

OBINNA A. UKOGU

✉ adrian.ukogu@gmail.com

in [LinkedIn](#)

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[ORCID](#)

EDUCATION

Ph.D., Applied Mathematics, University of Washington

Sep 2020 - June 2026

M.Sc. awarded (Dec 2021)

Dissertation: *Design Principles of the T Cell Immune Response*

B.A., Biophysics and Mathematics (magna cum laude), Amherst College

2014 - 2018

Thesis: *Using Queueing Theory to Model Enzyme-Substrate Interactions*

SKILLS

Scientific Modeling with dynamical systems, stochastic processes, agent-based simulations, optimization, information theory, statistical mechanics; statistical inference; high-performance computing (HPC); data processing & visualization

Technical Python, Git, Slurm, Mathematica, MATLAB, R, SAS, SQL, IGOR

RESEARCH ACTIVITY

Applied Mathematics and Theoretical Biophysics Research Assistant

Sep 2020 - Present

Advised by Armita Nourmohammad (UW); Collaborated with Ivana Bozic (UW) and Hao Yuan Kueh (UW)

How does the immune system use receptors and antibodies to control the composition of the gut microbiota? [1]

- Formulated the problem of immune control of microbial populations as a tractable constrained optimization problem, and derived solutions to explain experimentally observed patterns of receptor-microbe binding.
- Generated predictions about microbe epitope targets of receptor/antibody binding to guide future experiments.

How do signal processing strategies determine the protectiveness of the cytotoxic CD8⁺ T-cell response? [2]

- Synthesized experimental literature to develop a novel, feedback-control model of the CD8⁺ T-cell response to infection.
- Implemented fast, agent-based simulations of the T-cell response with HPC resources and used numerical optimization (simulated annealing, grid search) to explore a high-dimensional model parameter space (Python, Slurm).

How does the flexible timing of T-cell memory differentiation allow its magnitude to scale with infection severity? [3]

- Collaborated with 3+ experimentalists to develop nonlinear ODE models of T-cell differentiation.
- Analyzed models with techniques from dynamical systems to derive predictions for *in vivo* experiments in mice.

What is the expected time before malignancy of different mutational pathways to colorectal cancer? [4]

- Analyzed a branching process model (Markov processes, martingales, PDEs) of mutational pathways and integrated biological measurements.
- Estimated the probability distribution of the time before malignancy using real-world measurements of mutation rates.

Senior Data Analyst

Jul 2018 - Dec 2020

Cornerstone Research, New York, NY

Performed economic and financial analysis for high-stakes litigation and regulatory matters.

- Collaborated with teams of 5+ analysts and managers to deliver targeted presentations and analyses to clients.
- Built, cleaned and analyzed large public and proprietary datasets to deliver insights to economic and financial queries.
- Implemented statistical models to test economic hypotheses critical for litigation or regulatory outcomes.

Experimental Biophysics Research Assistant

Jan 2015 - Jul 2018

Advised by Ashley Carter (Amherst College)

How does a single strand of DNA fold? [5], [7]

- Designed single-molecule biochemical assays using optical microscopy and tethered particle motion techniques.
- Analyzed microscopy image data (IGOR) and fit statistical mechanical models to infer the energetics of DNA folding.

PUBLICATIONS

1. **O. Ukogu**, A. Walczak, T. Mora, A. Nourmohammad, “Immune control of the gut microbiota,” *in preparation*
2. **O. Ukogu**, Z. Montague, G. Altan-Bonnet, A. Nourmohammad, “Design principles of the cytotoxic CD8⁺ T-cell response,” PNAS (2026), [pnas.2528202123](#).

3. K. Abadie, . . . , **O. Ukogu** et al., “Reversible, tunable epigenetic silencing of TCF1 generates flexibility in the T cell memory decision,” *Immunity* (2024), [j.immuni.2023.12.006](https://doi.org/10.1016/j.immuni.2023.12.006).
4. R. Zhang, **O. Ukogu**, I. Bozic, “Waiting times in a branching process model of colorectal cancer initiation,” *Theoretical Population Biology* (2023), [j.tpb.2023.04.001](https://doi.org/10.1016/j.tpb.2023.04.001).
5. **O. Ukogu** et al., “Protamine loops DNA in multiple steps,” *Nucleic Acids Research*, 48, 6108–6119 (2020), <https://doi.org/10.1093/nar/gkaa365>.
6. M. Barnett, A. Folsom, **O. Ukogu**, W.J. Wesley, and H. Xu, “Quantum Jacobi forms and balanced unimodal sequences,” *Journal of Number Theory*, 186, 16–34 (2018), [j.jnt.2017.10.022](https://doi.org/10.1016/j.jnt.2017.10.022).
7. A. D. Smith, **O. Ukogu**, . . . , A. R. Carter, “Optical methods for measuring DNA folding,” *Mod. Phys. Lett. B*, 31, 1730001 (2017).

PRESENTATIONS

Talk, <i>APS March Meeting</i> , Denver, CO	Mar 2026
Talk, <i>Physics of Life Symposium</i> , CUNY Graduate Center, New York, NY	Apr 2025
Talk, <i>SIAM Life Sciences Conference</i> , Portland, OR	Jun 2024
Talk, <i>APS March Meeting</i> , Minneapolis, MN	Mar 2024

HONORS AND AWARDS

DBIO Best Talk Award (selected presenter), APS March Meeting	Mar 2026
SIAM Travel Grant (\$3,000) for SIAM Conference on the Life Sciences	Jun 2024
Best Poster Prize, Gordon Research Conference, Stochastic Physics in Biology	Jan 2023
Joseph Hammack Award, UW Department of Applied Mathematics, 2020-2021	Jun 2021
Phi Beta Kappa, Amherst College	May 2018
Walker Award for Leadership, Amherst College Department of Mathematics, 2017-2018	May 2018
Walker Teaching Award, Amherst College Department of Mathematics, 2016-2017	May 2017

COMPETITIVE WORKSHOPS & TRAININGS

<i>Spring 2025 Data Science Boot Camp</i> , The Erdős Institute	Jan 2025 - Apr 2025
<i>Interactions and Co-evolution between Viruses and Immune Systems</i> . KITP	Sep 2024
<i>Emergence of Information in Molecular Systems</i> . Munich Institute for Astro-, Particle and Biophysics	Jul 2024
<i>Janelia Theoretical Biophysics Workshop</i> . Janelia Research Campus, VA	Oct 2023
<i>Theoretical Biological Physics</i> . Les Houches School of Physics Session CXXI	Jul 2023

SERVICE & LEADERSHIP

UW Math Hour Olympiad	June 2023 - Present
– Serve as a competition judge, evaluating middle and high school students’ solutions and providing feedback.	
Applied Mathematics Graduate Student Representative	Sep 2023 - Jun 2025
– Participated in faculty meetings and represented graduate students’ interests in the department.	
– Coordinated office assignments, student input to faculty hiring, and seminar speaker selection.	
– Organized community-building events for graduate students.	
Mini-symposium Co-organizer	
– <i>Eco-Evolutionary Process in Biology: Mathematical and Physical Perspectives</i> , SIAM Life Sciences, June 2024.	
– <i>Data-driven Mathematical Models for Prediction and Control of Biology</i> , SIAM PNW, October 2025.	

TEACHING

Teaching Assistant	Sep 2015 - May 2018, Jan 2021 - Present
– UW: Calculus II, Calculus III, Linear Algebra, Probability and Stochastic Processes, Dynamical Systems.	
– Amherst College: Intermediate Calculus, Linear Algebra, Introduction to Real Analysis.	

REFEREES

Prof. Armita Nourmohammad, Yale University, armita.nourmohammad@yale.edu
 Dr. Grégoire Altan-Bonnet, National Cancer Institute, gregoire.altan-bonnet@nih.gov
 Prof. Ivana Bozic, University of Washington, ibozic@uw.edu
 Dr. Aleksandra Walczak, École Normale Supérieure, aleksandra.walczak@phys.ens.fr