MICHAEL BAYM

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Harvard Medical School
Department of Biomedical Informatics
10 Shattuck St., Countway 303
Boston, MA 02115

Academic Appointments

Harvard Medical School
Associate Professor, Department of Biomedical Informatics — 2024 – present
Assistant Professor, Department of Biomedical Informatics — 2017 – 2024
Member, Laboratory of Systems Pharmacology — 2017 – present
Affiliate Faculty, Department of Microbiology — 2022 – present

Broad Institute of MIT and Harvard
Associate Member — 2019 – present

Rice University
Visiting Scholar in the Center for Theoretical Biological Physics — Spring 2017

Education and Training

Harvard Medical School
Postdoctoral Fellow in Systems Biology — 2009 – 2017
Advisor: Roy Kishony

Massachusetts Institute of Technology
Ph.D. in Applied Mathematics — 2009
Advisor: Bonnie Berger

University of Illinois at Urbana-Champaign (UIUC)
A.M. in Mathematics — 2003
B.S. in Mathematics with Highest Distinction — 2002
Senior Theses in Mathematics and Chemical Biology

Prizes, Awards, and Honors

Systems, Synthetic and Quantitative Biology PhD Program Mentorship Award — 2022

A. Clifford Barger Excellence in Mentoring Award (HMS) (about) — 2021
Harvard Medical-wide mentorship award

Pew Biomedical Scholarship (about) — 2020

Sloan Research Fellowship (about) — 2020
in Computational and Evolutionary Molecular Biology

Packard Fellowship for Science and Engineering (about) — 2018

NSF Mathematical Sciences Postdoctoral Research Fellowship (about) — 2009

Hertz Foundation Graduate Fellowship (about)	2004
ASEE-NDSEG Graduate Fellowship (about)	2004
Undergraduate Mathematics Major Award (UIUC Math) (about)	2002
Salma Wanna Award (UIUC Math) (about)	2001
Colgate-Palmolive Award for Undergraduate Research (UIUC)	2001
Chancellor's Scholar (UIUC) (about)	1999 – 2002

Publications

Google Scholar: `https://scholar.google.com/citations?user=AKLIO9AAAAAJ`

Reviewed Articles

1. K. Břinda, L. Lima, S. Pignotti, N. Quinones-Olvera, K. Salikhov, R. Chikhi, G. Kucherov, Z. Iqbal, **M. Baym**, *Efficient and Robust Search of Microbial Genomes via Phylogenetic Compression*, Nature Methods, *to appear*.
   Preprint: `https://www.biorxiv.org/content/10.1101/2023.04.15.536996`
2. N. Quinones-Olvera*, S.V. Owen*, L.M. McCully, M.G. Marin, E.A. Rand, A.C. Fan, O.J. Martins Dosumu, K. Paul, C.E. Sanchez Castaño, J.S. Paull, R. Petherbridge, **M. Baym**, *Diverse and abundant phages exploit conjugative plasmids*, Nature Communications, **15**, 3197 (2024)
3. A. Couce*, A. Limdi*, M. Magnan, S.V. Owen, C.M. Herren, R.E. Lenski, O. Tenaillon†, **M. Baym**†, *Changing fitness effects of mutations through long-term bacterial evolution*, Science, **383**, eadd1417 (2024)
4. S.G. Sutcliffe, S.A. Kraemer, I. Ellmen, J.J. Knapp, A.K. Overton, D. Nash, J.I. Nissimov, T.C. Charles, D. Dreifuss, I. Topolsky, P.I. Baykal, L. Fuhrmann, K.P. Jablonski, N. Beerenwinkel, J.I. Levy, A.S. Olabode, D.G. Becker, G. Gugan, E. Britnell, A.F.Y. Poon, R. Valieris, R.D. Drummond, A. Defelicibus, E. Dias-Neto, R.A. Rosales, I.T. Silva, A. Orfanou, F. Psomopoulos, N. Pechlivanis, L. Pipes, Z. Chen, J.A. Baaijens, **M. Baym**, B.J. Shapiro, *Tracking SARS-CoV-2 variants of concern in wastewater: an assessment of nine computational tools using simulated genomic data*, Microbial Genomics, **10 (5)**, 001249 (2024)
5. A. Limdi, **M. Baym**, *Resolving deleterious and near-neutral effects requires different pooled fitness assay designs*, Journal of Molecular Evolution, **91**, 325–333 (2023)
6. A. Nyerges, S. Vinke, R. Flynn, S.V. Owen, E.A. Rand, B. Budnik, E. Keen, K. Narasimhan, J.A. Marchand, M. Baas-Thomas, M. Liu, K. Chen, A. Chiappino-Pepe, F. Hu, **M. Baym**, G.M. Church, *Swapped genetic code blocks viral infections and gene transfer,* Nature, **615**, 720–727 (2023)
7. C.L. Dulberger*, C.A. Guerrero-Bustamante*, S.V. Owen, S. Wilson, M.G. Wuo, R.A. Garlena, L.A. Serpa, D.A. Russell, J. Zhu, B.J. Braunecker, G.R. Squyres, **M. Baym**, L. Kiessling, E.C. Garner, E.J. Rubin†. G.F. Hatfull†, *Mycobacterial nucleoid-associated protein Lsr2 is required for productive mycobacteriophage infection*, Nature Microbiology, **8**, 695–710 (2023)
8. J.A. Baaijens*, A. Zulli*, I.M. Ott*, M.E. Petrone, T. Alpert, J.R. Fauver, C.C. Kalinich, C.B.F. Vogels, M.I. Breban, C. Duvallet, K. McElroy, N. Ghaeli, M. Imakaev, M. Mckenzie-Bennett, K. Robison, A. Plocik, R. Schilling, M. Pierson, R. Littlefield, M. Spencer, B.B. Simen, Yale SARS-CoV-2 Genomic Surveillance Initiative, W.P. Hanage, N.D. Grubaugh†, J. Peccia†, **M. Baym**†, *Lineage abundance estimation for SARS-CoV-2 in wastewater using transcriptome quantification techniques*, Genome Biology, **23**, 1–20 (2022)

9. C. Herren, **M. Baym**, *Decreased thermal niche breadth as a trade-off of antibiotic resistance*, The ISME Journal, **16**, 1843–1852 (2022)
10. J.E. Silpe*, J.W.H. Wong*, S.V. Owen, **M. Baym**, E.P. Balskus, *The gut bacterial natural product colibactin triggers induction of latent viruses in diverse bacteria*, Nature, **603**, 315–320 (2022)
11. S.V. Owen*, N. Wenner*, C. Dulberger, E. Rodwell, A. Bowers-Barnard, N. Quinones-Olvera, D.J. Rigden, E.J. Rubin, E.C. Garner, **M. Baym**†, J.C.D. Hinton†, *Prophage-encoded phage defense proteins with cognate self-immunity*, Cell Host and Microbe, **29**, 1620–1633 (2021)
12. A.R. Rowe, F. Salimijazi, L. Trutschel, J. Sackett, O. Adesina, I. Anzai, L.H. Kugelmass, **M. Baym**, B. Barstow, *Identification of a Pathway for Electron Uptake in Shewanella oneidensis*, Communications Biology, **4**, 957 (2021)
13. K. Břinda, **M. Baym**†, G. Kucherov†, *Simplitigs as an efficient and scalable representation of de Bruijn graphs*, Genome Biology, **22**, 96 (2021)
14. L. Kennedy-Shaffer, **M. Baym**, W.P. Hanage, *Perfect as the enemy of good: tracing transmissions with low-sensitivity tests to mitigate SARS-CoV-2 outbreaks*, The Lancet Microbe, **2**, e219–24 (2021)
15. J. Kim, J.H. Bae, **M. Baym**, D.Y. Zhang, *Metastable Hybridization-based DNA Information Storage to Allow Rapid and Permanent Erasure*, Nature Communications, **11**, 5008 (2020)
16. J. Qian, Z. Lu, C.P. Mancuso, H. Jhuang, R. del Carmen Barajas-Ornelas, S.A. Boswell, F.H. Ramírez-Guadiana, V. Jones, A. Sonti, K. Sedlack, L. Artzi, G. Jung, M. Arammash, M. E. Pettit , M. Melfi, L. Lyon, S. V. Owen, **M. Baym**, A.S. Khalil, P. A. Silver, D.Z. Rudner, M. Springer, *Barcoded microbial system for high-resolution object provenance*, Science, **368**, 1135–1140 (2020)
17. D. Russ, F. Glaser, E.S. Tamar, I. Yelin, **M. Baym**, E.D. Kelsic, C. Zampaloni, A. Haldimann, R. Kishony, *Escape mutations circumvent a tradeoff between resistance to a beta-lactam and resistance to a beta-lactamase inhibitor*, Nature Communications, **11**, 2029 (2020)
18. K. Břinda, A. Callendrello, K. C. Ma, D,R. MacFadden, T. Charalampous, R.S. Lee, L. Cowley, C. B. Wadsworth, Y. H. Grad, G, Kucherov, J. O'Grady, **M. Baym**, W.P. Hanage, *Rapid heuristic inference of antibiotic resistance and susceptibility by genomic neighbor typing*, Nature Microbiology, **5**, 455-464 (2020)
19. R. Canals, R. R. Chaudhuri, R. E. Steiner, S.V. Owen, N. Quinones-Olvera, M. A. Gordon, **M. Baym**, M. Ibba, J. C. D. Hinton, *The fitness landscape of the African Salmonella Typhimurium ST313 strain D23580 reveals unique properties of the pBT1 plasmid*, PLOS Pathogens, **15(9)**, e1007948 (2019)
20. I. A. Anzai, L. Shaket, O. Adesina, **M. Baym**†, B. Barstow†, *Rapid curation of gene disruption collections using Knockout Sudoku*, Nature Protocols, **12**, 2110–2137 (2017)
21. D.T. Riglar, T.W. Giessen, **M. Baym**, S.J. Kerns, M.J. Niederhuber, R.T. Bronson, J.W. Kotula, G.K. Gerber, J.C. Way, P.A. Silver, *Engineered bacteria can function in the mammalian gut long-term as live diagnostics of inflammation*, Nature Biotechnology, **35**, 653–658 (2017)
22. C. Myhrvold, **M. Baym**, N. Hanikel, L.L. Ong, J.S. Gootenberg, P. Yin, *Barcode Extension for Analysis and Reconstruction of Structures*, Nature Communications, **8**, 14698 (2017)
23. **M. Baym***, L. Shaket, I.A. Anzai, O. Adesina, B. Barstow*, *Rapid Construction of a Whole-genome Transposon Insertion Collection for* Shewanella oneidensis *by Knockout Sudoku*, Nature Communications, **7**, 13270 (2016)
24. L.K. Stone, **M. Baym**, T.D. Lieberman, R. Chait, J. Clardy, R. Kishony, *Compounds that select against the tetracycline resistance efflux pump*, Nature Chemical Biology, **12**, 902–904 (2016)
25. **M. Baym**, T.D. Lieberman, E.D. Kelsic, R. Chait, R. Gross, I. Yelin, R. Kishony, *Spatiotemporal microbial evolution on antibiotic landscapes*, Science, **353**, 1147–1151 (2016)

Media attention including: PBS News Hour, CNN, NPR, The Atlantic, Haaretz, The Scientist, Smithsonian, Vox, Vice Motherboard, Wired, Gizmodo, Slate

26. A. Palmer*, E. Toprak*, **M. Baym**, S. Kim, A. Veres, S. Bershtein, R. Kishony, *Delayed commitment to evolutionary fate in antibiotic resistance fitness landscapes*, Nature Communications, **6**, 7385 (2015)
27. **M. Baym***, S. Kryazhimskiy*, T.D. Lieberman*, H. Chung*, M.M. Desai, R. Kishony, *Inexpensive Multiplexed Library Preparation for Megabase-Sized Genomes*, PLoS ONE, **10**, e0128036 (2015)
28. D.J. Klein, **M. Baym**, and P. Eckhoff, *The Separatrix Algorithm for Synthesis and Analysis of Stochastic Simulations with Applications in Disease Modeling*, PLoS ONE **9**, e103467 (2014)
29. N.M. Daniels, A. Gallant, J. Peng, L.J. Cowen, **M. Baym**, and B. Berger, *Compressive genomics for protein databases*, Bioinformatics **29:13** i283–i290 (2013)
30. **M. Baym** and D.B. West, *Bounds on the* k*-dimension of Products of Special Posets*, Order **30** 779–796 (2013)
31. P.-R. Loh*, **M. Baym***†, and B. Berger†, *Compressive Genomics*, Nature Biotechnology **30** 627–630 (2012)
    Selected for Highlights Track at RECOMB 2013 and ISMB 2013
32. D. Park, R. Singh, **M. Baym**, C. Liao, and B. Berger, *IsoBase: A Database of Functionally Related Proteins across PPI Networks*, Nucleic Acids Research, **39** D295–300 (2011)
33. D.S. Lun, G. Rockwell, N.J. Guido, **M. Baym**, J.A. Kelner, B. Berger, J.E. Galagan, and G.M. Church,*Large-scale identification of genetic design strategies using local search*, Molecular Systems Biology **5:296** (2009)
34. C.-S.Liao, K. Lu, **M. Baym**, R. Singh, and B. Berger, *IsoRankN: Spectral methods for global alignment of multiple protein networks*, Bioinformatics, **25(12)**: i253–258 (2009)
35. **M. Baym***, C. Bakal*, N. Perrimon and B. Berger, *High-Resolution Modeling of Cellular Signaling Networks.*, Proceedings of the 12th Annual International Conference on Research in Computational Molecular Biology (RECOMB) LNBI **4955**: 257–271 (2008)
36. **M. Baym** and A.W. Hübler, *Conserved quantities and adaptation to the edge of chaos*, Phys. Rev. E. **73**, 056210 (2006)

Preprints

37. E.A. Rand, S.V. Owen, N. Quinones-Olvera, K. Jean, C. Hernandez-Perez, **M. Baym**, *Phage DisCo: targeted discovery of bacteriophages by co-culture*, (2024)
    Preprint: `https://www.biorxiv.org/content/10.1101/2024.11.22.624878`
38. Y. J. Jiao*, **M. Baym***, A. Veres, R. Kishony, *Population diversity can jeopardize the efficacy of antibiotic cycling*, (2017)
    Preprint: `http://www.biorxiv.org/content/early/2016/10/20/082107`

*Authors contributed equally. †Co-senior author.

Review Articles

39. C. Souque, I. González Ojeda, **M. Baym**, *From Petri dishes to patients to populations: scales and evolutionary mechanisms driving antibiotic resistance*, Annual Reviews Microbiology, **78** (2024) (2024)
40. **M. Baym***, L.K. Stone*, R. Kishony, *Multidrug evolutionary strategies to reverse antibiotic resistance*, Science, **351**, 6268 (2016)

Consensus Report

41. Contributing author to "*Combating Antimicrobial Resistance and Protecting the Miracle of Modern Medicine*", National Academy Press, Washington, DC, (2021)

Perpective

42. **M. Baym**, *Sustainable Stewardship Needs Evolution*, Cell Host and Microbe, **26(1)**: 8 (2019)

Patents

Full list of 60 issued US patents searchable at: `https://patents.google.com/?inventor=Michael+Baym` or at `https://ppubs.uspto.gov/pubwebapp/static/pages/ppubsbasic.html`

Teaching and Mentoring

Courses

Harvard University

Community Phages Summer Phage Discovery Internship (w/ Roxbury Community College)	2022-present
Concepts in Genome Analysis (Graduate)	2018-present

MIT Teaching Assistant in Mathematics

Group Theory with Applications to Physics (Graduate)	2004
Principles of Applied Mathematics (Undergraduate)	2003

Postdoctoral Fellows

Tatiana Ruiz-Bedoya, PhD 2024-present

Fernando Rossine, PhD 2021-present

Célia Souque, PhD 2022-2024
Now: ECDC EUPHEM Fellow at Norwegian Institute of Public Health, Oslo

Siân Owen, PhD 2018-2024
Now: Research Scientist, Wadsworth Center, and Assistant Professor, SUNY Albany

Lucy McCully Espinosa, PhD 2019-2023
Now: Viral Sequencing Microbiologist, Massachusetts Department of Public Health

Karel Břinda, PhD 2017-2022
Now: INRIA Starting Faculty, INRIA, Rennes, France

Jasmijn Baaijens, PhD 2019-2021
Now: Assistant Professor of Computer Science, TU Delft, The Netherlands

Cristina Herren, PhD 2017-2021
Now: Assistant Teaching Professor of Marine and Environmental Sciences, Northeastern University

PhD Students

Kepler Mears Biological and Biomedical Sciences 2024-present

Shreyas Pai Systems, Synthetic, and Quantitative Biology 2023-present

Sophia Wiesenfeld Systems, Synthetic, and Quantitative Biology 2023-present

Amy Zamora Systems, Synthetic, and Quantitative Biology 2021-present

Arya Kaul Bioinformatics and Integrative Genomics 2020-present

Eleanor Rand Systems, Synthetic, and Quantitative Biology 2020-present

Natalia Quiñones-Olvera Systems, Synthetic, and Quantitative Biology 2018-2024

Anurag Limdi Molecules, Cells, and Organisms 2018-2023

Masters Students

Adele Collin Masters in Biomedical Informatics (HMS) 2023-present

Eve Rahbé École Polytechnique Fédérale de Lausanne (EPFL) 2018-2019
Best Masters Thesis in Life Sciences and Technology (EPFL)

Simone Pignotti Université Paris-Est 2018

Undergraduates

Jess Liang MSI Summer Internship / Harvard College Summer 2024-present

Alice Fan Sysbio Summer Internship / BU Summer 2022

Carmen Hernandez Perez SHURP / Cal State Northridge Summer 2022

Katelyn Lee Sysbio Summer Internship / Caltech Summer 2021

Mische Holland SIMBI / University of California San Diego Summer 2019 & 2020

Gabriella "Elle" Deich MIT MSRP / Duke University Summer 2019

Isabel Ott University of Georgia Summer 2018

Winston Michalek Harvard College Spring 2018

Media Coverage (selected)

60 Minutes (CBS) Could antibiotic-resistant "superbugs" become a bigger killer than cancer? 2019

NPR Here and Now (audio interview) Viral Video Shows How Frighteningly Fast Bacteria Can Evolve 2016

PBS News Hour Watch antibiotic-resistant bacteria evolve right before your eyes 2016

CNN See for yourself A giant petri dish models antibiotic resistance 2016

NPR WATCH : Bacteria Invade Antibiotics And Transform Into Superbugs 2016

The Atlantic Stunning Videos of Evolution in Action 2016

Wired A Gorgeous and Unsettling Video of Evolution in Action 2016

Slate Watch Evolution Occur Before Your Eyes 2016

Sydney Morning Herald Scientists reveal the frightening speed at which bacteria can develop antibiotic resistance 2016

Other Positions Held

Institute for Disease Modeling at Intellectual Ventures 2009 – 2014
Research Consultant in Epidemiological Modeling and Biomedical Technologies

Santa Fe Institute (SFI) 2003
Visiting Researcher in Chaos Theory and Theoretical Biology
Advisors: Alfred Hübler and Stuart Kauffman

UIUC Department of Chemistry 2001, 2002
Research Assistant in Computational Chemical Biology
Advisor: Zaida Luthey-Schulten

UIUC Department of Mathematics 2001
UNIX Consultant

Sigma Digital Designs 1996 – 1998
Co-founder and web content designer

Service

Infectious disease surveillance through wastewater analysis, Lorentz Center workshop, Leiden, NL 2024
Workshop Organizer

Harvard BIG Program 2017-
Admissions committee and interviewer

Harvard SSQBio Program 2017-
Admissions interviewer

NSF Division of Environmental Biology 2022
Ad hoc reviewer

NIAID/NIH Special Emphasis Panel 2022
Panel Member

National Academies of Sciences, Engineering, and Medicine (NASEM) Committee on the Long-term Health and Economic Effects of Antimicrobial Resistance 2020 – 2021
Committee Member

New PI Slack 2019 – 2022
Board Member

Harvard BBS Program 2019
Admissions committee

American Society of Microbiology ASM Microbe Meeting 2019
Session Organizer: "Molecular Insights from Experimental Evolution"

Natural Sciences and Engineering Research Council (NSERC), Canada 2018
External Reviewer

Peer Reviewed Medical Research Program (PRMRP) for the Department of Defense Congressionally Directed Medical Research Programs (CDMRP) 2018
Panel Reviewer

Harvard Data-Powered Strategies to Counteract Antibiotic Resistance Symposium 2018
Organizer

Harvard Biostatistics – Biomedical Informatics – Big Data (B3D) Seminar 2017 – 2018
Organizer

L'Agence Nationale de la Recherche (National Research Agency), France 2017
External reviewer

The Wellcome Trust, UK 2017
Peer reviewer

NSF Division of Environmental Biology 2017
Ad hoc reviewer

PLOS Genetics 2017
Guest Editor

NSF Division of Environmental Biology 2009
Panel reviewer

MIT Applied Mathematics Graduate Student Seminar (SPAMS) 2007 – 2008
Organizer