

Elliot MacKrell, Ph.D.

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[GitHub Portfolio](#) • [Personal Website](#) • [LinkedIn](#)

Education

California Institute of Technology

Pasadena, CA

Ph.D. Chemical Engineering

2016-2024

Thesis (Defended 6/20/24): *Global Analysis of Protein Synthesis and Degradation in Escherichia coli*

University of Florida

Gainesville, FL

B.S. Chemical Engineering

2016

Minor: Biomolecular Engineering

Research Experience

California Institute of Technology, Division of Chemistry and Chemical Engineering

2016-Present

Postdoctoral Scholar (2024-Present); Advisor: Prof. David A. Tirrell

Ph.D. Candidate - NSF Graduate Fellow (2016-2024); Advisor: Prof. David A. Tirrell

- Discovered global regulatory roles of proteolysis by combining chemoproteomic analysis, linear modeling, text mining, and machine learning to identify novel protease substrates in *Escherichia coli*.
- Developed and deployed an open-source interactive application for filtering, normalization, differential expression analysis, and pathway enrichment analysis of mass spectrometry-based proteomics data. ([repository](#)) ([publication](#))
- Identified DNA repair factors recruited to colibactin-induced DNA interstrand cross-links in *Xenopus* egg extracts via differential expression analysis and time-series clustering of chromatin mass spectrometry data. ([preprint](#))

EMD Serono, Department of Translational Medicine and Global Clinical Development

2022

Bioinformatics Co-op; Supervisor: Dr. Irina Kalatskaya

- Developed Shiny application for visualizing cell type-specific transcript abundance, identifying differentially expressed genes, and conducting gene set enrichment analysis in clinical samples across autoimmune disease states.
- Established pipeline and Shiny application for the real-time analysis of text mining data from PubMed to identify genes, pathways, and diseases of therapeutic interest through information-theoretic and statistical approaches.

Harvard Medical School, Wellman Center for Photomedicine, Massachusetts General Hospital

2015

NSF REU Fellow; Advisor: Prof. Robert Redmond

- Investigated the effects of photocrosslinking on ex vivo tissue biomechanics via cyclic uniaxial tensile testing.

Johns Hopkins University School of Medicine, Department of Radiation Oncology

2014

NSF REU Fellow; Advisor: Prof. Robert Ivkov

- Evaluated the anti-tumor immune response generated by magnetic nanoparticle hyperthermia and ionizing radiation treatments in a mouse model for cancer.

University of Florida, Department of Chemistry

2012-2015

Undergraduate Research Assistant; Advisor: Prof. Brent S. Sumerlin

- Developed an amphiphilic and pH-responsive copolymer for phloem-specific drug delivery in plants by functionalizing polysuccinimide (PSI) with various hydrophilic molecules.

Publications

Altshuller, M., He, X., **MacKrell, E. J.**, Wernke, K. M., Wong, J.W. H., Sellés Baiget, S., Wang, T. Y., Chou, T. F., Duxin, J. P., Baskus, E. P., Herzon, S. B., Semlow, D. R. "The Fanconi anemia pathway repairs colibactin-induced DNA interstrand cross-links." **bioRxiv**, 2024. <https://doi.org/10.1101/2024.01.30.576698>

Jones, J.J., **MacKrell, E.J.**, Wang, T.Y., Lomenick, B., Roukes, L.M., and Chou, T.F. “tidyproteomics: An open-source R package and data object for quantitative proteomics post analysis and visualization.” **BMC Bioinformatics**, **2023**, *24*, 239. <https://doi.org/10.1186/s12859-023-05360-7>

Hill, M.R., **MacKrell, E.J.**, Forsthoefel, C.P., Jensen, S., Chen, M., Moore, G., He, Z.L. and Sumerlin, B.S. “Biodegradable and pH-Responsive Nanoparticles Designed for Site-Specific Delivery in Agriculture.” **Biomacromolecules**, **2015**, *16*, 1276-1282. <https://doi.org/10.1021/acs.biomac.5b00069>

Manuscripts in preparation

MacKrell, E. J., Lomenick, B., Chou, T. F., and Tirrell, D. A. “Global protease substrate identification reveals instability of diverse regulators in *Escherichia coli*.” Manuscript in preparation.

MacKrell, E. J., Lomenick, B., Chou, T. F., and Tirrell, D. A. “MazF activates the cold shock response in *Escherichia coli*.” Manuscript in preparation.

Technical Skills

Bioinformatics and statistics: Mass spectrometry-based proteomics analysis, RNA-seq analysis, Text mining, Machine learning, Cloud computing, Shiny application development, Linear modeling, Regulatory network analysis, Gene set enrichment, Bayesian inference

Programming languages: Python, R, Bash

Machine learning: Scikit-learn, PyTorch, XGBoost

Data analysis and visualization: Pandas, NumPy, Matplotlib, Seaborn, Jupyter Notebook, Shiny, Bioconductor, tidyverse

Cloud and development tools: Docker, AWS EC2, Git, Visual Studio Code, RStudio

Software suites: GeneData Profiler, Proteomics analysis suites (MaxQuant, Proteome Discoverer), Clarivate CBDD

Laboratory skills: Molecular cloning, Bacterial culture, Genome editing (Recombination, CRISPR-Cas9), Immunoblotting, Confocal microscopy, Proteomics sample preparation

Awards and Honors

CEMI Pilot Grant , California Institute of Technology	2018
CEMI Fellow , California Institute of Technology	2016-2024
NSF Graduate Research Fellowship , California Institute of Technology	2016-2021
Yao Su Student Research Prize , HST Summer Institute	2015
NSF REU Fellowship , Harvard-MIT Division of Health Sciences and Technology (HST)	2015
Collins Engineering Scholarship , University of Florida	2015
NSF REU Fellowship , Johns Hopkins University Institute for NanoBioTechnology (INBT)	2014
University Scholars Program , University of Florida	2013

Presentations

MacKrell, E.J., Sweredoski, M.J., Moradian, A., Garbos, S.D., Tirrell, D.A. “Engineered Protein Degradation for Time-Resolved Proteomics in Bacteria.” Poster presentation delivered at ASM Microbe, San Francisco, CA, June 2019.

Liu, X., **MacKrell, E.J.**, Tirrell, D.A. “Selective Protein Labeling of Nutrient-Limited Cells in Heterogeneous Biofilms with Bio-Orthogonal Non-Canonical Amino Acid Tagging (BONCAT)” Poster presentation delivered at the Institute for Collaborative Biotechnologies Summer Meeting, Santa Barbara, CA, July 2017.

MacKrell, E.J., McCormack, M., Goldstone, R. and Redmond, R. "Effects of Photocrosslinking on Tissue Biomechanics." Poster presentation delivered at the Harvard-MGH Summer Institute Presentations, Cambridge, MA, August 2015.

Hill, M.R., **MacKrell, E.J.**, Forsthoefel, C.P., Jensen, S., Moore, G., He, Z.L. and Sumerlin, B.S. "Biodegradable and pH-Responsive Nanoparticles Designed for Site-Specific Delivery in Agriculture." Poster presentation delivered at the AIChE Annual Student Conference, Atlanta, GA, November 2014.

MacKrell, E.J., Attaluri, A.C., Zhou, H., Hedayati, M. and Ivkov, R. "Immunomodulation via Nanoparticle-Mediated Hyperthermia and Ionizing Radiation to Enhance Resistance against Distal Tumors." Oral presentation delivered at the Johns Hopkins University Nano-Bio Symposium, Baltimore, MD, August 2014.

Hill, M.R., **MacKrell, E.J.** and Sumerlin, B.S. "pH-Responsive and Biodegradable Nanoparticles Capable of Loading and Releasing Small-Molecule Cargo." Poster presentation delivered at the Florida Undergraduate Research Conference, Miami, FL, February 2014.

Teaching Experience

California Institute of Technology

- **Undergraduate Senior Thesis Mentor**, Cindy Cao 2019-2021
- **Graduate Teaching Assistant**, ChE 141: Data Science for Chemical Systems 2020
- **Graduate Teaching Assistant**, ChE 103c: Transport Phenomena (Mass Transport) 2018-2019
- **Certificate of Practice in University Teaching**, Caltech Center for Learning and Teaching Outreach 2018-2020
- **Undergraduate Research Mentor**, Samuel Owens 2017

University of Florida

- **Society for Biomaterials Education Challenge**, Society for Biomaterials, University of Florida Chapter 2015
- **Tutoring for Engineering Excellence (TEE) Chair**, Tau Beta Pi, Florida Alpha Chapter 2014-2015