

JOHN VAN DE WETERING

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EDUCATION

PhD

September 2016 - August 2020

Radboud University Computer Science Department

Nijmegen, the Netherlands

- 4 year PhD programme as part of *Quantum Computation, Logic and Security* ERC Advanced grant.
- Promoter: Bart Jacobs.
- Supervisor: Aleks Kissinger.
- Thesis: *Quantum Theory from Principles, Quantum Software from Diagrams*. arXiv:2101.03608

Undergraduate

2011-2016

Radboud University

Nijmegen, The Netherlands

- Bachelor in Mathematics *Cum laude* 2011-2014
- Bachelor in Physics *Cum laude* 2011-2014
- Master in Mathematical Physics *Bene meritum* 2014-2016
 - Master Thesis at Oxford University Feb-Jul 2016 supervised by Bob Coecke. Resulted in two papers (13 and 16 under heading Publications).
- Honours programme 2014-2015
 - Report presented at *WEI Education and Humanities Academic Conference* in Vienna and Ireland *International Conference on Education* in Dublin.

WORK EXPERIENCE

Postdoctoral research fellowship

December 2020 - November 2022

Visiting Researcher Oxford Quantum Group

Oxford, United Kingdom

- I was awarded a NWO Rubicon two-year individual fellowship.
- The research project is to implement a quantum compiler using diagrammatic methods.

Technical Advisor

September - December 2019

Cambridge Quantum Computing

Cambridge, United Kingdom

- Hired for my expertise in quantum circuit optimisation.
- I found and implemented new methods for optimising quantum circuits.

SUMMARY

- 19 published papers, 6 additional preprints.
- 99 citations in 2020 and 297 citations total (according to Google Scholar).
- Creator of open-source software PyZX, downloaded more than 12.000 times (according to PePy.tech).
- Co-supervised 5 Master students. Lecturer on two Master level quantum computing courses.

TEACHING EXPERIENCE

Radboud University

Various teaching

2011 - Present

Nijmegen, the Netherlands

- Co-lecturer of 2018 & 2019 Master's course *Quantum Processes and Computation*. I designed teachers' materials and the lectures.
- Co-supervised Master students Stach Kuijpers, Sal Wolffs, Louis Lemonnier, Arianne Meijer and Yanbin Chen, leading to 3 papers and preprints.
- Teacher's assistant for courses covering Linear algebra, Probability theory, Analysis, Differential equations and Complex functions during undergrad and PhD.

OUTREACH AND ACADEMIC SERVICE

- Member of the Gender Equality Working Group of the European Quantum Flagship project.
- Member of the Organizing Committee QPL2020.
- Member of the Program Committee of QPL2021 and ACT2021.
- Reviewed for the journals *Quantum*, *LMCS*, *Proceedings of the Royal Society A*, *npj Quantum Information* and *ACM TQC*.
- Reviewed for the conferences *LICS*, *QPL*, *ACT*, *FSCD*, and *AsiaCrypt*.
- Presented my research to a wide non-academic audience at FOSDEM software meetings.
- Heavily involved in the construction of the ZX-calculus website and Wikipedia page.

GRANTS

NWO Rubicon Fellowship

2020

Diagrammatic Quantum Computation

Rubicon website

- Recipients: John van de Wetering
- Amount: €180,000,-.
- The NWO Rubicon is a competitive individual research fellowship allowing researchers that have just finished their PhD to perform research at an international institute for up to two years.

Unitary Fund

2018

Awarded for development of PyZX

<http://unitary.fund>

- Recipients: John van de Wetering and Aleks Kissinger
- The Unitary Fund is a \$2000,- grant to support open-source quantum software.

SOFTWARE

PyZX

April 2018 - Present

Co-creator and lead developer

github.com/Quantomatic/pyzx

- Open-source Python library for quantum circuit optimisation with the ZX-calculus.
- Its T-count minimisation routine is the current state-of-the-art.
- It is used by academics in Oxford, Nancy and Grenoble.
- Industry interest by Cambridge Quantum Computing, IBM, DWave and QuTech.

INVITED TALKS AND LECTURES

- Invited speaker National conference of Portuguese Mathematical Society (ENSPM2021). *The algebraic structure of quantum effects*.
- Invited speaker Second International Workshop on Programming Languages for Quantum Computing (PlanQC 2021). *Quantum compilation using the ZX-calculus*.
- Invited speaker Quantum Resource Estimation 2021. *Quantum compilation using the ZX-calculus*.

- Guest lecturer for the Quantum Engineering Centre of the University of Bristol. 2021.
An introduction to the ZX-calculus.
- Talk at the MIT Categories Seminar 2020. *An effect-theoretic reconstruction of quantum theory.*
- Invited lecturer for L'Agape Summer School 2020. *Quantum Theory from First Principles.*
- Invited speaker for ZX Calculus Workshop Grenoble, France (February 25 2019).
- Talk at open-source software conference FOSDEM 2020.
Quantum circuit optimisation, verification, and simulation with PyZX.
- Talk at open-source software conference FOSDEM 2019.
PyZX: Graph-theoretic optimization of quantum circuits.

CONFERENCE TALKS

Note: All talks resulted from having a peer-reviewed abstract accepted.

- Applied Category Theory 2021. *The ZH-calculus: completeness and extensions.*
- Applied Category Theory 2021. *A Categorical Construction of the Real Unit Interval.*
- Quantum Physics and Logic 2021. *The ZH-calculus: completeness and extensions.*
- Quantum Physics and Logic 2021. *Constructing quantum circuits with global gates.*
- International Workshop on Quantum Compilation 2020. *There and back again: A circuit extraction tale.*
- Quantum Physics and Logic 2020.
Dichotomy between deterministic and probabilistic models in countably additive effectus theory.
- Quantum Computing Theory in Practice 2020. *Quantum Circuit Optimisation with the ZX-calculus.*
- Workshop on String Diagrams in Computation, Logic and Physics.
Simulation of quantum circuits by ZX-diagram contraction.
- Applied Category Theory 2019. *An effect-theoretic reconstruction of quantum theory.*
- Quantum Physics and Logic 2019. *PyZX: Large Scale Automated Diagrammatic Reasoning.*
- European Quantum Technology Conference 2019.
T-count optimization of quantum circuits using graph-theoretical rewriting of ZX-diagrams.
- Symposium on Compositional Structures (December 2018).
PyZX: Quantum circuit optimization using the ZX-calculus.
- Foundations 2018. *Reconstruction of Quantum Theory from Universal Filters.*
- Quantum Physics and Logic 2018. *Sequential Measurement characterises Quantum Theory.*
- Quantum Physics and Logic 2018. *Purity in Euclidean Jordan Algebras.*
- Quantum Physics and Logic 2017. *Quantum Theory is a Quasi-Stochastic Process Theory.*
- Workshop on Semantic Spaces at the Intersection of NLP, Physics and Cognitive Science 2016.
Entailment Relations on Distributions.

PUBLICATIONS

Note: In reverse chronological order. As is common in theoretical computer science, authors are usually listed in alphabetical order.

1. John van de Wetering. A Categorical Construction of the Real Unit Interval. *To appear in Proceedings of Applied Category Theory (ACT2021).* 2021.
2. Miriam Backens, Hector Miller-Bakewell, Giovanni de Felice, Leo Lobski and John van de Wetering. There and back again: A circuit extraction tale. *Quantum Vol. 5, 421.* 2021.
3. John van de Wetering. Constructing quantum circuits with global gates. *New Journal of Physics Vol. 23, 043015.* 2021.
4. Abraham Westerbaan, Bas Westerbaan and John van de Wetering. The three types of normal sequential effect algebras. *Quantum Vol. 4, 378.* 2020.

5. Aleks Kissinger and John van de Wetering. Reducing the number of non-Clifford gates in quantum circuits. *Physical Review A Vol. 102, 2.* 2020.
6. Abraham Westerbaan, Bas Westerbaan and John van de Wetering. A characterisation of ordered abstract probabilities. *Proceedings of the 35th Annual ACM/IEEE Symposium on Logic in Computer Science (LICS).* 2020.
7. Louis Lemonnier, John van de Wetering and Aleks Kissinger. Hypergraph simplification: Linking the path-sum approach to the ZH-calculus. *Proceedings of the 17th International Conference on Quantum Physics and Logic (QPL).* 2020.
8. Kenta Cho, Bas Westerbaan and John van de Wetering. Dichotomy between deterministic and probabilistic models in countably additive effectus theory. *Proceedings of the 17th International Conference on Quantum Physics and Logic (QPL).* 2020.
9. John van de Wetering. Commutativity in Jordan Operator Algebras. *Journal of Pure and Applied Algebra Vol. 224, 11.* 2020.
10. Ross Duncan, Aleks Kissinger, Simon Perdrix and John van de Wetering. Graph-theoretic Simplification of Quantum Circuits with the ZX-calculus. *Quantum Vol. 4, 279.* 2020.
11. Aleks Kissinger and John van de Wetering. PyZX: Large Scale Automated Diagrammatic Reasoning. *Proceedings 16th International Conference on Quantum Physics and Logic, Chapman University, Orange, CA, USA., 10–14 June 2019.* 2019.
12. Aleks Kissinger and John van de Wetering. Universal MBQC with generalised parity-phase interactions and Pauli measurements. *Quantum Vol. 3, 134.* 2019.
13. John van de Wetering. Sequential Product Spaces are Jordan Algebras. *Journal of Mathematical Physics Vol. 60, 6.* 2019.
14. John van de Wetering. An effect-theoretic reconstruction of quantum theory. *Compositionality Vol. 1, 1.* 2019.
15. Abraham Westerbaan, Bas Westerbaan, and John van de Wetering. Pure maps between Euclidean Jordan Algebras. *Proceedings of the 15th International Conference on Quantum Physics and Logic, Halifax, Canada, 3–7th June 2018.* 2018.
16. John van de Wetering. Ordering quantum states and channels based on positive Bayesian evidence. *Journal of Mathematical Physics Vol. 59, 10,* 2018.
17. John van de Wetering. Three characterisations of the sequential product. *Journal of Mathematical Physics Vol. 59, 8,* 2018.
18. John van de Wetering. Quantum Theory is a Quasi-stochastic Process Theory. *Proceedings of the 14th International Conference on Quantum Physics and Logic, Nijmegen, The Netherlands, 3-7 July 2017.*
19. John van de Wetering. Entailment Relations on Distributions. *Proceedings of the 2016 Workshop on Semantic Spaces at the Intersection of NLP, Physics and Cognitive Science, Glasgow, Scotland. 11th June 2016.*

PREPRINTS

1. Aleks Kissinger and John van de Wetering. Simulating quantum circuits with ZX-calculus reduced stabiliser decompositions. *arXiv:2109.01076.2021.*
2. Miriam Backens, Aleks Kissinger, Hector Miller-Bakewell, John van de Wetering and Sal Wolffs. Completeness of the ZH-calculus. *arXiv:2103.06610.* 2021.

3. John van de Wetering. ZX-calculus for the working quantum computer scientist. *arXiv preprint arXiv:2012.13966*.
4. Richard East, John van de Wetering, Nicholas Chancellor and Adolfo Grushin. AKLT-states as ZX-diagrams: diagrammatic reasoning for quantum states. *arXiv preprint arXiv:2012.01219*.
5. Stach Kuijpers, John van de Wetering and Aleks Kissinger. Graphical Fourier Theory and the Cost of Quantum Addition. *arXiv preprint arXiv:1904.07551*.
6. John van de Wetering and Sal Wolffs. Completeness of the Phase-free ZH-calculus. *arXiv preprint arXiv:1904.07545*.