Mike Miller Eismeier

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Employment

University of Vermont 2023-
Assistant Professor

Columbia University 2019-2023
Ritt Assistant Professor of Mathematics

Education

UCLA 2014-2019
Ph.D. in Mathematics
Advanced to Candidacy: February 2017
Ph.D. granted: June 2019

Santa Clara University 2010-2014
B.Sc. in Mathematics

Publications

Monopoles, twisted integral homology, and Hirsch algebras,
with Francesco Lin, available at arXiv:2108.00984.
To appear in Geometry & Topology (updated April 2023).

3-manifolds without any embedding in symplectic 4-manifolds,
with Aliakbar Daemi and Tye Lidman, available at arXiv:2207.03631.
To appear in Geometry & Topology (updated May 2023).

Fourier transforms and integer homology cobordism,
available at arXiv:2206.07029.
To appear in Algebraic & Geometric Topology (updated August 2023).

Hyperplanes in abelian groups and twisted signatures,
with Aiden Sagerman, Topology Appl. 339 (2023), Paper No. 108692.

The distance from a point to its opposite along the surface of a box,
with Edward F. Schaefer, Pi Mu Epsilon Journal, **14**, 2015, 143-154

Preprints

Instantons and rational homology spheres,
with Aliakbar Daemi, available at arXiv:2210.14071.

Equivariant instanton homology,
PhD thesis. Available at arXiv:1907.01091 (as S. Michael Miller).
In review at Memoirs of the AMS since July 2019; revisions submitted July 2023.

Lecture series

Equivariant instanton homology, and instantons mod 2 August 2024
A minicourse on the foundations of equivariant instanton homology and the *suspension technique* developed by Ali Daemi and myself; I explained how this proves that the equivariant instanton complex is 'well-defined', and how the same technique leads to results constraining the topology of indefinite cobordisms.

"Gauge theory in Tokyo" conference, University of Tokyo

Transversality and gluing for framed instantons July 2023
A minicourse on the foundations of the framed instanton theory, the appearance of obstructed gluing theory, and its relation to Floer's theory. The series concludes in a research talk on applications to surgery theory of 3-manifolds.

"Gauge theory and applications" workshop, Universität Regensburg.

Invited talks

Chern–Simons invariants and Cosmetic surgery August 2024
"Gauge theory in Tokyo" conference, University of Tokyo

Filtered instanton Floer homology and cosmetic surgery May 2024
"Gauge Theory, Low-Dimensional Topology, and Geometric Analysis Conference", Rutgers – New Brunswick

Instantons, indefinite cobordisms, and Dehn surgery April 2024
Gauge Theory Virtual Seminar

Gauge theory and indefinite 4-manifolds February 2024
"Geometry and topology" seminar, Dartmouth

Chern–Simons and diffeomorphism invariants December 2023
"Geometry and topology" seminar, MIT

Filtered instanton homology and cosmetic surgery October 2023
Gauge Theory Virtual Seminar

Filtered instanton homology and cosmetic surgery October 2023
9th KTGU Workshop, Kyoto University

CS implies CS July 2023
"Topology of 3- and 4-dimensional manifolds" conference, Princeton University

A first look at an equivariant surgery sequence May 2023
"Instantons and foams" conference, MIT

Instantons, suspension, and surgery April 2023
The second of a pair of joint talks on joint work with Ali Daemi.
"Gauge Theory and Low Dimensional Topology" conference, IMSA, U Miami

Cobordism maps without equivariant transversality March 2023
2023 Midwest Geometry Conference, Kansas State University

Instantons and Dehn surgery March 2023
Colloquium, Kansas State University

Instantons, indefinite manifolds, and Dehn surgery December 2022
Symplectic Geometry, Gauge Theory, and Low-Dimensional Topology Seminar, Stony Brook University

Instantons mod 2 and indefinite 4-manifolds September 2022
Topology seminar, Harvard University

Monopole Floer homology, Hirsch algebras, and twisted homology November 2021
Topology seminar, Princeton University

Monopole Floer homology and twisted homology September 2021
Geometry/Topology seminar, Rutgers University in New Brunswick

Invariance and functoriality in equivariant instanton homology May 2021
Gauge Theory Virtual seminar

Mod 2 instanton homology and homology cobordism September 2019
AMS Special Session on Floer Homology in Dimensions 3 and 4

Madison, WA

Equivariant instanton homology and group cohomology August 2019
Conference on Floer Homotopy Theory and Low-Dimensional Topology, University of Oregon

Equivariant instanton homology and group cohomology April 2019
Topology Seminar, University of Arkansas

Equivariant instanton homology and group cohomology December 2018
Symplectic Geometry, Gauge Theory, and Categorification Seminar, Columbia University

Equivariant instanton homology and group cohomology October 2018
Geometric Analyis Seminar, Rutgers University

Equivariant instanton homology and group cohomology October 2018
Topology Seminar, Princeton University

Equivariant instanton homology and group cohomology September 2018
Geometry and Topology Seminar, MIT

Equivariant instanton homology and group cohomology July 2018
Conference on Gauge Theory and Applications, Universität Regensburg

Equivariant instanton homology and group cohomology May 2018
Seminar in Topology and Symplectic Geometry, Stony Brook University

Student-oriented talks

Instantons: from physics to exotic topology February 2023
Michael Zhao Memorial Student Colloquium, Columbia University

dg-Algebras, twisted homology, and homotopy commutativity September 2021
Michael Zhao Memorial Student Colloquium, Columbia University

ℓ^p is not ℓ^q February 2021
Undergraduate Math Society Lecture, Columbia University

The winding number throughout mathematics October 2020
Undergraduate Math Society Lecture, Columbia University

Triangulations and homology cobordism April 2019
Graduate Student Mathematics Colloquium, University of Arkansas

Awards

At Columbia University:

Received Presidential Award for Outstanding Teaching Spring 2023
One of 5 recipients (of 600 nominees).

Finalist, Presidential Award for Outstanding Teaching Spring 2022
10 finalists, 600 nominees.

Nominee, Mark Van Doren Award for Teaching Spring 2022
12 nominees.

Department of Mathematics Junior Faculty Recognition Award for Excellence in Teaching Spring 2021

At UCLA:

Pacific Journal Prize June 2019

UCLA Dissertation Year Fellowship June 2018

O'Neill Memorial Travel Grant May 2017

Horn-Moez Prize for excellence in first-year graduate studies June 2015

Teaching

Instructor (UVM)

MATH 3551 (Abstract Algebra I)	Fall 2023
MATH 3555 (Abstract Algebra II)	Spring 2024
MATH 6551 (Abstract Algebra III)	Fall 2025

Instructor (Columbia)

Math 1201 (Multivariable Calculus I)	Fall 2019, Spring 2020, Summer 2020, Fall 2021, Spring 2022
Math 1202 (Multivariable Calculus II)	Spring 2021
Math 1207 (Honors Math A)	Fall 2022
Math 1208 (Honors Math B)	Spring 2023
Math 2010 (Linear Algebra)	Spring 2021
Math 3952 (Undergraduate seminar)	Spring 2023
Math 4501 (Topology)	Fall 2020, Fall 2021

Teaching assistant (UCLA)

Math 31B (Integral Calculus)	Fall 2014
Math 32A (Multivariable Calculus)	Fall 2015, Fall 2017
Math 33A (Linear Algebra)	Winter 2015
Math 123 (Foundations of Geometry)	Winter 2018
Math 132 (Complex Analysis)	Spring 2015, Summer 2016
Math 170B (Probability Theory II)	Summer 2015
Math 225A (Differential Topology)	Fall 2015, Fall 2016, Fall 2017
Math 225B (Differential Geometry)	Winter 2015, Winter 2016, Winter 2017
Math 225C (Algebraic Topology)	Spring 2016

Mentorship

Supervised undergraduate research Summer 2024

Supervised undergraudate Lisa Faulkner on research in monopole Floer homology, developing a Lefschetz decomposition over $\mathbb{Z}$ towards computing $\overline{HM}(S^1 \times \Sigma_g)$.

Jointly supervised graduate research Spring 2024-Fall 2024

With Spencer Backman, helped PhD student Sienna Unter develop a research project on the d-invariants of graphs.

Supervised senior thesis Summer 2022-Spring 2023

Columbia University, with Arjun Kunidoor.
Topic: Atiyah–Singer's index theorem and the early history of instantons.

Joint research with undergraduate Spring 2022, Summer 2022

Columbia University, with Aiden Sagerman. Led to the publication 'Hyperplanes in abelian groups and twisted signatures'.

Directed independent study courses 2019-2024

University of Vermont. Three courses, five students. Topics in abstract algebra; complex analysis and the prime number theorem.

Columbia University. Eight courses, thirteen students.
Topics: History of Lagrange multipliers; differential topology; point-set topology; algebraic topology; integral geometry; advanced linear algebra (twice); differential geometry for electromagnetism

Service

Served as referee 2020-2023
Journal of Differential Geometry; Communications in Analysis and Geometry; Geometry & Topology; Mathematische Annalen; Algebraic & Geometric Topology; Michigan Mathematics Journal

Organized SGGTC seminar 2019-2020; 2022-2023
Columbia University

TA for minicourse on Instanton Floer homology July 2019
PCMI Graduate Student Summer School

Took official notes for Floer Homotopy conference/summer school Summer 2017
UCLA

Organized Graduate Student Seminar Fall 2015-Winter 2017
UCLA