Curriculum Vitæ – Cole Comfort

Personal Information

Full Name: Cole Robert Comfort

Email: `cole.r.comfort@gmail.com`

Website: `https://colecomfort.github.io/`

Research Interests

Categorical semantics for quantum computing and quantum error correction.
Monoidal category theory and graphical languages.
Categorical semantics for linear logic.

Selected Publications (last 5 years)

Complete equational theories for classical and quantum Gaussian relations
Robert I. Booth, Titouan Carette, Cole Comfort. *arXiv preprint*, 2024. arXiv:2403.10479.

Graphical Symplectic Algebra
Robert I. Booth, Titouan Carette, Cole Comfort. *arXiv preprint*, 2024. arXiv:2401.07914.

Denotational semantics for Stabiliser Quantum Programs
Robert I. Booth, Cole Comfort. *Preprint*, 2024. https://colecomfort.github.io/pdfs/QEC.pdf.

Dagger linear logic for categorical quantum mechanics
J.R.B. Cockett, Cole Comfort, Priyaa Srinivasan. *Logical Methods in Computer Science* 17(4), 2021.
DOI: 10.46298/lmcs-17(4:8)2021.

Employment

Postdoctoral Scholar (joint project) *October 2023–November 2026*
Équipe QUACS, Université Paris-Saclay (CNRS, ENS Paris-Saclay, Inria, LMF, Gif-sur-Yvette, France).
Équipe MOCQUA, Université de Lorraine (CNRS, Inria, LORIA, Nancy, France).
Research focus: categorical semantics of quantum computing and quantum error correction.

Researcher *September 2021–January 2022*
Tallinn Institute of Technology, Estonia.
Supervisor: Prof. Paweł Sobociński.
Research focus: diagrammatic methods in theoretical computer science.

Education

Doctorate of Philosophy, Computer Science, Clarendon Scholar *October 2019–October 2023*
University of Oxford, United Kingdom
Supervisors: Profs. Aleks Kissinger and Bob Coecke
Thesis Title: *A Diagrammatic Approach to Networks of Spans and Relations*

Thesis Based Master of Science, Computer Science *September 2017–July 2019*
University of Calgary, Canada
Supervisor: Prof. Robin Cockett
Thesis Title: *Classifying reversible logic gates with ancillary bits*
GPA Received: 4.000/4.000

Bachelor of Science (Honours) First Class, Computer Science *September 2013–June 2017*
University of Calgary, Canada
Minor: Pure Mathematics
Concentration: Algorithms and Complexity Theory
Supervisor: Prof. Robin Cockett
Thesis Title: *The Category CNOT*
GPA Received: 3.735/4.000

RESEARCH FUNDING

Clarendon Fund Scholarship   *October 2019–October 2023*
Prestigious scholarship awarded by Oxford University Press to outstanding prospective doctoral students.
Only two recipients per year in Computer Science.
Wrote a research proposal on diagrammatic methods for infinite-dimensional quantum circuits.

Queen Elizabeth II Graduate (Master's) Research Scholarship   *2018*
Government of Alberta, awarded for excellence in graduate research.

Queen Elizabeth II Graduate (Master's) Scholarship   *2017*
Government of Alberta, awarded for outstanding academic performance.

Graduate Research Award   *2017–2018*
Two units, University of Calgary.

GRANTS

Mitacs Globalink Research Award   *September 2018–December 2018*
Project: *Investigating Infinite Dimensional Models of Quantum Computation*.
Visits: Oxford (supervised by Prof. Bob Coecke) and Edinburgh (supervised by Prof. Chris Heunen).
Wrote a successful grant application to obtain travel funding.
Resulted in the publication of the article, "Dagger linear logic for categorical quantum mechanics."

AWARDS

Best Student Paper Award   *July 2023*
The Algebra for Stabilizer Codes
19th International Conference on Quantum Physics and Logic (QPL 2023).

Best Student Paper Award   *June 2020*
The ZX&-calculus: A complete graphical calculus for classical circuits using spiders
17th International Conference on Quantum Physics and Logic (QPL 2020).

Distinguished Presentation Award   *July 2021*
A Graphical Calculus for Lagrangian Relations
4th International Conference on Applied Category Theory (ACT 2021).

PUBLICATIONS

Conference Publications

[1] J. Hefford and C. Comfort, "Coend optics for quantum combs," p. 63–76, Aug. 2023. [Online].
    Available: http://dx.doi.org/10.4204/EPTCS.380.4

[2] C. Comfort and A. Kissinger, "A graphical calculus for Lagrangian relations," *Electronic Proceedings in Theoretical Computer Science*, vol. 372, pp. 338–351, Nov. 2022. [Online]. Available: https://doi.org/10.4204/eptcs.372.24

[3] C. Comfort, "The ZX&-calculus: A complete graphical calculus for classical circuits using spiders (best student paper)," vol. 340.   Open Publishing Association, 2021, pp. 60–90. [Online]. Available: https://doi.org/10.4204/eptcs.340.4

[4] J. Cockett and C. Comfort, "The category TOF," vol. 287.   Open Publishing Association, Jan. 2019, pp. 67–84. [Online]. Available: https://doi.org/10.4204/eptcs.287.4

[5] R. Cockett, C. Comfort, and P. Srinivasan, "The category CNOT," vol. 266.   Open Publishing Association, Feb. 2018, pp. 258–293. [Online]. Available: https://doi.org/10.4204/eptcs.266.18

Journal Articles

[6] J. Cockett, C. Comfort, and P. Srinivasan, "Dagger linear logic for categorical quantum mechanics," *Logical Methods in Computer Science*, vol. Volume 17, Issue 4, Nov. 2021. [Online]. Available: https://doi.org/10.46298/lmcs-17(4:8)2021

Preprints

[7] R. I. Booth, T. Carette, and C. Comfort, "Complete equational theories for classical and quantum Gaussian relations," 2024. [Online]. Available: https://arxiv.org/abs/2403.10479

[8] ——, "Graphical symplectic algebra," 2024. [Online]. Available: https://arxiv.org/abs/2401.07914

[9] C. Comfort, "The algebra for stabilizer codes (best student paper, QPL 2023)," 2023. [Online]. Available: https://arxiv.org/abs/2304.10584

[10] C. Comfort, A. Delpeuch, and J. Hedges, "Sheet diagrams for bimonoidal categories," 2020. [Online]. Available: https://arxiv.org/abs/2010.13361

[11] C. C. Robert Booth, "Denotational semantics for stabiliser quantum programs," 2025. [Online]. Available: https://colecomfort.github.io/pdfs/QEC.pdf

[12] C. Comfort, "Gaussian probability theory is completely positive," 2025. [Online]. Available: https://colecomfort.github.io/pdfs/SVD.pdf

SERVICE

Program committee member
8th International Conference on Applied Category Theory (ACT 2025)

Journal reviewer
Logical Methods in Computer Science
Polynesian Journal of Mathematics
Bulletin of the London Mathematical Society
ACM Transactions on Quantum Computing
Journal of Physics A: Mathematical and Theoretical
Compositionality

Conference subreviewer
53rd ACM SIGPLAN Symposium on Principles of Programming Languages (POPL 2026)
21st International Conference on Quantum Physics and Logic (QPL 2024)
39th Annual ACM/IEEE Symposium on Logic in Computer Science (LICS 2024)
20th International Conference on Quantum Physics and Logic (QPL 2023)
18th Theory of Quantum Computation, Communication and Cryptography (TQC 2023)
19th International Conference on Quantum Physics and Logic (QPL 2022)
47th International Symposium on Mathematical Foundations of Computer Science (MFCS 2022)
25th International Conference on Foundations of Software Science and Computation Structures (FOSSACS 2022)
4th International Conference on Applied Category Theory (ACT 2021)

Organizer
QUACS informal seminar series   *November 2024–ongoing*
ZX-calculus seminar series   *October 2019–July 2021*

TEACHING ACTIVITIES

Tutor   *July 2023*
Quantinuum, Oxford, United Kingdom
Teaching categorical quantum mechanics to high-school students.
Organized as part of quantum education research project.

Tutor   *Michaelmas 2020*
Department of Computer Science, University of Oxford, United Kingdom
Course: Categories Proofs and Processes

Tutor   *Michaelmas 2020*
Department of Computer Science, University of Oxford, United Kingdom
Course: Quantum Processes and Computation

Teaching Assistant   *Winter Term 2019*
Department of Computer Science, University of Calgary, Canada
Course: CPSC 313, Introduction to Computability

Teaching Assistant   *Winter Term 2018*
   Department of Computer Science, University of Calgary, Canada
   Course: CPSC 411, Compiler Construction

Teaching Assistant   *Fall Term 2017*
   Department of Computer Science, University of Calgary, Canada
   Course: CPSC 521, Foundations of Functional Programming

RESEARCH VISITS

Maquarie University, Sydney, Australia   *October 2025*
   Invited by Prof. JS Lemay in the Centre of Australian Category Theory group in the Department of
   Mathematics.

Quantinuum, Oxford, UK   *February 2025*
   Visited the group of Prof. Bob Coecke at the quantum computing company Quantinuum.
   Collaborated with Dr. Giovani de Felice.

Technische Universität, Dresden Dresden, Germany   *December 2023*
   Invited by the geometric methods in mathematics group of Prof. Ulrich Krähmer.

Centre INRIA Saclay, Gif-sur-Yvette, France   *May 2024*
   Visited the QUACS group in the Laboratoire de Methodes Formelles.

University of Edinburgh, Edinburgh, UK   *November 2023*
   Visited Dr. Robert Booth in the Quantum Software group, in the School of Informatics.

Centre INRIA Saclay, Gif-sur-Yvette, France   *July 2023*
   Visited the QUACS group in the Laboratoire de Methodes Formelles.

Centre INRIA Nancy, Nancy, France   *June 2023*
   Visited the MOCQUA group in LORIA.

Università degli Studi di Pisa, Pisa, Italy   *May 2023*
   Visited Prof. Filippo Bonchi in the Dipartimento di Informatica.

University College London, London, UK   *March 2022*
   Visited Prof. Fabio Zanasi in the Programming Principles, Logic and Verification Group in the Department
   of Computer Science.

University of Edinburgh, Edinburgh, UK   *November-December 2018*
   Visited Prof. Chis Heunen in the Quantum Software group, in the School of Informatics.

University of Oxford, Oxford, UK   *September-November 2018*
   Visited Prof. Bob Coecke in the Quantum Group, in the Department of Computer Sience.

INVITED TALKS, AND RESEARCH VISIT TALKS

TBA. Topos Institute Colloquium. Online. October 2025. Invited by Dr. David Spivak.

Categorical semantics for discrete time dynamics. Australian Category Seminar, Macquarie University.
Sydney, Australia. September 2025. Invited by Prof. JS Lemay.

String diagrams for classical mechanics. Maths&Stats Seminar, Western Sydney University. Sydney,
Australia. September 2025. Invited by Prof. Colin Reid.

Syntax and semantics for mechanical processes. Australian Category Seminar, Macquarie University.
Sydney, Australia. September 2025. Invited by Prof. JS Lemay.

Graphical algebra and quantum circuits. Technische Universität Dresden, Germany. December 2023.
Invited by the geometric methods in mathematics group of Prof. Ulrich Krähmer.

Graphical Calculi for Phase-Space Representations in Quantum Mechanics. Prague Mathematical
Physics Seminar (online). Charles University, Czech Republic. March 2023. Invited by Prof. Branislav
Jurco.

A ZX-calculus for continuous-variable Gaussian quantum circuits. QUACS seminar. Centre INRIA
Paris-Saclay, Gif-Sur-Yvette, France. May 2024.

Graphical Symplectic Algebra. Università degli Studi di Pisa, Pisa, Italy. Ma 2023.

Graphical Symplectic Algebra. QUACS seminar (online). Centre INRIA Paris-Saclay, Gif-Sur-Yvette, France. May 2023 . Invited by Prof. Renaud Vilmart.

Graphical Symplectic Algebra. Programming Principles, Logic, and Verification Group seminar. University College, London, United Kingdom. March 2022.

REFEREED PRESENTATIONS

Graphical Symplectic Algebra and **Complete equational theories for classical and quantum Gaussian relations** *(two consecutive talks)*. 7th International Conference on Applied Category Theory (ACT 2024). University of Oxford, United Kingdom. June 2024.

The Algebra of Stabilizer Codes. 19th International Conference on Quantum Physics and Logic (QPL 2023). Paris, France. July 2023.

Coend Optics for Quantum Combs. 5th International Conference on Applied Category Theory (ACT 2022). University of Strathclyde, Glasgow, Scotland. July 2022.

A Graphical Calculus for Lagrangian Relations. *Distinguished presentation.* The 4th International Conference on Applied Category Theory (ACT 2021). University of Cambridge, United Kingdom. July 2021.

The ZX&-calculus: A complete graphical calculus for classical circuits using spiders. 17th International Conference on Quantum Physics and Logic (QPL 2020) (online due to COVID). Paris, France. June 2020.

The category TOF. 15th International Conference on Quantum Physics and Logic (QPL 2018). Dalhousie University, Halifax, Canada. June 2018.

The Category CNOT. 14th International Conference on Quantum Physics and Logic. Radboud University, Nijmegen, Netherlands (QPL 2017). July 2017.

WORKSHOP TALKS

A complete equational theory for Gaussian quantum circuits. 31st Foundational Methods in Computer Science Workshop (FMCS 2024). University of Calgary, Kanaskis, Canada. July 2024.

A phase-space approach to rewriting infinite-dimensional quantum circuits. LHC Days 2024). Nantes, France. July 2024.

Graphical Symplectic Algebra. 29th Foundational Methods in Computer Science Workshop (FMCS 2022). University of Calgary, Kanaskis, Canada. July 2022.

A Graphical Calculus for Lagrangian Relations. Tangent Categories and their Applications (online due to COVID). University of Calgary, Kananaskis, Canada. June 2021.

Circuit Relations for Real Stabilizers: Towards TOF+H. 27th Foundational Methods in Computer Science Workshop (FMCS 2019). University of Calgary, Kananaskis, Canada. May 2019.

Circuit Relations for Real Stabilizers: Towards TOF+H. 4th Symposium on Compositional Structures (SYCO 2019). Chapman University, Orange, United States. May 2019.

The category TOF. 26th Foundational Methods in Computer Science Workshop (FMCS 2018). Mount Allison University, Sackville, Canada. May 2018.

The Category CNOT. 25th Foundational Methods in Computer Science Workshop (FMCS 2017). University of Ottawa, Canada. June 2017.

The Category CNOT. Calgary Applied and Industrial Mathematical Sciences Conference. University of Calgary, Canada. May 2017.