Jeroen Zuiddam

Curriculum vitae

May 5, 2025

1. Contact details

University of Amsterdam
Room F2.44
Korteweg–de Vries Institute for Mathematics
University of Amsterdam
Science Park 107
1098 XG Amsterdam
The Netherlands

Centrum Wiskunde & Informatica
Room L213
Centrum Wiskunde & Informatica
Science Park 123
1098 XG Amsterdam
The Netherlands

`https://staff.fnwi.uva.nl/j.zuiddam/`
j.zuiddam@uva.nl

2. Research interests

Computational complexity theory, algebraic complexity theory, tensors, matrix multiplication algorithms, quantum information theory, entanglement, communication complexity, discrete mathematics and graph theory, Shannon capacity of graphs, representation theory, algebraic geometry, semi-algebraic geometry, combinatorial optimization

3. Education

2018 PhD, Mathematics and Computer Science, *cum laude*, University of Amsterdam

2014 MSc Mathematics, *cum laude*, University of Amsterdam

2012 BSc Mathematics, *cum laude*, University of Amsterdam
BSc Computer Science, *cum laude*, University of Amsterdam

4. Professional appointment

2021 – Assistant professor, Korteweg–de Vries Institute for Mathematics, University of Amsterdam

2021 – Researcher, Centrum Wiskunde & Informatica (CWI), Amsterdam

2020 – 2021 Simons Junior Fellow, Courant Institute, New York University, NY, hosted by Oded Regev

2018 – 2020 Postdoctoral member, School of Mathematics, Institute for Advanced Study, Princeton, NJ, hosted by Avi Wigderson

2014 – 2018 PhD student, Centrum Wiskunde & Informatica, Amsterdam, supervised by Harry Buhrman.

5. Grants and Fellowships

2025 Visiting Scholar and long-term participant, Semester program on "Complexity and Linear Algebra", Simons Institute for the Theory of Computing, UC Berkeley, Fall 2025
https://simons.berkeley.edu/programs/complexity-linear-algebra

2024 NWO EINF Grant for Computing Time on the National Computer Facilities, Dutch Research Council NWO (EINF-8278)

2023 NWO ENW M-1 Grant (€333.737 ≈ $363.174), Dutch Research Council NWO

2022 NWO EINF Grant for Computing Time on the National Computer Facilities, Dutch Research Council NWO (EINF-4415)

2022 CRM–Simons Professorship at the Centre de Recherches Mathématiques, Simons Foundation, November 2022

2021 NWO Veni Grant (€280.000 ≈ $314.000), Dutch Research Council NWO

2020 Simons Junior Fellowship ($409.179), Simons Society of Fellows, Simons Foundation, NYC

6. Scientific publication

6.1. PhD thesis

Algebraic complexity, asymptotic spectra and entanglement polytopes,
University of Amsterdam, October 2018

Advisors: Harry Buhrman and Matthias Christandl

https://hdl.handle.net/11245.1/9a8030e9-f708-4c95-9d50-f2a5919e75ed

6.2. Scientific journals

1. J. Zuiddam, *A note on the gap between rank and border rank*, Linear Algebra and its Applications, 2017
arxiv:1504.05597, doi:10.1016/j.laa.2017.03.015

2. J. Briët and J. Zuiddam, *On the orthogonal rank of Cayley graphs and impossibility of quantum round elimination*, Quantum Information and Computation, 2017
arxiv:1608.06113, http://www.rintonpress.com/xxqic17/qic-17-12/0106-0116.pdf

3. H. Buhrman, M. Christandl, C. Perry and J. Zuiddam, *Clean quantum and classical communication protocols*, Physical Review Letters, 2016
arxiv:1605.07948, doi:10.1103/PhysRevLett.117.230503

4. M. Christandl, A.K. Jensen and J. Zuiddam, *Tensor rank is not multiplicative under the tensor product*, Linear Algebra and its Applications, 2018
arxiv:1705.09379, doi:10.1016/j.laa.2017.12.020

5. M. Christandl and J. Zuiddam, *Tensor surgery and tensor rank*, Computational complexity, 2018
arxiv:1606.04085, doi:10.1007/s00037-018-0164-8

6. K. Bringmann, C. Ikenmeyer and J. Zuiddam, *On algebraic branching programs of small width*, Journal of the ACM, 2018
arxiv:1702.05328, doi:10.1145/3209663

7. M. Christandl, P. Vrana and J. Zuiddam, *Asymptotic tensor rank of graph tensors: beyond matrix multiplication*, Computational complexity, 2018
arxiv:1609.07476, doi:10.1145/3209663

8. M. Bläser, M. Christandl and J. Zuiddam, *The border support rank of two-by-two matrix multiplication is seven*, Chicago Journal of Theoretical Computer Science, 2018
arxiv:1705.09652, doi:10.4086/cjtcs.2018.005

9. J. Zuiddam, *The asymptotic spectrum of graphs and the Shannon capacity*, Combinatorica, 2019
arxiv:1807.00169, doi:10.1007/s00493-019-3992-5

10. S. Arunachalam, P. Vrana and J. Zuiddam, *The asymptotic induced matching number of hypergraphs: balanced binary strings*, Electronic Journal of Combinatorics, 2020
arxiv:1905.03148, doi:10.37236/9019

11. M. Christandl, P. Vrana and J. Zuiddam, *Barriers for fast matrix multiplication from irreversibility*, Theory of Computing, 2020
arxiv:1812.06952

12. Y. Li and J. Zuiddam, *Quantum asymptotic spectra of graphs and non-commutative graphs, and quantum Shannon capacities*, IEEE Transactions on Information Theory, 2021
arxiv:1810.00744, doi:10.1109/TIT.2020.3032686

13. M. Christandl, F. Gesmundo, M. Michałek, J. Zuiddam, *Border rank non-additivity for higher order tensors*, SIAM Journal on Matrix Analysis and Applications, 2021
arxiv:2007.05458, doi.org/10.1137/20M1357366

14. M. Christandl, P. Vrana and J. Zuiddam, *Universal points in the asymptotic spectrum of tensors*, Journal of the American Mathematical Society, 2023
arxiv:1709.07851, doi:10.1090/jams/996

15. S. Kopparty, G. Moshkovitz and J. Zuiddam, *Geometric rank of tensors and subrank of matrix multiplication*, Discrete Analysis, 2023
arxiv:2002.09472, https://discreteanalysisjournal.com/article/73322-geometric-rank-of-tensors-and-subrank-of-matrix-multiplication

16. M. Christandl, V. Lysikov and J. Zuiddam, *Weighted slice rank and a minimax correspondence to Strassen's spectra*, Journal de Mathématiques Pures et Appliquées, 2023
arxiv:2012.14412, doi:10.1016/j.matpur.2023.02.006

17. M. Christandl, F. Gesmundo and J. Zuiddam, *A gap in the subrank of tensors*, SIAM Journal on Applied Algebra and Geometry, 2023
arxiv:2212.01668, doi:10.1137/22M1543276

18. H. Derksen, V. Makam and J. Zuiddam, *Subrank and Optimal Reduction of Scalar Multiplications to Generic Tensors*, Journal of the London Mathematical Society
arxiv:2205.15168, doi:10.1112/jlms.12963

6.3. Refereed conference proceedings

The full version of items 20, 21, 22 and 23 appeared in a journal.

19. H. Buhrman, M. Christandl and J. Zuiddam, *Nondeterministic quantum communication complexity: the cyclic equality game and iterated matrix multiplication*, Proceedings of Innovations in Theoretical Computer Science Conference (ITCS), 2017
arxiv:1603.03757, doi:10.4230/LIPIcs.ITCS.2017.24

20. K. Bringmann, C. Ikenmeyer and J. Zuiddam, *On algebraic branching programs of small width*, Proceedings of Computational Complexity Conference (CCC), 2017
doi:10.4230/LIPIcs.CCC.2017.20

21. M. Christandl, P. Vrana and J. Zuiddam, *Universal points in the asymptotic spectrum of tensors*, Proceedings of the 50th Annual ACM SIGACT Symposium on Theory of Computing (STOC), 2018
arxiv:1709.07851, doi:10.1145/3188745.3188766
Invited to submit a full version of the paper to the journal Theory of Computing

22. M. Christandl, P. Vrana and J. Zuiddam, *Barriers for fast matrix multiplication from irreversibility*, Proceedings of Computational Complexity Conference (CCC), 2019
arxiv:1812.06952, doi:10.4230/LIPIcs.CCC.2019.26
Invited to submit a full version of the paper to the journal Theory of Computing

23. S. Kopparty, G. Moshkovitz and J. Zuiddam, *Geometric rank of tensors and subrank of matrix multiplication.* Proceedings of Computational Complexity Conference (CCC), 2020
arxiv:2002.09472, doi:10.4230/LIPIcs.CCC.2020.35

24. R. Robere and J. Zuiddam, *Amortized Circuit Complexity, Formal Complexity Measures, and Catalytic Algorithms*, Proceedings of 62nd Annual IEEE Symposium on Foundations of Computer Science (FOCS), 2021
eccc:2021/035, doi:10.1109/FOCS52979.2021.00079

25. M. Christandl, O. Fawzi, H. Ta and J. Zuiddam, *Larger Corner-Free Sets from Combinatorial Degenerations*, Proceedings of Innovations in theoretical computer science (ITCS), 2022
arxiv:2111.08262

26. H. Derksen, V. Makam and J. Zuiddam, *Subrank and Optimal Reduction of Scalar Multiplications to Generic Tensors*, Proceedings of Computational Complexity Conference (CCC), 2022
arxiv:2205.15168, doi:10.4230/LIPIcs.CCC.2022.9

27. J. Briët, M. Christandl, I. Leigh, A. Shpilka and J. Zuiddam, *Discreteness of asymptotic tensor ranks*, Proceedings of Innovations in theoretical computer science (ITCS), 2024
arxiv:2306.01718

28. M. Christandl, K. Hoeberechts, H. Nieuwboer, P. Vrana and J. Zuiddam, *Asymptotic tensor rank is characterized by polynomials*, 57th Annual ACM Symposium on Theory of Computing (STOC), 2025
arxiv:2411.15789

29. M. van den Berg, M. Christandl, V. Lysikov, H. Nieuwboer, M. Walter and J. Zuiddam, *Computing moment polytopes of tensors with applications in algebraic complexity and quantum information*, 57th Annual ACM Symposium on Theory of Computing (STOC), 2025

6.4. Manuscripts in submission to a scientific journal

30. M. Christandl, F. Le Gall, V. Lysikov and J. Zuiddam, *Barriers for rectangular matrix multiplication*, Computational complexity
`arxiv:2003.03019`

31. A. Wigderson and J. Zuiddam, *Asymptotic spectra: Theory, applications and extensions*, Bulletin of the AMS
`https://staff.fnwi.uva.nl/j.zuiddam/papers/convexity.pdf`

32. M. Christandl, O. Fawzi, H. Ta and J. Zuiddam, *Symmetric Subrank of Tensors and Applications*, Forum of Mathematics, Sigma
`arxiv:2104:01130`

33. J. Briët, M. Christandl, I. Leigh, A. Shpilka and J. Zuiddam, *Discreteness of asymptotic tensor ranks*, Discrete Analysis
`arxiv:2306.01718`

34. F. Gesmundo and J. Zuiddam, *The next gap in the subrank of 3-tensors*, Linear Algebra and its Applications
`arxiv:2307.06115`

35. D. de Boer, P. Buys and J. Zuiddam, *The asymptotic spectrum distance, graph limits, and the Shannon capacity*
`arxiv:2404.16763`

6.5. Manuscripts

36. M. van den Berg, M. Christandl, V. Lysikov, H. Nieuwboer, M. Walter and J. Zuiddam, *Explicit non-free tensors*
`arxiv:2503.22650`

37. M. van den Berg, M. Christandl, V. Lysikov, H. Nieuwboer, M. Walter and J. Zuiddam, *The moment polytope of matrix multiplication is not maximal*
`arxiv:2503.22633`

7. Scientific conferences organized

Nov 2022	Thematic program "Symmetries: Algebras and Physics", Centre de Recherches Mathématiques, Montréal, Canada. Co-organizer. November–December, 2022 `https://www.crmath.ca/en/`
Apr 2025	8th Workshop on Algebraic Complexity Theory (WACT), Ruhr-Universität Bochum, Germany. Co-organizer. April, 2025 `http://qi.rub.de/wact`

8. Scientific talks

8.1. Talks in refereed conferences

Jan 2024 — Innovations in Theoretical Computer Science (ITCS), 2024
Talk: Discreteness of asymptotic tensor ranks

Jan 2024 — Conference on Quantum Information Processing (QIP), 2024
Talk: Discreteness of asymptotic tensor ranks

Jul 2022 — Computational Complexity Conference (CCC), Philadelphia, 2022
Talk: Subrank and Optimal Reduction of Scalar Multiplications to Generic Tensors

Feb 2022 — Symposium on Foundations of Computer Science (FOCS 2021), Denver, 2022
Talk: Amortized Circuit Complexity, Formal Complexity Measures, and Catalytic Algorithms

Feb 2022 — Innovations in Theoretical Computer Science (ITCS), Berkeley, 2022
Talk: Larger Corner-Free Sets from Combinatorial Degenerations

July 2020 — Computational Complexity Conference (CCC), Saarbrücken, 2020
Talk: Geometric rank of tensors and subrank of matrix multiplication

July 2019 — Computational Complexity Conference (CCC), New Brunswick, 2019
Talk: Barriers for fast matrix multiplication from irreversibility

Jun 2018 — Symposium on the Theory of Computing (STOC), Los Angeles, 2018
Talk: Universal points in the asymptotic spectrum of tensors

Jan 2018 — Conference on Quantum Information Processing (QIP), Delft, 2018
Talk: Universal points in the asymptotic spectrum of tensors

July 2017 — Computational complexity conference (CCC), Riga, 2017
Talk: On algebraic branching programs of small width

Jan 2017 — Innovations in theoretical computer science (ITCS), Berkeley, 2017
Talk: Nondeterministic quantum communication complexity

8.2. Invited talks

Jun 2024 — Oberwolfach, Complexity Theory workshop
Organizers: Irit Dinur, Salil Vadhan, Peter Bürgisser
Talk: Asymptotic spectrum distance, graph limits, and the Shannon capacity

May 2024 — SIAM Conference on Applied Linear Algebra (LA24), Sorbonne Université, Paris, France
Talk: Discreteness of Asymptotic Tensor Ranks

Feb 2024 — IPAM Workshop: Tensor Networks (TNK2024), UCLA, Los Angeles, USA
Talk: Discreteness of Asymptotic Tensor Ranks

Mar 2023 — University of Copenhagen, Denmark
Talk: Subrank of tensors

Mar 2023 — Workshop on Algebraic Complexity Theory (WACT), University of Warwick, UK
Talk: Subrank of tensors

Feb 2023	Tel Aviv University, Israel Talk: The subrank of a random tensor
Sep 2022	Kickoff workshop, Simons Semester on Algebraic Geometry with Applications to TEnsors and Secants, Warsaw University, Poland Talk: The subrank of random tensors
Aug 2022	Workshop Semidefinite & Polynomial Optimization, Centrum Wiskunde & Informatica, Amsterdam Talk: Shannon capacity via Real Algebraic Geometry and Strassen's Positivstellensatz
Apr 2022	Abel Prize Laureates Lectures, Centrum Wiskunde & Informatica, Amsterdam `https://youtu.be/px6gNU4S_NI?si=Eqzny3alVB_acqVG`
Mar 2022	Workshop on Random Tensors, Centre International de Rencontres Mathématiques (CIRM), Luminy, Marseille, France
Nov 2021	Oberwolfach, Complexity Theory workshop Talk: Asymptotic spectra: Theory, applications and extensions
Sep 2021	Applied Algebra Seminar, UW Madison Talk: Geometric rank of tensors and applications
May 2021	Workshop on Efficient Tensor Representations for Learning and Computational Complexity, Institute for Pure & Applied Mathematics, UCLA Talk: Subrank, slice rank and partition rank
May 2021	Spring 2021 Virtual Meeting of the AMS Western Section Talk: Subrank, slice rank and partition rank
Mar 2021	Computer science and discrete math seminar, Institute for Advanced Study Talk: Amortized Circuit Complexity, Formal Complexity Measures, and Catalytic Algorithms
Jan 2021	UCSD Theory seminar Talk: Tensor tools for problems in Combinatorics and Complexity
Dec 2020	2020 Junior Theorists Workshop, Northwestern University, Chicago Talk: Tensor Tools for Problems in Combinatorics and Complexity
Oct 2020	Centrum Wiskunde & Informatica, From Euclidean to Geodesic Convex Optimization online reading group, Amsterdam Talk: Extremal Combinatorics, Tensor scaling, Moment Polytopes
Aug 2020	Mathematics Department, Texas A&M University Talk: Combinatorics, Tensors and Geometry
Jun 2020	Chennai Mathematical Institute, seminar on Recent Connections to GCT and Progress in GCT Talk: Geometric Rank of Tensors
May 2020	Centrum Wiskunde & Informatica, Amsterdam Talk: Geometric Rank of Tensors
Jan 2020	Department of Mathematics, University of Copenhagen Talk: The asymptotic spectrum of tensors and barriers for fast matrix multiplication

Oct 2019 Rutgers/DIMACS Theory of Computing Seminar
Talk: The asymptotic spectrum of tensors and barriers for fast matrix multiplication

Oct 2019 Simons Collaboration on Algorithms & Geometry, New York City
Talk: The asymptotic spectrum of tensors and barriers for fast matrix multiplication

May 2019 NYU Theoretical computer science seminar
Talk: The asymptotic spectrum of graphs: duality for Shannon capacity

May 2019 Lorentz center Leiden, Mathematics of quantum information theory workshop
Talk: Asymptotic spectra

April 2019 Rutgers discrete mathematics seminar
Talk: The asymptotic spectrum of graphs: duality for Shannon capacity

March 2019 Princeton discrete mathematics seminar
Talk: The asymptotic spectrum of graphs: duality for Shannon capacity

Nov 2018 Oberwolfach, Complexity Theory workshop
Talk: Asymptotic spectra

Jul 2018 Facets of complexity, Technische Universität Berlin
Talk: Asymptotic spectra of tensors and graphs: matrix multiplication exponent and Shannon capacity

Apr 2018 Dutch Mathematical Congress, Royal Dutch Mathematical Society
Talk: The asymptotic spectrum of tensors

Jan 2017 Stanford Institute for Theoretical Physics Seminar, Stanford University
Talk: On the tensor rank of graph tensors

Nov 2016 Department of Mathematics, QMATH conference, University of Copenhagen
Talk: On the tensor rank of graph tensors

Oct 2016 Algorithms and complexity seminar, Max-Planck-Institut für Informatik, Saarbrücken
Talk: On the tensor rank of graph tensors

Jan 2015 Department of Mathematics, University of Copenhagen
Talk: Finding large gaps between tensor rank and border rank via algebras

8.3. Departmental talks

Oct 2021 General Mathematics Colloquium, Korteweg-de Vries Institute for Mathematics, University of Amsterdam
Talk: Asymptotic spectra and applications

Sep 2019 Computer science and discrete math seminar, Institute for Advanced Study
Talk: The asymptotic spectrum of graphs
Talk: Asymptotic spectra and applications

Sep 2018 Computer science and discrete math seminar, Institute for Advanced Study
Talk: The asymptotic spectrum of tensors
Talk: Asymptotic spectra and applications

June 2018 Algorithms and Complexity group seminar, Centrum Wiskunde & Informatica
Talk: The asymptotic spectrum of tensors

9. Student supervision

2024 – 2028 Anna Luchnikov, University of Amsterdam, PhD student.

2024 – 2028 Annika Holtrup, University of Amsterdam, PhD student.

2024 Koen Hoeberechts, University of Amsterdam, MSc Thesis.

2024 Midas Kiebert, University of Amsterdam, co-advised with John van de Wetering, BSc Thesis.

2023 – 2027 Maxim van den Berg, University of Amsterdam, PhD student, co-advised with Michael Walter.

2023 Maxim van den Berg, University of Amsterdam, MSc Thesis.

2023 Jelle Sipkes, University of Amsterdam, co-advised with Nic Resch, BSc Thesis.

2022 Jim Wittebol, University of Amsterdam, MSc Thesis.

2022 Emiel Wiedijk, University of Amsterdam, co-advised with Chris Schaffner, BSc Thesis.

2018 Pjotr Buys, University of Amsterdam, co-advised with Guus Regts, MSc Thesis.

2017 Jana Wagemaker, University of Amsterdam, co-advised with Harry Buhrman, BSc Research Project.

10. Teaching

Introduction to information theory, University of Amsterdam, course coordinator and lecturer, 2024

Proofs (Verzamelingen en getallen), University of Amsterdam, course coordinator and lecturer, 2021, 2022, 2023

Linear algebra, Amsterdam University College, University of Amsterdam, lecturer, 2022

Computational complexity, University of Amsterdam, teaching assistant and co-lecturer, 2015. `http://complexity.buhrman.nl/2015/index.html`

Computer algebra and Latex, University of Amsterdam, teaching assistant and co-lecturer, 2012, 2013, 2014. `http://uva-fnwi.github.io/LaTeX/`

Algorithms and complexity, University of Amsterdam, teaching assistant and co-lecturer, 2014

Nominated for lecturer of the year, Korteweg-de Vries Institute for Mathematics, University of Amsterdam, 2022 and 2024.

11. Refereeing

11.1. Academic funding agencies

Israel Science Foundation (ISF), European Research Council (ERC), National Science Centre Poland (NCN).

11.2. Scientific journals

Algebra & Number Theory, Annales Henri Poincaré, Communications in Mathematical Physics, Computational Complexity, Linear and Multilinear Algebra, Discrete Mathematics, IEEE Transactions on Information Theory, Indagationes Mathematicae, Journal of the ACM, Proceedings of the AMS, Quantum, SIAM Journal on Applied Algebra and Geometry (SIAGA), SIAM Review (SIREV), Theory of Computing

11.3. Scientific conferences

Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC), International Colloquium on Automata, Languages and Programming (ICALP), Quantum Information Processing (QIP), Computational Complexity Conference (CCC), Foundations of Computer Science (FOCS), Innovations in Theoretical Computer Science (ITCS), IEEE International Symposium on Information Theory (ISIT), International Symposium on Mathematical Foundations of Computer Science (MFCS), ACM-SIAM Symposium on Discrete Algorithms (SODA), Symposium on Theoretical Aspects of Computer Science (STACS), Symposium on Theory of Computing (STOC)

12. Other activities

Member of the committee for the preparation of the government accreditation of the mathematics programmes, University of Amsterdam, 2012–2013

Editorial board member of popular science journal “Amsterdam Science”, University of Amsterdam, 2015

Co-organizer General Mathematics Colloquium, Korteweg-de Vries Institute for Mathematics, 2021–

Advisory committee member, Centre de Recherches Mathématiques, Montréal, Canada, for the programme Symmetries: Algebras and Physics, 2022

Hiring committee member, tenure track assistant professor position, University of Amsterdam, 2023

Doctorate committee member, Jeroen Huijben, University of Amsterdam, 2023

Doctorate committee member, Harold Nieuwboer, University of Amsterdam, 2024

Doctorate committee member, Yanlin Chen, University of Amsterdam, 2024

Doctorate committee member, Dmitri Grinko, University of Amsterdam, 2025

13. References

Avi Wigderson
Institute for Advanced Study
School of Mathematics
1 Einstein Drive, Princeton, NJ 08540, USA
Email: avi@ias.edu

Noga Alon
Princeton University
Department of Mathematics
Princeton, NJ 08540, USA
Email: nalon@math.princeton.edu

Matthias Christandl
University of Copenhagen
Department of Mathematical Sciences
Universitetsparken 5, 2100 Copenhagen Ø, Denmark
Email: christandl@math.ku.dk

Peter Bürgisser
Technische Universität Berlin
Institut für Mathematik
Straße des 17. Juni 136, 10623 Berlin, Germany
Email: pbuerg@math.tu-berlin.de

Harry Buhrman
University of Amsterdam
Institute for Logic, Language and Computation
Science Park 107, 1098 XG Amsterdam, Netherlands
Email: buhrman@cwi.nl