to grow: From microtubules to cancer
- Center for Theoretical Biological Physics Seminar, *Rice University* 2016
  Beyond the Standard Model of Growth: From Chiral Cells to Polymer Networks
- Widely Applied Mathematics *Harvard University* 2016
  Survival of the chiral: Chiral microbes succeed by altering spatial structure
- Squishy Physics, *Harvard University* 2016
  Assembly and control of large microtubule complexes
- XXIII Summer School Nicolás Cabrera, *Madrid, Spain* 2016
  Phase transitions in populations dynamics of microbes and cancer
- Channing Network Science Seminar, *Harvard Medical School* 2016
  Ecology and evolution of cancer tumors
- First MIT Meeting on Quantitative Ecology, *Massachusetts Institute of Technology* 2016
  The games microbes play
- Aspen Institute for Physics, *Aspen, CO* 2016
  Evolution during cooperative growth
- Center for Genomics and Computational Biology Seminar Series, *Duke University* 2015
  The tug-of-war between deleterious and beneficial mutations in cancer
- Hariri Institute for Computing and Computational Science & Engineering, *Boston, MA* 2015
  Why cancer is so rare?

- American Physical Society March Meeting, *San Antonio, TX* 2015
  Diffusion-limited mutualism
- Digestive Disease Week, *Chicago* 2014
  Community structure of bacteria in the human microbiome
- Biology Department Seminar Series, *Boston University* 2014
  Evolutionary dynamics in cancer
- 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
- 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

PEER-REVIEWED PUBLICATIONS

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**, (accepted)

- 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-naive children with Crohn disease*, **Journal of Crohn's and Colitis**, 1-7 (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 Kellermayer, 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)