

Sean C. Sanford

GRADUATE STUDENT · NOVICE MATHEMATICIAN

Department of Mathematics

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Education

Indiana University

PHD STUDENT

- Currently ABD
- Advisor: Julia Plavnik

Bloomington, IN

2017-present

University of Hawaii at Mānoa

M.A. IN MATHEMATICS

- Worked for the department as a SUPER-M Fellow, and as a TA
- Passed qualifying exams in Algebra and Analysis

Honolulu, HI

2014-2017

University of Hawaii at Mānoa

B.S. IN MATHEMATICS, WITH A MINOR IN JAPANESE

- Took the Putnam Exam twice and scored a 12 in 2008, and a 21 in 2009
- Solved three of the department's undergraduate Hanf Competition problems
- Studied abroad in Spring '09 at Obirin University in Machida, Japan

Honolulu, HI

2006-2010

Research

GENERAL INTERESTS

- Tensor Categories
- Enriched and Higher Category Theory
- Topological Quantum Field Theories
- Algebraic Topology

Current Projects

EXTENSION THEORY OF TENSOR CATEGORIES BY GROUPS

- In a 2009 paper, Etingof, Nikshych and Ostrik establish an obstruction theory method for classifying extensions of fusion categories by groups. Their paper focuses on the case of fusion categories over algebraically closed fields. The goal of this project is to understand the changes that must be made in order to adapt these techniques to the non-semisimple, and non-algebraically closed cases.

NON-SPLIT TAMBARA-YAMAGAMI CATEGORIES OVER THE REALS

- In 1998, Daisuke Tambara and Shigeru Yamagami investigated a simple set of fusion rules, and proved under which circumstances those rules could be given a coherent associator. In this project, we are investigating a generalization of such fusion rules to the setting where the simple objects are no longer required to be absolutely simple. Over the real numbers, this means that objects are either real, complex or quaternionic.
- This is joint work with Julia Plavnik and Dalton Sconce.

UNIVERSAL TRACES

- For finite-dimensional vector spaces, the coend of the Hom-functor is isomorphic to the base field, and the corresponding universal cowedge is precisely the trace map. More generally, this coend defines an important trace-like invariant $T(\mathcal{C})$ for every (suitably nice) category \mathcal{C} . This has applications to the theory of modified traces, which are essential to the definition of 3-manifold invariants coming from nonsemisimple TQFTs.

Papers

Smooth Actions of Compact Lie Groups on S^2 are Smoothly Equivalent to Linear Actions

[Available here](#)

MASTER'S THESIS

Submitted Spring 2017

- In a 2006 paper, Boris Kolev reproved the classical result of Kerékjártó that any topological action on S^2 by a compact group is topologically equivalent to a linear action. It was suggested by Dovermann, Schulz and others that this result should extend to the smooth category. In this paper we prove that every smooth action of a compact Lie group on S^2 is *smoothly* conjugate to a linear action. The result is achieved by constructing explicit smoothings of the conjugating function supplied by Kerékjártó's theorem.

Presentations

Topology Algebra and Combinatorics (TACo) Seminar

SPEAKER

- Presented on fusion categories over non-algebraically closed fields.

Loyola Chicago (Virtual)

March 2022

JMM 2022: Special Session Hopf Algebras and Tensor Categories

SPEAKER

- This extended version of the MCA 2021 talk will cover more cases and examples from the non-split Tambara-Yamagami over the reals project (see the research section for more details).

JMM (Virtual)

April 2022

OSU Mathematics: Quantum Symmetries Seminar

SPEAKER

- Presented an in-depth talk about fusion categories over non-algebraically closed fields.

Columbus, OH

December 2021

Rice Mathematics: Algebraic Geometry and Number Theory Seminar

SPEAKER

- Presented an introductory talk about fusion categories over non-algebraically closed fields.
- This talk was similar in topic to those given at Loyola Chicago and Rice, but for an audience with broader interests.

Houston, TX

September 2021

Mathematical Congress of the Americas: Special Session on Quantum Symmetries

DIGITAL 'POSTER' PRESENTER

- Recorded a 15 minute talk about non-split Tambara-Yamagami categories over the reals.
- This talk was an advertisement for an REU project for which I was a mentor. See the research section for more details.
- The full video of this talk can be found [here](#).

MCA (online conference)

July 2021

Quantum Symmetries Student Seminar

SPEAKER

- Presented an expository talk about nondegeneracy conditions for nonsemisimple tensor categories, as proven by K. Shimizu in 2016.
- The notes from this talk can be found [here](#). They contain lots of interesting string diagram calculations.

QSSS (online seminar)

September 2020

Summer School on Surgery and the Classification of Manifolds

PARTICIPANT

- Presented a 30 minute mini-lecture on Handlebody Theory.

Calgary, Alberta, Canada

July 2016

Service

October,
2021

Co-Organizer, 2021 AMS Fall Western Sectional: Special Session on Tensor Categories and Applications

Virtual

Honors & Awards

Spring
2022

AMS Graduate Student Travel Grant, Joint Mathematics Meeting

Seattle, WA

Spring

2020, &

Spring

2021

Hazel King Thompson Scholarship, IU Math Department Annual Awards Ceremony

Bloomington, IN

Spring

2018

James P. Williams Memorial Award, IU Math Department Annual Awards Ceremony

Bloomington, IN

Fall'16 -
Spring'17

Kotaro Kodama Scholarship,

Honolulu, HI

Fall'16 -
Spring'17

UHM Math Departmental Merit Scholarship,

Honolulu, HI

Fall'14 -
Summer'15

Super-M Fellowship,

Honolulu, HI

Teaching

IU Math Department

UNDERGRADUATE MENTOR

Bloomington, IN

Fall 2020 - Summer 2021

- Served as a mentor for IU's directed reading program in Fall '20 and Spring '21.
- Served as a mentor for an REU project with Dalton Sconce in Summer '21.
This project was productive, and we are currently working on cleaning up these results for publication.

IU Math Department

TA AND INSTRUCTOR

Bloomington, IN

Fall 2017 - present

- Instructor of record for College Algebra for IU's Groups Scholars program for first-generation, underrepresented students.
- Authored a [video lecture series](#) for my algebra students.
- Instructor of record for Pre-Calculus/Trigonometry
- Instructor for Math of Decision and Beauty

UHM Math Department

TA AND INSTRUCTOR

Honolulu, HI

Fall 2015 - Spring 2017

- Instructor of record for Calculus I
- TA for Calculus I, II and II Honors
- Miscellaneous proctoring and grading duties for the department.

University of Hawaii Outreach College

CALCULUS I, II INSTRUCTOR

Honolulu, HI

Summer 2015 and 2016

- Instructor of record for Calculus I condensed 6 week Summer course in 2016.
- Instructor of record for Calculus II condensed 10 week Summer course in 2015.
- Primary responsibilities: Lecturing, assigning homework, grading, proctoring exams, etc.

Freelance

MATH TUTOR

Honolulu, HI

Fall 2010 - Summer 2014 (intermittent)

- Tutored various levels of mathematics from middle school to undergraduate.
- Topics include: Algebra I/II, Geometry, Trigonometry, Calculus I-III, Differential Equations, Linear Algebra, etc.

Outreach

The Super-M Program

SUPER-M FELLOW

Oahu and Molokai, HI

Fall 2014 - Spring 2015

- This was a STEM Outreach program associated with the UHM Math Dept. that was funded by an NSF Grant through the Gk-12 Program.
- Primary duties: developing new and innovative lesson plans for k-12 math classes, and running outreach events.
- Worked with underprivileged children at the Institute for Human Services summer school.
- Organized the neighbor island community event Molokai Math Day 2015
- Represented the program in a presentation at the international conference COAV 2015 in Putrajaya, Malaysia.

Volunteer Outreach

VARIOUS

Oahu and Molokai, HI

2015-2017

- Ran an Origami activity booth at Molokai Math Day. (Spring 2016)
- Ran activity booths at UH Mānoa's annual Be A Scientist Night. (Winter 2016)
- Ran the model rockets activity booth at the Institute for Astronomy's Open House. (Spring 2016 and 2017)
- Volunteered for IFA's Solar Telescope booth at Honolulu's Children and Youth Day. (Summer 2016)

References

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