

EDUCATION

- University of Wisconsin** Madison, WI, USA
Ph.D. in Physics, Advisors: [Eric Smith](#), [David Baum](#) 2018–2023
– Thesis: [Mathematics of evolution in chemical reaction networks and the origins of biochemical life](#)
- Kansas State University** Manhattan, KS, USA
M.S. in Physics, Advisor: [Lado Samushia](#) 2016–2018
– Thesis: [Improvement in techniques for understanding the large scale structure of the Universe](#)
- Indian Institute of Technology** New Delhi, India
B.Tech. in Engineering Physics 2011–2015

RESEARCH INTERESTS

I am deeply interested in applying mathematical physics to develop techniques for understanding various aspects of complex systems. My research focuses on stochastic chemical reaction networks, large deviations theory, optimal control, and Hamiltonian dynamical systems. I think about various aspects of the kinetics, thermodynamics, and probability landscapes induced by stochastic chemical reaction networks and ways to control them.

PUBLICATIONS

- Victor Blanco, Gabriel Gonzalez, **Praful Gagrani**
[On the optimal growth of autocatalytic subnetworks: A Mathematical Optimization Approach](#)
arXiv, 2024
- Praful Gagrani**, David Baum
[The evolution of complexity and the transition to biochemical life](#)
arXiv, 2024
- Alyssa M Adams, Elliott Jacopin, **Praful Gagrani**, Olaf Witkowski
[An Open-Ended Approach to Understanding Local, Emergent Conservation Laws in Biological Evolution](#)
arXiv, 2024
- Praful Gagrani**, Victor Blanco, Eric Smith, David Baum
[Polyhedral geometry and combinatorics of an autocatalytic ecosystem](#)
Journal of Mathematical Chemistry, 2024
- Praful Gagrani**, Eric Smith
[Action functional gradient descent algorithm for estimating escape paths in stochastic chemical reaction networks](#)
Physical Review E, 2023
- Zhen Peng, Alex Plum, **Praful Gagrani**, David Baum
[An ecological framework for the analysis of prebiotic chemical reaction networks](#)
Journal of theoretical biology, 2020

Praful Gagrani, Lado Samushia

Information content of the angular multipoles of redshift-space galaxy bispectrum

Monthly Notices of the Royal Astronomical Society, 2017

David W. Pearson, Lado Samushia, **Praful Gagrani**

Optimal weights for measuring redshift space distortions in multitracer galaxy catalogues

Monthly Notices of the Royal Astronomical Society, 2016

EXPERIENCE

University of Tokyo

Project Researcher at the Laboratory of Quantitative Biology, PI: **Tetsuya J. Kobayashi**

- Optimal control of stochastic chemical reaction networks

Tokyo, Japan

Fall 2024 onwards

University of Wisconsin-Madison

Postdoctoral Researcher at the Wisconsin Institute for Discovery, PI: **David Baum**

- Understanding the origins of biochemical life using chemical reaction networks

Madison, WI, USA

Fall 2023 - 2024

Kansas State University

Intern at the Department of Physics, Guide: Lado Samushia

- Information content of the angular multipoles of galaxy bispectrum

Manhattan, KS, USA

Spring 2016

University of Texas-Austin

Intern at the Department of Astronomy, Guide: **Paul Shapiro**

- **Supersonic baryon-dark matter drift velocity**

Austin, TX, USA

Fall 2015

University of California

Intern at the Department of Physics and Astronomy, Guide: **Lloyd Knox**

- Gravitational driving of acoustic oscillations in primordial plasma

Davis, CA, USA

Summer 2014

TALKS

- **Invited speaker** at Universal Biology Institute, Tokyo Dec 2024
Talk on *A chemical reaction network-based framework for the origins of biochemical life*
- **Speaker** at Astrobiology Science Conference (AbSciCon), Providence, Rhode Island May 2024
Talk on *Evolution of complexity and the origins of biochemical life*
- **Invited speaker** at Theoretical Chemistry seminar, University of Vienna Mar 2024
Talk on *Autocatalysis and its applications from economics to the origins of life*
- **Invited speaker** at the Graph Theory seminar, Leipzig University Mar 2024
Talk on *Polyhedral geometry of autocatalysis and applications from Economics to the Origins of Life*
- **Invited speaker** at the Physics seminar, University of Luxembourg Feb 2024
Talk on *Evolution of complexity in CRNs and the origins of biochemical life*
- **Invited speaker** at the Young Researcher's seminar at the University of Granada Feb 2024
Talk on *Polyhedral and differential geometry of chemical reaction networks.*
- **Invited speaker** at the University of Wisconsin-Madison Apr 2023
Talk on *A(ction) functional gradient descent algorithm for finding instantons in chemical reaction networks.*
- **Invited speaker** at the French National Centre for Scientific Research (CNRS) Mar 2023
Zoom talk on *the geometry and combinatorics of an autocatalytic ecology* to Philippe Nghe and collaborators.
- **Invited speaker** at University of Portsmouth Jun 2017
Talk on *information content of bispectrum* at the Institute of Cosmology and Gravitation (ICG).

OUTREACH AND TEACHING

- **Staff** at Navajo Math Circles June 2024
2 week summer [math camp](#) for Navajo school students.
- **Invited speaker** at Morgridge Institute for Research Jun 2021
[Rural summer science camp](#).
- **Outreach volunteer** at University of Wisconsin-Madison Oct 2020
Hands-on physics for fifth graders ([news article](#)).
- **Teaching Assistant** at University of Wisconsin-Madison 2018 –2022
Courses include physics for non-physics, physics, and advanced physics undergraduates.
- **Teaching Assistant** at Kansas State University 2016 –2017
Introductory physics for physics majors.

EXTRACURRICULAR INTERESTS

- Eastern, postmodern and Whiteheadian philosophy
[YouTube link](#) to a dialogue with [Matt Segall](#), a Whiteheadian scholar.
- Guitarist and singer-songwriter.
[YouTube links](#) to a [solo show](#), [group performance](#), and a [competition in 2016](#).
- I also enjoy traveling, rock climbing, running, and meditation.