

# ROBERT MARSLAND III

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## Positions

<b>Visiting Scholar</b> Environmental Science & Policy, University of California, Davis	2023 - present
<b>Postdoctoral Scholar</b> Theoretical Biophysics Group, Department of Physics, Boston University	2017 - 2020

## Education

<b>Licentiate Candidate in Dogmatic Theology</b> Pontifical University of the Holy Cross, Rome, Italy	2022 - present
<b>Baccalaureate in Theology</b> Pontifical University of the Holy Cross, Rome, Italy	2022
<b>Doctor of Philosophy in Physics</b> Massachusetts Institute of Technology, Cambridge, MA	2017
<b>Master of Studies in Philosophy of Physics</b> Oxford University, Oxford, UK Distinction	2012
<b>Bachelor of Arts in Physics; Certificate in Latin Language and Literature</b> Princeton University, Princeton, NJ Summa cum laude, GPA 3.9	2011

## Teaching

<b>Lecturer, <i>Intermediate Mechanics</i> (PY408)</b> <i>Boston University</i> Designed and presented lectures, homework and exams	2018
<b>Media Arts and Sciences (MAS) Facilitator</b> <i>Massachusetts Institute of Technology</i> Organized and led weekly breakfast meetings for freshmen in the MAS program, consisting of interactive physics demonstrations and research talks from MIT Media Lab groups; organized and led four physics review sessions each semester.	2013 - 2014
<b>Graduate Teaching Assistant, <i>Introduction to Classical Mechanics</i> (8.01)</b> <i>Massachusetts Institute of Technology</i> Managed a team of five undergraduate teaching assistants to facilitate three hours of Technology Enabled Active Learning classes per week.	2013

## Seminars

### **Statistical Mechanics of Microbiomes**

Complex Systems Colloquium, University of Michigan  
September 24, 2019

### **Designing Diverse Microbial Consortia: Challenges and Opportunities**

Indigo Ag, Inc.  
July 18, 2019

### **Towards a Statistical Physics of Ecosystems**

Center for the Physics of Biological Function, Princeton University  
April 2, 2019

### **Machine Learning, Statistical Physics and Ecological Dynamics**

APS March Meeting, invited session  
March 7, 2019

### **Statistical Mechanics of Microbiomes**

Parsons Lab Microbial Systems Seminar Series, MIT  
February 20, 2019

### **Statistical Mechanics of Microbiomes**

Working Group on Irreversible Processes in Ecological Evolution, Santa Fe Institute  
January 29, 2019

### **Microbial Communities in Python**

Guest lecture for MIT graduate course *Computational Ecology* (1.871)  
October 3, 2018

### **Mean-field theory for ecological steady states**

MIT Nonequilibrium Statistical Mechanics Seminar  
February 20, 2018

### **Statistical Mechanics of Microbial Communities**

BU Biophysics Seminar  
February 5, 2018

### **Dynamic Self-Assembly in Living Matter**

Tel Aviv University Biosoft Seminar  
July 31, 2017

### **The Edge of Thermodynamics: Driven Steady States in Physics and Biology**

IGERT Summer Institute, Brandeis University  
May 31, 2017

### **Dynamic Self-Assembly in Living Matter**

BU Biophysics Seminar  
December 14, 2016

### **Dynamic Self-Assembly in Living Matter**

Lewis-Sigler Theory Symposium, Princeton University  
November 30, 2016

## Short Talks and Posters

### **The Minimum Environmental Perturbation Principle: Niche Theory as Optimization**

Gordon Research Conference: Stochastic Physics in Biology  
January 6-11, 2019

### **The Minimum Environmental Perturbation Principle: Niche Theory as Optimization**

Theoretical Biophysics Workshop, Emory University  
January 16-18, 2019

### **The Community Simulator: a Python package for community ecology**

PCTS Workshop: Bridging Theory and Experiment in Microbial Communities  
December 12-14, 2018

### **Available energy fluxes drive a transition in diversity, stability, and functional structure of microbial communities**

BU Biological Design Center Symposium  
May 16, 2018

### **Who's in Charge? From environmental filtering to ecosystem engineering in microbial communities**

MIT Physics of Living Systems Short Talks  
May 11, 2018

### **Statistical Mechanics of Microbial Communities**

MIT-Harvard Microbiome Symposium  
April 13, 2018

### **Statistical Mechanics of Microbial Communities**

Simons Conference on Theory & Biology  
April 13, 2018

### **Statistical Mechanics of Microbial Communities**

APS March Meeting  
March 9, 2018

### **Far-from-equilibrium distribution from near-steady-state work fluctuations**

UC Berkeley Stat Mech Meeting, Poster Session  
January 8, 2016

### **Some thermodynamic aspects of driven steady states**

MIT Biophysics Retreat  
September 14, 2015

### **Counting states in driven systems**

New England Complex Fluids Workshop  
June 27, 2014

## Meetings/Seminars Organized

### **BU Theory in Biology Meeting**

*Spring 2018*

*Boston University*

Organized a two-day workshop on the Boston University campus featuring twelve invited speakers on the topic of “community ecology, evolution and the origin of life.”

*Co-organizers:* Prof. Kirill Korolev, Prof. Pankaj Mehta, Prof. Daniel Segre

### **Boston University Biophysics Seminar**

*2017 - 2018*

*Boston University*

Led a team of three faculty members to coordinate weekly lunch seminars given by local faculty and postdocs for the BU biophysics community.

*Co-organizers:* Prof. Kirill Korolev, Prof. Maria Kamenetska, Prof. Daniel Segre

### **Non-Equilibrium Statistical Mechanics Seminar**

*Fall 2016*

*Massachusetts Institute of Technology*

Organized weekly presentations by graduate students and postdocs on important tools and results in theoretical non-equilibrium statistical mechanics.

### **Philosophical Presuppositions of Science**

*Summer 2015*

*Elmbrook University Center*

Planned and led weekly discussions with MIT and Harvard students from a variety of disciplines on the place of scientific knowledge within the broader context of human knowledge. Selected topical readings each week from articles by Richard Feynman, Philip Anderson, and Paul Davies.

### **Scientific Representation**

*Spring 2012*

*Grandpont House, Oxford*

Planned and led weekly discussions with Oxford students from a variety of disciplines on readings from *Scientific Representation* by Bas van Fraassen (2008).

*Co-organizer:* Dr. Nicholas Teh

## Journals Refereed

**The American Naturalist, Ecology Letters, Physical Review Letters, Physical Review E, Physical Review Research, Physica A, American Journal of Physics, PLOS One, PLOS Computational Biology, Journal of Statistical Mechanics, Entropy, iScience**

## Publications

Z. Feng, R. Marsland III, J. W. Rocks and Pankaj Mehta, "Emergent competition shapes the ecological properties of multi-trophic ecosystems." *arXiv:2303.02983* (2023).

P. Mehta and R. Marsland III, "Cross-feeding shapes both competition and cooperation in microbial ecosystems." *arXiv:2110.04965* (2021).

F. S. Valdovinos, S. Dritz and R. Marsland III, "Transient dynamics in plant-pollinator networks: fewer but higher quality of pollinator visits determines plant invasion success." *Oikos* **2023**(6):e09634 (2023).

W. Cui, R. Marsland III and P. Mehta, "Diverse communities behave like typical random ecosystems." *Phys. Rev. E*. **104**:034416 (2021).

F.S. Valdovinos and R. Marsland III, "Niche theory for mutualism: A graphical approach to plant-pollinator network dynamics." *The American Naturalist*. **197**:393 (2021).

R. Marsland III, O. Howell, A. Mayer and P. Mehta, "Tregs self-organize into a computing ecosystem and implement a sophisticated optimization algorithm for mediating immune response." *PNAS*. **118**:e2011709118 (2021).

R. Marsland III and P. Mehta, "Data-driven modeling reveals a universal dynamic underlying the COVID-19 pandemic under social distancing." *arXiv:2004.10666* (2020).

W. Cui, R. Marsland III and P. Mehta, "Effect of resource dynamics on species packing in diverse ecosystems." *Phys. Rev. Lett.* **125**:048101 (2020).

O. Howell, W. Cui, R. Marsland III and P. Mehta, "Machine learning as ecology." *J. Phys. A: Math. Theor.* **53**:334001 (2020).

R. Marsland III, W. Cui and P. Mehta, "The Minimum Environmental Perturbation Principle: A New Perspective on Niche Theory." *The American Naturalist*. **196**:291 (2020).

R. Marsland III, W. Cui, J. Goldford and P. Mehta, "The Community Simulator: a Python package for microbial ecology." *PLoS One*. **15**:e0230430 (2020).

R. Marsland III, W. Cui and P. Mehta, "A minimal model for microbial biodiversity can reproduce experimentally observed ecological patterns." *Scientific Reports*. **10**:3308 (2020).

L. Ikonomidou, M.J. Herriges, S.L. Lewandowski, R. Marsland, C. Villacorta, I.S. Caballero, D.B. Frank, R.M. Sanghrajka, K. Dame, M.M. Kańduła, J. Hicks-Berthet, M.L. Lawton, C. Christodoulou, A.J. Fabian, E. Kolaczyk, X. Varelas, E.E. Morrissey, J.M. Shannon, P. Mehta and D.N. Kotton, "The in vivo genetic program of murine primordial lung epithelial progenitors." *Nature Communications*. **11**:1 (2020).

Joshua E. Goldford, Hyman Hartman, Robert Marsland III and Daniel Segrè, "Environmental boundary conditions for the origin of life converge to an organo-sulfur metabolism." *Nature Ecology & Evolution* **3**:1715 (2019).

R. Marsland III, W. Cui and J. Horowitz, "The Thermodynamic Uncertainty Relation in biochemical oscillations." *Journal of the Royal Society: Interface* **16** (2019).

P. Mehta, W. Cui, C.-H. Wang and R. Marsland III, "Constrained optimization as ecological dynamics with applications to random quadratic programming in high dimensions." *Phys. Rev. E* **99**:052111 (2019).

- R. Marsland III, W. Cui, J. Goldford, A. Sanchez, K. Korolev and P. Mehta, "Available energy fluxes drive a transition in the diversity, stability and functional structure of microbial communities." *PLoS Comp. Biol.* **15**:e1006793 (2019).
- R. Marsland III and J. England, "Active regeneration unites high- and low-temperature features in cooperative self-assembly," *Phys. Rev. E* **98**:022411 (2018).
- R. Marsland III and J. England, "Limits of Prediction in Thermodynamic Systems: A Review," *Rep. Prog. Phys.* **81**:016601 (2018).
- K. He, R. Marsland III, S. Upadhyayula, E. Song, S. Dang, B. R. Capraro, W. Wang, W. Skillern, R. Gaudin, M. Ma and T. Kirchhausen, "Dynamics of phosphoinositide conversion in clathrin-mediated endocytic traffic," *Nature* **552**:410 (2017).
- N. Perunov, R. Marsland III and J. England, "Statistical Physics of Adaptation," *Phys. Rev. X* **6**:021036 (2016).
- R. Marsland III and J. England, "Far-from-equilibrium distribution from near-steady-state work fluctuations," *Phys. Rev. E* **92**(5):052120 (2015).
- R. Marsland III, H.R. Brown, and G. Valente, "Time and irreversibility in axiomatic thermodynamics," *American Journal of Physics* **83**(7):628-634 (2015).
- T. Bhamre, R. Marsland III, I.K. Kominis, B.H. McGuyer, and W. Happer, "Collision Kernels from Velocity-Selective Optical Pumping with Magnetic Depolarization," *Phys. Rev. A* **87**(4):043412 (2013).
- R. Marsland III, B. H. McGuyer, B. A. Olsen, and W. Happer, "Spin-velocity correlations of optically pumped atoms," *Phys. Rev. A* **86**(2):023404 (2012).
- B. H. McGuyer, R. Marsland III, B. A. Olsen, and W. Happer, "Cusp Kernels for Velocity-Changing Collisions," *Phys. Rev. Lett.* **108**(18):183202 (2012).
- N. Kostinski, B. A. Olsen, R. Marsland, B. H. McGuyer, and W. Happer, "Temperature-insensitive laser frequency locking near absorption lines," *Rev. Sci. Instr.* **82**(3):033114 (2011).