

# Christopher Mathy, PhD

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Interested in integrating protein biophysics with systems biology for developing better protein engineering approaches. Dual experimental and computational training. **Experimental:** biochemistry and biophysics of proteins, and techniques for measuring their quantitative functions in cells. **Computational:** large-scale analysis of interaction networks and omics data, as well as protein modeling in Rosetta.

## EDUCATION

PhD in Bioengineering	UC San Francisco and UC Berkeley	2022
<i>Systems biology of allosteric GTPase mutations</i> , advised by Tanja Kortemme, PhD		
BS in Bioengineering, with honors	Stanford University	2016
<i>Engineering the NK1 Fragment of the Human Hepatocyte Growth Factor for Dual Use as a Potent Agonist and a Gene Therapy Delivery Vehicle</i> , advised by Jennifer Cochran, PhD		

## PUBLICATIONS

### Peer-reviewed:

1. Perica, T\*, Mathy, CJP\*, Xu J, Jang GM, Zhang Y, Kaake R, Ollikainen N, Braberg H, Swaney DL, Lambright DG, Kelly MJS, Krogan NJ, & Kortemme T. (2021). Systems-level effects of allosteric perturbations to a model molecular switch. *Nature*, 599, 152–157.  
\* denotes equal contribution.
2. Baker JJ, Mathy CJP, Schaletzky J. (2021) A proposed workflow for proactive virus surveillance and prediction of variants for vaccine design. *PLOS Computational Biology*, 17(12), e1009624.
3. Bouhaddou M, Memon D, Meyer B et al. [including Mathy CJP] (2020). The Global Phosphorylation Landscape of SARS-CoV-2 Infection. *Cell*, 182(3), 685–712.e19.
4. Gordon DE, Jang GM, Bouhaddou M et al. [including Mathy CJP] (2020). A SARS-CoV-2 protein interaction map reveals targets for drug repurposing. *Nature*, 583(7816), 459–468.

### Pre-prints:

Mathy CJP, Mishra P, Flynn JM, Perica T, Mavor D, Bolon DNA\*, Kortemme T\*. (2022). Complete mutational mapping of a GTPase switch in vivo reveals novel allosteric regulation. In bioRxiv (p. 2022.04.13.488230). <https://doi.org/10.1101/2022.04.13.488230>

\* denotes co-corresponding author.

### Additional works:

Mathy CJP (2016). Engineering the NK1 Fragment of the Human Hepatocyte Growth Factor for Dual Use as a Potent Agonist and a Gene Therapy Delivery Vehicle. *Stanford Digital Repository*. Senior Undergraduate Thesis, <http://purl.stanford.edu/kw533qg7356>

## AWARDS

2022	Bioengineering Service and DEIB Awards - for service to the graduate program and contributions to diversity, equity, inclusion, and belonging. (\$1500)
2018 - 2021	Byers Family Discovery Fellow, UC San Francisco. (\$6000)
2019	Best Poster, Quantitative Biosciences Consortium Retreat, UC San Francisco.
2016	Top 10 team nationwide, NIBIB/VentureWell Design by Biomedical Undergraduate Teams Challenge.

## INVITED TALKS

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- 2021-11-11 Integrating biophysics and high-throughput systems biology to uncover new models of GTPase switch function. *Special Guest Speaker, Pathology Advanced Translational Research Unit (PATRU)*. Emory University School of Medicine Department of Pathology and Laboratory Medicine.
- 2021-08-09 Conformational switching constrains the mutational tolerance of novel allosteric sites in the GTPase Gsp1. *Annual RosettaCon Protein Design Conference*. RosettaCommons, virtual conference.
- 2021-04-07 Integrating biophysics and systems biology to uncover new models of GTPase switch function. *19th Annual National Graduate Student Symposium*. St. Jude Children's Research Hospital, Memphis, TN.
- 2020-01-28 Integrating biophysics and systems biology to understand mutations of the GTPase Ran/Gsp1. *Signaling Across Scales Symposium*. Quantitative Biosciences Institute, UC San Francisco.
- 2018-10-27 Mapping molecular properties of Gsp1 point mutants to cellular phenotype. *Bioengineering Retreat*. UC Berkeley - UC San Francisco Graduate Group in Bioengineering.

## POSTER PRESENTATIONS

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- 2021-10-14 [Mathy CJP](#), Mavor D, Flynn JM, Perica T, Mishra P, Kelly MJS, Kortemme T, Bolon DN. Conformational switching constrains the mutational tolerance of novel allosteric sites in the GTPase Gsp1. UC Berkeley – UC San Francisco Bioengineering Retreat.
- 2019-10-05 [Mathy CJP](#), Perica T, Xu J, Zhang Y, Ollikainen N, Jang G, Kaake R, Swaney D, Kelly MJS, Krogan NJ, Kortemme T. Allosteric coupling between interfaces and the nucleotide binding site of the small GTPase Gsp1 influences cellular processes. Quantitative Biosciences Consortium, UCSF. *Received Best Poster Award*
- 2019-06-02 [Mathy CJP](#), Perica T, Zhang Y, Ollikainen N, Xu J, Jang G, Kaake R, Swaney D, Kelly MJS, Krogan NJ, Kortemme T. Targeted mutational perturbations of the small GTPase Ran reveal how pleiotropy is encoded in a model molecular switch. *Protein Science* (Vol. 28, pp. 200-201). Annual Protein Society Meeting.
- 2018-08-09 [Mathy CJP](#), Perica T, Zhang Y, & Kortemme T. Biophysical analysis to map molecular properties of Gsp1 point mutations to their cellular scale phenotypes. Annual RosettaCon Protein Design Conference.
- 2018-02-21 [Mathy CJP](#), Perica T, & Kortemme T. Mapping of molecular-level perturbations to systems-level phenotypes in Gsp1/Ran, a highly conserved protein switch. Biophysical Society Annual Meeting.
- 2017-10-07 [Mathy CJP](#), Perica T, & Kortemme T. Mathematical modeling of Gsp1, a protein switch, to map mutations to phenotypic perturbations. UC Berkeley – UC San Francisco Bioengineering Retreat.
- 2016-05-24 [Mathy CJP](#). Engineering the NK1 Fragment of the Human Hepatocyte Growth Factor for Dual-Use as a Potent Agonist and a Gene Therapy Delivery Vehicle. Stanford Bioengineering Honors Poster Fair.
- 2016-04-07 Baisiwal S, [Mathy CJP](#), Moahi K, & Malavé C. Gel-Aid, Redefining Wound Packing: An Absorbent Removable Hydrogel. Stanford Tau Beta Pi + IEEE Engineering Showcase.
- 2015-10-24 [Mathy CJP](#), Lim S, & Cochran JR. Internalization Study of the NK1 Fragment of the Human Hepatocyte Growth Factor. Symposium of Undergraduate Research and Public Service at Stanford University.
- 2013-08-29 [Mathy CJP](#), Lim S, & Cochran JR. Development of Reporter Cell Assay for Engineering Human Hepatocyte Growth Factor. *Summer Research Experience for Undergraduates Poster Fair at Stanford University*

## TEACHING

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- 2021 Teaching Assistant, UCSF Biophysics 219: Computational Protein Design. Prepared exercises on computational protein modeling in Rosetta. Led a project group which successfully predicted the binding affinities of mutations in the SARS-CoV-2 Spike protein with the ACE2 receptor using  $\Delta\Delta G$  calculations in Rosetta. Prepared lectures for first year UCSF graduate students, including the topic of protein design for therapeutic applications.
- 2018 Certificate, Science Teaching Effectiveness Program for Upcoming Professors (STEP-UP) workshop, UC San Francisco. 16-hour program on evidence-based teaching strategies that support student-centered learning in the college classroom, with an emphasis on supporting diverse learners.
- 2016 Teaching assistant, BIOE 131: Ethics in Bioengineering, Stanford University.

2014 - 2016      Personal tutor for middle- and high-school aged students in the San Francisco Bay Area.

## SERVICE & OUTREACH

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2021 - 2022      Co-President, UC Berkeley - UCSF Graduate Group in Bioengineering Association of Students. Non-voting member of the graduate program Executive Committee, advocating for student issues.

2020 - 2022      Admissions Committee, UC Berkeley - UCSF Graduate Group in Bioengineering Association of Students. Performed holistic admissions review for 70 applicants to the graduate program alongside faculty and 9 other PhD students.

2020 - 2021      Specialist, Rapid Reviews COVID-19 (MIT Press). Screened and pitched preprints for review and publication at Rapid Reviews COVID-19, an open-access overlay journal based at UC Berkeley.

2018 - 2019      Volunteer Educator, UCSF Science & Health Education Partnership. Taught scientific lessons in collaboration with teachers at local area elementary schools.

2017 - 2019      Retreat Committee, UC Berkeley - UCSF Graduate Group in Bioengineering Association of Students. Organized two annual scientific meetings with over 150 attendees.

2017 - 2019      Recruitment Committee, UC Berkeley - UCSF Graduate Group in Bioengineering Association of Students. Organized two annual visits for over 50 PhD program applicants.

2018              UCSF Center for Community Engagement Research Committee. Strategic planning and grant application review for partnerships between UCSF and community organizations.

2017              Volunteer Educator, Bay Area Scientists in Schools. Taught scientific lessons in collaboration with teachers at local area elementary schools.

## MENTORSHIP

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2019              Wilson Nieves Vasquez, UCSF Biophysics PhD Student. Supervised for 10-week rotation project using hydrogen-deuterium exchange to study the differences in GTPase conformations.

2019              Maru Jaime Garza, UCSF Biophysics PhD Student. Supervised for 10-week rotation project using 1-D <sup>31</sup>P-NMR to study the effect of partner binding on GTPase conformations.

2019              Christina Stephens, UCSF Biophysics PhD Student. Supervised for 10-week rotation project using computational protein modeling to examine how mutations impact GTPase conformational dynamics.

## ADDITIONAL RESEARCH EXPERIENCE

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**PhD Rotation Student**              PI: Michael Keiser, PhD              UC San Francisco              2017  
*Prediction of drug target proteins using a neural network trained on 3-dimensional fingerprints of small molecules.*  
Trained neural networks to predict protein target activation EC50 values using vectorized representations of small molecules drugs.

**PhD Rotation Student**              PI: Adam P Arkin, PhD              UC Berkeley              2016  
*Engineering a genetic circuit for proportional regulation of protein production.*  
Designed experiments for implementing proportional feedback control with genetic circuit components.

**Undergraduate Biodesign Team**              PI: Fan Yang, PhD              Stanford University              2015-2016  
*Gel-Aid, a removable, alginate-based hydrogel for wound packing after surgical-site infections.*  
Year-long class project (four person team) on clinical needs-based biomedical device development. We partnered with clinicians to design, prototype, and validate a hydrogel-based solution for wound management. The translational potential of our invention was recognized by the University and we filed a provisional patent through Stanford University's Office of Technology & Licensing (May 27, 2016 U.S. Provisional Application No.: 62/342830). Additionally, we were recognized with an honorable mention (top 10 team, nationwide) at the 2016 NIBIB/VentureWell Design by Biomedical Undergraduate Teams (DEBUT) National Challenge.

**Undergraduate Researcher**              PI: John Löfblom, PhD              KTH Royal Inst. of Tech., Stockholm, Sweden              2015  
*Characterization of VEGFR2-binding affibodies for biotherapy applications.*  
Purified six multivalent affibody proteins grown in *E. coli* and measured thermal stability using circular dichroism. Evaluated angiogenic potency using an ELISA-linked VEGFR2 phosphorylation assay.