Calvin McPhail-Snyder

Mathematician

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Education and employment

2023– **Assistant Research Professor (non tenture-track)**, *Duke University, Department of Mathematics*

2021–2023 **Phillip Griffiths Assistant Research Professor (postdoc)**, *Duke University, Department of Mathematics*
Mentor: Adam S. Levine

2021–2023 **Visiting Scholar**, *University of North Carolina at Chapel Hill, Department of Mathematics*
Mentor: David V. E. Rose

2015–2021 **PhD in Mathematics**, *University of California, Berkeley, Department of Mathematics*
Thesis: "$\mathrm{SL}_2(\mathbb{C})$-holonomy invariants of links"
Advisor: Nicolai Reshetikhin

2011–2015 **BA**, *University of Virginia*
Majors: Mathematics, Economics

Research interests

Quantum topology

Hyperbolic 3-manifolds

Chern-Simons theory

Volume conjectures

Publications

[1] Calvin McPhail-Snyder. "Holonomy invariants of links and nonabelian Reidemeister torsion". In: *Quantum Topology* 13.1 (Mar. 2022), pp. 55–135. DOI: 10.4171/qt/160. arXiv: 2005.01133v3 [math.QA].

[2] Calvin McPhail-Snyder and Kyle A. Miller. "Planar diagrams for local invariants of graphs in surfaces". In: *Journal of Knot Theory and Its Ramifications* 29.01 (Jan. 2020), p. 1950093. DOI: 10.1142/s0218216519500937. arXiv: 1805.00575 [math.GT].

Preprints

[3] Calvin McPhail-Snyder. *Hyperbolic structures on link complements, octahedral decompositions, and quantum* $\mathfrak{sl}_2$. 48 pages. Mar. 2022. arXiv: 2203.06042 [math.GT]. Submitted.

[4] Calvin McPhail-Snyder. *Surgery calculus for classical* $\mathrm{SL}_2(\mathbb{C})$ *Chern-Simons theory*. 34 pages. Oct. 2022. arXiv: 2210.09469 [math.GT].

[5] Kai-Chieh Chen, Calvin McPhail-Snyder, Scott Morrison, and Noah Snyder. *Kashaev–Reshetikhin invariants of links*. 25 pages. Aug. 2021. arXiv: 2108.06561 [math.GT]. Submitted.

In preparation

[6] Calvin McPhail-Snyder and Nicolai Reshetikhin. *Quantization of the complex volume for link exteriors*. In preparation: current version 98 pages.

Invited talks

October 2023 **Oregon State University**, *Quantizing the hyperbolic volume*, Geometry-Topology Seminar

March 2023 **AMS Southeastern Sectional**, *Surgery calculus for 3-manifolds with hyperbolic structures*, Special Session on Topology and Geometry of 3- and 4-Manifolds

November 2022 **Michigan State University**, *Hyperbolic tensor networks and the volume conjecture*, Geometry and topology seminar

June 2022 **Korea Institute for Advanced Study**, *Quantum hyperbolic topology*, Mathematics seminar (virtual)

April 2022 **University of Virginia**, *Quantum hyperbolic topology*, Geometry seminar

February 2022 **Indiana University**, *Quantum hyperbolic topology*, Topology seminar

October 2021 **UNC Chapel Hill**, *Quantum invariants from unrestricted quantum groups*, Geometric methods in representation theory seminar

September 2021 **Indiana University**, *Quantum invariants from unrestricted quantum groups*, Quantum topology seminar (virtual)

September 2021 **Duke University**, *Making the Jones polynomial more geometric*, Topology and geometry seminar

September 2021 **Australian Geometric Topology Webinar**, *Making the Jones polynomial more geometric*

April 2021 **UC Berkeley**, *What do quantum invariants say about the geometry of knot complements?*, 3-manifolds seminar

September 2019 **UC Berkeley**, *Holonomy invariants from quantum groups*, Representation theory and mathematical physics seminar

November 2017 **Centre for Quantum Geometry of Moduli Spaces**, *Diagrammatic algebras and categories on quantum algebra*, QGM Nielsen retreat

Contributed talks

June 2022 **SAGE Days Duluth**, *Lightning talk*

June 2020 **Nearly Carbon Neutral Geometric Topology Conference**, *Holonomy invariants of links*, topic group on quantum invariants and low-dimensional topology

Awards and grants

Summer 2020 **Summer Grant**, *UC Berkeley Mathematics Department*

Spring 2019 **James H. Simons Fellowship**, *UC Berkeley Mathematics Department*
Semester-long research fellowship

Summer 2018 **Summer Grant**, *UC Berkeley Mathematics Department*

Teaching and mentoring

Teaching

2021– **Postdoc and assistant research professor**, *Duke University*

I was (or will be) the primary instructor (lectured, assigned homework, wrote exams) for the following courses:

- Complex Analysis (Math 333) Fall 2022
- Introduction to Abstract Algebra (Math 401) Spring 2022, Spring 2023
- Linear Algebra and Applications (Math 221) Fall 2023

In addition, I worked as a teaching assistant (ran discussion sections, graded exams) for Matrices and Vector Spaces (Math 218-2) in Fall 2021.

2015–2021 **Graduate student instructor**, *UC Berkeley*

I taught discussion sections (typically 6 hours per week), wrote and graded quizzes, and graded exams. Courses:

- Calculus for Life Science Majors (Math 10A) Fall 2015
- Multivariable Calculus (Math 53) Spring 2016, Fall 2016, Spring 2017, Summer 2017 (online)
- Linear Algebra (Math 54) Spring 2018, Fall 2018
- Discrete Mathematics (Math 55) Fall 2017, Spring 2020, Spring 2021 (online)
- Advanced Linear Algebra (Math 110) Fall 2019, Fall 2020 (online)

Summer–Fall 2020 **Remote innovation fellow**, *UC Berkeley*

As part of the transition to online learning, the GSI Teaching & Resource Center sponsored training for graduate student instructors. As a remote innovation fellow, I:

- Participated in an eight-week training program on best practices for online learning
- Produced best practices guide for use by other mathematics and statistics instructors
- Applied knowledge by helping redesign Math 110 (advanced linear algebra) for online learning during the all-remote Fall 2020 semester.

Summer 2018, 2019 **Instructor**, *Stanford Pre-Collegiate Studies*

I taught a three-week course on knot theory for advanced high school students. I designed the curriculum, supervised teaching assistants, and evaluated student projects and performance.

Summer 2016 **Summer instructor**, *UC Berkeley*

I taught multivariable calculus (Math 53) as the primary instructor. I gave lectures, assigned homework, and wrote exams.

Mentoring

Fall 2023 **Undergraduate research mentor**, *Duke University*

Two of my students from my 2023 Math+ group continued working on the project as an independent study course.

Summer 2023 **Math+ project leader**, *Duke University*

Math+ (formerly DOmath) is a program for collaborative student research in mathematics. During the summer undergraduate students work together in groups of 2-4 on a research project for eight weeks. Each group is led by a faculty mentor assisted by a graduate student. In Summer 2023 lead a research group of four students on a project in hyperbolic knot theory.

Spring 2023 **Reading course supervisor**, *Duke University*

In the spring 2023 semester I will supervise a reading course with an undergraduate student (Kehan Wang) on topics in knot theory.

Summer 2022 **PRUV mentor**, *Duke University*

PRUV fellows are undergraduates selected to work with faculty on a research project over the summer; they then continue their project into a senior thesis. I helped Adam S. Levine mentor a PRUV fellow (Sarah Northover) working on a research project in quantum topology.

2016–2017 **Directed reading program mentor**, *UC Berkeley*

Each semester I guided an undergraduate student through a semester-long reading program and summary presentation. Students and topics:

- Michael Fermanian, elementary differential geometry, Spring 2016
- Enya Hsiao, quantum groups, Spring 2017
- Mengyang Zhang, conformal field theory, Fall 2017

Professional activities

Reviewer for

- *Quantum Topology*
- *Illinois Journal of Mathematics*

I organized the GRASP (**g**eometry, **r**epresentation theory, **a**nd **s**ome **p**hysics) student seminar in Fall 2018