

# Arun Debray

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## Employment

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### Golomb Visiting Assistant Professor

PURDUE UNIVERSITY, DEPARTMENT OF MATHEMATICS

Fall 2021 – Spring 2024

## Education

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### The University of Texas at Austin

PH.D. IN MATHEMATICS

2021

Thesis: “Taking topological field theory at phase value,” advised by Daniel Freed.

### Stanford University

B.S. IN MATHEMATICS WITH HONORS

2015

Thesis: “Modular Representation Theory and the CDE Triangle,” advised by Akshay Venkatesh.

## Publications and Preprints

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### Published

1. (with Sam Gunningham) The Arf-Brown TQFT of  $\text{Pin}^-$  Surfaces. In *Topology and Quantum Theory in Interaction*, Contemp. Math. volume 718, pp. 49–87. 2018. ([arXiv:1803.11183](#)).
2. The low-energy TQFT of the generalized double semion model. *Comm. Math. Phys.* volume 375, issue 2, pp. 1079–1115. 2020. ([arXiv:1811.03583](#)).
3. Stable diffeomorphism classification of some unorientable 4-manifolds. *Bull. London Math. Soc.* volume 54, issue 6, pp. 2219–2231. 2022. ([arXiv:2102.03965](#)).
4. (with Markus Dierigl, Jonathan J. Heckman, and Miguel Montero) The anomaly that was not meant IIB. *Fortschr. Phys.* volume 70, issue 1. 2022. ([arXiv:2107.14227](#)).
5. (with Yu Leon Liu and Christoph Weis) Constructing the Virasoro groups using differential cohomology. *Int. Math. Res. Not. IMRN*, volume 2023, number 21, pp. 18537–18574. 2023. ([arXiv:2112.10837](#)).
6. (with Ivano Basile, Matilda Delgado, and Miguel Montero) Global anomalies & bordism of non-supersymmetric strings. *J. High Energy Physics* volume 2024, number 92, 2024 ([arXiv:2310.06895](#)).

### Accepted

7. (with Matthew Yu) What bordism-theoretic anomaly cancellation can do for U, 2022 ([arXiv:2210.04911](#)). Accepted, *Communications in Mathematical Physics*.
8. (with Markus Dierigl, Jonathan J. Heckman, and Miguel Montero) The Chronicles of IIBordia: Dualities, Bordisms, and the Swampland, 2023 ([arXiv:2302.00007](#)). Accepted, *Advances in Theoretical and Mathematical Physics*.
9. Bordism for the 2-group symmetries of the heterotic and CHL strings, 2023 ([arXiv:2304.14764](#)). Accepted, *Higher Structures in Geometry, Topology and Physics*, Contemp. Math. AMS.

### Submitted

10. Invertible phases for mixed spatial symmetries and the fermionic crystalline equivalence principle, 2021 ([arXiv:2102.02941](#)).
11. (with Matthew Yu) Adams spectral sequences for non-vector-bundle Thom spectra, 2023 ([arXiv:2305.01678](#)).
12. Differential cohomology (encyclopedia article), 2023 ([arXiv:2312.14338](#)).
13. (with Weicheng Ye and Matthew Yu) Bosonization and Anomaly Indicators of (2+1)-D Fermionic Topological Orders, 2023 ([arXiv:2312.13341](#)).
14. (with Sanath K. Devalapurkar, Cameron Krulewski, Yu Leon Liu, Natalia Pacheco-Tallaj, and Ryan Thorngren) The Smith Fiber Sequence of Invertible Field Theories, 2024 ([arXiv:2405.04649](#)).

### Preprints (will be submitted)

15. (with Sanath K. Devalapurkar, Cameron Krulewski, Yu Leon Liu, Natalia Pacheco-Tallaj, and Ryan Thorngren) A Long Exact Sequence in Symmetry Breaking: order parameter constraints, defect anomaly-matching, and higher Berry phases, 2023 ([arXiv:2309.16749](#)).
16. (with Cameron Krulewski) Smith homomorphisms and  $\text{Spin}^h$  structures, 2024 ([arXiv:2406.08237](#)).

## OTHER WORKS

- Appendix to “Topological Superconductors on Superstring Worldsheets” by Justin Kaidi, Julio Parra-Martinez, and Yuji Tachikawa. SciPost Phys. volume 9, issue 1, 2020 ([arXiv:1911.11780](#)).
- (with Søren Galatius and Martin Palmer) Appendix to “Lectures on Invertible Field Theories” by Søren Galatius. In *Quantum field theory and manifold invariants*, edited by Daniel S. Freed, Sergei Gukov, Ciprian Manolescu, Constantin Teleman and Ulrike Tillmann. IAS/Park City Mathematics Series volume 28, 2021 ([arXiv:1912.08706](#)).
- Appendix to “Toric 2-group anomalies via cobordism” by Joe Davighi and Nakarin Lohitsiri. J. High Energ. Phys. volume 2023, issue 19. 2023. ([arXiv:2302.12853](#)).

## Books

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1. (edited jointly with Araminta Amabel and Peter Haine) *Differential Cohomology: Categories, Characteristic Classes, and Connections*, 2021 ([arXiv:2109.12250](#)). Under contract with Cambridge University Press.

## Talks

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June 2024	<b>Anomaly cancellation in string theory using homotopy theory</b> , String Math 2024, ICTP
March 2024	<b>Bosonization and anomalies of 3d fermionic topological orders</b> , Conference on Higher Categorical Tools for Quantum Phases of Matter, Perimeter
January 2024	<b>Anomalies and generalized cohomology</b> , The University of Kentucky
December 2023	<b>Anomaly indicators for symmetries of 3d spin TFTs</b> , Perimeter Institute (online)
October 2023	<b>Constructing the Virasoro groups with differential cohomology</b> , Wichita State/Texas Tech Topology and Geometry Seminar (online)
July 2023	<b>The twisted Wu formula</b> , Young Faculty Speaker, Graduate Student Topology and Geometry Conference (online)
June 2023	<b>From Borel-equivariant bordism to the fermionic crystalline equivalence principle</b> , Equivariant Bordism Theory and Applications, Casa Matemática Oaxaca
May 2023	<b>IIBordia</b> , (joint with Jonathan J. Heckman), Swampland Seminar (online)
May 2023	<b>Spectral sequences (5-lecture series)</b> , Atlantic TQFT Spring School
April 2023	<b>The twisted Wu formula and Adams spectral sequences for non-vector-bundle Thom spectra</b> , Midwest Topology Seminar
April 2023	<b>Non-vector-bundle Thom spectra and applications to anomalies</b> , Perimeter Institute Mathematical Physics Seminar
March 2023	<b>Twisted string bordism and a potential anomaly in <math>E_8 \times E_8</math> heterotic string theory</b> , Geometric/Topological Quantum Field Theories and Cobordisms 2023, NYU Abu Dhabi
January 2023	<b>Algebraic topology and the Swampland</b> , UT Austin Geometry Seminar
January 2023	<b>Review of anomalies and invertible field theories</b> , (joint with Matthew Yu), Global Categorical Symmetries Postdoc and Graduate Student Colloquium (online)
October 2022	<b>Computing anomalies of theories of supergravity using bordism</b> , Higher Structures & Field Theory Seminar (online)
June 2022	<b>Anti-unitary symmetries of 3d finite abelian spin gauge theories</b> , Perimeter Institute Conference on Global Categorical Symmetries Gong Show
May 2022	<b>Introduction to cobordism theory (3-lecture series)</b> , Geometric Aspects of the Swampland conference, Madrid
November 2021	<b>The anomaly of the duality symmetry in type IIB string theory</b> , Perimeter Institute Math Physics Seminar (online)
July 2021	<b>Invertible phases for mixed spatial symmetries</b> , Higher Structures in QFT and String Theory Gong Show (online)
July 2021	<b>Modeling invertible topological phases of matter using homotopy theory</b> , Harvard Center of Mathematical Sciences and Applications Interdisciplinary Science Seminar (online)
June 2021	<b>From bordism groups to crystalline SPT phases</b> , TopFlavours (online)
June 2021	<b>Stable diffeomorphism classification of some unorientable 4-manifolds</b> , (Online) Workshop in Geometric Topology
March 2021	<b>Stable diffeomorphism classification of some unorientable 4-manifolds</b> , MIT Topology Seminar (online)
November 2020	<b>Two Physics Applications of Invertible Field Theories</b> , Harvard Center of Mathematical Sciences and Applications Special Seminar (online)

August 2020	<b>From Crystalline Topological Phases of Matter to Bordism</b> , Graduates Reminisce Online On Topology Summer Seminar
April 2020	<b>What: Bordism groups. Why: Condensed-matter physics. How: The Adams spectral sequence.</b> , Graduate Online Anything Topology Series
April 2020	<b>Topological Phases and Topological Field Theories</b> , Mathematical Sciences Research Institute Graduate Student Seminar (online)
March 2020	<b>Topological Phases and Topological Field Theories</b> , Johns Hopkins Topology Seminar
July 2019	<b>The low-energy TQFT of the generalized double semion model</b> , Park City Mathematics Institute Research Program 2019
August 2018	<b>The low-energy TQFT of the generalized double semion model</b> , Conference on Higher Algebra and Mathematical Physics, Perimeter Institute
November 2017	<b>The low-energy TQFT of the generalized double semion model</b> , Contributed talk, Texas Analysis and Mathematical Physics Symposium
January 2017	<b>Lattice models and TQFTs</b> , AT&T Foundry Palo Alto weekly seminar series

## Service

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### Purdue Topology Seminar

2022–24

Organizer.

### Co-organizer: UT summer mini-courses

2020, 2021

Co-organized a program of several week-long online math mini-courses run by and for graduate students.

### Teacher: UT summer mini-courses

2017, 2018, 2019, 2020, 2021

Taught week-long mini-courses on subjects including characteristic classes, topological field theory, and spectral sequences for grad students.

### UT Math Club

Fall 2015, Spring 2016, Fall 2016,  
Fall 2019, Spring 2021

Spoke at UT Austin's undergraduate math club on SET and maximal caps; cohomology; and Frobenius algebras and TQFTs.

### Teaching assistant: Park City Mathematics Institute

Summer 2019

TA for Søren Galatius' course on invertible field theories for grad students.

### 10/8 theorem learning seminar

Spring 2019

Co-organized a learning seminar at UT Austin on Furuta's proof of the 10/8 theorem.

### Homotopy theory learning seminar

Fall 2018

Co-organized a learning seminar at UT Austin on the Adams-Novikov spectral sequence.

### Saturday Morning Math Group

Fall 2018

Gave a talk to high schoolers about the mathematics of SET.

### Gromov-Witten theory learning seminar

Spring 2018

Co-organized a learning seminar at UT Austin on Gromov-Witten theory.

### Quantum topology and categorification learning seminar

Spring 2017

Co-organized a learning seminar at UT Austin on Chern-Simons theory, the Jones polynomial, and Khovanov homology.

### Student geometry seminar, UT Austin

Fall 2016, Fall 2017

Organizer.

### A-Star Math Tournament

2015

Head proctor and co-organizer.

### Berkeley Math Tournament

2012, 2015

Proctor and grader.

### Stanford Math Tournament

2012, 2013, 2014

Head proctor, proctor, and problem writer.

### American Regions Math League (ARML)

2012

Coached the San Francisco-Bay Area A2 team.

## Honors, awards, and fellowships

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Spring 2024	<b>Nominated, Residential Academic Initiatives Favorite Faculty</b> , Purdue University
Spring 2021	<b>Frank Gerth III Dissertation Award</b> , UT Austin Department of Mathematics
F19 – S20	<b>Continuing Fellowship</b> , UT Austin
S17, S18	<b>Geometry Research and Training Grant (RTG) Fellowship</b> , UT Austin Department of Mathematics
Fall 2017	<b>Honorable mention, Visualizing Science Competition</b> , UT Austin College of Natural Sciences
Spring 2017	<b>Honorable mention, National Science Foundation Graduate Research Fellowship Program</b> , National Science Foundation
Fall 2016	<b>Prelim Excellence Award</b> , UT Austin Department of Mathematics
F15 – S16	<b>Geometry Research and Training Grant (RTG) Fellowship</b> , UT Austin Department of Mathematics
Spring 2013	<b>Boothe Prize for Excellence in First-Year Writing</b> , Stanford University

## Conferences attended

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April 2016	Graduate Student Topology and Geometry Conference, University of Indiana
April 2017	Conference on invertible objects and duality in derived algebraic geometry and homotopy theory, University of Regensburg
April 2017	Texas Algebraic Geometry Symposium, Rice University
June 2017	Strongly Correlated Topological Phases of Matter, Stony Brook
July 2017	Homotopy Theory: tools and applications, UIUC
August 2017	Topological and Geometric Methods in QFT, Montana State University
November 2017	Texas Analysis and Mathematical Physics Symposium, UT Austin
February 2018	Texas Geometry and Topology Conference, University of Houston
April 2018	Texas Algebraic Geometry Symposium, Texas A&M University
July 2018	The topology and geometry of low-dimensional manifolds: a celebration of the mathematics of Bob Gompf, UT Austin
August 2018	Conference on Higher Algebra and Mathematical Physics, Perimeter Institute
January 2019	Between Topology and Quantum Field Theory: A conference in celebration of Dan Freed's 60th birthday, UT Austin
June 2019	QFT for Mathematicians, Perimeter Institute
July 2019	Park City Mathematics Institute Graduate Summer School on quantum field theory and manifold invariants
January 2020	MSRI: Introductory Workshop: Quantum Symmetries
February 2020	MSRI: Introductory Workshop: Higher Categories and Categorification
March 2020	MSRI: Tensor categories and topological quantum field theories (online)
March 2020	MSRI: $(\infty, n)$ -categories, factorization homology, and algebraic $K$ -theory (online)
April 2020	Graduate Online Anything Topology Seminar (online)
June 2021	Viva Talbot! (online)
June 2021	Workshop in Geometric Topology (online)
June 2021	TopFlavours (online)
July 2021	Higher Structures in QFT and String Theory (online)
October 2021	Generalized Cohomology and Physics (online)
November 2021	MSRI: Chern-Simons and other topological field theories
May 2022	Geometric Aspects of the Swampland
June 2022	Perimeter Institute Conference on Global Categorical Symmetries
June 2022	QFT for Mathematicians 2022, Perimeter Institute
November 2022	Simons Collaboration on Global Categorical Symmetries Annual Meeting
March 2023	Geometric/Topological Quantum Field Theories and Cobordisms 2023 (attended remotely over Zoom)
April 2023	Midwest Topology Seminar
May 2023	Atlantic TQFT Spring School
June 2023	Equivariant bordism and applications
July 2023	Graduate Student Topology and Geometry Conference (online)
March 2024	Higher Categorical Tools for Quantum Phases of Matter
June 2024	String Math 2024

## Teaching experience

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### **Instructor of Record for MA265: Linear algebra**

PURDUE UNIVERSITY

2021, 2022, 2024

This is an introductory linear algebra course typically taken by Purdue engineering majors.

### **Instructor of Record for MA266: Ordinary differential equations**

PURDUE UNIVERSITY

Fall 2023

This is a first course in ordinary differential equations typically taken by Purdue engineering majors.

### **Wolverine Pathways Summer Institute**

THE UNIVERSITY OF MICHIGAN, ANN ARBOR

Summer 2023

Wolverine Pathways is a college preparatory program for students from under-served communities in the southeast Michigan area. In my role as a teacher for the Summer Institute, I helped develop the curriculum of the Summer Institute and worked with rising high school seniors on topics including modular arithmetic, trigonometry, and an introduction to topology and geometry.

### **Instructor of Record for MA351: Linear algebra**

PURDUE UNIVERSITY

Spring 2023

This is an introductory linear algebra course typically taken by Purdue math and computer science majors, with an emphasis on concepts and building intuition.

### **Teaching Assistant**

THE UNIVERSITY OF TEXAS AT AUSTIN

Fall 2020, Spring 2021

TAed UT's grad algebraic topology and differential topology courses, including grading problem sets.

### **Supplemental Instruction (SI) Teaching Assistant**

THE UNIVERSITY OF TEXAS AT AUSTIN

Fall 2016, Fall 2017, Fall 2018

- M408N: Differential Calculus for Science
- M408L: Integral Calculus
- Taught in a "flipped classroom," teaching sections, holding office hours, and participating in the Sanger Learning Center SI Program.

### **Directed Reading Program Mentor**

THE UNIVERSITY OF TEXAS AT AUSTIN

Spring 2016 – Spring 2021

- Mentored undergraduates on projects including lattice-based cryptography, point-set topology, symplectic geometry, and cobordism.

### **Math 50 Series Tutor**

STANFORD UNIVERSITY

Winter 2013 – Spring 2015

- Tutored linear algebra, multivariable calculus, and differential equations.

## Other experience

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### **Member, Mathematical Sciences Research Institute, Program on Quantum Symmetries**

BERKELEY, CA

Spring 2020

### **Software Engineering Internship, Dropbox**

SAN FRANCISCO, CA

Summer 2015

### **Research Internship, AT&T Foundry**

PALO ALTO, CA

Summer 2014

### **Computer Science Undergraduate Research Internship (CURIS), Stanford University**

PALO ALTO, CA

Summer 2013