Nikolas Schonsheck — Curriculum Vitæ

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Education & Employment

The Rockefeller University

Independent Fellow — August 2024-present
Center for Studies in Physics and Biology

University of Delaware

Postdoctoral Fellow — July 2021-July 2024
Department of Mathematical Sciences
PI: Chad Giusti

The Ohio State University

Ph.D. in Mathematics — May 2021
Supervisor: John E. Harper

Vassar College

B.A. in Mathematics, general and subject honors — May 2015
Minor in social and political philosophy

Publications & Preprints

10. **Topological data analysis of circulant structure in neural architecture and function** (with N. Sanderson). In preparation.

9. **Learning local geometry and nonlinear topology of neural manifolds via spike-timing dependent plasticity** (with C. Giusti). Available at https://www.biorxiv.org/content/10.1101/2025.08.27.672728v1.

8. **Dowker's theorem for higher order relations** (with C. Giusti, V. Itskov, M. Robinson, R. Sazdanovic, V. de Silva, M. Vaupel, H-R. Yoon). Submitted. Available at https://arxiv.org/abs/2506.10909.

7. **$O(k)$-equivariant dimensionality reduction on Stiefel manifolds** (with A. Lee, H. Lee, J. Perea, M. Weinstein). *SIAM Journal on the Mathematics of Data Science*, **7**(2), 2025. Available at https://arxiv.org/pdf/2309.10775.pdf.

6. **Spherical coordinates from persistent cohomology** (with S. Schonsheck). *Journal of Applied and Computational Topology*, **8**, 149-173 (2024). Available at https://arxiv.org/pdf/2209.02791.pdf.

5. **Toroidal coordinates: decorrelating circular coordinates with lattice reduction** (with J. Bush, H. Gakhar, J. Perea, T. Rask, L. Scoccola, L. Zhou). 39^{th} *International Symposium on Computational Geometry (SoCG 2023)*, **258**, 57:1-57:20 (2023). Available at https://arxiv.org/abs/2212.07201.

4. **On the chromatic localization of the homotopy completion tower for O-algebras** (with C. Ogle). *New York Journal of Mathematics*, **28**, 1042-1056 (2022).

3. **TQ-completion and the Taylor tower of the identity functor**. *Journal of Homotopy and Related Structures*, **17**, 201-216 (2022).

2. **Fibration theorems for TQ-completion of structured ring spectra**. *Tbilisi Math. Journal: Special Issue on Homotopy Theory, Spectra, and Structured Ring Spectra*, 1-15 (2020).

1. **On the cop number of generalized Petersen graphs** (with T. Ball, R. Bell, J. Guzman, and M. Hanson-Colvin). *Discrete Mathematics*, **340** (6), 1381-1388 (2017).

Teaching Experience

University of Delaware

Instructor

Math 367: Seminar on Applied Topology	Spring 2023
Math 349: Elementary Linear Algebra	Fall 2022
Math 401: Introduction to Analysis	Spring 2022

The Ohio State University

Instructor

Math 1149: Trigonometry	Summer 2018

Co-instructor

Math 1125: Mathematics for Elementary Teachers I	Fall 2019
Math 1149: Trigonometry	Summer 2017

Graduate Teaching Associate

Regular duties included planning material for and conducting two recitation meetings per week, writing and grading quizzes, grading homework.

Math 1150: Precalculus	Fall 2020
Math 1161: Accelerated Calculus I	Fall 2018, Fall 2017
Math 1151: Calculus I	Spring 2018, Fall 2016 Spring 2016, Fall 2015
Math 1152: Calculus II	Spring 2017

Vassar College

Undergraduate Assistant Fall 2014-Spring 2015

Held six office hours per week for upper-level mathematics classes.

Research Mentoring and Service

Summer Scholars Program Summer 2023-Spring 2024

Undergraduate summer research program at University of Delaware. Supervising two undergraduate students applying persistent cohomological techniques to artificial neural networks and Hebbian learning rules.

GEMS Summer Program Summer 2022

Summer research program at University of Delaware; supervisor to one undergraduate and one graduate student studying propagation of cyclical data features through feedforward neural networks.

Directed Reading Program (University of Delaware) Spring 2022-present

Co-founded and continue to organize Directed Reading Program at University of Delaware; supervised reading projects on simplicial homology, elementary number theory, and combinatorial pursuit games.

Knots and Graphs undergraduate research working group Summer 2020

Summer research program similar to an REU but only open to Ohio State students; volunteered to mentor two groups of four undergraduate students working on problems in graph coloring.

Directed Reading Program (Ohio State) Spring 2019

Oversaw a reading course on introductory algebraic topology while a graduate student at Ohio State.

Honors, Awards, & Fellowships

Teaching

Excellence in Teaching Award (Nominated) Spring 2023
University of Delaware, independently nominated for "excellent work and your positive impact on student learning."

Phil Huneke Distinguished Graduate Teaching Associate Award Spring 2021
Departmental. This award recognizes "mathematics graduate students who have demonstrated excellence in the classroom and a high level of commitment to undergraduate mathematics education." Awarded for the 2019-2020 academic year, but awards delayed to 2021 due to the COVID-19 pandemic.

Graduate Associate Teaching Award Spring 2020
University-wide. "Ohio State's highest recognition of teaching done by graduate students." Ten recipients chosen each year out of over 3,000 graduate TA's.

First-year Graduate Teaching Associate Award Spring 2016
Departmental. "This award recognizes outstanding first year Graduate Teaching Associates within the OSU Department of Mathematics."

Research & Scholarship

Research Training Groups (RTG) Fellowship Summer 2020, Spring 2020
Department of Mathematics, The Ohio State University Spring 2019

Mary Evelyn Wells and Gertrude Smith Prize Spring 2011
Department of Mathematics, Vassar College

Other Service and Activities

Minisymposium on Topology and Geometry in Neuroscience July 2025
Co-organized minisyposium, SIAM Applied Algebraic Geometry Conference

Computational Systems Neuroscience 2025 March 2025
Reviewer for COSYNE 2025.

JMM Special Session January 2024
Applied Topology Beyond Persistence Diagrams
Co-organized special session on applied topology focusing on applications of homological algebra beyond the industry standard of persistence diagrams.

JMM Special Session January 2023
Applied Topology: Theory and Implementation
Co-organized special session on applied topology with a particular view towards bridging the gap between the theory and implementation of recent research in applied topology and topological data analysis.

AMS Mathematics Research Communities Summer 2022
Participant in MRC: Data Science at the Crossroads of Analysis, Geometry, and Topology. Worked with two groups of other early career researchers on projects in topological data analysis. Projects are ongoing and in preparation to submit for publication.

Addressing Barriers to Participation in STEM Fall 2021-present
Member, committee of University of Delaware Anti-Racism Initiative. Activities have included developing materials for holistic admission processes, lobbying for required diversity and inclusion questions in faculty hiring, and successfully advocating the raise of minimum graduate student stipend.

Invited Panelist, AWM Chapter at Marian University Spring 2021
Served as a panelist for a discussion on transitioni ng from an undergraduate liberal arts school to graduate school/industry in STEM fields.

Buckeye Aha! Math Moments Summer 2020
Volunteered to mentor and review student work for this outreach initiative of the Department of Mathematics at OSU.

Mentor for TA training Summer 2020, 2019, 2018, 2017
Assisted in summer training of incoming TA's at Ohio State.

TA Peer mentor Fall 2019, 2018, 2017, 2016
Served in the peer-mentoring program for new TA's at Ohio state; oversaw a total of 14 new teaching associates.

Selected Research Talks

Invited and contributed talks

EPFL Topology Seminar September 2025
"Circles in the brain: learning local geometry
and nonlinear topology via spike-timing dependent plasticity"

Workshop on Topological Data Analysis August 2025
Fields Institute, Toronto, Ontario
"Tutorial: Topological and Geometric Methods in Neuroscience"

SIAM Conference on Applied Algebraic Geometry July 2025
Madison, Wisconsin
"Minitutorial on Topological and Geometric Methods in Neuroscience"
"Learning Circular Coordinate Systems via Spike Timing Dependent Plasticity"

Vassar College Colloquium December 2024
"An introduction to applied algebraic topology"

SIAM Conference on Mathematics of Data Science October 2024
Atlanta, Georgia
"Topological dimensionality reduction via persistent cohomology"
"Hebbian learning of cyclic features of neural code" (poster)

International Conference on Mathematical Neuroscience June 2024
University College Dublin
"Relative neural population size modulates learnability of cyclic features of neural code"

NEXTEN Conference, Washington University in St. Louis May 2024
Washington University in St. Louis
"Relative neural population size modulates learnability of cyclic features of neural code"
(Poster presentation.)

JMM Special Session on Applied Topology: Theory, Algorithms, January 2024
and Applications, San Francisco
"Spherical parameterizations of data via persistent cohomology"

AMS Sectional Special Session on Discrete, Algebraic, October 2023
and Topological Methods in Mathematical Biology, Creighton University
"Hebbian learning of cyclic structures in neural coding"

Computational Neuroscience Annual Meeting, Leipzig, Germany July 2023

"Relative neural population size modulates learnability of cyclic features of neural code"
(Poster presentation)

Joint Mathematics Meetings, MRC Special Session January 2023
"Equivariant dimensionality reduction on Stiefel manifolds"

Geometry-Topology Seminar, Oregon State University October 2022
"Spherical coordinates from persistent cohomology"

Topology Seminar, University of Iowa April 2021
"Fibration theorems, functor calculus, and chromatic connections in O-algebras"

Graduate Student Topology and Geometry Conference, Indiana University April 2021
"Functor calculus and chromatic connections in O-algebras"

Topology Seminar, University of Regina January 2021
"Fibration theorems, functor calculus, and chromatic connections in O-algebras"

Graduate Conference in Algebra and Topology, Binghamton University November 2020
"TQ-completion: fibration theorems and connections to functor calculus"

Algebraic Topology Seminar, UCLA October 2020
"Fibration theorems and functor calculus for structured ring spectra"

Topology Seminar, Pennsylvania State University-Altoona September 2020
"TQ-completion: fibration theorems and connections to functor calculus"

Topology Seminar, University of Virginia September 2020
"TQ-completion: fibration theorems and connections to functor calculus"

AMS Sectional Special Session on Homotopy Theory, University of Virginia March 2020
"TQ-completion of certain fibration sequences"
(This conference was canceled due to the COVID-19 pandemic;
notes available at `http://people.virginia.edu/~jeb2md/Schonsheck2020.pdf`)

Young Topologists Meeting, EPFL, Switzerland July 2019
"Topological Quillen homology of structured ring spectra"

Mathematics Colloquium, Vassar College February 2019
"Homotopy theory—from the fundamental group to structured ring spectra"

Young Topologists Meeting, University of Copenhagen July 2018
"An introduction to symmetric spectra"

Informal talks

GOATS 2 Online Mini-Conference June 2020
"Fibration Theorems for TQ-completion of structured ring spectra"
(Available at `https://youtu.be/NZ71N1-CUZQ`)

GROOT Summer Seminar, online May 2020
"Fibration Theorems for TQ-completion of structured ring spectra"
(Available at `https://youtu.be/DkjCgY1kjF8` and `https://youtu.be/EUAh8fwjF9M`)

Student Homotopy Seminar, Ohio State Mathematics Department 2018-2020
"Pro-nilpotent homology types"
"Fibration theorems for TQ-completion of structured ring spectra"
"Long homology localization towers"
"Localization and completion with respect to topological Quillen homology"
"Cosimplicial resolution model structures"
"The role of principal fibrations"
"Completion of spaces and ring spectra with respect to homology"
"Operads and the recognition principle"

"Comparing $H\mathbb{Z}$-algebras in Sp^{Σ} to unbounded chain complexes"
"Why symmetric spectra?"

Graduate Student Seminar, Ohio State Mathematics Department January 2019
"Homotopy theory—from the fundamental group to structured ring spectra"

Seminar-∞, Ohio State Mathematics Department Fall 2017
"The Dold-Kan Correspondence"
"Eilenberg-Zilber and geometric realization"

Various Presentations 2014-2015
"The game of Cops and Robbers on graphs"

Conference participation

Fields Institute Workshop on Topological Data Analysis August 2025

BIRS Workshop: Cycle Representatives in Applied Homological Algebra August 2025

SIAM Conference on Applied Algebraic Geometry July 2025

COSYNE Computational Systems Neuroscience March 2025

SIAM Conference on Mathematics of Data Science October 2024

International Conference on Mathematical Neuroscience June 2024

NEXTEN Conference, Washington University in St. Louis May 2024

Joint Mathematics Meetings, San Francisco, CA January 2024

Neural Coding and Combinatorics, ICERM, Brown University November 2023

Topology and Geometry in Neuroscience, ICERM, Brown University October 2023

AMS Central Sectional Meeting, Creighton University October 2023

Computational Neuroscience 2023 July 2023
Annual meeting, Leipzig, Germany

Applied Homological Algebra Beyond Persistence Diagrams June 2023
Workshop, American Institute for Mathematics

Joint Mathematics Meetings, Boston MA January 2023

Algebraic Topology and Topological Data Analysis: August 2022
A Conference in Honor of Gunnar Carlsson
Institute for Mathematics and its Applications, University of Minnesota

Mathematics Research Communities: June 2022
Data Science at the Crossroads of Analysis, Geometry, and Topology
American Mathematical Society, Beaver Hollow, NY

Hot Topics Workshop: May 2022
Topological and Dynamical Analysis of Brain Connectomes
ICERM, Brown University

COSYNE: Computational Systems Neuroscience, Lisbon, Portugal March 2022

Graduate Student Topology and Geometry Conference, Indiana University April 2021

Graduate Conference in Algebra and Topology, Binghamton University November 2020

Midwest Topology Seminar, Virtual, Wayne State University October 2020

GOATS 2 Online Mini-Conference June 2020

AMS Sectional Meeting, University of Wisconsin-Madison	September 2019
Young Topologists Meeting, EPFL, Switzerland	July 2019
Midwest Topology Seminar, Michigan State University	May 2019
Graduate Student Topology and Geometry Conference, UIUC	March 2019
Functor Calculus Workshop, Ohio State University	March 2019
Midwest Topology Seminar, University of Kentucky	September 2018
Young Topologists Meeting, University of Copenhagen	July 2018
Midwest Topology Seminar, Indiana University	April 2018
AMS Sectional Meeting, Ohio State University	March 2018
Midwest Topology Seminar, Northwestern University	March 2018
Midwest Topology Seminar, Wayne State University	November 2017
Homotopy Theory: Tools and Applications, UIUC	July 2017