
Postdoctoral Researcher
2012 - 2016
Massachusetts Institute of Technology
Ragon Institute of MGH, MIT & Harvard
Adviser: Arup K Chakraborty

PhD, Physics
2006 - 2012
Rutgers, The State University of New Jersey
Adviser: Joel L Lebowitz

BS, Physics & Mathematics
2002 - 2006
Duke University
Magna cum laude
Honors thesis adviser: M Ronen Plesser

Research Interests
I use methods from statistical physics and machine learning to study pathogen evolution and human immunity. I am particularly interested in highly mutable pathogens such as HIV, and the dynamical interactions between microbes and the immune system.

Publications
2016
Lorenzi JCC⁼, Cohen YZ⁼, Cohn LB, Kreider EF, **Barton JP** et al. Paired quantitative and qualitative assessment of the replication-competent HIV-1 reservoir and its relationship to integrated proviral DNA. PNAS 113 (49) E7908-E7916.

Barton JP[†], De Leonardis E, Coucke A, Cocco S[†]. ACE: Adaptive cluster expansion for maximum entropy graphical model inference. Bioinformatics 32(20): 3089-3097. Code: github.com/johnbarton/ACE.

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, 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.

- Publications
- 2014 **Barton JP**, Cocco S, De Leonardis E, Monasson R. Large pseudocounts and L_2 -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.
- 2011 **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"
- 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. Modeling 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. Submitted.
- Barton JP**, Chakraborty AK, Shrinivas K. Modeling the effects of human immunity on pathogen evolution. In preparation.
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- Invited talks
- 2016 116th Statistical Mechanics Conference, Rutgers University
Initiative for the Theoretical Sciences, CUNY (declined for family reasons)
Department of Microbiology, University of Pennsylvania 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

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| Contributed presentations | 2016 | IMES Research Progress Meeting 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 IBD, 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 |
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| | Honors & Awards | eLife Early-Career Reviewer (2016) 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) Phi Beta Kappa, National honor society Sigma Pi Sigma, National physics honor society Phi Eta Sigma, National honor society |
| Teaching Experience | <hr/> | |
| | | Teaching assistant, Honors Physics III (Physics 273), Rutgers University (2011) Senior teaching assistant, Extended General Physics (Physics 201), Rutgers University (2010) Teaching assistant, Extended General Physics (Physics 201/202), Rutgers University (2006 - 2009) Teaching assistant, General Physics I-II (Physics 52L-54L), Duke University (2003 - 2004) |