

## Alexander Wilce

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### Education

Ph.D. in Mathematics, University of Massachusetts/Amherst, 1989

B. A. in Mathematics, Oberlin College, 1983

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### Research Interests

Foundations of quantum mechanics; generalized probabilistic theories; quantum information theory, quantum logic and probability theory; ordered algebraic and topological structures.

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### Academic Positions

Susquehanna University	
Professor of Mathematics	2022 –
Department Head, Mathematics and Computer Science	2020 –
Associate Professor of Mathematics	2008–2022
Assistant Professor of Mathematics	2002–2008
Juniata College, Assistant Professor of Mathematics	1997–2002
University of Pittsburgh/Johnstown, Assistant Professor of Mathematics	1990–1996
University of New Hampshire/Durham, Visiting Assistant Professor	1989–1990
University of Massachusetts/Amherst, Teaching Assistant/Associate	1983–1989

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### Other affiliations and short-term visitorships

Perimeter Institute for Theoretical Physics (2007, 2015); Oxford Computing Laboratory (2009, 2015); Department of Physics, University of Pavia (2010); Slovak Academy of Sciences (1996); Associate, Center for Philosophy of Science, University of Pittsburgh (1995–)

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## Publications and Preprints

**Peer-reviewed publications** These include journal articles, papers in peer-reviewed conference proceedings, and refereed book chapters. Where available, links are given either to the papers themselves, if open-access, or to preprints on the arXiv or elsewhere. An asterisk indicates a student coauthor.

1. [Composites and categories of euclidean Jordan algebras](#) (with H. Barnum and M. Graydon), *Quantum* **4** (2020) ([arXiv:1606.09331](#))
2. [Dynamical states and the conventionality of \(non-\) classicality](#), in M. Hemmo and O. Shenker, eds., *Quantum, Probability, Logic: Itamar Pitowsky's Work and Influence*, Springer (2020) ([philsci-archive.pitt.edu/16721](#))
3. [Conjugates, filters and quantum mechanics](#), *Quantum* **3** (2019)
4. [A royal road to quantum mechanics \(or thereabouts\)](#), invited paper for a special issue of *Entropy on quantum foundations*. *Entropy* **20** (2018), 227
5. [A shortcut from categorical quantum mechanics to convex operational theories](#), in B. Coecke and A. Kissinger, (Eds.), *Proceedings of the 14th International Conference on Quantum Physics and Logic (QPL) EPTCS 266* (2018), 222-236.
6. [A royal road to quantum theory \(extended abstract\)](#), in R. Duncan and C. Huenen (Eds.) *Proceedings of the 13th International Conference on Quantum Physics and Logic (QPL), EPTCS 236* (2017) 245-254
7. [Post-classical probability theory](#) (with H. Barnum), invited chapter for R. Spekkens and G. Chiribella (eds.), *Quantum Theory: Informational Foundations and Foils*, Springer, 2016
8. [Some nearly quantum theories](#) (with H. Barnum and M. Graydon), in C. Huenen, P. Selinger and B. Spitters (Eds.), *Proceedings of the 12th International Conference on Quantum Physics and Logic (QPL), EPTCS 195* (2015), 59-70 ([arXiv:1507.06278](#))
9. [Local tomography and the Jordan structure of quantum theory](#) (with H. Barnum), *Foundations of Physics* **44** (2014), 192-212
10. [Ensemble steering, weak self-duality, and the structure of probabilistic theories](#) (with H. Barnum and P. Gaebler\*), *Foundations of Physics* **43** (2013), 1411-1427
11. [Symmetry, compact closure, and dagger-compactness for categories of convex operational models](#) (with H. Barnum and R. Duncan), *Journal of Philosophical Logic* **vol**, 2013

12. [Symmetry and self-duality in categories of probabilistic models](#), in B. Jacobs, P. Selinger and B. Spitters, (Eds.), Proceedings of the 8th International Conference on Quantum Physics and Logic, EPTCS **95** (2012)
13. [Teleportation in general probabilistic theories](#) (with H. Barnum, J. Barrett and M. Leifer), in S. Abramsky and M. Mislove, *The Mathematics of Information Flow* (Proceedings of Symposia in Applied Mathematics **71**), American Mathematical Society, 2012
14. [Four and a half axioms for finite-dimensional quantum theory](#), in Y. Ben-Menahem and M. Hemmo (eds), *Probability in Physics*, The Frontiers Collection, Springer, 2012
15. [Information processing in convex operational theories](#) (with H. Barnum), extended abstract, ENTCS **270** (2011)
16. [Symmetry and composition in probabilistic theories](#), Electronic Notes in Theoretical Computer Sciences **270** (2011) 191-207 ([arXiv:0910.1527](#))
17. [Entropy and information causality in general probabilistic theories](#) (with H. Barnum, J. Barrett, L. Clark, M. Leifer, R. Spekkens, N. Stepanik\*, and R. Wilke\*), New Journal of Physics **12** (2010) , 1367-2630; [Addendum](#), Vol **14** (2012), 129401-129403.
18. [Formalism and interpretation in quantum theory](#), invited paper for a Festschrift celebrating Jeffrey Bub's 65th Birthday, Foundations of Physics **44** (2010) ([philsci-archive.pitt.edu/3794](#)).
19. Covariance in quantum logic (with Quan Tran\*), International Journal of Theoretical Physics **47** (2008), 15-25.
20. [A Generalized no-broadcasting theorem](#) (with H. Barnum, J. Barrett and M. Leifer), Physical Review Letters **99** (2007) 24051;
21. Symmetry and topology in quantum logic, International Journal of Theoretical Physics **44** (2005), 2265-2279.
22. [Compact orthoalgebras](#), Proceedings of the American Mathematical Society **133** (2005), 2911-2920.
23. [Topological test spaces](#), International Journal of Theoretical Physics **44** (2005), 1227-1238.
24. [Degenerate fibers in the Stone-Ćech compactification of the universal bundle of a finite group](#) (with D. V. Feldman), Transactions of the American Mathematical Society **354** (2002), 3757-3769.

25. [Quantum logic and probability](#), invited article for the *Stanford Encyclopedia of Philosophy* E. Zalta (Ed.), Spring, 2002 (revisions 2006, 2021)
26. On generalized Sasaki projections, *International Journal of Theoretical Physics* **39** (2000) 969-974.
27. [Perspectivity and congruence in partial abelian semigroups](#), *Mathematica Slovaca* **48** (1998) 117-135.
28. [Superentangled states](#) (with R. Clifton, D. V. Feldman, H. Halvorson and M. Redhead), *Physical Review A* **58** (1998) 135-145. Preprint: [arXiv:quant-ph/9711020](#))
29. Abelian extensions of quantum logics (with D. V. Feldman), *International Journal of Theoretical Physics* **37** (1998) 39-42.
30. [Pull-backs and product tests](#), *Helvetica Physica Acta* **70** (1997) 803-812.
31. Symmetric test spaces, in S. Hotaling and S. Pirich, eds., *Photonic Quantum Computing (Proceedings of the SPIE, 3076)* (1997) 116-129.
32. Representations of D-posets (with S. Pulmannov), *International Journal of Theoretical Physics* **34** (1995) 1689-1696.
33. Partial abelian semigroups, *International Journal of Theoretical Physics* **34** (1995) 1807-1812.
34. Sigma-additivity in manuals and orthoalgebras (with D. V. Feldman), *Order* **10** (1993) 383-392.
35. Tensor products in generalized measure theory, *International Journal of Theoretical Physics* **31** (1992) 1915-1928.
36. Tensor products of frame manuals, *International Journal of Theoretical Physics* **29** (1990) 805-814.

#### Invited but non-refereed work

37. [Quantum information theory and quantum foundations](#), introduction to special issue of *Foundations of Physics* on foundational aspects of quantum information (with Howard Barnum and Stephanie Wehner); *Foundations of Physics* **48** (2018), 853-856
38. Test Spaces, invited chapter for *The Handbook of Quantum Structures: Quantum Logic*, K. Engesser, D. Gabbay and D. Lehman, eds., North Holland, 2009, pp. 443-549.

39. Invited [review](#) of *Quantum Entanglement: selected papers of Rob Clifton*, (Jeremy Butterfield and Hans Halvorson, Eds.), *Philosophy of Science* **73** (2006), 122-124.
40. [Compactness and symmetry in quantum logic](#), in *Quantum Theory: reconsideration of foundations II*, Andrei Khrennikov (ed.), Växjö University Press, 2004. (Invited contribution to the proceedings of the second Växjö conference on foundations of quantum mechanics.)
41. *Current research in Operational Quantum Logic*, (Editor, with B. Coecke and D. J. Moore), Springer, 2000.
42. Free extensions of group actions, induced representations, and the foundations of physics, (with D. J. Foulis), Chapter 6 (pp. 139-165) of [41].
43. Test spaces and orthoalgebras, Chapter 4 (pp. 81-114) of [41].
44. [Operational quantum logic: an overview](#) (with B. Coecke and D. J. Moore), introduction (pp. 1-36) to [41].

**Preprints** Unpublished work publicly available as arXiv preprints

45. [Symmetry, self-duality and the Jordan structure of finite-dimensional quantum mechanics](#) (2011)
46. [Ordered linear spaces and categories as frameworks for information-processing characterizations of quantum and classical theory](#) (with H. Barnum) (2009)
47. [Cloning and broadcasting in generic probabilistic theories](#) (with H. Barnum, J. Barrett and M. Leifer), [arxiv:quant-ph/0611295](#) (2006)
48. [Influence-free states on coupled quantum systems](#) (with H. Barnum, C.Fuchs, and J. Renes) (2005)

**Manuscripts in Preparation**

49. Locally Tomographic Shadows (with H. Barnum and M. Graydon)
50. Quantum Axiomatics *à la Carte*

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## Selected Presentations

(Full list on request. Videos of talks at Perimeter Institute for Theoretical Physics can be found [here](#).)

1. Some categories of euclidean Jordan algebras, invited talk, special session on applications of operator theory in quantum mechanics, International Workshop on Operator Theory and its Applications (IWOTA), Chapman University, August 2021 (remote)
2. Reconstructing and extending quantum theory, invited talk, special session on quantum foundations, ENTSPM2021 (remote), July 2021
3. Three ways to classicalize (almost) any probabilistic theory, invited talk (remote), Perimeter Institute, June 2021
4. Quantum reconstructions *à la carte*, invited talk, workshop on quantum foundations, Perimeter Institute, July-August 2018
5. A shortcut from categorical quantum mechanics to convex operational theories, QPL 14, Nijmegen, Netherlands, July 2017
6. Categories of probabilistic models (and vice versa), IQSA satellite meeting, Nijmegen, Netherlands, July 2017
7. A royal road to quantum mechanics (or thereabouts), QPL 13, Strathclyde University, Glasgow, June 2016
8. Some nearly quantum theories, QPL 12, Oxford University, July, 2015
9. A recipe for probabilistic theories, Networks and Applied Algebra Seminar, Penn State University, December 2014
10. Some nearly quantum theories, invited talk, Celebrating 10 years of categorical quantum mechanics, Oxford, October 2014 (quite a different talk from no. 6)
11. A royal road to quantum mechanics (or thereabouts), invited talk, Amsterdam quantum logic workshop, March 2014
12. Probabilistic foundations for finite-dimensional quantum theory, invited talk, AMS/ASL special session on logic and probability, Baltimore, January 2014
13. Two stories about quantum logic, invited talk, “Logic Across the Disciplines” conference, James Madison University, September 2013

14. Conjugates, correlation and the Jordan structure of quantum theory, invited talk, Workshop on the Quantum Landscape, Perimeter Institute, May 2013 (also as a contributed talk, Workshop on Quantum Information and Quantum Foundations, University of British Columbia, July 2013)
15. Symmetry, self-duality and the Jordan structure of quantum theory, invited talk, Workshop on Conceptual Foundations and Foils for Quantum Information Processing, Perimeter Institute for Theoretical Physics, August 2011
16. Homogeneous self-dual cones and the structure of quantum theory, Focus session on Quantum Information and Quantum Foundations, American Physical Society March meeting, Dallas, April 2011
17. For “measurement”, 16th Conference on Foundations of Physics, University of Aberdeen, July 2010
18. Four and a half axioms for quantum mechanics, invited talk, Workshop on Reconstructing Quantum Theory, Perimeter Institute for Theoretical Physics, August, 2009
19. Symmetry and composition in general probabilistic theories, Quantum Physics and Logic (QPL VI), Oxford Computing Laboratory, April 2009 (contributed); also presented at the workshop Quantum Logics Inspired by Quantum Computing, Indiana University, May 2009 (invited).
20. Entanglement and measurement in abstract probabilistic theories, invited talk, 22nd Annual International Workshop on the History and Philosophy of Science, Jerusalem Van Leer Center, Jerusalem, December 2008; also as an invited talk, Foundations Seminar, Perimeter Institute for Theoretical Physics, Waterloo, Canada, March 2009

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## Grants and Awards

Minigrant (\$6,000) from the FQXi Foundation for research on *Decoherence in Generalized Probabilistic Theories*, January-August 2018

Grant (\$42,000) from the FQXi Foundation for research on *Conjugates, Correlation and Quantum Mechanics*, 2013-2016

Senior Staff, NSF-supported REU on quantum information theory, SU (2008, 2009).

SU Summer Research Partners grant, Summer 2005. (Supported work with Quan Tran, resulting in publication [19] above.)

Biennial Research Prize (later renamed the von Neumann Prize) of the International Quantum Structures Association (IQSA), 2004

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## Teaching

**Courses Taught** (Number in brackets = frequency; includes courses for Spring 2023)

Complex Analysis (7), Real Analysis (5), Abstract Algebra (6), Advanced Linear Algebra (3), Differential Geometry (1), Topology (1), Applied Analysis (3), Probability Theory (1), Foundations of Quantum Mechanics (2), Differential Equations (14), Foundations of Analysis (2), Discrete Structures (12) Linear Algebra (10), Calculus III (5), Calculus II (20+), Calculus I (20+), Introductory topics in Mathematics (3), Introductory Statistics ( $\omega_1$ ), Principles of Computer Science (3), Data Structures (1).

### Course Notes

I have written, and continually revise, very extensive original course materials (notes, with exercises) to support my teaching in most areas. For Calculus (I and II), Linear Algebra, Discrete Structures, and Real Analysis, these amount to complete textbooks. I also generated an extensive set of notes (with exercises) to support the REU in Quantum Information Theory hosted by SU in 2008 and 2009.

### Other Teaching

*Senior Colloquium Projects Directed* (SU) include: Nick Woody, Ramsey Theory, 2004; Quan Tran, symmetry in quantum logic, 2006; Chad Halinan, Modal logic (co-directed with Sarah Blansett) 2014; Steve Lipkowitz, Quantum information theory, 2015; Cat Tomkiel, Bell's theorem and hidden variables, 2016, Liz Ballas, Integral Projection Methods, 2022

*Recent independent Study Courses Supervised:* Advanced linear algebra, algebraic topology, general topology, measure theory, quantum information theory.

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## Service to the Profession

### Editorial Work

- Editorial board of *Quantum*, 2016-present
- Associate editor, *Algebra Universalis*, 2021-present
- Invited guest editor (with H. Barnum and S. Wehner) for a special issue of Foundations of Physics on foundational aspects of quantum information theory (Foundations of Physics **48**, <https://link.springer.com/journal/10701/48/8>), 2018.
- Co-editor (with B. Coecke and D. Moore) of *Current Research in Operational Quantum Logic*, Kluwer, 2000.



## Conference and Workshop Organization and Participation

- Principal organizer, Special Session on Quantum Structures, Southeastern Sectional Meeting of the American Mathematical Society, Atlanta, March 2002
- Co-organizer, first and second Workshops on Operational Quantum Logic, Free University of Brussels, July, 1998 and May, 1999
- Member of the program committees for the following conferences and workshops:
  - Quantum Interactions I (Stanford, March 2007) and II (Oxford, March 2008);
  - Quantum Physics and Logic (QPL) VI (Oxford, April 2009), VII (Oxford, May 2010), XV (Chapman University, 2019), XVII (Paris, virtual, 2020), and XVIII (Gdansk, virtual, 2021);
  - Quantum Structures IX (Sopot, July 2008) and XI (Cagliari, July 2012)
- Invited discussant, New Directions in the Foundations of Physics, American Institute of Physics, College Park, MD, April 2003, 2004, 2005 (session chair), 2007 (session chair), 2008, 2010; AMS Carriage House, Washington DC 2013, 2015; Tarquinia, Italy, 2017; Viterbo, Italy, 2018; Viterbo, Italy 2020 (cancelled).
- Member of Scientific Council of the International Quantum Structures Association (IQSA), 2008-2010
- Invited participant, joint AMS-SIAM conference on Doubly Stochastic Measures, Copulas and Joint Distributions with Given Marginals, University of Washington, Seattle, 1993. (Served as a referee for the conference proceedings.)

**Refereeing** Occasional referee for Algebra Universalis, British Journal for the Philosophy of Science, Cambridge University Press, Foundations of Physics, International Journal of Theoretical Physics, Nature, Nature Communications, Nature Physics, Order, Physical Review A, Physical Review Letters, Physica Scripta, Proceedings of the National Academy of Sciences (US), Quantum, Studia Logica, and Studies in the History and Philosophy of Science.

**Doctoral Committees** Outside member, doctoral committees of Robert Flammang (Ph.D. Physics, University of Pittsburgh, 1997). Member of Thesis committees for Kenta Cho (Ph.D., Informatics, Radboud University, Netherlands, 2019) and John van de Wetering (Ph.D., Informatics, Radboud University, Netherlands, 2021).

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## Departmental and University Service

Academic Planning and Assessment Committee, Juniata College, Sept. 1998-October 2001 (Chair, 1998-2000)

Executive Committee, Juniata College, January-April 2001

Helped to design and teach an interdisciplinary general education course, "Cultural Analysis" (mandatory for all sophomores at Juniata College), fall 1998 and fall 1999. Responsible for portions of the course dealing with history of science. Served on the oversight committee for this course, spring 1999 - spring 2000

Inaugurated and organized regular departmental colloquium series at Juniata College (Fall 1998-Spring 2001) and Susquehanna University (spring 2003-2008; 2018-present)

Task Force on Evaluation of the Committee on Teaching and Learning, SU, spring 2003

Claritas Science Speaker Committee (responsible for selecting the annual Claritas Science Lecturer) SU, fall 2002-present.

Library Committee, SU, fall 2003-spring 2006

Faculty Research and Development Committee, SU, fall 2006-spring 2008

Member of working group for "Analytical thought" component of new core curriculum, SU, summer 2007

Committee on the Central Curriculum, SU, fall 2017-present

Member of Departmental Search Committees at UPJ (Mathematics, 1991; Psychology, 1995), Juniata College (Mathematics/Computer Science, 1996 and 2000), and Susquehanna University (Mathematical Sciences, 2004, 2006, 2018)

Participation in Science Action Day (a program of lectures for High School students) at SU, fall 2002-2005, 2007

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## REFERENCES

Howard Barnum, Independent scholar, Los Alamos, NM  
(hnbarnum@aol.com; hbarnum@unm.edu)

Giulio Chiribella, Department of Computer Science, University of Hong Kong  
(giulio@cs.hku.hk)

Bob Coecke, Quantum and Department of Computer Science, Oxford University  
(coecke@cs.ox.ac.uk)

David V. Feldman, Department of Mathematics, University of New Hampshire  
(David.Feldman@unh.edu)

Chris Fuchs, Department of Physics, University of Massachusetts/Boston  
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John Harding, Department of Mathematical Sciences, New Mexico State University  
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