

Contact Information:

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Employment/Education:

2020–Present **The Ohio State University**, Ohio, USA. Associate professor
 2016–2020 **The Ohio State University**, Ohio, USA. Assistant professor
 2014-16 **University of California, Los Angeles**, California, USA. Assistant adjunct professor (postdoc)
 Postdoctoral supervisors: [Sorin Popa](#) and [Dmitri Shlyakhtenko](#)
 2012-14 **University of Toronto**, Ontario, Canada. Mathematics postdoctoral fellow
 Postdoctoral supervisors: [Dror Bar-Natan](#) and [George Elliott](#)
 2005-12 **University of California, Berkeley**, California, USA. Mathematics Ph.D.
 Advisor: [Vaughan F.R. Jones](#)
 Dissertation: “Planar structure for inclusions of finite von Neumann algebras”
 2001-5 **The George Washington University**, Washington, D.C., USA,
 Mathematics, B.A., Ruggles Prize 2003 and 2005
 Physics, B.S., Howard Hughes Fellow in Bioinformatics 2004
 Chemistry, B.S., George Gamow Fellow 2003
 Columbian School Distinguished Scholar, Summa Cum Laude, Phi Beta Kappa.

Scientific/Academic Honors and Grants:

- NSF DMS grant 2154389 “Quantum Symmetries: Subfactors, Topological Phases, and Higher Categories” 2022-25
- Senior Participant on OSU’s NSF QuSTEAM C-ACCEL grant. I am co-lead for Course 3: Mathematical Methods for Quantum Information Science (working title)
- OSU 2020 ASC Early-Career Faculty Excellence Award
- NSF CAREER grant DMS 1654159 2017-2022 “Representing and classifying enriched quantum symmetry”, with 2019 supplement DMS 1927098 and 2021 supplement DMS 2051170.
- NSF DMS grant 1500387 2015-16 “Classifying subfactors and fusion categories”, transferred to OSU as NSF DMS grant 1655912 2016-18
- AMS-Simons travel grant 2014-15
- Summer support for Summers 2013 and 2014 through DARPA grant HR0011-12-1-0009
- NSF East Asia and Pacific Summer Institute grant 1015571 Summer 2010
- Conference grants:
 - K-Theory Foundation, Fields Institute, and ICMS support for a 2023 twinned conference on C^* -algebras and tensor categories at the Fields Institute and ICMS (with Courtney, Henriques, Peters, Tikuisis, and White)
 - Contact organizer for a BIRS workshop 2023/12/3-8 on [Subfactors and Fusion \(2-\)Categories](#) (with Gannon, Johnson-Freyd, and Plavnik)
 - Contact organizer for [AIM SQuaREs](#) workshop 2023/1/30 - 2/3 on Higher symmetries of fusion 2-categories (with Johnson-Freyd, C. Jones, Nikshych, Plavnik, and Reutter)
 - Contact organizer for an AIM workshop on [Higher Categories and Topological Order](#) 2022/9/26-30 (with Bridgeman, Osborne, and Plavnik)
 - Contact organizer for an AIM workshop on [Fusion Categories and Tensor Networks](#) 2021/3/8-12 (with Bridgeman, Osborne, and Plavnik)

- Co-organizer for an IPAM workshop on [Actions of tensor categories on C*-algebras](#) 2021/1/25-29 (with Peters, Tikuisis, and White)
- Co-PI for NSF DMS-1936283 for [2019 East Coast Operator Algebra Symposium](#) (with C. Jones and Moscovici)
- Contact organizer for a BIRS workshop 2018/10/14-19 on [Fusion Categories and Subfactors](#) (with Gannon, Morrison, and Plavnik)
- Contact organizer for an AMS MRC workshop 2018/6/10-16 on [Quantum symmetries: subfactors and fusion categories](#)
- Coauthored successful grant NSF DMS-1665434 for [Quantum Symmetries: Subfactors and Planar Algebras](#) Conference 2017 (with Brothier, Jones, Snyder, and Tener)
- Contact organizer for [AIM SQuaREs](#) workshop 2016/9/12-16, 2017/11/27 - 12/1, and 2019/1/28 - 2/1 on Classifying fusion categories (with Grossman, Izumi, Morrison, Peters, and Snyder)
- US Junior Oberwolfach Fellow for 2015 workshop [Subfactors and Conformal Field Theory](#)
- Coauthored proposal for 2015 Oberwolfach workshop [Subfactors and Conformal Field Theory](#) (with official organizers Bisch, Gannon, Jones, and Kawahigashi)
- Coauthored successful grant NSF DMS-1400275 for [Subfactor Theory in Mathematics and Physics](#) Conference 2014 (with Bisch, Brothier, Jones, Morrison, and Snyder)
- Contact organizer for a BIRS workshop 2014/4/13-18 on [Classifying Subfactors and Fusion Categories](#) (with Jones, Morrison, Peters, and Snyder)

Peer reviewed journal articles:

1. *A 3-categorical perspective on G-crossed braided categories* (with Corey Jones and David Reutter). To appear **J. Lond. Math. Soc.** [arXiv:2009.00405](#)
2. *The Extended Haagerup fusion categories* (with Pinhas Grossman, Scott Morrison, Emily Peters, and Noah Snyder). To appear **Ann. Sci. Éc. Norm. Supér.** [arXiv:1810.06076](#)
3. *Extension theory for braided-enriched fusion categories* (with Corey Jones, Scott Morrison, and Julia Plavnik). To appear **Int. Math. Res. Not.** [arXiv:1910.03178](#)
4. *Planar algebras in braided tensor categories* (with André Henriques and James Tener). To appear **Mem. Amer. Math. Soc.** [arXiv:1607.06041](#)
5. *The classification of subfactors with index at most $5\frac{1}{4}$* (with Narjess Afzaly and Scott Morrison). To appear **Mem. Amer. Math. Soc.** [arXiv:1509.00038](#)
6. *Q-system completion for C* 2-categories* (with Quan Chen, Roberto Hernández Palomares, and Corey Jones). **J. Funct. Anal.** 283 (2022), no. 3, Paper No. 109524. [arXiv:2105.12010](#)
7. *Q-system completion is a 3-functor* (with Quan Chen). **Theory Appl. Cat.** Vol. 38, 2022, No. 4, 101-134. [arXiv:2106.12437](#)
8. *The module embedding theorem via towers of algebras* (with Desmond Coles, Peter Huston, and Srivatsa Srinivas). **J. Funct. Anal.** 280 (2021), no. 11, Paper No. 108965. [MR4227743](#) [arXiv:1810.07049](#)
9. *Unitary dual functors for unitary multitensor categories.* **Higher Structures** 4(2):22-56, 2020. Available at https://journals.mq.edu.au/index.php/higher_structures/article/view/101, [arXiv:1808.00323](#)
10. *Monoidal categories enriched in braided monoidal categories* (with Scott Morrison). **Int. Math. Res. Not.** 2019, no. 11, 3527–3579 [MR3961709](#), [arXiv:1701.00567](#)
11. *Realizations of algebra objects and discrete subfactors* (with Corey Jones). **Adv. Math.** 350 (2019), p 588-661 [MR3948170](#), [arXiv:1704.02035](#)

12. Spontaneous symmetry breaking from anyon condensation (with Marcel Bischoff, Corey Jones, and Yuan-Ming Lu). **J. High Energy Phys.** (2019) 2019: 62. [MR3933137](#), [arXiv:1811.00434](#)
13. *Operator algebras in rigid C^* -tensor categories* (with Corey Jones). **Comm. Math. Phys.** 355 (2017), no. 3, 1121–1188, [MR3687214](#), [arXiv:1611.04620](#)
14. *Bicommutant categories from fusion categories* (with André Henriques). **Selecta Math. (N.S.)** 23 (2017), no. 3, 1669–1708, [MR3663592](#), [arXiv:1511.05226](#).
15. *C^* -algebras from planar algebras I: canonical C^* -algebras associated to a planar algebra* (with Michael Hartglass). **Trans. Amer. Math. Soc.** 369 (2017), no. 6, 3977–4019, [MR3624399](#), [arXiv:1401.2485](#).
16. *Categorified trace for module tensor categories over braided tensor categories* (with André Henriques and James Tener). **Documenta Math.** 21 (2016) 1089–1149 [arXiv:1509.02937](#)
17. *Quotients of $A_2 * T_2$* (with Masaki Izumi and Scott Morrison). **Canad. J. Math.** 68 (2016), no. 5, 999–1022. [MR3536926](#) (abbreviated version of *Fusion categories between $C \boxtimes D$ and $C * D$* , [arXiv:1308.5723](#)).
18. *Calculating two-strand jellyfish relations* (with Emily Peters). **Pacific J. Math.** 277 (2015), no. 2, 463–510. [MR3402358](#), [arXiv:1308.5197](#).
19. *2-supertransitive subfactors at index $3 + \sqrt{5}$* (with Scott Morrison). **J. Funct. Anal.** 269 (2015), no. 9, 2845–2870. [MR3394622](#), [arXiv:1406.3401](#)
20. *Infinite index subfactors and the GICAR categories* (with Vaughan F. R. Jones). **Comm. Math. Phys.** 339 (2015), no. 2, 729–768. [MR3370617](#), [arXiv:1410.0856](#)
21. *Subfactors of index exactly 5* (with Masaki Izumi, Scott Morrison, Emily Peters, and Noah Snyder). **B. Lond. Math. Soc.** (2015) 47 (2): 257–269. [MR3335120](#), [arXiv:1406.2389](#).
22. *Constructing spoke subfactors using the jellyfish algorithm* (with Scott Morrison). **Trans. Amer. Math. Soc.**, 367 (2015), no. 5, 3257–3298. [MR3314808](#), [arXiv:1208.3637](#)
23. *Chirality and principal graph obstructions*. **Adv. Math.** 273 (2015), no. 19, 32–55. [MR3311757](#), [arXiv:1307.5890](#)
24. *1-supertransitive subfactors with index at most $6\frac{1}{5}$* (with Zhengwei Liu and Scott Morrison). **Comm. Math. Phys.** 334 (2015), no. 2, 889–922. [MR3306607](#), [arXiv:1310.8566](#)
25. *C^* -algebras from planar algebras II: the Guionnet-Jones-Shlyakhtenko C^* -algebras* (with Michael Hartglass). **J. Funct. Anal.** 267 (2014), no. 10, 3859–3893. [MR3266249](#), [arXiv:1401.2486](#)
26. *Principal graph stability and the jellyfish algorithm* (with Stephen Bigelow). **Math. Ann.** 358 (2014), no. 1–2, 1–24. [MR3157990](#), [arXiv:1208.1564](#)
27. *A planar calculus for infinite index subfactors*. **Comm. Math. Phys.** 319 (2013), no. 3, 595–648, [MR3040370](#), [arXiv:1110.3504](#)
28. *Rigid C^* -tensor categories of bimodules over interpolated free group factors* (with Arnaud Brothier and Michael Hartglass). **J. Math. Phys.** 53 (2012), no. 12, 123525 (43 pages), [arXiv:1208.5505](#), [DOI:10.1063/1.4769178](#)
29. *A cyclic approach to the annular Temperley-Lieb category*. **J. Knot Theory Ramifications** 21 (2012), no. 6, 1250049, 40 pp. [MR2903179](#), [arXiv:0912.1320](#).
30. *Subfactors of index less than 5, Part 4: Vines* (with James Tener). **Internat. J. Math.** 23 (2012), no. 3, 1250017, 18 pp. [MR2902286](#), [arXiv:1010.3797](#)
31. *Subfactors of index less than 5, Part 2: Triple points* (with Scott Morrison, Emily Peters, and Noah Snyder). **Internat. J. Math.** 23 (2012), no. 3, 1250016, 33 pp. [MR2902285](#), [arXiv:1007.2240](#).
32. *The embedding theorem for finite depth subfactor planar algebras* (with Vaughan F. R. Jones). **Quantum Topol.** 2 (2011), no. 3, 301–337. [MR2812459](#), [arXiv:1007.3173](#)

Peer reviewed conference proceedings:

33. *Q-systems and compact W^* -algebra objects* (with Corey Jones). Topological phases of matter and quantum computation, 63–88, **Contemp. Math.**, 747, Amer. Math. Soc., Providence, RI, 2020. [MR4079745](#), [arXiv:1707.02155](#)
34. *Lifting shadings on symmetrically self-dual subfactor planar algebras* (with Zhengwei Liu and Scott Morrison). Topological phases of matter and quantum computation, 51–61, **Contemp. Math.**, 747, Amer. Math. Soc., Providence, RI, 2020. [MR4079744](#), [arXiv:1709.05023](#)
35. *The generator conjecture for 3^G subfactor planar algebras* (with Zhengwei Liu). **Proceedings of the 2014 Maui and 2015 Qinhuangdao conferences in honour of Vaughan F. R. Jones' 60th birthday**, 344–366, Proc. Centre Math. Appl. Austral. Nat. Univ., 46, Austral. Nat. Univ., Canberra, 2017. [MR3635674](#), [arXiv:1507.04794](#)

Conference proceedings:

36. *Planar algebras in modular tensor categories*. (joint work with André Henriques and James Tener). 2015. **Oberwolfach Reports**. Volume 12, Issue 2, 2015, [DOI:10.4171/OWR/2015/16](#)
37. *Modular distortion and extremality for II_1 multifactor bimodules* (joint work with André Henriques, Marcel Bischoff, Ian Charlesworth, Sam Evington, and Luca Giorgetti). 2019. **Oberwolfach Reports**. Volume 16, Issue 4, 2019, [DOI:10.4171/OWR/2019/49](#)

arXiv preprints:

38. *Completion for braided enriched monoidal categories* (with Scott Morrison and Julia Plavnik). [arXiv:1809.09782](#)
39. *Representations of fusion categories and their commutants* (with André Henriques). [arXiv:2004.08271](#)
40. *Distortion for multifactor bimodules and representations of multifusion categories* (with Marcel Bischoff, Ian Charlesworth, Samuel Evington, and Luca Giorgetti). [arXiv:2010.01067](#)
41. *Classification of $\mathbb{Z}/2\mathbb{Z}$ -quadratic unitary fusion categories*. (with Cain Edie-Michell and Masaki Izumi). [arXiv:2108.01564](#)
42. *Compact quantum metric spaces from free graph algebras*. (with Konrad Aguilar and Michael Hartglass). [arXiv:2109.06985](#)
43. *A categorical Connes' $\chi(M)$* (with Quan Chen and Corey Jones). [arXiv:2111.06378](#)

Computing packages:

44. **FusionAtlas**, a package for *Mathematica* and *Scala* (with Scott Morrison, Emily Peters, Noah Snyder, and James Tener), available at http://tqft.net/wiki/Atlas_of_subfactors.

Research Interests:

Subfactors, planar algebras, tensor and fusion categories, low dimensional higher categories, topological phases of matter, conformal and topological field theories, diagrammatic algebras, von Neumann algebras, C^* -algebras, noncommutative geometry, knot theory

Visiting scholar positions:

- **Mathematical Sciences Research Institute**, Berkeley, CA, USA, March 2020, [Semester on Quantum Symmetries](#)
- **The Australian National University**, Canberra, Australia, March 2017, March 2014, and Jan-Feb 2013, host researcher [Scott Morrison](#)
- **Isaac Newton Institute for the Mathematical Sciences**, Cambridge, England, January 2017, [Programme on Operator Algebras: Subfactors and their Applications](#)

- **Hausdorff Research Institute for Mathematics**, Bonn, Germany, May-June 2016, [Trimester on von Neumann algebras](#)
- **Institut Henri Poincaré**, Paris, France, May-June 2011, Trimester on von Neumann algebras and ergodic theory of groups actions
- **Vanderbilt University**, Nashville, TN, USA, Jan-Feb 2011, host researcher [Jesse Peterson](#)
- **University of Tokyo**, Japan, Summer 2010, NSF East Asia and Pacific Summer Institute, host researcher [Yasuyuki Kawahigashi](#)
- **Institute for the Mathematical Sciences** (IMSc), Chennai, India, Feb 2009, host researcher [V.S. Sunder](#)

Academic service:

- Conferences and seminars organized:
 - International conferences/workshops co-organized:
 1. 2021 AIM workshop on Fusion Categories and Tensor Networks
 2. 2021 IPAM workshop on Actions of tensor categories on C*-algebras
 3. 2019 OSU Summer Research Program on Quantum Symmetries
 4. 2018 BIRS workshop on Subfactors and Fusion Categories
 5. 2018 AMS MRC workshop on [Quantum symmetries: subfactors and fusion categories](#)
 6. 2017 Mathematical Congress of the Americas Special Session on von Neumann algebras
 7. 2016 AIM SQuaRE on Classifying Fusion Categories
 8. 2015 Oberwolfach workshop on Subfactors and Conformal Field Theory (coauthored proposal as unofficial organizer)
 9. 2014 Subfactor Theory in Mathematics and Physics
 10. 2014 BIRS workshop on Classifying Subfactors and Fusion Categories
 - National conferences co-organized:
 1. 2019 East Coast Operator Algebra Symposium at The Ohio State University
 2. 2018 AMS Special Session at the Central Spring Sectional Meeting on Quantum Symmetries
 3. 2017 Quantum Symmetries: Subfactors and Planar Algebras
 4. 2017 AMS JMM Special Session [Advances in Operator Algebras](#)
 5. 2015 AMS Special Session at Memphis sectional meeting on [von Neumann algebras](#)
 6. 2015 AMS JMM Special Session [Classification Problems in Operator Algebras](#)
 7. 2014 AMS JMM Special Session [Classification Problems in Operator Algebras](#)
 8. 2011 Subfactors in Maui
 9. 2011 Subfactors in Tahoe
 10. 2010 Subfactors in Tahoe
 - Micro-conferences co-organized:
 1. 2017 and 2018 [Operators on Hilbert spaces In Ohio](#) Conference at The Ohio State University
 2. 2016 [Bodega Bay Subfactor Microconference](#)
 3. 2015 UC Subfactor retreat at UC Santa Barbara
 4. 2015 [Bodega Bay Subfactor Microconference](#)
 - Organized many weekly seminars at UC Berkeley, the Fields institute, UCLA, and OSU:
 1. Fall 2016 - Present - OSU Non-Commutative Geometry and Operator Algebras seminar
 2. Fall 2016 - Present - OSU Quantum Algebra/Quantum Topology seminar

3. Spring 2015 - Spring 2016 - UCLA Subfactor reading course
 4. Fall 2013 - Spring 2014 - [Quantum Algebra Seminar](#) at the Fields Institute
 5. Fall 2009 - Spring 2012 - UC Berkeley Subfactor seminar
 6. Spring 2008 - Fall 2009 - UC Berkeley Student subfactor seminar
- Co-organizer of the delocalized University Quantum Symmetries Lectures (uqsl) Zoom seminar series (with Corey Jones and Julia Plavnik), 2020-Present
 - Co-editor for conference proceedings for 2014 and 2015 Subfactor Conferences on Mathematics and Physics, Maui and Qinhuangdao, in honor of Vaughan F. R. Jones' 60th birthday (with Scott Morrison)
 - Served on several NSF panels.
 - Reviewed articles or gave quick opinions for Adv. Math., Algebr. Geom. Top., B. Lond. Math. Soc., Can. Math. Bull., Contemp. Math., Comm. Math. Phys., Documenta Math., Duke Math. J., Group. Geom. Dynam., Int. J. Math., Int. Math. Res. Not., J. Alg., J. Algebra Appl., J. Am. Math. Soc., J. Math. Phys., J. Pure Appl. Algebra, J. Operat. Theor., Math. Reports, Nuc. Phys. B, Proc. Amer. Math. Soc., Quantum Topol., Trans. Amer. Math. Soc.
 - Reviewed articles for Mathematical Reviews, and Zentralblatt MATH.
 - Served on OSU's Quantum Task Force in Spring 2020 and Autumn 2021

Postdocs, PhD students, and undergraduate researchers mentored:

Postdocs at OSU:

- Corey Jones, Zassenhaus Assistant Professor 2018-2020

PhD students at OSU:

- Giovanni Ferrer, expected PhD 2026
- Daniel Wallick, expected PhD 2026
- David Green, expected PhD 2025
- Quan Chen, expected PhD 2023
- Zachary Dell, expected PhD 2022
- Peter Huston, expected PhD 2022
- Roberto Hernandez Palomares, PhD 2021
Thesis: Quantum symmetries for quantum spaces
OSU Presidential Fellowship 2020-21

Undergraduate researchers:

- Quinn Kolt (Rochester Institute of Technology)
Project: Mathematical animation videos for tensor categories
- Jessica Christian (University of Maryland Baltimore County)
Project: A lattice model for condensation in Levin-Wen systems
- Marcos Badillo, Giovanni Ferrer, and Geraldo Soto Rosa (University of Puerto Rico Mayagüez)
Project: Computing bi-invertible connections on graph pairs from subfactor classification
- Desmond Coles and Srivatsa Srinivas (OSU)
Project: The module embedding theorem via towers of algebras [MR4227743](#)
- André Hernandez Espiet and Brian Reyes Vélez (University of Puerto Rico Mayagüez)
Project: Skein theoretic approach to Liu's theorem for quotients of $\text{Vec}(\mathbb{Z}/2) * \text{Fib}$
- Giovanni Ferrer (University of Puerto Rico Mayagüez)
Project: Module categories for Temperley-Lieb 2-categories [MR4098904](#)
- Unofficially co-mentored 3 Stanford undergraduates on computing Turaev-Viro invariants over 5 weeks during Summer 2015 [SURIM program](#)

Other mentoring:

- I am an NRMN-CAM Trained Facilitator for mentor training, and I am part of OSU's NRMN-CAM mentor training team <https://u.osu.edu/osupac/mentoring-training/>.
- Senior Mentor for the Operator Algebra Mentor Network.
2020 Mentees: Priyanga Ganesan and Kathryn McCormick
2021 Mentees: Francesca Arici, Mateusz Wasilewski, Antje Dabeler, Kari Eifler, Lise Wouters
2022 Mentees (joint with Karen Strung): Kate Gibbins, Comfort Mintah, Lauren Ruth

Teaching:

2016-Present: Assistant Professor at The Ohio State University

- Topological phases of matter (8800, topics course)
- Quantum algebra (8160, topics course)
- Functional analysis (7211, 7212, grad course)
- Real analysis (6211, grad course)
- Foundations of higher mathematics (3345)
- Linear algebra (2568)

2014-16 Assistant Adjunct Professor at UCLA

- Operator algebras (259A, grad course)
- Real analysis (131A, 131B)
- Linear algebra and applications (33A)
- Differential equations (33B)
- Calculus for Life Sciences Students (3B)
- Probability for Life Sciences Students (3C)

2012-14 Postdoctoral Fellow at University of Toronto

- Complex variables (MAT334H1)
- Linear algebra (MAT223F)
- Engineering Sciences enriched Calculus I (MAT194H1)
- Calculus 1A (MAT135H1)

2005-11 UC Berkeley Graduate Student Instructor (instructor and teaching assistant)

Instructor:

- Graduate Prelim workshop (Analysis)
- Undergraduate research seminar (191)
- Complex analysis (185)
- Linear algebra (110)
- Introduction to proof writing (74)
- Matrix theory/differential equations (54)
- Calculus (16B)

Teaching Assistant:

- Topology and analysis (202B, grad course)
- Complex analysis (185)
- Linear algebra (110)
- Discrete mathematics (55)
- Matrix theory/differential equations (54)
- Multivariable calculus (53)
- Calculus (1A, 16A, 16B)

Additional training and awards:

- 2020 OSU Drake Institute for Teaching and Learning endorsement for mentor training
- Attended Autumn 2018 OSU program on Better Science Through Better Mentoring
- 2014 F. V. Atkinson Teaching Award at the University of Toronto (postdoctoral teaching award)
- 3 courses (2 hours each) at the University of Toronto's Centre for Teaching Support and Innovation
- Attended Spring 2011 UC Berkeley program on How Students Learn: <http://gsi.berkeley.edu/howstudentslearn/schedule.html>
- 2008-9 Outstanding GSI Award at UC Berkeley (can only receive once)