

# Renaud Vilmart

## Curriculum Vitae

Born on September the 9th, 1993, in Reims (France).

## Background

### Positions

- 2020 - ... Inria Starting Faculty Position (ISFP), Inria Saclay, Laboratoire Méthodes Formelles (LMF), Université Paris Saclay.
- 2019 - 2020 Postdoc, Laboratoire de Recherche en Informatique (LRI), Université Paris Sud.
- 2016 - 2019 Ph.D. Thesis in computer science, Loria, Université de Lorraine.

### Formation

- 2015 - 2016 LMFI Master, Université de Lorraine.
- 2013 - 2016 École des Mines de Nancy, Université de Lorraine.
- 2011 - 2013 "Classe préparatoire" (CPGE), lycée Clemenceau, Reims.
- 2011 Baccalauréat scientifique, Lycée Libergier, Reims.  
Equ. A levels, with honours (mention très bien).

### Teaching

- 2023 - 2024 Advanced Quantum Computation and Error Correction, M2 QDCS, UPSaclay, 21h.  
  
Elements of Theoretical Computer Science, Master ArteQ, ENS Paris Saclay, 10h.  
  
Initiation to Functional Programming, practical work, L2 double diplôme Maths-Info, UPSaclay, 30h.
- 2022 - 2023 Advanced Quantum Computation and Error Correction, M2 QDCS, UPSaclay, 10h.  
  
Computer science project, practical work, L2 double diplôme Maths-Info, UPSaclay, 50h.

	Formal Verification of Quantum Programs, MOVEP summer school, 1h30.
2021 - 2022	Advanced Quantum Computation and Error Correction, M2 QDCS, UPSaclay, 10h.  Computer science project, practical work, L2 double diplôme Maths-Info, UPSaclay, 50h.
2020 - 2021	Computer science project, practical work, L2 double diplôme Maths-Info, UPSaclay, 50h.
2016 - 2019	Training course on ZX-calculus.  Introduction to algorithmic and programming, practical work, L1 and L2, Université de Lorraine.  "Certificat informatique et internet" (C2I, degree for office automation), L1, Université de Lorraine.  Software for professionals, practical work, L2, Université de Lorraine.

## Responsibilities

2023 - ...	Co-supervision of the "Groupe de Travail Informatique Quantique" (GTIQ), part of "Groupement de Recherche Informatique Fondamentale et ses Mathématiques (GdR-IFM)
2023 - ...	Member of the scientific committee of the Inria Saclay center
2023 - ...	Member of the steering committee of "parcours recherche" at CentraleSupélec
2023 - ...	Member of the scientific board of the "ENSEA Quantum Computing" student association

## Conferences

2024	Member of the QPL'24 program committee
2023	Member of the QPL'23 program and organising committees

## Collaborations

2023 - 2027	ANR TaQC (local principal investigator)
2022 - 2027	PEPR EPIQ (task leader)
2021 - 2024	European project HPCQS (task leader)

2023 - 2027	AAP régional AsTech i-Demo AeroQat
2022 - 2027	European project HQI
2021 - 2024	Inria challenge EQIP

## Supervision

### PhD students

2024 - ...	Co-supervision (50%) with Benoît Valiron (50%) of Julien Lamiroy's Ph.D. thesis
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### Internships

2024	Antoine Guilmin-Crépon, M1, graphical language for infinite dimensional quantum systems
2023	Colin Blake, M2, Hermiticity-preserving ZX-diagrams
	Sunheang Ty, M2, quantum linear solver for finite element method, co-supervised with Benoît Valiron and IRT SystemX
	Fatima-Zahra Merimi, M1, tensor networks for graph counting problems
	Joaquim Gaspar Minarelli, M1, graphical manipulation of Hamiltonians, co-supervised with Benoît Valiron
	Rui Cesista, L3, expressing ZW-diagrams in the Many-Worlds calculus, co-supervised with Marc de Visme
2022	Alice Petiot, L3, automated search of low stabiliser-rank decompositions

### Parcours Recherche and TER

2023 - 2024	Malo Leroy, parcours recherche CentraleSupélec, abstract interpretation of quantum states with decision diagrams
2021 - 2023	Pierrick Bournez, parcours recherche CentraleSupélec, circuit optimisation and synthesis with decision diagrams
	Matteo Debart, parcours recherche CentraleSupélec, additive decision diagrams
2022 - 2023	Fatima-Zahra Merimi, TER, tensor networks for graph counting problems
	Rui Cesista & Tilmann Berland, TER, token machine for ZW-diagrams

## Research engineer

2023 - 2024 Mathieu Nguyen, implementation of diagrammatic manipulations for hamiltonian optimisation, part of the HPCQS european project

## Invited Talks

2024 *Why we care about quantum computing, and how we deal with it*, IRT SystemX, Paris Saclay

2023 *Picturing Matchgate Computations*, ENSEA quantum computing, Cergy

2022 *How to Verify Quantum Processes*, MOVEP summer school, Aalborg, Denmark

2021 *ZX-Calculi for Quantum Computing and their Completeness*, Société Informatique de France, online

*Quantum Circuits and ZX-Calculus*, LaBRI, Bordeaux

*ZX-Calculus: Quantum Computing Made Intuitive*, ENSEA quantum computing, Cergy

2020 *Completeness of ZX-Calculi for Quantum Computing*, LIG, Grenoble

2018 *Complete Axiomatisation for Clifford+T ZX-Calculus*, LACL, Créteil

## Awards

- Kleene Award 2019: Best student paper award for a LiCS paper
- Accessit to the 2020 Gilles Kahn PhD thesis Award (Société Informatique de France)

## Publications

### Journal

[J1] Carette, T., Jeandel, E., Perdrix, S., & Vilmart, R. (2021). Completeness of Graphical Languages for Mixed State Quantum Mechanics. *ACM Transactions on Quantum Computing*, 2(4), 1–28. <https://doi.org/10.1145/3464693>

[J2] Jeandel, E., Perdrix, S., & Vilmart, R. (2020). Completeness of the ZX-Calculus. *Logical Methods in Computer Science*, 16(2), 11:1-11:72. [https://doi.org/10.23638/LMCS-16\(2:11\)2020](https://doi.org/10.23638/LMCS-16(2:11)2020)

[J3] Vilmart, R. (2024). Rewriting and Completeness of Sum-Over-Paths in Dyadic Fragments of Quantum Computing. *Logical Methods in Computer Science*, 20(1). [https://doi.org/10.46298/LMCS-20\(1:20\)2024](https://doi.org/10.46298/LMCS-20(1:20)2024)

## Conference

- [C1] Carette, T., Hoffreumon, T., Larroque, É., & Vilmart, R. (2023). Complete Graphical Language for Hermiticity-Preserving Superoperators. *38th Annual ACM/IEEE Symposium on Logic in Computer Science (LICS) 2023*, 1–22. <https://doi.org/10.1109/LICS56636.2023.10175712>
- [C2] Carette, T., Moutot, E., Perez, T., & Vilmart, R. (2023). Compositionality of planar perfect matchings. *50th International Colloquium on Automata, Languages, and Programming (ICALP 2023)*, 261, 120:1-120:17. <https://doi.org/10.4230/LIPIcs.ICALP.2023.120>
- [C3] Carette, T., Perdrix, S., Vilmart, R., & Jeandel, E. (2019). Completeness of Graphical Languages for Mixed States Quantum Mechanics. *ICALP*, 132. <https://doi.org/10.4230/LIPIcs.ICALP.2019.108>
- [C4] Chardonnet, K., Valiron, B., & Vilmart, R. (2021a, June). Geometry of Interaction for ZX-Diagrams. *TLLA 2021 - 5th International Workshop on Trends in Linear Logic and Applications*. <https://hal-lirmm.ccsd.cnrs.fr/lirmm-03272411>
- [C5] Chardonnet, K., Valiron, B., & Vilmart, R. (2021b). Geometry of Interaction for ZX-Diagrams. *MFCS 2021 - 46th International Symposium on Mathematical Foundations of Computer Science*, 202, 30:1-30:16. <https://doi.org/10.4230/LIPIcs.MFCS.2021.30>
- [C6] Clément, A., Delorme, N., Perdrix, S., & Vilmart, R. (2024, February). Quantum Circuit Completeness: Extensions and Simplifications. *International Conference on Computer Science Logic CSL 2024*. <https://doi.org/10.4230/LIPIcs.CSL.2024.20>
- [C7] Jeandel, E., Perdrix, S., & Vilmart, R. (2017). Y-Calculus: A language for real Matrices derived from the ZX-Calculus. *International Conference on Quantum Physics and Logics (QPL)*. <https://hal.science/hal-01445948>
- [C8] Jeandel, E., Perdrix, S., & Vilmart, R. (2019, June). A Generic Normal Form for ZX-Diagrams and Application to the Rational Angle Completeness. *LICS 2019 - 34th Annual ACM/IEEE Symposium on Logic in Computer Science*. <https://doi.org/10.1109/LICS.2019.8785754>
- [C9] Jeandel, E., Perdrix, S., & Vilmart, R. (2018a). A Complete Axiomatisation of the ZX-Calculus for Clifford+T Quantum Mechanics. *The 33rd Annual ACM/IEEE Symposium on Logic in Computer Science, LICS 2018*, 559–568. <https://doi.org/10.1145/3209108.3209131>
- [C10] Jeandel, E., Perdrix, S., & Vilmart, R. (2018b). Diagrammatic Reasoning beyond Clifford+T Quantum Mechanics. *The 33rd Annual Symposium on Logic in Computer Science*, 569–578. <https://doi.org/10.1145/3209108.3209139>
- [C11] Jeandel, E., Perdrix, S., Vilmart, R., & Wang, Q. (2017). ZX-Calculus: Cyclotomic Supplementarity and Incompleteness for Clifford+T quantum mechanics. *MFCS 2017 - 42nd International Symposium on Mathematical Foundations of Computer Science*, 15. <https://hal.science/hal-01445707>
- [C12] Kissinger, A., Vilmart, R., & van de Wetering, J. (2022). Classical simulation of quantum circuits with partial and graphical stabiliser decompositions. *17th Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC 2022)*, 232(5), 5:1-5:13. <https://doi.org/10.4230/LIPIcs.TQC.2022.5>

- [C13] Vilmart, R. (2019, June). A Near-Minimal Axiomatisation of ZX-Calculus for Pure Qubit Quantum Mechanics. *LICS 2019 - 34th Annual ACM/IEEE Symposium on Logic in Computer Science*. <https://doi.org/10.1109/LICS.2019.8785765>
- [C14] Vilmart, R. (2018). A ZX-Calculus with Triangles for Toffoli-Hadamard, Clifford+T, and Beyond. In P. Selinger & G. Chiribella (Eds.), *QPL 2018* (Vol. 287, pp. 313–344). <https://doi.org/10.4204/EPTCS.287.18>
- [C15] Vilmart, R. (2023). Completeness of Sum-Over-Paths for Toffoli-Hadamard and the Dyadic Fragments of Quantum Computation. *CSL 2023 - 31st EACSL Annual Conference on Computer Science Logic*, 252, 36:1-36:17. <https://doi.org/10.4230/LIPIcs.CSL.2023.36>
- [C16] Vilmart, R. (2021a). Quantum Multiple-Valued Decision Diagrams in Graphical Calculi. *MFCS 2021 - 46th International Symposium on Mathematical Foundations of Computer Science*, 202, 89:1-89:15. <https://doi.org/10.4230/LIPIcs.MFCS.2021.89>
- [C17] Vilmart, R. (2021b). The Structure of Sum-Over-Paths, its Consequences, and Completeness for Clifford. In C. T. Stefan Kiefer (Ed.), *Foundations of Software Science and Computation Structures (FoSSaCS) 2021* (Vol. 12650, pp. 531–550). [https://doi.org/10.1007/978-3-030-71995-1\\_27](https://doi.org/10.1007/978-3-030-71995-1_27)

## Book Chapter

- [BC1] Chareton, C., Bardin, S., Lee, D., Valiron, B., Vilmart, R., & Xu, Z. (2023). *Formal Methods for Quantum Algorithms* (pp. 319–422). CRC Press. <https://doi.org/10.1201/9781003090052-7>

## Thesis

- [T1] Vilmart, R. (2019). *ZX-Calculi for Quantum Computing and their Completeness* [Theses, Université de Lorraine]. <https://hal.science/tel-02395443>