Griffin Chure, PhD (He/Him) | Curriculum Vitae

Email: griffinchure@gmail.com | Website: gchure.github.io | GitHub: gchure | ORCiD: 0000-0002-2216-205

I am a biological physicist with broad experience leveraging mathematical modeling, Bayesian statistical inference, and scientific software engineering to understand and interpret the emergent behavior of complex systems, ranging from cells to climates. I am passionate about building performant, robust software that employs quantitative methods to simulate physical systems and statistically analyze multimodal data. I believe fruitful science is borne from deep, altruistic collaboration between scientists and engineers across disciplines.

Education

PhD Biochemistry & Molecular Biophysics — Caltech
Division of Biology and Biological Engineering | Rob Phillips Lab — 2013 – 2020

BSc Biology (Honors) – Cell & Molecular Emphasis — University of Utah
BSc Chemistry (Minor Physics) – Biological Emphasis — 2009 – 2013
Department of Biology | David F. Blair Lab

Professional Experience

Postdoctoral Fellow — Jan. 2021 – Present
Stanford University | Stanford CA, USA | Department of Biology | Jonas Cremer Lab

Summary: I use a combination of theory, computation, and experiment to reverse engineer the regulatory circuits within cells that govern their physiology, ecology, and evolution. To do so, I build Python-based computational frameworks to run ecosystem-scale simulations of microbial communities and statistically analyze multimodal biological data.

Highlighted Project: I built and maintain hplc-py, an open-source Python tool for automated peak detection, deconvolution, and quantification of chemical signals chromatographic data.

Postdoctoral Scholar — Jun. 2020 – Dec. 2020
Caltech | Pasadena CA, USA | Department of Applied Physics | Rob Phillips Lab

Summary: I quantitatively explored the breadth and depth of human impacts on Earth's biogeochemistry and built resources for the rapid discovery of high-quality and accessible data sources.

Highlighted Project: I built anthroponumbers.org where I designed and developed both the backend database (stack: Django, PostgreSQL, Elasticsearch) and the frontend user interface (stack: Bootstrap, Vega-LiteJS). I collected, curated, standardized, and visualized the data which populates the database.

PhD Candidate — Jun. 2014 – Jun. 2020
Caltech | Pasadena CA, USA | Division of Biology and Biological Engineering | Rob Phillips Lab

Summary: I used statistical physics to derive and experimentally dissect predictive models of gene regulatory networks in bacteria. I routinely built state-of-the-art Bayesian inference pipelines (using Python + Stan) applying multilevel modeling, Markov Chain Monte Carlo (MCMC), and generative modeling of data-generating processes in biological measurements.

Highlighted Project: In Chure *et al.* 2019, I derived a statistical mechanical model of allosteric transcriptional regulation in bacteria that directly links the location of a mutation within a repressor to the biophysical parameters that describe its behavior. This allowed us to build a quantitative map between genotype and phenotype, a major goal of modern evolutionary biology.

Technical Skills

Development Skills
Python, Stan, Julia, JavaScript, Git+GitHub, GitHub Actions, bash, Linux, Matplotlib, Bokeh, NumPy, SciPy, Pandas, SymPy, scikit-learn, PyTorch

Analytical Skills
Bayesian Statistics, Probability Theory, Statistical Mechanics and Thermodynamics, Computational Statistics & Numerical Simulation, Quantitative Image Analysis, Linear Algebra

Publications

** Equal contribution. † Corresponding Author.*

Paradox of the Sub- Plankton: Plausible Mechanisms and Open Problems Underlying Strain-Level Diversity in Microbial Communities | Akshit Goyal† and Griffin Chure† | *Environmental Microbiology 27* DOI: 10.1111/1462-2920.70094 — 2025

Coordination Between Cytoplasmic and Envelope Densities Shapes Cellular Geometry in *Escherichia coli* — 2025
Griffin Chure†, Roshali T. de Silva, Richa Sharma, Michael C. Lanz and Jonas Cremer†
bioRxiv | DOI: 10.1101/2023.10.28.564462 | GitHub Repository

Quantifying the Daily Harvest of Fermentation Products From the Human Gut Microbiota — 2024
Markus Arnoldini†, Richa Sharma*, Claudia Moresi*, Griffin Chure, Julien Chabbey, Emma Slack and Jonas Cremer†
bioRxiv | DOI: 10.1101/2024.01.05.573977

Hplc-py: A Python Utility for Rapid Quantification of Complex Chemical Chromatograms — 2024
Griffin Chure† and Jonas Cremer | *Journal of Open Source Software* 9(94) | DOI: 10.21105/joss.06270
Software Documentation | Source Code

An Optimal Regulation of Fluxes Dictates Microbial Growth In and Out of Steady-State — 2023
Griffin Chure† and Jonas Cremer† | *eLife* | DOI: 10.7554/eLife.84878 | GitHub Repository | Paper Website

> ***Feature:*** *Avi I. Flamholz and Akshit Goyal (2023). "Matching metabolic supply to demand optimizes microbial growth." Trends in Microbiology. DOI: 10.1016/j.tim.2023.06.003*

Be Prospective, Not Retrospective: A Philosophy for Reproducibility in Modern Biological Research — 2022
Griffin Chure† | *arXiv* | DOI: 10.48550/arXiv.2210.02593 | Template Repository

Anthroponumbers.org: A Quantitative Database of Human Impacts on Planet Earth — 2022
Griffin Chure*†, Rachel A. Banks*, Avi I. Flamholz, Nicholas S. Sarai, Mason Kamb, Ignacio Lopez-Gomez, Yinon M. Bar-On, Ron Milo and Rob Phillips† | *Patterns* 3 | DOI: 10.1016/j.patter.2022.100552
GitHub Repository | Website

> ***Feature:*** *Selected as cover article for September 2022 issue.*
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> ***News Coverage:*** *Featured in articles by EurekAlert.org, Caltech, and Wired Magazine.*

Fundamental Limits on the Rate of Bacterial Growth and Their Influence on Proteomic Composition — 2021
Nathan M. Belliveau*, Griffin Chure*, Christina L. Hueschen, Hernan G. Garcia, Jane Kondev, Daniel S. Fisher, Julie A. Theriot† and Rob Phillips† | *Cell Systems* 12 | DOI: 10.1016/j.cels.2021.06.002
GitHub Repository | Paper Website

> ***Feature:*** *Selected as cover article for September 2021 issue.*

First-Principles Prediction of the Information Processing Capacity of a Simple Genetic Circuit — 2020
Manuel Razo-Mejia, Sarah S. Marzen, Griffin Chure, Muir J. Morrison, Rachel Taubman and Rob Phillips†
Physical Review E 102, 022404 | DOI: 10.1103/PhysRevE.102.022404

> ***Feature:*** *Selected as an "Editor's Suggested Article" for August 2020 issue*

Sequence-Dependent Dynamics of Synthetic and Endogenous RSSs in V(D)J Recombination — 2020
Soichi Hirokawa, Griffin Chure, Nathan M. Belliveau, Geoffery A. Lovely, Michael Anaya, David G. Schatz, David Baltimore and Rob Phillips† | *Nucleic Acids Research* 48(12) | DOI: 10.1093/nar/gkaa418
GitHub Repository | Paper Website

Theoretical Investigation of a Genetic Switch for Metabolic Adaptation — 2020
Kathrin S. Laxhuber, Muir J. Morrison, Griffin Chure, Nathan M. Belliveau, Charlotte Strandkvist, Kyle L. Naughton and Rob Phillips†| *PLoS ONE* 15(5) | DOI: 10.1371/journal.pone.0226453

Physiological Adaptability and Parametric Versatility in a Simple Genetic Circuit — 2019
Griffin Chure, Zofii A. Kaczmarek and Rob Phillips† | *bioRxiv* | DOI: 10.1101/2019.12.19.878462
GitHub Repository | Paper Website

Predictive Shifts in Free Energy Couple Mutations to Their Phenotypic Consequences — 2019
Griffin Chure, Manuel Razo-Mejia, Nathan M. Belliveau, Tal Einav, Stephanie L. Barnes, Zofii A. Kaczmarek, Mitchell Lewis and Rob Phillips† | *PNAS* 116(35) | DOI: 10.1073/pnas.1907869116 | GitHub Repository | Paper Website

Figure 1 Theory Meets Figure 2 Experiments in the Study of Gene Expression 2019
Rob Phillips†, Nathan M. Belliveau, Griffin Chure, Manuel Razo-Mejia, Clarissa Scholes and Hernan G. Garcia
Annual Reviews of Biophysics 48 | DOI: 10.1146/annurev-biophys-052118-115525

Connecting the Dots Between Osmotic Shock, Mechanosensitive Channel Abundance, and Survival at Single-Cell Resolution | Griffin Chure*, Heun J. Lee*, Akiko Rasmussen and Rob Phillips† 2018
Journal of Bacteriology 200(23) | DOI: 10.1128/JB.00460-18 | GitHub Repository | Paper Website
Feature: *Selected as an "article of significant interest" for December 2018 issue.*

Tuning Transcriptional Regulation Through Signaling: A Predictive Theory of Allosteric Induction 2018
Manuel Razo-Mejia*, Stephanie L. Barnes*, Nathan M. Belliveau*, Griffin Chure*, Tal Einav*, Mitchell Lewis and Rob Phillips† | *Cell Systems* 6 | DOI: 10.1016/j.cels.2018.02.004 | GitHub Repository | Paper Website
Featured Spotlight: *Quincey Justman (2018). "Splitting the World with Absolute Measurements: A Call for Collaborations in Physical Biology." Cell Systems (6). DOI: 10.1016/j.cels.2018.04.006*

Selected Invited Talks

The Form of Growth and Growth of Form: Understanding Cell Growth and Size Homeostasis From First Principles
Colorado School of Mines | Golden CO, USA | Quantitative Biosciences and Engineering Seminar Series Feb. 2024
The Ohio State University | Columbus OH, USA | Department of Microbiology Seminar Series Nov. 2024

How To Live Forever: Recipes for Reproducible Biological Research in the Digital Age
UC Berkeley | Berkeley CA, USA | Reproducibility in the Life Sciences Workshop Jul. 2023
Caltech | Pasadena CA, USA | Guest Lecture for BE/Bi 103: Data Analysis in the Life Sciences Nov. 2022 & 2023
New Science Foundation | Boston MA, USA | Guest Lecture for 2022 Fellows Jul. 2022

On Fundamental Limits, Degenerate Dimensions, and Serendipitous Consequence in Rapid Cellular Growth
Chan-Zuckerberg Biohub | San Francisco CA, USA | Invited Seminar by Dr. Ranen Avenir Mar. 2023

The Anthroponumbers: Building Quantitative Literacy for a Human Dominated Planet
Carnegie Institution for Science | Palo Alto CA, USA | Department of Global Ecology Lunch Seminar Series Sep. 2021

Selected Conference Presentations

An Optimal Regulation of Fluxes Dictates Microbial Growth In and Out of Steady-State Apr. 2023
Oral Presentation | Northern California Geobiology Symposium | Stanford CA, USA

Tight Control Over Cytoplasmic and Membrane Densities Defines Regulation of Cell Geometry in *E. coli* Mar. 2023
Oral Presentation | American Physical Society March Meeting | Minneapolis MN, USA

Hail to the Flux: or the Optimal Regulation of Cellular Resources Beyond Steady State Jan. 2023
Oral Presentation | Chan-Zuckerberg Biohub Physics of Life Conference | San Francisco CA, USA

Analytical Descriptions of Fundamental Constraints in Protein Synthesis and Microbial Growth Mar. 2022
Oral Presentation | American Physical Society March Meeting | Chicago IL, USA

The Energetics of Molecular Adaptation Jul. 2019
Oral Presentation | NORDITA Summer Course on Predictability and Control in Evolution | Stockholm, Sweden

Mentorship

Direct Mentorship of Graduate Students
Stanford University | Stanford CA, USA | Three Biology and Biophysics Graduate Students 2021–Present
Caltech | Pasadena CA, USA | Seven Biology, Physics, & Bioengineering Graduate Students 2015 – 2020
Summary: *I directly mentored students on projects covering cell physiology, experimental biochemistry, and statistical physics.*

Direct Mentorship of University Undergraduate Students
Caltech | Pasadena CA, USA | Three Biology and Applied Physics Undergraduates 2015 – 2020

University of Utah | Salt Lake City UT, USA | Two Chemistry Undergraduates 2011 – 2013

Summary: I directly mentored undergraduate students on a mix of honor's thesis projects, varying from experimental biochemistry to computational biology.

Direct Mentorship of Community College Undergraduate Students

Stanford University | Stanford CA, USA | Research Mentor | Three Physics & Mech. Eng. Undergraduates 2023

Summary: I directly mentored SF Bay Area community college students through the Stanford Small Science Group (SSG) program on 10-week research projects covering climate science and theoretical physics.

Direct Mentorship of Junior High School Students

Caltech | Pasadena CA, USA | Caltech RISE Physics, Biology, and Math Tutor | Three Jr. High Students 2015 – 2016

Summary: I tutored Pasadena, CA local junior high school students from underrepresented and disadvantaged backgrounds through the Caltech RISE Program. Topics included basic physics, cell biology, algebra, and geometry.

Service & Leadership

Scientific Committee Member for the Biohub "Physics of Life" Conference

Chan-Zuckerberg Biohub | San Francisco CA, USA Jan. & Oct. 2023, Sep. 2024

Summary: A biophysics conference for researchers in the SF bay area. Responsibilities included organizing the conference schedule, reading and scoring abstracts, introducing speakers, and mediating Q&A.

Session Chair and Organizer for "Quantitative Cell Physiology" Focus Session at APS

Upcoming: American Physical Society Global Physics Summit | Anaheim CA, USA Mar. 2025

American Physical Society March Meeting | Minneapolis, MN, USA Mar. 2024

American Physical Society March Meeting | Las Vegas NV, USA Mar. 2023

Summary: An internationally attended annual physics conference with a large biological physics community. Responsibilities included organizing a field-specific focus session, reading and scoring abstracts, introducing speakers, and mediating Q&A.

ENVISION International Research Proposal Competition Judge

ENVISION by WiSTEM | International 2021 – 2023

Summary: I served as a research proposal judge for an international research competition for high-school aged women and genderqueer students. Responsibilities included reading and scoring 5–6 page research proposals on feasibility, creativity, rigor, and scholarship. Topics included biomedical engineering and microbiology.

Graduate Student Council Program Co-Chair

Caltech Biochemistry & Molecular Biophysics Graduate Program | Pasadena CA, USA 2015 – 2018

Summary: I served as the co-chair of the graduate student council for my PhD program. Responsibilities included planning and organizing recruitment events, planning and organizing annual program retreats, design and administration of a program-wide student wellness survey, and conflict mediation between graduate students and their adviser.

Academic Honors & Awards

NSF Postdoctoral Research Fellowship in Biology | $230,000 USD Jan. 2021 – Dec. 2023

NSF Graduate Research Fellowship | Honorable Mention 2015

Amgen Research Fellowship | Full Stipend 2015

University of Utah "Honors at Entrance" Scholarship | Full Tuition Aug. 2009 – May 2013

Teaching Experience

Examples of my teaching materials, with a focus on computational exploration of biophysical principles, are available on the "Teaching" section of my personal website.

California Institute of Technology, Pasadena CA, USA

The Great Human Experiment by the Numbers 2020
Caltech APh 150 | Teaching Assistant with Prof. Rob Phillips | Undergraduate & Graduate Student Enrollment

Evolution 2020
Caltech Bi/Ge/ESE 105 | Teaching Assistant with Profs. Rob Phillips & Victoria Orphan | Undergraduate Enrollment

Physical Biology of the Cell 2018
Caltech BE/APh 161 | Teaching Assistant with Prof. Justin Bois | Undergraduate & Graduate Student Enrollment

Physical Biology Bootcamp 2017 – 2019
Caltech BE 262 | Optics Teaching Assistant with Prof. Rob Phillips | Incoming Graduate Student Enrollment

The Great Ideas of Biology 2017
Caltech Bi 1 | Head Teaching Assistant with Prof. Rob Phillips | Freshman Undergraduate Students

Data Analysis in the Biological Sciences 2015–2016
Caltech BE/Bi 103 | Teaching Assistant with Prof. Justin Bois | Undergrad, Graduate Student, & Postdoc Enrollment

Introduction to Programming for the Biological Sciences Bootcamp 2016
Caltech BE/Bi/NB 203 | Teaching Assistant with Prof. Justin Bois | Graduate Student & Postdoc Enrollment

The Great Experimental Ideas of Biology 2014–2015
Caltech Bi 1X | Head Teaching Assistant with Prof. Justin Bois | Undergraduate Student Enrollment

University of Utah, Salt Lake City UT, USA

Advanced Biochemistry Laboratory 2013
Lab Section Teaching Assistant with Prof. David Goldenberg | Undergraduate Student Enrollment

Principles of Genetics Sp. & Fa. 2012
Teaching Assistant with Prof. John S. Parkinson | Undergraduate & Graduate Student Enrollment

Molecular Biology Research Bootcamp 2010
Teaching Assistant with Prof. Rosemary Gray | Undergraduate Student Enrollment

Introduction to Biology 2010
Teaching Assistant with Prof. Tanya Vickers | Undergraduate Student Enrollment

International & Extramural

CSHL Physical Biology of the Cell 2015 & 2023
Computational Instructor | Cold Spring Harbor Laboratory, NY USA | Graduate Student Enrollment

IBDM Cell Biology by the Numbers 2018
Computational Instructor | Turing Centre for Development, Marseille FR | Graduate Student & Postdoc Enrollment

MBL Physical Biology of the Cell 2018
Optics Faculty Member | Marine Biological Laboratory, MA USA | Graduate Student, Postdoc, & Faculty Enrollment

MBL Physiology: Modern Cell Biology Using Microscopic, Biochemical, and Computational Approaches 2015–2018
Research Faculty Member | Marine Biological Laboratory, MA USA | Graduate Student, Postdoc, & Faculty Enrollment

GIST Physical Biology of the Cell 2016–2017
Computational Instructor | Gwangju Institute of Science and Technology, Gwangju PRK | Graduate Student Enrollment

KITP Evolutionary Cell Biology 2015
Research Instructor | Kavli Institute for Theoretical Physics, CA USA | Graduate Student, Postdoc, & Faculty Enrollment