

Dorian Rudolph

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RESEARCH INTERESTS

- **Quantum complexity theory**
- Continuous-variable quantum computation, boson sampling
- Quantum algorithms, cryptography
- Theoretical computer science

EDUCATION

- (*Expected 2026*) PhD in Computer Science, Paderborn University, Germany 2021–2026
Thesis: The quantum satisfiability problem and more (*working title*)
Supervisor: Prof. Dr. Sevag Gharibian
- Master in Computer Science, Paderborn University, GPA 1.0¹ 2018–2020
Thesis: On the Power of P with Access to a QMA Oracle
Supervisor: Prof. Dr. Sevag Gharibian
- Bachelor in Computer Science, Paderborn University, GPA 1.0 2015–2018
Thesis: Decontaminating Planar Regions With Finite Automaton Robots and Tiles
Supervisor: Prof. Dr. Christian Scheideler

EMPLOYMENT

- Research assistant for Prof. Dr. Sevag Gharibian, Quantum Computation, 2021–now
Department of Computer Science & Institute for Photonic Quantum Systems (PhoQS),
Paderborn University
- Freelance software developer (Embedded Linux, C++) 2022
- Student research assistant for Prof. Dr. Christian Scheideler, 2016–2020
Theory of Distributed Systems, Paderborn University
- Software developer at Ferber-Software GmbH, Lippstadt (C#, TypeScript, SQL) 2013–2017

PREPRINTS

1. U. Chabaud, S. Gharibian, S. Mehraban, A. Motamedi, H. R. Naeij, D. Rudolph, D. Sambrani. Energy, Bosons and Computational Complexity. [arXiv:2510.08545](#), 2025.
2. S. Grewal, D. Rudolph. On the Pure Quantum Polynomial Hierarchy and Quantified Hamiltonian Complexity. [arXiv:2510.06522](#), 2025.
3. G. Karaikos, D. Rudolph, J. J. Meyer, J. Eisert, S. Gharibian. How hard is it to verify a classical shadow? [arXiv:2510.08515](#), 2025.

PUBLICATIONS AND TALKS

4. D. Rudolph. Towards a universal gateset for QMA_1 . [arXiv:2411.02681](#), 2024.
 - Poster at QIP 2025.
 - Talk at AQIS 2025.

¹German grades go from 1.0 (best) to 5.0 (fail).

5. J. Kamminga, D. Rudolph. On the Complexity of Pure-State Consistency of Local Density Matrices. [arXiv:2411.03096](#), 2024.
 - Talk at QIP 2025 (both authors are students).
 - To appear in the Proceedings of the 16th Innovations in Theoretical Computer Science Conference (ITCS 2026).
6. M. Aldi, S. Gharibian, D. Rudolph. An unholy trinity: TFNP, polynomial systems, and the quantum satisfiability problem. [arXiv:2412.19623](#), 2024.
 - Talk at TQC² 2024 (Theory of Quantum Computation, Communication and Cryptography).
 - Poster at QIP² 2024 (Quantum Information Processing).
 - To appear in the Proceedings of the 16th Innovations in Theoretical Computer Science Conference (ITCS 2026).
7. D. Rudolph, S. Gharibian, D. Nagaj. Quantum 2-SAT on low dimensional systems is QMA₁-complete: Direct embeddings and black-box simulation. [arXiv:2401.02368](#), 2024.
 - Proceedings of the 16th Innovations in Theoretical Computer Science Conference (ITCS 2025), [DOI:10.4230/LIPIcs.ITCS.2025.85](#).
 - Talk at TQC 2024.
 - Poster at QIP 2024.
8. A. Agarwal, S. Gharibian, V. Koppula, D. Rudolph. Quantum Polynomial Hierarchies: Karp-Lipton, error reduction, and lower bounds. [arXiv:2401.01633](#), 2024.
 - Proceedings of the 49th International Symposium on Mathematical Foundations of Computer Science (MFCS 2024), [DOI:10.4230/LIPIcs.MFCS.2024.7](#).
 - Poster at QIP 2024.
9. S. Gharibian, D. Rudolph. Quantum space, ground space traversal, and how to embed multi-prover interactive proofs into unentanglement. [arXiv:2206.05243](#), 2022.
 - Proceedings of the 14th Innovations in Theoretical Computer Science Conference (ITCS 2023), [DOI:10.4230/LIPIcs.ITCS.2023.53](#), 2023.
 - Talk at QIP 2022.
10. S. Gharibian, D. Rudolph. On polynomially many queries to NP or QMA oracles. [arXiv:2111.02296](#), 2021.
 - Proceedings of the 13th Innovations in Theoretical Computer Science Conference (ITCS 2022), [DOI:10.4230/LIPIcs.ITCS.2022.75](#).
 - Talk at TQC 2022.
 - Poster at QIP 2022.

Non-quantum computing work:

11. K. Hinnenthal, D. Rudolph, C. Scheideler. Shape Formation in a Three-dimensional Model for Hybrid Programmable Matter.
 - Talk at 36th European Workshop on Computational Geometry, [\[ext. abstract\]](#), 2020.
12. D. Rudolph. Approximating the Sweepwidth of Polygons with Holes.
 - Talk at 35th European Workshop on Computational Geometry (EuroCG) [\[ext. abstract\]](#), 2019.
13. R. Gmyr, K. Hinnenthal, I. Kostitsyna, F. Kuhn, D. Rudolph, C. Scheideler. Shape Recognition by a Finite Automaton Robot.
 - Proceedings of the 43rd International Symposium on Mathematical Foundations of Computer Science (MFCS 2018), [DOI:10.4230/LIPIcs.MFCS.2018.52](#).
14. R. Gmyr, K. Hinnenthal, I. Kostitsyna, F. Kuhn, D. Rudolph, C. Scheideler, T. Strothmann. Forming tile shapes with simple robots.
 - Natural Computing **19**, [DOI:10.1007/s11047-019-09774-2](#), 2020.

²QIP is the flagship conference in quantum information. TQC is a leading conference in quantum computation.

- Proceedings of DNA Computing and Molecular Programming (DNA 2018), DOI:10.1007/978-3-030-00030-1_8.

INVITED WORKSHOPS AND TALKS

1. Talk at LIP6 (Sorbonne University) in 2024, hosted by A. Grilo.
On the Complexity of Pure-State Consistency of Local Density Matrices.
2. Talk at IRIF (Université Paris Cité) in 2024, hosted by S. Apers.
Towards a universal gateset for QMA_1 .
3. Talk at the Slovak Academy of Sciences in 2024, hosted by D. Nagaj.
Quantum 2-SAT on low dimensional systems is QMA_1 -complete: Direct embeddings and black-box simulation.
4. Dagstuhl Seminar 21261: Quantum Complexity: Theory and Application, 2021.
5. Bertinoro Workshop on Distributed Geometric Algorithms, DiG 2019.
6. Dagstuhl Seminar 18331: Algorithmic Foundations of Programmable Matter, 2018.

TEACHING

- **Teaching assistant:** Computability and Complexity 2025
- **Supervisor:** Master's student project group. 2024–2025
Topic: Vector Graphics on Modern Hardware
- **Supervisor:** Bachelor thesis of Simon-Luca Kremer. 2024
Quantum k-SAT Related Hypergraph Problems

SERVICE

- **Chair:** 2nd NRW Quantum Theoretical CS Workshop ([web](#)). Invited speakers: 2024
S. Apers, J. Eisert, O. Gühne, R. König, T. Stollenwerk, M. Stroeck, M. Walter, R. de Wolf
- **Local organizer:** 50th International Colloquium on Automata, Languages, and Programming (ICALP 2023) 2023
- **Reviewer:**
 - CCC 2023 (Computational Complexity Conference)
 - CIMP 2024, 2025 (Communications in Mathematical Physics)
 - ICALP 2025 (International Colloquium on Automata, Languages and Programming)
 - IEEE Transactions on Information Theory 2023
 - ITCS 2025 (Innovations in Theoretical Computer Science)
 - JACM 2025 (Journal of the ACM)
 - MFCS 2022 (Mathematical Foundations of Computer Science)
 - QCTIP 2025 (Quantum Computing Theory in Practice)
 - QIP 2023, 2024, 2025 (Quantum Information Processing)
 - SICOMP 2025 (SIAM Journal on Computing)
 - TQC 2023 (Theory of Quantum Computation, Communication and Cryptography)

DISTINCTIONS AND AWARDS

- Master thesis: Award for outstanding thesis 2022
(effectively best STEM thesis award at Paderborn University)

- Bachelor thesis: Award for outstanding academic achievements 2019
- PRISMA Program 2019–2020
(Elite research funding program for talented Master students)
- Heinz-Nixdorf Program (Support for talented Bachelor students) 2017–2018
- Founding member of the CTF team and nonprofit “/upb/hack e.V.”. 2018–now
We teach students about hacking and participate in “capture the flag” information security competitions. 3rd place in “Cyber Security Rumble Germany” and “Midnight Sun CTF”.
- Scholarship: German Academic Scholarship Foundation (18.000€ total) 2015–2020
“Germany’s largest, oldest and most prestigious scholarship foundation.”
- Winner of the 33rd Bundeswettbewerb Informatik 2015
(5 winners across Germany, federal computer science competition for high school students)