

Education

- 2012 – Massachusetts Institute of Technology
Ragon Institute of MGH, MIT, and Harvard
Postdoctoral Adviser: Arup K Chakraborty
- 2006 – 2012 Rutgers, The State University of New Jersey
PhD, Physics. Adviser: Joel L Lebowitz
- 2002 – 2006 Duke University
BS, Physics (with distinction) and Mathematics, Magna cum laude
Honors Thesis Adviser: M Ronen Plesser

Research Interests

I use quantitative methods, rooted in statistical physics and machine learning, to study pathogen evolution and human immunity. I'm particularly interested in the evolution of highly mutable pathogens such as HIV, and how we might develop immunotherapies to fight them.

Publications

- 2016 **Barton JP**[†], De Leonardis E, Coucke A, Cocco S[†]. ACE: adaptive cluster expansion for maximum entropy graphical model inference. *Bioinformatics*, in press.
- Barton JP**, Goonetilleke N, Butler TC, Walker BD, McMichael AJ, Chakraborty AK. Relative rate and location of intra-host HIV evolution to evade cellular immunity is predictable. *Nature Communications* 7:11660.
- Butler TC⁼, **Barton JP**⁼, Kardar M, Chakraborty AK. Identification of drug resistance mutations in HIV from constraints on natural evolution. *Physical Review E* 93(2): 022412.
- Barton JP**, Chakraborty AK, Cocco S, Jacquin H, Monasson R. On the entropy of protein families. *Journal of Statistical Physics* 162(5): 1267-1293.
• *Part of the special issue "Information Processing in Living Systems"*
- 2015 **Barton JP**, Kardar M, Chakraborty AK. Scaling laws describe memories of host–pathogen riposte in the HIV population. *PNAS* 112(7): 1965-1970.
• *Awarded MIT Postdoctoral Association Travel Grant, 2015 APS March Meeting*
• *Highlighted on the MIT Postdoctoral Association website*
- 2014 Mann JK⁼, **Barton JP**⁼, Ferguson AL⁼, Omarjee S, Walker BD, Chakraborty AK, Ndung'u T. The fitness landscape of HIV-1 Gag: Advanced modeling approaches and validation of model predictions by in vitro testing. *PLoS Computational Biology* 10(8): e1003776.
- Barton JP**, Cocco S, De Leonardis E, Monasson R. Large pseudocounts and L₂-norm penalties are necessary for the mean-field inference of Ising and Potts models. *Physical Review E* 90(1): 012132.
- 2013 Shekhar K, Ruberman CF, Ferguson AL, **Barton JP**, Kardar M, Chakraborty AK. Spin models inferred from patient-derived viral sequence data faithfully describe HIV fitness landscapes. *Physical Review E* 88(6): 062705.
- Barton JP**, Sontag ED. The energy costs of insulators in biochemical networks. *Biophysical Journal* 104(6): 1380-1390.
- Barton J**, Cocco S. Ising models for neural activity inferred via selective cluster expansion: structural and coding properties. *Journal of Statistical Mechanics* 2013(03): P03002.
• *Part of the special issue "Statistical Physics and Neuroscience"*

⁼ Equal contributions [†] Co-corresponding authors

2011 **Barton J**, Lebowitz JL, Speer ER. Phase diagram of a generalized ABC model on the interval. *Journal of Statistical Physics* 145(3): 763-784.

Barton J, Lebowitz JL, Speer ER. The grand canonical ABC model: a reflection asymmetric mean-field Potts model. *Journal of Physics A: Mathematical and Theoretical* 44: 065005.

- *Included in the Journal of Physics A Highlights of 2011 collection*

Current work Rajkoomar E⁺, **Barton JP**⁺, Mann JK, Ndung'u T, Chakraborty AK. Modelling and in vitro testing of the HIV-1 Nef fitness landscape. Submitted.

Chakraborty AK, **Barton JP**. Rational design of effective vaccine targets and strategies for HIV: a crossroad of statistical physics, biology, and medicine. In preparation.

Quadeer AA, **Barton JP**, McKay MR, Chakraborty AK. Evolutionary constraints revealed by the fitness landscape of poliovirus-1 vp1 capsid protein. In preparation.

Barton JP, Chakraborty AK, Shrinivas K. Modeling the effects of human immunity on pathogen evolution. In preparation.

Invited talks

2016 Department of Microbiology, University of Pennsylvania Perelman School of Medicine

Coevolution in Proteins and RNA, Theory and Experiments Workshop

Keystone Systems Immunology Meeting (short talk selected from abstracts)

2015 Systems Immunology Workshop, Cincinnati Children's Hospital Medical Center

Mathematical Physics Seminar, Rutgers University

Center for Biophysics and Computational Biology, Temple University

Keystone HIV Vaccines Meeting (short talk selected from abstracts)

Monday Meeting, Ragon Institute of MGH, MIT and Harvard

2014 Institute for Advanced Study Focused Program on Computational and Experimental Immunology, Hong Kong University of Science and Technology

Monday Meeting, Ragon Institute of MGH, MIT and Harvard

2013 Harvard Microbial Evolution Group, Harvard University

Contributed presentations

2016 Koch Institute Immune Engineering Symposium, MIT

APS March Meeting

2015 Forecasting Evolution Conference (short talk invitation declined)

Third Annual Winter Q-Bio Meeting

2014 112th Statistical Mechanics Conference, Rutgers University

MIT Biophysics Retreat

MIT-MGH Meeting on IDB, Microbiome and Autoimmune Disease

2013 First Annual Winter Q-Bio Meeting

2012 108th Statistical Mechanics Conference, Rutgers University

107th Statistical Mechanics Conference, Rutgers University

2011 106th Statistical Mechanics Conference, Rutgers University

Honors and Awards

Lindau Nobel Laureate Meeting Attendee, Siemens AG Fellow (2015)

MIT Postdoctoral Association Travel Grant (2014)

Rutgers University Departmental Graduate Assistantship (2010, 2012)

GAANN Fellowship, Rutgers University (declined; 2006)

Phi Beta Kappa, National honor society

Sigma Pi Sigma, National physics honor society

Phi Eta Sigma, National honor society

Teaching Experience

Teaching assistant, Honors Physics III (Physics 273), Rutgers University

Senior teaching assistant, Extended General Physics (Physics 201), Rutgers University

Teaching assistant, Extended General Physics (Physics 201/202), Rutgers University

Teaching assistant, General Physics I-II (Physics 52L-54L), Duke University