

# Nikolas Schonsheck — Curriculum Vitæ

Center for Studies in Physics and Biology  
The Rockefeller University  
New York, NY 10065

Office: Smith Hall Annex B17  
Email: [nschonsheck@rockefeller.edu](mailto:nschonsheck@rockefeller.edu)  
Website: <https://niko-schonsheck.github.io/>

## 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

**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>.

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

**$O(k)$ -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>.

**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>.

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

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

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

**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).

**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
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#### **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 minisymposium, 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 transitioning 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*

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| <b>Workshop on Topological Data Analysis</b><br><b>Fields Institute, Toronto, Ontario</b><br>"Tutorial: Topological and Geometric Methods in Neuroscience"   | August 2025   |
| <b>SIAM Conference on Applied Algebraic Geometry</b><br><b>Madison, Wisconsin</b><br>"Minitutorial on Topological and Geometric Methods in Neuroscience"<br>"Learning Circular Coordinate Systems via Spike Timing Dependent Plasticity" | July 2025     |
| <b>Vassar College Colloquium</b><br>"An introduction to applied algebraic topology"  | December 2024 |
| <b>SIAM Conference on Mathematics of Data Science</b><br><b>Atlanta, Georgia</b><br>"Topological dimensionality reduction via persistent cohomology"<br>"Hebbian learning of cyclic features of neural code" (poster)                    | October 2024  |
| <b>International Conference on Mathematical Neuroscience</b><br><b>University College Dublin</b><br>"Relative neural population size modulates learnability of cyclic features of neural code"   | June 2024     |
| <b>NEXTEN Conference, Washington University in St. Louis</b><br><b>Washington University in St. Louis</b><br>"Relative neural population size modulates learnability of cyclic features of neural code"<br>(Poster presentation.)        | May 2024      |
| <b>JMM Special Session on Applied Topology: Theory, Algorithms, and Applications, San Francisco</b><br>"Spherical parameterizations of data via persistent cohomology"   | January 2024  |
| <b>AMS Sectional Special Session on Discrete, Algebraic, and Topological Methods in Mathematical Biology, Creighton University</b><br>"Hebbian learning of cyclic structures in neural coding"   | October 2023  |
| <b>Computational Neuroscience Annual Meeting, Leipzig, Germany</b><br>"Relative neural population size modulates learnability of cyclic features of neural code"<br>(Poster presentation)  | July 2023     |
| <b>Joint Mathematics Meetings, MRC Special Session</b><br>"Equivariant dimensionality reduction on Stiefel manifolds"  | January 2023  |
| <b>Geometry-Topology Seminar, Oregon State University</b><br>"Spherical coordinates from persistent cohomology"  | October 2022  |
| <b>Topology Seminar, University of Iowa</b><br>"Fibration theorems, functor calculus, and chromatic connections in $O$ -algebras"  | April 2021    |
| <b>Graduate Student Topology and Geometry Conference, Indiana University</b><br>"Functor calculus and chromatic connections in $O$ -algebras"  | April 2021    |

<b>Topology Seminar, University of Regina</b> “Fibration theorems, functor calculus, and chromatic connections in $O$ -algebras”	January 2021
<b>Graduate Conference in Algebra and Topology, Binghamton University</b> “TQ-completion: fibration theorems and connections to functor calculus”	November 2020
<b>Algebraic Topology Seminar, UCLA</b> “Fibration theorems and functor calculus for structured ring spectra”	October 2020
<b>Topology Seminar, Pennsylvania State University-Altoona</b> “TQ-completion: fibration theorems and connections to functor calculus”	September 2020
<b>Topology Seminar, University of Virginia</b> “TQ-completion: fibration theorems and connections to functor calculus”	September 2020
<b>AMS Sectional Special Session on Homotopy Theory, University of Virginia</b> “TQ-completion of certain fibration sequences” (This conference was canceled due to the COVID-19 pandemic; notes available at <a href="http://people.virginia.edu/~jeb2md/Schonsheck2020.pdf">http://people.virginia.edu/~jeb2md/Schonsheck2020.pdf</a> )	March 2020
<b>Young Topologists Meeting, EPFL, Switzerland</b> “Topological Quillen homology of structured ring spectra”	July 2019
<b>Mathematics Colloquium, Vassar College</b> “Homotopy theory—from the fundamental group to structured ring spectra”	February 2019
<b>Young Topologists Meeting, University of Copenhagen</b> “An introduction to symmetric spectra”	July 2018

### *Informal talks*

<b>GOATS 2 Online Mini-Conference</b> “Fibration Theorems for TQ-completion of structured ring spectra” (Available at <a href="https://youtu.be/NZ71N1-CUZQ">https://youtu.be/NZ71N1-CUZQ</a> )	June 2020
<b>GROOT Summer Seminar, online</b> “Fibration Theorems for TQ-completion of structured ring spectra” (Available at <a href="https://youtu.be/DkjCgY1kjF8">https://youtu.be/DkjCgY1kjF8</a> and <a href="https://youtu.be/EUAh8fwjF9M">https://youtu.be/EUAh8fwjF9M</a> )	May 2020
<b>Student Homotopy Seminar, Ohio State Mathematics Department</b> “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 $Sp^\Sigma$ to unbounded chain complexes” “Why symmetric spectra?”	2018-2020
<b>Graduate Student Seminar, Ohio State Mathematics Department</b> “Homotopy theory—from the fundamental group to structured ring spectra”	January 2019
<b>Seminar-<math>\infty</math>, Ohio State Mathematics Department</b> “The Dold-Kan Correspondence” “Eilenberg-Zilber and geometric realization”	Fall 2017

**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 Workshop, American Institute for Mathematics	June 2023
Joint Mathematics Meetings, Boston MA	January 2023
Algebraic Topology and Topological Data Analysis: A Conference in Honor of Gunnar Carlsson Institute for Mathematics and its Applications, University of Minnesota	August 2022
Mathematics Research Communities: Data Science at the Crossroads of Analysis, Geometry, and Topology American Mathematical Society, Beaver Hollow, NY	June 2022
Hot Topics Workshop: Topological and Dynamical Analysis of Brain Connectomes ICERM, Brown University	May 2022
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