

Sergio Eraso

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EDUCATION **Massachusetts Institute of Technology — Ph.D. in Physics** *Sept 2023 – Expected 2028*
Dean of Science Fellow | Advisor: Mehran Kardar | Field: Nonequilibrium statistical physics & biophysics.

Emory University — B.S. in Physics & Mathematics *Sept 2019 – May 2023*
Magna Cum Laude | Study abroad, Yonsei University, Seoul (Sep–Dec 2022).

SKILLS **Programming:** Python, Julia, Mathematica, \LaTeX ; NumPy, SciPy, multiprocessing, matplotlib, Git.
Quantitative Methods: Stochastic processes & SDEs, Fokker–Planck and master equations, Monte Carlo, first-passage / extreme-value statistics, dynamical systems.

Statistics & Computation: Statistical inference, maximum-likelihood estimation, hypothesis testing, randomized search methods (simulated annealing, genetic algorithms), nonlinear regression.

Languages: Spanish Native Speaker, Korean A2.

RESEARCH **Goal:** Explain how living systems generate predictable large-scale order — from bacterial swarms and branching tissue networks to expanding populations — using mathematical modeling and stochastic simulation to uncover *universal coarse-grained principles* behind experimentally observed collective behavior. Contributions at MIT Physics:

Evolution in expanding populations. Used stochastic surface-growth models to explain super-diffusive scaling observed in bacterial range-expansion experiments, connecting coarse-grained population-front dynamics to KPZ universality and non-Gaussian Tracy–Widom fluctuation statistics.

Branching networks in biology. Developed master-equation and Monte Carlo models of stochastic filament growth, identifying universality classes of branch-length distributions controlled by microscopic branching rates and linking local growth mechanisms to coarse-grained network statistics.

Active matter near boundaries. Derived Fokker–Planck and coarse-grained hydrodynamic theory for self-propelled particles (e.g. bacteria) in 2D wedge confinement, predicting power-law density and current modulations set by boundary geometry; verified analytic scaling with parallel Langevin-dynamics simulations on a computing cluster.

Immune system resource allocation. Built a [systems-level PDE model](#) coupling innate/adaptive immune dynamics to tissue-level glucose reservoirs, fitting parameters to biological data and using sensitivity analysis to show how cytokine-regulated resource redistribution controls pathogen clearance and immune robustness.

Selected talks: MIT Dean’s Fellows Symposium, invited (2026) · APS Global Physics Summit (2026, 2023) · Rutgers Statistical Mechanics Conference (2025)

SELECTED TECHNICAL PROJECTS **Constrained scheduling optimizer** (Emory Residence Life, 2021). Built a public GitHub applet for university residence-life staff scheduling, reducing manual rota construction from hours to seconds. Modeled availability, coverage, and fairness requirements as a constrained combinatorial optimization problem solved with warm-start stochastic local search.

Computational statistical-physics curriculum (Tecnológico de Monterrey, 2025). Designed and taught a [week-long Python-based course](#) introducing stochastic simulation, entropy, phase transitions, and neural networks to 20 high school and undergraduate students from non-physics backgrounds; built notebook-based coding labs emphasizing model-building, data analysis, and physical intuition.

LEADERSHIP & SERVICE **Graduate-student representative**, *MIT Physics Education Committee* (Sep 2025–Present). Represent over 450 students by contributing to departmental decisions on curriculum design, degree requirements, and educational policy.

Executive board, *MIT Latino Graduate Student Association* (Sept 2025–Present). Organize community programming and communications for over 350 Latino graduate students across MIT.

Research mentor, *MIT Directed Reading Program* | *Illinois Mentor Matching Engine*. Mentored students on quantitative projects including Hopfield-network literature, hypothesis testing on public cancer-genomics data, and engineering design; guided students in reading technical literature, analyzing data, and presenting results.