

EMRE R. ALCA

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EXPERIENCE

Ph.D student in Physics, University of Pennsylvania

Supervisor: Prof. Andrea Liu

Philadelphia, PA.

September 2025 - present

- Began analytically and computationally investigating the dynamic instability of microtubules as a mechanism by which the microtubule spindle explores a combinatorial search space to solve spatial positioning optimization problems, working in close collaboration with Dr. Reza Farhadifar and Prof. Michael Shelly (Flatiron Institute).

Associate of Systems Biology, Harvard Medical School

Supervisor: Prof. Jeremy Gunawardena; funded by the [NITMB](#)

Boston, MA.

January 2024 - May 2025

- Analytically proved new, qualitatively different, bounds and trade-offs on error correction performance in kinetic proofreading at and away from thermodynamic equilibrium (publication in preparation).
- Developed [linearframework.py](#), a Python package for the symbolic calculation of closed-form expressions for the steady-state and transient quantities of continuous-time Markov processes.
- Used the Harvard O2 cluster to perform numerical experiments to support analytic predictions.
- Supervised an undergraduate student numerically exploring, and finding, new conjectures for structural constraints on hidden Markov models using the Harvard Orchestra 2 cluster and [linearframework.py](#).

Visiting Research Student, California Institute of Technology

Supervisor: Prof. Erik Winfree

Pasadena, CA.

May 2023 - August 2023

- Investigated an analogy between Ising models, Hopfield networks, and liquid-liquid phase separation.
- Applied this analogy to the design of phase-separating droplets.
- Developed differentially optimizable simulations of partial differential equations's (Cahn-Hilliard equations in Python) accelerated using spectral differentiation.

Research Assistant, University of Toronto

Supervisor: Prof. Alan Aspuru-Guzik

Toronto, On.

November 2020 - February 2022

- Developed Python wrappers for the control of multiple proprietary robotic chemistry platforms, making previously incompatible machines interoperable and implemented fully automated experimental workflows with machine learning recommended conditions ([published in Digital Discovery](#)).

EDUCATION

University of Pennsylvania

Ph.D Student in Physics; Supervisor: Prof. Andrea Liu

September 2025 - Present

University of Toronto

H.B.Sc. Physics Major & Cognitive Science Major with Distinction

September 2019 - November 2023

TECHNICAL STRENGTHS

Math & Physics

Stochastic Processes, Thermodynamics, Graph Theory,
Neural Networks, Dynamical Systems & Chaos

Programming Languages

Python, Java, JavaScript

Software

NumPy, Matplotlib, SciPy, Git, PyTorch, Tensorflow, Excel

Design

LaTeX, Illustrator, Photoshop, Fusion360