Contact Information:

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Research Interests: Operator algebras, tensor categories and their applications in mathematical physics (in particular, algebraic approaches to quantum field theories, quantum spin systems, topological phases of matter, and quantum cellular automata).

Employment/Education:

2020- Present	**North Carolina State University**, Assistant Professor.
2018-2020	**The Ohio State University**, Zassenhaus Assistant Professor (Postdoc). Faculty mentor: David Penneys
2016-2018	**Australian National University**, Postdoctoral fellow. Faculty mentor: Scott Morrison
2011-16	**Vanderbilt University**, Ph.D. in Mathematics (May 2016). Advisor: Vaughan F.R. Jones Dissertation: "Annular representation theory with applications to approximation and rigidity properties for rigid C*-tensor categories"
2007-11	**The University of North Carolina Asheville**, B.A. in Mathematics (May 2011).

Funding:

- PI, NSF Standard Grant DMS 2247202, "Categorical Symmetries of Operator Algebras," 8/1/2023-7/31/2026.
- PI, NSF Standard Grant DMS 2100531/1901082, "Applications of Tensor Categories in Operator Algebras," 07/01/2019-06/30/2023.
- Co-PI with Henri Moscovici and David Penneys, NSF Standard Grant DMS 1936283, (Conference) "2019 East Coast Operator Algebra Symposium," 09/01/2019-8/31/2020.

Publications:

1. *Composing topological domain walls and anyon mobility* (with Peter Huston, Fiona Burnell, and David Penneys). to appear in **SciPost Physics** arXiv:2208.14018.
2. *Unitary connections on Bratteli diagrams* (with Paramita Das, Mainak Ghosh, and Shamindra Ghosh). to appear in **J. Top. Anal.** arXiv:2211.03822.
3. *Q-system completion of C* 2-categories* (with Quan Chen, Roberto Hernandez Palomares, and David Penneys). **J. Funct. Anal.** DOI:10.1016/j.jfa.2022.109524, arXiv:2105.12010.
4. *A 3-categorical perspective on G-crossed braided fusion categories* (with David Penneys and David Reutter). **J. Lond. Math. Soc.** DOI:10.1112/jlms.12687, arXiv:2009.00405.
5. *A categorical Connes' $\chi(M)$* (with Quan Chen and David Penneys). **Math. Ann.** DOI:10.1007/s00208-023-02695-7, arXiv:2111.06378.
6. *Computing fusion rules for spherical G-extensions of fusion categories* (with Marcel Bischoff). **Sel. Math. New Ser.** DOI:10.1007/s00029-021-00725-3, arXiv:1909.02816.

7. *Remarks on Anomalous Symmetries of C*-algebras.* **Comm. Math. Phys.** DOI:10.1007/s00220-021-04234-4, arXiv:2011.13898.
8. *Triangle presentations and tilting modules for SL_{2k+1}.* **Journal of Combinatorial Algebra** DOI:10.4171/JCA/50, arXiv:2005.07172.
9. *Extension theory for braided-enriched fusion categories* (with Scott Morrison, David Penneys, and Julia Plavnik). **Int. Math. Res. Not.** DOI:10.1093/imrn/rnab133, arXiv:1910.03178.
10. *Rank-finiteness for G-crossed braided fusion categories* (with Scott Morrison, Eric C. Rowell, and Dmitri Nikshych). **Transform. Groups.** DOI:10.1007/s00031-020-09576-2, arXiv:1902.06165.
11. *Fusion rules for $\mathbb{Z}/2\mathbb{Z}$ permutation gauging* (with Cain Edie-Michell and Julia Plavnik). **J. Math. Phys.** DOI:10.1063/1.5117843, arXiv:1804.01657.
12. *Realizations of algebra objects and discrete subfactors* (with David Penneys). **Adv. Math.** DOI:10.1016/j.aim.2019.04.039, arXiv:1704.02035.
13. *Spontaneous symmetry breaking from anyon condensation* (with Marcel Bischoff, Yuan-Ming Lu, and David Penneys). **J. High Energy Phys.** DOI:10.1007/JHEP02(2019)062, arXiv:1811.00434.
14. *Fusing Binary Interface Defects in Topological Phases: The Vec($\mathbb{Z}/p\mathbb{Z}$) case* (with Daniel Barter and Jacob C. Bridgeman). **J. Math. Phys.** arXiv:1810.09469.
15. *Domain walls in topological phases and the Brauer-Picard ring for* Vec($\mathbb{Z}/p\mathbb{Z}$) (with Daniel Barter and Jacob C. Bridgeman). **Comm. Math. Phys.** DOI:10.1007/s00220-019-03338-2, arXiv:1806.01279.
16. *Vanishing of categorical obstructions for permutation orbifolds* (with Terry Gannon). **Comm. Math. Phys.** DOI:10.1007/s00220-019-03288-9, arXiv:1804.08343.
17. *Annular representations of free product categories* (with Shamindra Kumar Ghosh and Madhav B Reddy). **J. Noncomm. Geom.** arXiv:1803.06817.
18. *Free oriented extensions of subfactor planar algebras* (with Shamindra Kumar Ghosh and Madhav B Reddy). **Internat. J. Math.** DOI:10.1142/S0129167X18500933, arXiv:1805.08971.
19. *Eigenvalues of rotations and braids in spherical fusion categories* (with Daniel Barter and Henry Tucker). **J. Algebra**, DOI:10.1016/j.jalgebra.2018.08.011, arXiv:1611.00071.
20. *Classification of Thurston-relation subfactor planar algebras* (with Zhengwei Liu and Yunxiang Ren). **Quantum Topol.** arXiv:1606.00779.
21. *Operator algebras in rigid C*-tensor categories* (with David Penneys). **Comm. Math. Phys.** arXiv:1611.04620.
22. *Quantum G_2 categories have property (T).* **Internat. J. Math.** arXiv:1504.08338.
23. *Annular representation theory for rigid C*-tensor categories* (with Shamindra Kumar Ghosh). **J. Funct. Anal.** arXiv:1502.06543.
24. *Q-systems and compact W*-algebra objects* (with David Penneys). **Contemporary Mathematics Series** (Peer reviewed conference proceedings). arXiv:1707.02155.

25. *Discrete homotopy theory and critical values of metric space* (with Jim Conant, Victoria Curnutte, Conrad Plaut, Kristen Pueschel, Maria Lusby, and Jay Wilkins). **Fund. Math.** arXiv:1205.2925.

Preprints:

1. *An index for quantum cellular automata on fusion spin chains* (with Junhwi Lim). arXiv:2309.10961.
2. *Local topological order and boundary algebras* (with Pietr Naaijkens, David Penneys, and Daniel Wallick). arXiv:2307.12552.
3. *DHR bimodules and symmetric quantum cellular automata.* arXiv:2304.00068.
4. *K-theoretic classification of inductive limit actions of fusion categories of AF-algebras* (with Quan Chen and Roberto Hernandez Palomares). arXiv:2207.11854.
5. *Equivariant fusion subcategories* (with César Galindo). arXiv:2111.09116.

Organizational Activities:

Seminars:

- (with other faculty and postdocs in the Algebra and Combinatroics seminar) NCSU Algebra and Combinatorics Seminar, Spring 2021-Present.
- (With David Penneys and Julia Plavnik) University Quantum Symmetry Lectures (UQSL), International online seminar. Autumn 2020-Present.
- (With Thomas Kerler and David Penneys) Quantum Algebra and Quantum Topology Seminar, Ohio State University, Autumn 2018-2020.

Conferences:

- (with Naihuan Jing, Kailash Misra, and Jianping Pan) 13th Southeastern Lie Theory Workshop, North Carloina State University, May 12-14 2023.
- (with Colleen Delaney) AMS Special Session on Fusion categories and their applications in physics (JMM, Seattle 2022)
- (With David Penneys) OSU Summer Research Program on Quantum Symmetries, 3 -14 June, 2019.
- (With David Penneys and Henri Moscovici) East Coast Operator Algebras Symposium, 12-13 October 2019.

Invited Talks:

- *K-theoretic classification of fusion category actions on locally semisimple algebras.* Southeastern Lie Theory Workshop, North Carolina State University. 14 May, 2023.
- *Quantum cellular automata on nets of algebras.* Noncommutative Geometry and Operator Algebras Spring Institute, Vanderbilt University. 9 May, 2023.
- *Braided tensor categories from operator algebras.* Functional Analysis Seminar, Oxford University. 24 January, 2023.
- *K-theoretic classification of inductive limit actions of fusion categories on AF-algebras.* Subfactor Seminar, Vanderbilt University. 11 November, 2022.
- *K-theoretic classification of inductive limit actions of fusion categories on AF-algebras.* Noncommutative Harmonic Analysis and Quantum Groups, Bedlow, Poland. 13 September, 2022.

- *K-theoretic classification of inductive limit actions of fusion categories on AF-algebras.* Follow-up workshop on von Neumann algebras, Hausdorff Institute of Mathematics, Bonn DE. August, 2022. *Mini-course: Braided tensor categories in operator algebras.* Summer school on Topological Quantum Groups, C*-tensor categories, and Subfactors, May 24-28 2022.
- *Braided tensor categories from operator algebras.* GAPT Seminar, Cardiff University, Wales. 9 December, 2021.
- *A categorical Connes' $\chi(M)$.* UCLA Functional Analysis Seminar, University of California, Los Angeles. 8 December, 2021.
- *A categorical Connes' $\chi(M)$.* Subfactor Seminar, Vanderbilt University. 12 November, 2021.
- *Computing fusion rules for G-extensions of fusion categories.* AMS Western Sectional Meeting (Online). 23 October, 2021.
- *Computing fusion rules for G-extensions of fusion categories.* BIRS-IASM workshop "Subfactors, Vertex Operator Algebras, and Tensor Categories". Hangzhou, China. 22 September, 2021.
- *Anomalous Symmetries of C*-algebras.* Functional Analysis and Operator Algebras Seminar, Online. 4 June, 2021.
- *Actions of fusion categories on topological spaces.* Quantum Group Seminar, Online. 3 May, 2021.
- *Symmetries of affine buildings and tilting modules for SL_n.* Algebra and Combinatorics Seminar, North Carolina State University. 1 March, 2021.
- *Anomalous symmetries of geometric C*-algebras.* Subfactor Seminar, Vanderbilt University, 12 February 2021.
- *Building pointed fusion category actions on C*-algebras.* IPAM Workshop "Actions of tensor categories on C*-algebras." University of California, Los Angeles. 6 January, 2021.
- *Triangle presentations and tilting modules for SL_n.* Oxford Topology Seminar, University of Oxford. 9 November, 2020.
- *Triangle presentations and tilting modules for SL_{2k+1}.* Lie Theory Seminar, Universidad Nacional de Cordoba. 13 July, 2020.
- *Rank finiteness for braided fusion categories.* Subfactor Seminar, Vanderbilt University, 24 April, 2020.
- *Vanishing of categorical obstructions for permutation orbifolds.* AMS Special Session on Mathematical Aspects of Conformal Field Theory, Joint Mathematics Meetings Denver, CO. 18 January 2020.
- *Braided tensor categories from finite von Neumann algebras.* AMS Special Session on Advances in Operator Algebras, Joint Mathematics Meetings Denver, CO. 17 January 2020.
- *Fusion categories and their applications in mathematical physics.* Special seminar, North Carolina State University. 10 January, 2020.
- *The higher dimensional algebra of matrix product operators and quantum spin chains.* Mathematical Physics and Operator Algebras Seminar, Michigan State University. 26 September, 2019.
- *Vanishing categorical obstructions for permutation orbifolds.* Algebra and Combinatorics Seminar, North Carolina State University. 9 Septmeber, 2019.
- *A survey of G-crossed braided fusion categories.* Operator Algebras and Applications, Simons Center for Geometry and Physics. 17-21 June, 2019.
- *Spontaneous symmetry breaking from anyon condensation.* Noncommutative Geometry and Operator Algebras Spring Institute 2019, Vanderbilt University. 6 May 2019.
- *Generalized crossed products and discrete subfactors.* Linear Anlaysis Seminar, Texas A & M. 22 February, 2019.

- *Spontaneous symmetry breaking from anyon condensation.* Fusion categories and Subfactors, Banff International Research Station. 16 October, 2018.
- *Generalized crossed products and discrete subfactors.* East Coast Operator Algebra Symposium, Texas Christian University. 13 October, 2018.
- *Vanishing categorical obstructions for permutation orbifolds.* Subfactor seminar, Vanderbilt University. 12 October, 2018.
- *Braided tensor categories associated to von Neumann algebras.* Subfactors in Maui. 21 May, 2018.
- $\mathbb{Z}/2\mathbb{Z}$ *permutation gauging of modular tensor categories.* Algebra seminar, University of Sydney. 20 October, 2017.
- *Operator algebras in rigid C*-tensor categories.* Differential geometry seminar, University of Adelaide. 6 October, 2017.
- *A categorical approach to discrete subfactors.* Quantum symmetries: Subfactors and planar algebras, Maui. 19 July, 2017.
- *Subfactors and quantum symmetry.* Mathematical Sciences Institute Colloqium, Australian National University. 27 April, 2017.
- *Discrete subfactors as generalized crossed products.* Operator algebra and noncommutative geometry seminar, University of Wollongong. 20 April, 2017.
- *Operator algebras in rigid C*-tensor categories.* Structure of operators algebras: subfactors and fusion categories, Isaac Newton Institute, Cambridge. 23 January, 2017.
- *Operator algebras in rigid C*-tensor categories.* Analysis seminar, University of Glasgow. 17 January, 2017.
- *Classification of planar algebras by skein theory.* Noncommutative geometry seminar, The Ohio State University. 8 September, 2016.
- *Frobenius-Schur indicators and rotation eigenvalues for pivotal tensor categories.* Quantum Mathematics Meeting, Australian National University. 5 August, 2016.
- *Annular representation theory and analytic properties for rigid C*-tensor categories.* NCGOA 2016, Hausdorff Institute for Mathematics, Bonn. 20 May, 2016.
- *Rigid C*-tensor category and their anaytic properties.* Seminar in Operator Theory and Operator Algebras, University of Virginia. 19 April, 2016.
- *Quantum G_2 categories have property (T).* Functional Analysis Seminar, University of California, Los Angeles. 24 February, 2016.
- *Planar algebras and tensor categories.* Invited lectures, Indian Statistical Institute, Kolkata. January, 2016.
- *Analytical properties for tensor categories.* AMS Southeastern Sectional Meeting, Memphis TN. 17 October, 2015.
- *Quantum G_2 categories have property (T).* Subfactor Seminar, Vanderbilt University. 25 September, 2015.
- *The tube algebra and representation theory of categories.* Subfactors and Conformal Field Theory, Oberwolfach Institute. March, 2015.
- *Representations and Universal Norm for the Tube Algebra of Rigid C*-tensor categories.* Subfactor Seminar, Vanderbilt University. 23 January, 2015.
- *Representations and Universal Norm for the Tube Algebra of Rigid C*-tensor categories, II.* Subfactor Seminar, Vanderbilt University. 30 January, 2015.
- *The Drinfeld center and affine annular representations of a planar algebra.* Subfactors in Maui. July, 2013.

Visiting Scholar:

- **Isaac Newton Institute for the Mathematical Sciences**, Cambridge, England, January 2017, Programme on Operator Algebras: Subfactors and their Applications.
- **Indian Statistical Institute**, (ISI), Kolkatta, India, January 2016, Host researcher: Shamindra Kumar Ghosh.

Academic Awards:

1. John Griggs Award for Outstanding Research, NCSU Department of Mathematics, April 2023.
2. B.F. Bryant Prize for Excellence in Teaching, Vanderbilt University, 2016.
3. Bjarni Jonsson Prize for Research, Vanderbilt University, 2016.

Teaching:

2020-Present: North carolina State University.

- Abstract Algebra for Math Majors (Math 407).
- Modern Algebra I/II (Graduate) (Math 521/721).
- Linear/Lie Algebra (Graduate) (Math 520/720).
- Representation Theory of Lie Algebras (Math 725).
- Reading courses in various topics.

2018-2020: Ohio State University.

- Linear Algebra (Math 2568).
- Discrete Mathematics (Math 2366).
- Mathematical Topics for Engineers (2177).

2011-2016: Vanderbilt University.

- Calculus II (Math 1301).
- Calculus I (Teaching assistant) (Math 1200, 1300).
- Calculus II (TA) (Math 1301).
- Differential Equations and Linear Algebra (TA).

Academic Service:

- **PhD Advisor** for
  (1) Emily McGovern (expected graduation 2024)
  (2) Sean Thompson (expected graduation 2024)
  (3) Kylan Schatz (expected graduation 2025)
  (4) Alexander Betz (expected Graduation 2026)
  (5) Ali Elokl (expected graduation 2026)
  (6) Noah Lanier (expected graduation 2026)
- REU Project Mentor, Ohio State University, Summer 2018.
- Teaching assistant for MRC program Quantum Symmetries: Subfactors and Fusion Categories, June 2018.
- Teaching assistant for MSRI Program Summer graduate school: planar algebras, quantum symmetries, and random matrices, June 2017.
- Honors Thesis Supervisor for An Ran Chen, Australian National University, 2017.
- Practice and Pedagogy Leader, Teaching Assistant Orientation, Vanderbilt University, 2014-2015.
- Refereed articles for: International Mathematics Research Notices, Analysis and PDE, Quantum Topology, Compositio Mathematica, Advances in Mathematics, Journal of Functional Analysis, Communications in Mathematical Physics, Journal of High Energy Physics, Journal of Pure and Applied Algebra, Documenta Math, International Journal of Mathematics, Quantum, Journal of Operator Theory