FLORIAN SCHWARZ

https://sites.google.com/view/florian-schwarz
PhD candidate, Department of Mathematics & Statistics, University of Calgary

EDUCATION

Doctor of Philosophy in Mathematics, University of Calgary *expected 2026*
Thesis supervisors: Dr. Kristine Bauer and Dr. Robin Cockett
Title of thesis: Bundles in categorical geometry

Master of Science in Mathematical Physics, Universität Würzburg *2021*
Thesis supervisor: Dr. Gregor Schaumann
Title of thesis: Pushforward construction for G-decorated defect Topological Quantum Field Theories

Bachelor of Science in Mathematics, Universität Würzburg *2021*
Thesis supervisor: Dr. Arno Kampf (Universität Augsburg)
Title of thesis: Characteristics of the Hofstadter spectrum of lattice electrons in a magnetic field

Bachelor of Science in Physics, Universität Augsburg *2018*
Thesis supervisor: Dr. Arno Kampf
Title of thesis: Characteristics of the Hofstadter spectrum of lattice electrons in a magnetic field

RESEARCH INTERESTS

I call my area "categorical geometry", generalizing geometric constructions to more abstract setups using (higher) category theory. For this purpose I work with tangent categories, restriction categories, bicategories and quasicategories. In particular, in my thesis I study bundles including tangent and differential bundles in tangent categories and principal bundles in join restriction categories. Interestingly, some examples for categorical geometry can be found in the Goodwillie functor calculus and the Johnson McCarthy functor calculus.

In addition I am currently interested in monoidal closed categories their application to quantum information.

For the future I am interested in applying my categorical techniques to other problems within mathematics, in particular to network-based dynamical systems related to sustainability like energy grids.

PUBLICATIONS

In review: R. Cockett, F. Schwarz, *Lie groups in tangent join restriction categories* (2025), `arXiv:2509.18410`

Preprint: F. Schwarz, *Differential bundles as functors from free modules* (2025), `arXiv:2512.21147`

Work in progress: F. Schwarz, *The dimension of the tangent bundle and the universality of the vertical lift*

Work in progress: K. Bauer, E. E, J. Parker, F. Schwarz, *A 2-categorical approach to differentiation in Abelian functor calculus*

INTERNSHIPS

Summer 2017: internship as a junior data scientist at the Munich-based software startup Celonis

Spring 2018: research internship in Quantum Field Theory at the Johannes-Gutenberg University, Mainz

AWARDS AND SCHOLARSHIPS

Merit based

Eyes High International Doctoral Scholarship: Established to attract and retain the best and brightest doctoral students from around the world in support of the University of Calgary's Eyes High vision of becoming one of the top five research universities in Canada.

Alberta Innovates Graduate student Sholarship 2023: The Graduate Student Scholarships program provides funding to enable full-time graduate students to research emerging technologies at participating post-secondary institutions.

Alberta Graduate Excellence Sholarship (AGES): Recognizing outstanding academic achievement in graduate studies.

Henrietta Weyland Graduate Scholarship in Mathematics: This scholarship is open to students registered full-time in a doctoral program in the Department of Mathematics and Statistics. Selection is based on academic excellence.

Studienstiftung des Deutschen Volkes: Excellence, Initiative, Responsibility: in line with these principles the Studienstiftung (German Academic Scholarship Foundation) supports young people with outstanding academic or artistic talents who can be expected to make an exceptional contribution to society.

Tuition reduction

International Graduate Tuition Awards 2021-2026: This award supports the recruitment and retention of international students to the University of Calgary.

Awards

Graduate Labour Union Advocacy Award: For my work in the role as a steward supporting academically employed graduate students

Fall 2023 GAT (Graduate Assistant Teaching) Excellence Award: This award serves as a testament to the exceptional dedication and contributions of the awardees as TAs, to the teaching and learning environment in our department.

2022-2023 Faculty of Science Fred A. McKinnon Graduate Teaching Award: To be awarded to the best graduate student teaching assistant in the Departments of Computer Science and Mathematics & Statistics on an annual basis

Fall 2022 GAT (Graduate Assistant Teaching) Excellence Award: This award serves as a testament to the exceptional dedication and contributions of the awardees as TAs, to the teaching and learning environment in our department.

TALKS AND CONFERENCES

*talks at international research conferences

Invited talks

F. Schwarz: **Principal bundles in join restriction categories**
Collaboration with R. Cockett
Georg-August-Universität Göttingen — February 2025

F. Schwarz: **Abelian functor calculus as a Cartesian differential category**
Collaboration with K. Bauer, E. E, J. Parker
École polytechnique fédérale de Lausanne — December 2024

F. Schwarz: **Group objects in tangent categories**
Collaboration with R. Cockett
CMS summer meeting at the University of Saskatchewan — June 2024

Contributed talks

F. Schwarz: **The dimension of the tangent bundle and the universality of the vertical lift**
*Category Theory Octoberfest — October 2025

F. Schwarz: **The dimension of the tangent bundle and the universality of the vertical lift**
Peripatetic Seminar at the University of Calgary — October 2025

F. Schwarz: Paper presentation
Martin Rohden et al.: **Impact of network topology on synchrony of oscillatory power grids**
Grad student seminar in the department of mathematics and statistics — August 2025

F. Schwarz: **Principal bundles in join restriction categories**
Collaboration with R. Cockett
*International Category Theory Conference CT2025 at Masaryk University, Brno — July 2025

F. Schwarz: **Principal bundles in join restriction categories**
Collaboration with R. Cockett
*Foundational Methods in Computer Science workshop at the University of Ottawa — June 2025

F. Schwarz: **Introduction to equivalences between bicategories and 2-categories**
Peripatetic Seminar at the University of Calgary — November 2024

F. Schwarz: **Differential bundles in tangent (infinity) categories**
Collaboration with K. Bauer
*Young Topologist Meeting at the Universität Münster — August 2024

F. Schwarz: **Differential bundles in tangent (infinity) categories**
Collaboration with K. Bauer
*Foundational Methods in Computer Science workshop at the University of Calgary — July 2024

F. Schwarz: **The Lie Algebra of a group object**
Collaboration with R. Cockett
Peripatetic Seminar at the University of Calgary — January 2024

F. Schwarz: **Differential bundles as functors**
Collaboration with K. Bauer
Peripatetic Seminar at the University of Calgary — December 2023

F. Schwarz: **Categorically generalizing bundles**
Collaboration with R. Cockett
Peripatetic Seminar at the University of Calgary — September 2023

F. Schwarz: **Partial Monoids**
Collaboration with R. Cockett
*Foundational Methods in Computer Science workshop at Mount Allison University — June 2023

F. Schwarz: **Summary of the 2023 IPCC synthesis report**
GUMS Math Climate day at the University of Calgary — May 2023

F. Schwarz: **Partial monoids**
Collaboration with R. Cockett
Peripatetic Seminar at the University of Calgary — April 2023

F. Schwarz: **Principal bundles in join restriction categories**
Collaboration with R. Cockett
Peripatetic Seminar at the University of Calgary — February 2023

F. Schwarz: **Tangent infinity Categories and why they are relevant**
*ICM geometry and topology session at the University of Copenhagen — July 2022

F. Schwarz: **Tangent infinity Categories and why they are relevant**
*Foundational Methods in Computer Science workshop at the Kananaskis field station — June 2022

F. Schwarz: **Tangent categories, Cartesian differential categories and how they are related**
Peripatetic Seminar at the University of Calgary — May 2022

Other conferences attended

Operads and calculus workshop, Belfast, Northern Ireland — April 2025

International Category Theory Conference, Santiago de Compostella, Spain — June 2024

(∞, n)**-categories and their applications**, Utrecht, Netherlands — April 2024

68th Cascade Topology seminar, Vancouver, Canada — April 2023

67th Cascade Topology seminar, Portland, USA — November 2022

Additionally I attended more than 20 summer schools about various topics including neurodiversity, homotopy type theory, programming on quantum computers information theory and algebraic topology.

TEACHING EXPERIENCE

Summer schools at the "Club der Ehemaligen deutscher Schülerakademien" (CdE)

Instructor at the CdE summer academy 2024: Teaching a course on topological quantum field theories to a diverse audience including school students

Instructor at the CdE pentecost academy 2023: Teaching a course on special relativity to a diverse audience including school students

Teaching at the University of Calgary

Instructor for Calculus I: Teaching lectures, designing assignments and exams, organizing teaching assistants, holding office hours, and coordinating with other instructors during the winter term 2025

Instructor for Linear Methods 1: Teaching both lectures and active learning sessions during winter term 2023

Teaching assistant with student contact (e.g tutorials, help center) 2021-2024: Analysis I, Linear Methods II, Calculus I for engineers, Calculus I, Inside Mathematics, Discrete Mathematics, Differential equations for engineers, and Mathematical Explorations

Julius Maximilian Universität Würzburg

Teaching assistant with tutorial Linear Algebra I (2020), Geometrical Mechanics (2021)

Review week: Linear Algebra I: I taught a week-long intensive review for exam preparation

Teaching assistant grading only: Analysis III (2018)

Universität Augsburg

Teaching assistant with tutorial Analysis II (2018)

LEADERSHIP EXPERIENCE

Conference organization

2023-2025: Central organizer of four iterations of the **Math and CS Climate Day**, a conference style one day event connecting mathematicians, statisticians and computer scientists to problems regarding the climate crisis.

2022 and 2024: Co-organizer of two iterations of the Foundational Methods in Computer Science (FMCS) workshop

2023: Co-organizer of the **Alberta graduate mathematics and statistics conference** (AGMSC)

Seminar organization

Organizer for the Peripatetic Seminar at the University of Calgary since 2023.

Organizer for the Graduate student seminar in fall 2024.

Society leardership

October 2024 - April 2025: **President** of the Graduate University of Calgary Mathematics and Statistics society (GUMS^2). Responsibilities include

- representation of GUMS^2,
- applying for funding from various sources,
- scheduling meetings, and
- enforcing the bylaws.

May 2024 - February 2025: **Chair of the** Graduate student association's (GSA's) **finance standing committee**. Responsibilities include

- selecting and scheduling the finance standing committee,
- handling the GSA's finances and designing the budget, and
- presenting the finances and the budget to the Graduate Representative Council.

April 2024-October 2024: **Vice President Academic** of the Graduate University of Calgary Mathematics and Statistics society (GUMS^2). Responsibilities include

- representing graduate student interests on the department's Graduate Committee,
- organizing the weekly Graduate student seminar, and
- communicating feedback on graduate courses to the department.

April 2023-October 2024: GUMS^2 **representative** in the department awards committee. Responsibilities include

- representing graduate student interests on the department's awards committee, and
- nominating professors for research and teaching based awards.

October 2022-April 2024: **Vice President Events** at the Graduate University of Calgary Mathematics and Statistics society (GUMS^2). Responsibilities include

- scheduling the events committee,
- delegating event preparations, and
- ensuring the successful execution of events.

LANGUAGES

Spoken languages

English (fluent), German (native speaker)

Programming languages

Python, Java, C, SQL