Jackson Van Dyke

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Education

University of Texas, Austin 2019-Present
Ph.D. in Mathematics (in progress)

University of California, Berkeley 2015-2019
B.A. in Mathematics
Honors thesis title: Non-sectorial gluing of Fukaya categories

Research Interests

My current research focuses on certain three and four-dimensional topological field theories (TFTs). One such theory, Rozansky-Witten theory, plays an important role in three-dimensional mirror symmetry and the geometric Langlands program. In practice I work with $\mathbb{E}_2$-categories (i.e. braided categories), (categorical) sheaf theory, and homotopy-theoretic obstructions to constructing TFTs from such data.
In the past I have studied computational models of nuclear fission.

Research Experience

Rozansky-Witten theory and the metaplectic anomaly
UT Austin Fall 2019-Present
Under the guidance of Professor David Ben-Zvi, I have been thinking about Rozansky-Witten theory. Specifically about the details involved in extending it down to a point. Some specific things I work with are sheaves of categories, anomalies, and higher gerbes.

Undergraduate senior thesis:
UC Berkeley Fall 2018, Spring 2019
Under the guidance of Professor Vivek Shende, I used microlocal sheaf theory, homotopy theory, and other tools to study certain symplectic manifolds arising in low-dimensional topology.

Research project on Dean's Scholarship:
University College London Summer 2017
I was awarded the Dean's Summer Scholarship at UCL for the summer of 2017. This opportunity was similar to an REU. I completed a research project under the supervision of Professor Michael Singer investigating the asymptotic behavior of partial density functions on hermitian line bundles. My particular work primarily involved Kähler geometry and complex analysis, and resulted in some original contributions [2].

Fission Reaction Event Yield Algorithm (FREYA):
Lawrence Berkeley National Laboratory Spring 2017 - Spring 2020
My project mathematically optimized FREYA, an algorithm which models nuclear fission. This project involved statistical analysis of large data sets using python.

Publications

[1] Antonio Alfieri and Jackson Van Dyke, *An introduction to knot Floer homology and curved bordered algebras*, Period. Math. Hungar. **80** (2020), no. 2, 211–236. MR 4109229

[2] J. Ross, M. Singer, and J. Van Dyke, *Asymptotics of partial density functions*, In preparation. 1

[3] A. Schmah, N. Buechel, S. Garrett, M. Lomnitz, X. Sun, J. Van Dyke, J. Xu, and J. Zhang, *Radiation Hardness Test of Eljen EJ-500 Optical Cement*, ArXiv e-prints (2017).

[4] J Van Dyke, L.A. Bernstein, and R. Vogt, *Parameter optimization and uncertainty analysis of freyafor spontaneous fission*, Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment **922** (2019), 36 – 46.

Honors and Awards

John and Anne Crawford Scholarship: Fall 2021-Spring 2022
This scholarship gives special consideration to law and math students. Donor criteria: Scholastic merit including artistic, musical and creative merit, and leadership roles in current or prior university or industry settings.

Frank Gerth III teaching excellence awards: Fall 2019-Spring 2020
Departmental awards which are "given each year to students who are proven teaching assistants or assistant instructors."

NSF Graduate Research Fellowship Program (honorable mention): Spring 2020

Dean's Honors List - College of Letters and Science:
UC Berkeley Spring 2018-2019
The Dean's Honors List recognizes outstanding academic achievement of students with semester GPA in the top 10% of L&S undergraduates.

International Dean's Summer Scholarship:
University College London Summer 2017
I spent the summer of 2017 doing research under Professor Michael Singer with support from the International Dean's Summer Scholarship from UCL. This is analogous to an REU opportunity in the United States.

Teaching Experience

Assistant instructor (IBL format): **Topology I**
University of Texas, Austin **Fall 2020, Spring 2022**
This course implemented the **inquiry based learning (IBL)** method. This is a successful contemporary teaching technique which is particularly well-represented at UT. The class was separated into two halves, which would meet separately. I taught one half, and the other assistant taught the other half. **My responsibilities included:** independently holding class over Zoom, grading exams, and managing an IBL-based in-class discussion every day. I developed my IBL-style teaching techniques with the help of Professor Michael Starbird and other IBL resources at UT.

Teaching assistant: **Multivariable Calculus, Series, Sequences**
University of Texas, Austin **Fall 2019, Spring 2020**
I held section, wrote and administered quizzes, graded assignments, and held office hours.

Undergraduate Student Instructor: **Calculus, ODEs, Linear Algebra**
University of California, Berkeley **Fall 2018**
I held section, wrote and administered quizzes, graded assignments, and held office hours.

Summer Program in Nuclear Physics:
University of Oslo, Oslo, Norway **May 2017**

I helped developed the curriculum for, and teach a course concerning the physics of nuclear fission and our ability to model it. This happened in conjunction with my research in theoretical nuclear physics developing the fission event algorithm FREYA.

Outreach

Sunday Morning Math Group Coordinator:
UT Austin Spring 2021-Fall 2021
The Sunday Morning Math Group (SMMG) is a UT sponsored outreach program aimed at junior high and high school students. I was responsible for:

- organizing and hosting 6-8 public "general sessions" for the community each semester, and
- organizing and proctoring two cycles of the "American Math Contest" (8, 10, and 12) and the "American Invitational Mathematics Examination" for those who qualified.

The "general sessions" are comprised of a talk given by a faculty member or graduate student, oftentimes in conjunction with an exercise session. Throughout 2021 there were a total of 9 exam sessions, during which I administered a total of **600 exams**. My time as the SMMG coordinator coincided with the COVID-19 pandemic, meaning I had the extra experience of arranging an online version of all of the above events.

Directed reading program:
UT Austin Fall 2019-Present
The DRP is an RTG program of the Department of Mathematics at the University of Texas at Austin. DRP pairs undergraduate students with graduate student mentors to undertake independent projects in mathematics. So far, I have mentored four students who completed high-level projects by the end of the semester.

Seminars organized

Jr. Geometry seminar
UT Austin Spring 2021

Talks Given

- **Geometric Representation Theory Seminar**
  UT Austin Fall 2020, Spring 2021
  - Wall crossing functors and $\mathcal{D}$-modules
  - Singular support of constructible sheaves
- **Junior Geometry Seminar**
  UT Austin Spring 2020, Fall 2020, Spring 2021, Fall 2021
  - Algebraic geometry and topological field theory
  - Algebraic geometry in machine learning
  - The categorical Weil representation
  - Categorification of quantization
- **Junior Geometry and String Theory Seminar**
  UT Austin Fall 2019, Spring 2020, Fall 2020, Spring 2021, Fall 2021
  - Introduction to the $\mathcal{A}$-model
  - Higher motion groups

  - Anomalies
  - Shifted geometric quantization
  - Four-dimensional TFTs from braided monoidal categories

- The structure of $\mathcal{M}_{\mathrm{FG}}$, **Chromatic Homotopy Theory Seminar**
  UT Austin Spring 2021

- Higher-dualizability, **Juvitop**
  MIT Fall 2020

- **Basic algebraic geometry seminar**
  UT Austin Spring 2020, Fall 2020, Spring 2021
  - Spherical varieties
  - Sheaves on stacks
  - The Weil conjectures

- **Triangulation conjecture Seminar**
  UT Austin Fall 2019

- Partial density functions and Hele-Shaw flow **Scholarship Project Presentation**
  University College London August 2017

- **University Program Review (UPR) Presentation**
  University of Michigan, Ann Arbor June 2018

- **Nuclear Fission Conference (NA22 collaboration):**
  Santa Fe, NM March 2017

Conferences Attended

(∞, n)-categories, factorization homology, and algebraic K-theory:
MSRI, Berkeley CA March 23, 2020 - March 27, 2020

Tensor categories and topological quantum field theories:
MSRI, Berkeley CA March 16, 2020 - March 20, 2020

New Perspectives in Gromov-Witten Theory:
IMJ-PRG, Sorbonne Universit, Paris June 3 - June 7, 2019

Princeton Summer School in Low-dimensional Topology and Symplectic Geometry:
Princeton University, Princeton, NJ June 11 - June 29, 2018

Enumerative Geometry Beyond Numbers:
MSRI, Berkeley CA January 22, 2018 - January 26, 2018

Skills

Type-setting: I have been typesetting all of my assignments and notes with LaTeX for multiple years. I take a large majority of my notes in real time.

Computer science: High level: Python, Low-level: C++, fortran, bash. I have also worked extensively with clusters and techniques such as parallel processing for working with computationally intensive projects. Specifically I have had experience with both computational geometry and analysis of large data sets.