Arun **Debray**

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Employment

Assistant Professor

The University of Kentucky, Department of Mathematics — *2024 – present*

Golomb Visiting Assistant Professor

Purdue University, Department of Mathematics — *2021 – 2024*

Education

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

Published

1. (with Sam Gunningham) The Arf-Brown TQFT of 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).
7. (with Matthew Yu) What bordism-theoretic anomaly cancellation can do for U. Comm. Math. Phys. volume 405, issue 7. 2024. (arXiv:2210.04911).
8. Bordism for the 2-group symmetries of the heterotic and CHL strings. In *Higher Structures in Geometry, Topology and Physics*, Contemp. Math. volume 802, pp. 227–297, 2024. (arXiv:2304.14764).
9. (with Markus Dierigl, Jonathan J. Heckman, and Miguel Montero) The Chronicles of IIBordia: Dualities, Bordisms, and the Swampland. Adv. Theor. Math. Phys. volume 28, number 3, pp. 805–1025. 2024. (arXiv:2302.00007).
10. (with Cameron Krulewski) Smith homomorphisms and Spin^h structures. Proc. Amer. Math. Soc. volume 152, number 2, pp. 897–912. 2025. (arXiv:2406.08237).

Accepted

11. (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. Accepted, J. High Energy Physics. 2023 (arXiv:2309.16749).
12. (with Weicheng Ye and Matthew Yu) Bosonization and Anomaly Indicators of (2+1)-D Fermionic Topological Orders. Accepted, Comm. Math. Phys. 2023 (arXiv:2312.13341).

Submitted

13. Invertible phases for mixed spatial symmetries and the fermionic crystalline equivalence principle, 2021 (arXiv:2102.02941).
14. (with Matthew Yu) Adams spectral sequences for non-vector-bundle Thom spectra, 2023 (arXiv:2305.01678).

15. (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).
16. (with Omar Antolín Camarena, Cameron Krulewski, Natalia Pacheco-Tallaj, Daniel Sheinbaum, and Luuk Stehouwer) Weak topological phases in the presence of interactions, 2024 (arXiv:2410.10031).
17. (with Matthew Yu) Type IIA string theory and tmf with level structure, 2024 (arXiv:2411.07299).
18. (with Weicheng Ye and Matthew Yu) Global Structure in the Presence of a Topological Defect, 2025 (arXiv:2501.18399).

Preprints (will be submitted)

19. (with Noah Braeger, Markus Dierigl, Jonathan J. Heckman, and Miguel Montero) Cobordism Utopia: U-Dualities, Bordisms, and the Swampland, 2025 (arXiv:2505.15885).

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

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.

Encyclopedia Articles

1. Differential cohomology, *Encyclopedia of Mathematical Physics* 2nd ed., Ed. Richard Szabo and Martin Bojowald, Academic Press, 2025. (arXiv:2312.14338).

Talks

October 2024	**String^h structures and Diaconescu-Moore-Witten anomalies**, Anomalology seminar (Zoom)
June 2024	**Anomaly cancellation in string theory using homotopy theory**, String Math 2024, ICTP
March 2024	**Bosonization and anomalies of 3d fermionic topological orders**, Conference on Higher Categorical Tools for Quantum Phases of Matter, Perimeter
January 2024	**Anomalies and generalized cohomology**, The University of Kentucky
December 2023	**Anomaly indicators for symmetries of 3d spin TFTs**, Perimeter Institute (online)
October 2023	**Constructing the Virasoro groups with differential cohomology**, Wichita State/Texas Tech Topology and Geometry Seminar (online)
July 2023	**The twisted Wu formula**, Young Faculty Speaker, Graduate Student Topology and Geometry Conference (online)
June 2023	**From Borel-equivariant bordism to the fermionic crystalline equivalence principle**, Equivariant Bordism Theory and Applications, Casa Matemática Oaxaca
May 2023	**IIBordia**, (joint with Jonathan J. Heckman), Swampland Seminar (online)
May 2023	**Spectral sequences (5-lecture series)**, Atlantic TQFT Spring School
April 2023	**The twisted Wu formula and Adams spectral sequences for non-vector-bundle Thom spectra**, Midwest Topology Seminar
April 2023	**Non-vector-bundle Thom spectra and applications to anomalies**, Perimeter Institute Mathematical Physics Seminar
March 2023	**Twisted string bordism and a potential anomaly in $E_8 \times E_8$ heterotic string theory**, Geometric/Topological Quantum Field Theories and Cobordisms 2023, NYU Abu Dhabi
January 2023	**Algebraic topology and the Swampland**, UT Austin Geometry Seminar
January 2023	**Review of anomalies and invertible field theories**, (joint with Matthew Yu), Global Categorical Symmetries Postdoc and Graduate Student Colloquium (online)
October 2022	**Computing anomalies of theories of supergravity using bordism**, Higher Structures & Field Theory Seminar (online)
June 2022	**Anti-unitary symmetries of 3d finite abelian spin gauge theories**, Perimeter Institute Conference on Global Categorical Symmetries Gong Show

May 2022	**Introduction to cobordism theory (3-lecture series),** Geometric Aspects of the Swampland conference, Madrid
November 2021	**The anomaly of the duality symmetry in type IIB string theory,** Perimeter Institute Math Physics Seminar (online)
July 2021	**Invertible phases for mixed spatial symmetries,** Higher Structures in QFT and String Theory Gong Show (online)
July 2021	**Modeling invertible topological phases of matter using homotopy theory,** Harvard Center of Mathematical Sciences and Applications Interdisciplinary Science Seminar (online)
June 2021	**From bordism groups to crystalline SPT phases,** TopFlavours (online)
June 2021	**Stable diffeomorphism classification of some unorientable 4-manifolds,** (Online) Workshop in Geometric Topology
March 2021	**Stable diffeomorphism classification of some unorientable 4-manifolds,** MIT Topology Seminar (online)
November 2020	**Two Physics Applications of Invertible Field Theories,** Harvard Center of Mathematical Sciences and Applications Special Seminar (online)
August 2020	**From Crystalline Topological Phases of Matter to Bordism,** Graduates Reminisce Online On Topology Summer Seminar
April 2020	**What: Bordism groups. Why: Condensed-matter physics. How: The Adams spectral sequence.,** Graduate Online Anything Topology Series
April 2020	**Topological Phases and Topological Field Theories,** Mathematical Sciences Research Institute Grad Student Seminar (online)
March 2020	**Topological Phases and Topological Field Theories,** Johns Hopkins Topology Seminar
July 2019	**The low-energy TQFT of the generalized double semion model,** Park City Mathematics Institute Research Program 2019
August 2018	**The low-energy TQFT of the generalized double semion model,** Conference on Higher Algebra and Mathematical Physics, Perimeter Institute
November 2017	**The low-energy TQFT of the generalized double semion model,** Contributed talk, Texas Analysis and Mathematical Physics Symposium
January 2017	**Lattice models and TQFTs,** AT&T Foundry Palo Alto weekly seminar series

Service

Committee work, University of Kentucky *2024–present*
Member of the Access, Community, and Engagement and Topology Prelim committees.

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.

Teaching experience

Instructor of Record for Math 322: Matrix algebra (honors)
The University of Kentucky *Spring 2025*
This is an honors-level undergraduate course in linear algebra typically taken by natural sciences and engineering majors.

Instructor of Record for Math 214: Calculus IV
The University of Kentucky *Spring 2025*
This is a first course in ordinary differential equations typically taken by University of Kentucky engineering majors.

Instructor of Record for Math 551: Topology I
The University of Kentucky *Fall 2024*
This is an introductory graduate-level course in topology intended to prepare students for the preliminary exam.

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

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*