

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

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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.

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## Education

### PhD Biochemistry & Molecular Biophysics

Division of Biology and Biological Engineering | Rob Phillips Lab

Caltech

2013 – 2020

### BSc Biology (Honors) – Cell & Molecular Emphasis

### BSc Chemistry (Minor Physics) – Biological Emphasis

Department of Biology | David F. Blair Lab

University of Utah

2009 – 2013

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## 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](https://github.com/gchure/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](https://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.

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## 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

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## Publications

\* Equal contribution. † Corresponding Author.

- Coordination Between Cytoplasmic and Envelope Densities Shapes Cellular Geometry in *Escherichia coli*** 2025  
Griffin Chure<sup>†</sup>, Roshali T. de Silva, Richa Sharma, Michael C. Lanz and Jonas Cremer<sup>†</sup>  
*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<sup>†</sup>, Richa Sharma\*, Claudia Moresi\*, Griffin Chure, Julien Chabbey, Emma Slack and Jonas Cremer<sup>†</sup>  
*bioRxiv* | DOI: 10.1101/2024.01.05.573977
- Hplc-py: A Python Utility for Rapid Quantification of Complex Chemical Chromatograms** 2024  
Griffin Chure<sup>†</sup> 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<sup>†</sup> and Jonas Cremer<sup>†</sup> | *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<sup>†</sup> | *arXiv* | DOI: 10.48550/arXiv.2210.02593 | [Template Repository](#)
- Anthroponumbers.org: A Quantitative Database of Human Impacts on Planet Earth** 2022  
Griffin Chure<sup>\*†</sup>, Rachel A. Banks\*, Avi I. Flamholz, Nicholas S. Sarai, Mason Kamb, Ignacio Lopez-Gomez, Yinon M. Bar-On, Ron Milo and Rob Phillips<sup>†</sup> | *Patterns* 3 | DOI: 10.1016/j.patter.2022.100552  
[GitHub Repository](#) | [Website](#)  
*Feature:* Selected as cover article for September 2022 issue.  
*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<sup>†</sup> and Rob Phillips<sup>†</sup> | *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<sup>†</sup>  
*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<sup>†</sup> | *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<sup>†</sup> | *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<sup>†</sup> | *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<sup>†</sup> | *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<sup>†</sup>, 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

<b>Connecting the Dots Between Osmotic Shock, Mechanosensitive Channel Abundance, and Survival at Single-Cell Resolution   <u>Griffin Chure</u>*</b> , Heun J. Lee*, Akiko Rasmussen and Rob Phillips <sup>†</sup> <i>Journal of Bacteriology</i> 200(23)   DOI: 10.1128/JB.00460-18   <a href="#">GitHub Repository</a>   <a href="#">Paper Website</a> <i>Feature: Selected as an "article of significant interest" for December 2018 issue.</i>	2018
<b>Tuning Transcriptional Regulation Through Signaling: A Predictive Theory of Allosteric Induction</b> Manuel Razo-Mejia*, Stephanie L. Barnes*, Nathan M. Belliveau*, <u>Griffin Chure</u> *, Tal Einav*, Mitchell Lewis and Rob Phillips <sup>†</sup>   <i>Cell Systems</i> 6   DOI: 10.1016/j.cels.2018.02.004   <a href="#">GitHub Repository</a>   <a href="#">Paper Website</a> <i>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</i>	2018

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## Selected Invited Talks

<b>The Form of Growth and Growth of Form: Understanding Cell Growth and Size Homeostasis From First Principles</b> Colorado School of Mines   Golden CO, USA   Quantitative Biosciences and Engineering Seminar Series The Ohio State University   Columbus OH, USA   Department of Microbiology Seminar Series	Feb. 2024 Nov. 2024
<b>How To Live Forever: Recipes for Reproducible Biological Research in the Digital Age</b> UC Berkeley   Berkeley CA, USA   Reproducibility in the Life Sciences Workshop Caltech   Pasadena CA, USA   Guest Lecture for BE/Bi 103: Data Analysis in the Life Sciences New Science Foundation   Boston MA, USA   Guest Lecture for 2022 Fellows	Jul. 2023 Nov. 2022 & 2023 Jul. 2022
<b>On Fundamental Limits, Degenerate Dimensions, and Serendipitous Consequence in Rapid Cellular Growth</b> Chan-Zuckerberg Biohub   San Francisco CA, USA   Invited Seminar by Dr. Ranen Avenir	Mar. 2023
<b>The Anthroponumbers: Building Quantitative Literacy for a Human Dominated Planet</b> Carnegie Institution for Science   Palo Alto CA, USA   Department of Global Ecology Lunch Seminar Series	Sep. 2021

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## Selected Conference Presentations

<b>An Optimal Regulation of Fluxes Dictates Microbial Growth In and Out of Steady-State</b> Oral Presentation   Northern California Geobiology Symposium   Stanford CA, USA	Apr. 2023
<b>Tight Control Over Cytoplasmic and Membrane Densities Defines Regulation of Cell Geometry in <i>E. coli</i></b> Oral Presentation   American Physical Society March Meeting   Minneapolis MN, USA	Mar. 2023
<b>Hail to the Flux: or the Optimal Regulation of Cellular Resources Beyond Steady State</b> Oral Presentation   Chan-Zuckerberg Biohub Physics of Life Conference   San Francisco CA, USA	Jan. 2023
<b>Analytical Descriptions of Fundamental Constraints in Protein Synthesis and Microbial Growth</b> Oral Presentation   American Physical Society March Meeting   Chicago IL, USA	Mar. 2022
<b>The Energetics of Molecular Adaptation</b> Oral Presentation   NORDITA Summer Course on Predictability and Control in Evolution   Stockholm, Sweden	Jul. 2019

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## 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
<i>Summary: I directly mentored students on projects covering cell physiology, experimental biochemistry, and statistical physics.</i>	

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

## 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.*

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## 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.*

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## 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

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## 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

<b>Evolution</b>	2020
Caltech Bi/Ge/ESE 105   Teaching Assistant with Profs. Rob Phillips & Victoria Orphan   Undergraduate Enrollment	
<b>Physical Biology of the Cell</b>	2018
Caltech BE/APh 161   Teaching Assistant with Prof. Justin Bois   Undergraduate & Graduate Student Enrollment	
<b>Physical Biology Bootcamp</b>	2017 – 2019
Caltech BE 262   Optics Teaching Assistant with Prof. Rob Phillips   Incoming Graduate Student Enrollment	
<b>The Great Ideas of Biology</b>	2017
Caltech Bi 1   Head Teaching Assistant with Prof. Rob Phillips   Freshman Undergraduate Students	
<b>Data Analysis in the Biological Sciences</b>	2015–2016
Caltech BE/Bi 103   Teaching Assistant with Prof. Justin Bois   Undergrad, Graduate Student, & Postdoc Enrollment	
<b>Introduction to Programming for the Biological Sciences Bootcamp</b>	2016
Caltech BE/Bi/NB 203   Teaching Assistant with Prof. Justin Bois   Graduate Student & Postdoc Enrollment	
<b>The Great Experimental Ideas of Biology</b>	2014–2015
Caltech Bi 1X   Head Teaching Assistant with Prof. Justin Bois   Undergraduate Student Enrollment	
<i>University of Utah, Salt Lake City UT, USA</i>	
<b>Advanced Biochemistry Laboratory</b>	2013
Lab Section Teaching Assistant with Prof. David Goldenberg   Undergraduate Student Enrollment	
<b>Principles of Genetics</b>	Sp. & Fa. 2012
Teaching Assistant with Prof. John S. Parkinson   Undergraduate & Graduate Student Enrollment	
<b>Molecular Biology Research Bootcamp</b>	2010
Teaching Assistant with Prof. Rosemary Gray   Undergraduate Student Enrollment	
<b>Introduction to Biology</b>	2010
Teaching Assistant with Prof. Tanya Vickers   Undergraduate Student Enrollment	
<i>International &amp; Extramural</i>	
<b>CSHL Physical Biology of the Cell</b>	2015 & 2023
Computational Instructor   Cold Spring Harbor Laboratory, NY USA   Graduate Student Enrollment	
<b>IBDM Cell Biology by the Numbers</b>	2018
Computational Instructor   Turing Centre for Development, Marseille FR   Graduate Student & Postdoc Enrollment	
<b>MBL Physical Biology of the Cell</b>	2018
Optics Faculty Member   Marine Biological Laboratory, MA USA   Graduate Student, Postdoc, & Faculty Enrollment	
<b>MBL Physiology: Modern Cell Biology Using Microscopic, Biochemical, and Computational Approaches</b>	2015–2018
Research Faculty Member   Marine Biological Laboratory, MA USA   Graduate Student, Postdoc, & Faculty Enrollment	
<b>GIST Physical Biology of the Cell</b>	2016–2017
Computational Instructor   Gwangju Institute of Science and Technology, Gwangju PRK   Graduate Student Enrollment	
<b>KITP Evolutionary Cell Biology</b>	2015
Research Instructor   Kavli Institute for Theoretical Physics, CA USA   Graduate Student, Postdoc, & Faculty Enrollment	