

GENE CHEN

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Physics Ph.D. candidate studying fluctuating and evolving systems—Markov chains, Langevin dynamics, population and neural dynamics—with analytical theory, numerical computation and experimental data.

EDUCATION

University of Virginia – Ph.D. in Physics (advanced to candidacy)

expected 2028

University of Maryland, College Park – B.S. in Physics

2021

RESEARCH EXPERIENCE

Lifting a Markov chain into the Mpemba effect

2026–present

University of Virginia · Advisor: Prof. Marija Vucelja

- Lead author of a study of irreversible (lifted) Markov chains—Glauber dynamics of the 1D Ising model under skew detailed balance—and of when breaking detailed balance induces a Mpemba-like relaxation speedup.
- Mapped the parameter space with Monte Carlo simulation and spectral analysis of the generator in Python; explained the regimes analytically; explored MCMC acceleration. To be presented at the 2027 APS Global Physics Summit.

Brain criticality from EEG data

2026–present

Initiated at APS 2026 with Richa Phogat (University of Newcastle, Australia) and Dima Watkins (UVA Physics)

- Model alpha-band EEG as active particles driven by colored noise to capture signatures of criticality, and estimate the distance from criticality in experimental recordings.
- Signal processing, regression and highly comparative time-series analysis (hctsa) in MATLAB; neural field theory for model building across physics and neuroscience.

Extending the Mpemba effect to the underdamped regime

2023–2026

University of Virginia · Advisor: Prof. Marija Vucelja · with S. Aharony Shapira and O. Raz (Weizmann)

- Solved the Klein-Kramers operator for a Brownian particle in a potential by discretization, matrix continued fractions and sparse eigensolvers in Mathematica on UVA's Rivanna cluster.
- Co-authored the resulting paper, which shows the overdamped Mpemba effect persists at finite damping. Submitted to *J. Phys. A: Math. Theor.*; preprint [arXiv:2607.11797](https://arxiv.org/abs/2607.11797).

Lagrangian formulation of Lotka-Volterra dynamics

2022–2025

Self-initiated project with Dima Watkins (UVA Physics), grown out of a weekly extracurricular discussion group

- Applied analytical mechanics to predator-prey dynamics; contributed talk at the 2026 APS Global Physics Summit.

Cosmic Ray Energetics and Mass (ISS-CREAM)

2019–2022

University of Maryland · Advisor: Prof. Eun-Suk Seo

- Derived channel gains to convert raw ISS-CREAM calorimeter ADC signals into energy for the cosmic-ray spectrum; analysis in Python (pandas) on remote Linux servers over SSH. Co-author, ICRC 2021 proceedings.

Earlier research – supermultiplet representation-space metrics (K. Stiffler, 2020–21); discrete-spacetime geometry (Wolfram Winter School, 2021); gene identification and cloning for transgenerational silencing (Y. Choi, 2018).

PUBLICATIONS

- S. Aharony Shapira, **G. Chen**, M. Vucelja, O. Raz, “Extending the Mpemba effect to the underdamped realm,” submitted to *J. Phys. A: Math. Theor.* (2026). doi:[10.48550/arXiv.2607.11797](https://doi.org/10.48550/arXiv.2607.11797)
- E.-S. Seo et al. (incl. **Y. Chen**), “Results from the Cosmic Ray Energetics And Mass for the International Space Station (ISS-CREAM) experiment,” *PoS(ICRC2021)* 095. doi:[10.22323/1.395.0095](https://doi.org/10.22323/1.395.0095)

SKILLS

Methods: Markov chain Monte Carlo (MCMC), lifted/non-reversible chains · Langevin dynamics · Fokker-Planck operators · spectral methods and sparse eigensolvers · PDE discretization · signal processing and regression

Computing: Python (NumPy, SciPy, pandas, Matplotlib) · Mathematica · MATLAB · Git · Linux/SSH · Slurm · LaTeX

TEACHING, LEADERSHIP & SERVICE

Financial Officer, Graduate Physics Society, University of Virginia

2024

Member, Social Council, Graduate School of Arts & Sciences, University of Virginia

2026

Teaching Assistant – Electricity & Magnetism Lab (UVA); Introductory Mechanics (UMD)

2021–2023