Andreas Klingler

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Work Experience

2024 – **Postdoctoral University Assistant**, University of Vienna, Austria.
Research Group: Quantum Information and Quantum Many-Body Physics
(led by Univ.-Prof. Norbert Schuch)

Education

2020 – 2024 **Ph.D. in Theoretical Physics**, University of Innsbruck, Austria.
Thesis: Positive and Invariant Tensor Decompositions: Approximations and Computational Complexity
supervised by assoz.-Prof. Gemma De les Coves and Univ.-Prof. Tim Netzer

2016 – 2022 **Bachelor and Master in Mathematics**, University of Innsbruck, Austria.
Thesis: The Causal Compatibility Problem in Categorical Probability
supervised by Ass.-Prof. Tobias Fritz

2015 – 2020 **Bachelor and Master in Theoretical Physics**, University of Innsbruck, Austria.
Thesis: Approximate Tensor Decompositions: Disappearance of Many Separations
supervised by assoz.-Prof. Gemma De les Coves and Univ.-Prof. Tim Netzer

Fellowships

2022 – 2024 DOC Fellowship of the Austrian Academy of Sciences (46 759€ p.a.)

2016 – 2020 Performance-based scholarships by the University of Innsbruck (1 500€ p.a.)

Conferences & Workshops

Invited Talks

3. Border Ranks of Positive and Invariant Tensor Decompositions: Applications to Correlations
Analytical and Combinatorial Methods in Quantum Information Theory II. Edinburgh, Scotland. July 25, 2023.

2. Border Ranks of Locally Positive and Invariant Tensor Decompositions
SIAM Conference on Applied Algebraic Geometry (AG 23). Eindhoven, The Netherlands. July 12, 2023.

1. General tensor decompositions with invariance, positivity and approximations
Annual congress of the Real Sociedad Matemática Española (RSME). Ciudad Real, Spain (Online). Jan. 19, 2022.

Contributed Talks

4. A homotopy method for convex optimization
MoPAT-24 – Moments and Polynomials: Applications and Theory. Konstanz, Germany. March 13, 2024.

3. The d-separation criterion in Categorical Probability
5$^{\text{th}}$ International Conference on Applied Category Theory (ACT 2022). Glasgow, Scotland. July 21, 2022 (distinguished presentation).

2. Approximate tensor decompositions: disappearance of many separations
16$^{\text{th}}$ Conference on Effective Methods in Algebraic Geometry (MEGA 2021). Tromsø, Norway (Online). June 11, 2021.

1. Approximate tensor decompositions: disappearance of many separations
15$^{\text{th}}$ Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC 2020). Riga, Latvia (Online). June 12, 2020.

─── Posters

9. On the Non-Closedness of positive Tensor Networks
Entanglement in Strongly Correlated Systems. Benasque, Spain. Feb. 23 – Mar. 08, 2025.

8. Many bounded versions of undecidable problems are NP-hard
18$^{\text{th}}$ Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC 2023). Aveiro, Portugal (Online). July 24 – July 28, 2023.

7. Many bounded versions of undecidable problems are NP-hard
Quantum Information Theory 2023. ICMAT Madrid, Spain. Mar. 20 – Mar. 31, 2023.

6. Border ranks of positive and invariant tensor decompositions
IAMP – EMS Summer School in Mathematical Physics. TU Munich, Germany. Aug. 29 – Sep. 2, 2022.

5. Border ranks of positive and invariant tensor decompositions
5$^{\text{th}}$ Seefeld Quantum Information Workshop. Seefeld, Austria. June 26 – July 1, 2022.

4. General decompositions with invariance, positivity and approximations
Random Tensors and related topics. CIRM Marseille, France. Mar. 14 – 18, 2022.

3. Approximate tensor decompositions: disappearance of many separations
25$^{\text{th}}$ Annual conference on Quantum Information Processing (QIP 2022). Pasadena, USA (Online). Mar. 7 – 11, 2022.

2. Tensor and polynomial decompositions: making invariance and positivity explicit
Joint annual meeting of the Austrian Physical Society (APS) and the Swiss Physical Society (SPS). Innsbruck, Austria. Aug. 30 – Sep. 3, 2021.

1. General decompositions with invariance, positivity and approximations
SFB BeyondC Winter Workshop 2021. Online. Feb. 16 – 17, 2021.

─── Attendance

3. Tsirelson $2\sqrt{2}$ memorial workshop
Vienna, Austria. Apr. 4 – 8, 2022.

2. Geometry and Optimization in Quantum Information
Oberwolfach, Germany (Online). Oct. 3 – 9, 2021.

1. Tensor Networks: Quantum Physics, Geometry and Applications
Levico, Italy. July 26 – 28, 2021.

Seminar talks

10. **Homotopy methods for convex optimization**
    Dep. of Applied Mathematics and Theoretical Physics (Univeristy of Cambridge, UK), Feb. 7, 2024.

9. **Positive Tensor Decompositions: Approximations and Relations to Recurrence Sequences**
   Group seminar of Norbert Schuchs's group (University of Vienna, Austria), Jan. 26, 2024.

8. **Exploring Positive Tensor Decompositions: Approximations, Border Ranks and Beyond**
   Group seminar of Martin Kliesch's group (University of Hamburg, Germany), Nov. 28, 2023. (Virtual)

7. **Border Ranks of Positive Tensor Decompositions**
   Functional analysis seminar (University of California San Diego, US), Nov. 7, 2023. (Virtual)

6. **Approximate, positive tensor decompositions**
   Group seminar of Renato Renner's group (ETH Zürich, Switzerland), May 13, 2022.

5. **General tensor decompositions and their border ranks**
   Group retreat of Tim Netzer's and Gemma De las Cuevas' groups (Maria Waldrast, Austria), Feb. 16, 2022.

4. **On the computational complexity of chess: Going beyond P and NP**
   Group retreat of Hans Briegl's, Gemma De las Cuevas' and Thomas Müller's groups (Obergurgl, Austria), Sep. 28, 2021.

3. **Tensor decompositions in the light of invariance, positivity and approximations**
   Ghent Junior Algebra and Geometry Seminar, July 12, 2021. (Virtual)

2. **Approximate tensor decompositions: disappearance of many separations**
   Group seminar of Martin Kliesch's group (University of Düsseldorf, Germany), May 7, 2021. (Virtual)

1. **Approximations of tensor decompositions**
   Seminar of Hans Briegel's group (University of Innsbruck, Austria), Mar. 31, 2020. (Virtual)

Research visits

3. **Department of Applied Mathematics and Theoretical Physics**
   University of Cambridge. February 6 – 9, 2024.

2. **Quantum Optics, Quantum Nanophysics and Quantum Information group**
   University of Vienna. January 29 – 31, 2024.

1. **Institute for Theoretical Physics**
   ETH Zürich. May 11 – 13, 2022.

Teaching experience

Thesis Supervision

2023 **Lukas Berger**
Matrix ranks in quantum information (Bachelor Thesis)

Courses

2024/25 **Quantum Information, Computing, and Algorithms** (Exercises)

2023/24 **Linear Algebra 1** (Exercises)

2021	Mathematical Methods of Physics 1 (Exercises)
2018/19	Analysis 1 (Practice)
2017/18	Analysis 1 (Tutorial)

Languages

German (mother tongue)   English (C1)   Spanish (A2)

References

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Norbert Schuch
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List of Publications & Preprints

12. **The Aldous–Hoover Theorem in Categorical Probability**
L. Chen, T. Fritz, T. Gonda, <u>A. Klingler</u>, A. Lorenzin[1]
arXiv:2411.12840 (2024)

11. **Positive Moments Forever: Undecidable and Decidable Cases**
G. De les Coves, J. Graf, <u>A. Klingler</u>[2], T. Netzer[1]
arXiv:2404.15053 (2024)

10. **Homotopy Methods for Convex Optimization**
<u>A. Klingler</u>[2], T. Netzer[1]
arXiv:2403.02095 (2024)

9. **Hidden Markov Models And The Bayes Filter in Categorical Probability**
T. Fritz, <u>A. Klingler</u>, D. McNeely, A. Shah-Mohammed, Y. Wang[1]
arXiv:2401.14669 (2024)

8. **Border Ranks of Positive and Invariant Tensor Decompositions: Applications to Correlations**
<u>A. Klingler</u>[2], T. Netzer, G. De les Coves
Quantum 9, 1649 (2025). arXiv:2304.13478

7. **Many bounded versions of undecidable problems are NP-hard**
<u>A. Klingler</u>[2], M. van der Eyden, S. Stengele, T. Reinhart, G. De las Cuevas
SciPost Physics **14**, 173 (2023). arXiv:2211.13532

6. **The d-separation criterion in Categorical Probability**
T. Fritz, <u>A. Klingler</u>[1,2]
Journal of Machine Learning Research **24** (46), 1–49 (2023). arXiv:2207.05740

5. **Polynomial decompositions with invariance and positivity inspired by tensors**
G. De las Cuevas, <u>A. Klingler</u>[2], and T. Netzer[1]
Linear Algebra and its Applications **698**, 537–588 (2024). arXiv:2109.06680

4. **Approximate Pythagoras numbers on $*$-algebras over $\mathbb{C}$**
P. Abbasi, S. Gribling, <u>A. Klingler</u>, and T. Netzer[1]
Journal of Complexity **74**, 101698 (2023). arXiv:2109.04772

3. **Approximate completely positive semidefinite rank**
P. Abbasi, <u>A. Klingler</u>, and T. Netzer[1]
Linear Algebra and its Applications **677**, 323–336 (2023). arXiv:2012.06471

2. **Cats climb entails mammals move: Preserving hyponymy in compositional semantics**
G. De las Cuevas, <u>A. Klingler</u>, M. Lewis, and T. Netzer[1]
Journal of Cognitive Science **22** (3), 311–353 (2021). arXiv:2005.14134

1. **Approximate tensor decompositions: Disappearance of many separations**
   G. De las Cuevas, <u>A. Klingler</u>[2], and T. Netzer[1]
   Journal of Mathematical Physics **62** (9), 093502 (2021) **(Editor's pick)**. arXiv:2004.10219

March 2, 2025

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[2]Corresponding author.