


# Péter Vrana

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## Employment

- 2019–** Associate professor  
Budapest University of Technology and Economics (BME), Hungary
- 2018** Guest professor  
University of Copenhagen (KU), Denmark (6 months, on leave from BME)
- 2017** Guest professor  
University of Copenhagen (KU), Denmark (6 months, on leave from BME)
- 2014–2019** Assistant professor  
Budapest University of Technology and Economics (BME), Hungary
- 2012–2013** Postdoc  
Swiss Federal Institute of Technology (ETH) Zurich, Switzerland
- 2011–2012** Postdoc  
Technical University of Munich (TUM), Germany

## Education

- 2009–2011** PhD (Physics)  
Budapest University of Technology and Economics (BME), Hungary  
Supervisor: Dr. Péter Lévyay  
Thesis: Group representations in entanglement theory
- 2004–2009** MSc (Engineering Physics)  
Budapest University of Technology and Economics (BME), Hungary

Languages: Hungarian (native), English (fluent), German (intermediate)

## Awards, grants

### Individual fellowships

- Bolyai János Research Fellowship of the Hungarian Academy of Sciences; 2019–2022; 3 years

## Participating researcher in grants

- Hungarian National Research, Development and Innovation Office (NKFIH) grant no. K 124152; 2017–2021
- MTA-BME Lendület Quantum Information Theory Research Group; 2018–2023
- Hungarian National Research, Development and Innovation Office (NKFIH) grant no. KH 129601; 2018–2021
- Quantum Technology National Excellence Program (HunQTech) of the National Research Development and Innovation Office of Hungary, Project No. 2017-1.2.1-NKP-2017-00001; 2018–2021

## Talks, conference presentations

- SIAM Conference on Applied Algebraic Geometry (AG21), Texas, 2021; *minisymposium talk*
- 16th Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC), Riga, 2021; *contributed talk*
- 24th Annual Conference on Quantum Information Processing (QIP), München, 2021; *contributed talk*
- 20th AQIS (virtual) conference, Sydney, 2020; *contributed talk*
- ICMS workshop on Analytical and combinatorial aspects of quantum information theory, Edinburgh, 2019; *invited talk*
- Quantum Information Theory and Mathematical Physics workshop, Budapest, 2019; *invited talk*
- Entanglement day 2018, Budapest; *contributed talk*
- Quantum Information Theory and Mathematical Physics workshop, Budapest, 2018; *invited talk*
- Masterclass on Tensors: Geometry and Quantum Information, Copenhagen, 2018; *lectures*
- QIP 2018, Delft; *coauthor of a contributed talk*
- Non-Local Seminar 2017, Vienna
- Quantum Information Theory and Mathematical Physics workshop, Budapest, 2017; *invited talk*
- Quantum Information Theory and Mathematical Physics workshop, Budapest, 2016; *invited talk*
- CEQIP 2016, Valtice; *poster*
- Entanglement day 2015, Budapest; *contributed talk*
- Entanglement day 2014, Budapest; *contributed talk*
- CEQIP 2014, Znojmo; *coauthor of a contributed talk*

## Conference proceedings

- [CVZ18] Matthias Christandl, Péter Vrana, and Jeroen Zuiddam. Universal points in the asymptotic spectrum of tensors. In *Proceedings of the 50th Annual ACM SIGACT Symposium on Theory of Computing*, pages 289–296. Association for Computing Machinery, 2018. (journal version: [5]). doi:10.1145/3188745.3188766.
- [CVZ19] Matthias Christandl, Péter Vrana, and Jeroen Zuiddam. Barriers for fast matrix multiplication from irreversibility. In Amir Shpilka, editor, *34th Computational Complexity Conference (CCC 2019)*, volume 137 of *Leibniz International Proceedings in Informatics (LIPIcs)*, pages 26:1–26:17. Schloss Dagstuhl–Leibniz-Zentrum fuer Informatik, 2019. (journal version: [6]). doi:10.4230/LIPIcs.CCC.2019.26.

## Student supervision

- Dávid Bugár, PhD, BME, expected graduation 2025
- Joël Felderhoff (from ENS de Lyon), internship at KU, 2018
- Dániel Vörös, BSc, BME, graduation June 2017
- Máté Farkas, MSc, BME, graduation June 2015

## Teaching activity

### Budapest University of Technology and Economics

- Algebraic and geometric methods in quantum information theory (for mathematics students, lectures, 2021)
- Mathematical Foundations of Quantum Theory (for physics students, exercises, 2020, 2021)
- Mathematical Methods of Classical Mechanics (for mathematics students, lectures, 2014, 2016, 2018, 2020)
- Quantum channels (for mathematics students, lectures, 2014)
- Calculus (for engineering students, lectures and exercises, several times)

### Technical University of Munich

- Undecidability (for mathematics students, exercises, 2012)
- Information theory (for mathematics students, exercises, 2012)

## Journal articles

- [1] Gergely Bunth and Péter Vrana. Equivariant relative submajorization. *IEEE Transactions on Information Theory*, 2022. arXiv:2108.13217, doi:10.1109/TIT.2022.3214465.

- [2] Péter Vrana. Asymptotic continuity of additive entanglement measures. *IEEE Transactions on Information Theory*, 68(5):3208–3217, 2022. [arXiv:2107.08537](#), [doi:10.1109/TIT.2022.3143845](#).
- [3] György Frank, Dániel Varjas, Péter Vrana, Gergő Pintér, and András Pályi. Topological charge distributions of an interacting two-spin system. *Phys. Rev. B*, 105:035414, Jan 2022. [arXiv:2012.14357](#), [doi:10.1103/PhysRevB.105.035414](#).
- [4] Christopher Perry, Péter Vrana, and Albert H Werner. The semiring of dichotomies and asymptotic relative submajorization. *IEEE Transactions on Information Theory*, 68:311–321, 2022. [arXiv:2004.10587](#), [doi:10.1109/TIT.2021.3117440](#).
- [5] Matthias Christandl, Péter Vrana, and Jeroen Zuiddam. Universal points in the asymptotic spectrum of tensors. *Journal of the American Mathematical Society*, 2021. [arXiv:1709.07851](#), [doi:10.1090/jams/996](#).
- [6] Matthias Christandl, Péter Vrana, and Jeroen Zuiddam. Barriers for fast matrix multiplication from irreversibility. *Theory of Computing*, 17(2):1–32, 2021. [arXiv:1812.06952](#), [doi:10.4086/toc.2021.v017a002](#).
- [7] Péter Vrana. Probabilistic refinement of the asymptotic spectrum of graphs. *Combinatorica*, 41:873–904, 2021. [arXiv:1903.01857](#), [doi:10.1007/s00493-020-4324-5](#).
- [8] Gergely Bunth and Péter Vrana. Asymptotic relative submajorization of multiple-state boxes. *Letters in Mathematical Physics*, 111(4), 2021. [arXiv:2007.11258](#), [doi:10.1007/s11005-021-01430-0](#).
- [9] Péter Vrana. A generalization of Strassen’s theorem on preordered semirings. *Order*, 39(2):209–228, July 2022. [arXiv:2003.14176](#), [doi:10.1007/s11083-021-09570-7](#).
- [10] Alonso Botero, Matthias Christandl, and Péter Vrana. Large deviation principle for moment map estimation. *Electronic Journal of Probability*, 26:1–23, 2021. [arXiv:2004.14504](#), [doi:10.1214/21-EJP636](#).
- [11] Matthias Christandl, Angelo Lucia, Péter Vrana, and Albert H Werner. Tensor network representations from the geometry of entangled states. *SciPost Physics*, 9:42, 09 2020. [arXiv:1809.08185](#), [doi:10.21468/SciPostPhys.9.3.042](#).
- [12] Srinivasan Arunachalam, Péter Vrana, and Jeroen Zuiddam. The asymptotic induced matching number of hypergraphs: balanced binary strings. *Electronic Journal of Combinatorics*, 27(3):P3.12, 2020. [arXiv:1905.03148](#), [doi:10.37236/9019](#).
- [13] Péter Vrana and Matthias Christandl. Distillation of Greenberger–Horne–Zeilinger states by combinatorial methods. *IEEE Transactions on Information Theory*, 65:5945–5958, 2019. [arXiv:1805.09096](#), [doi:10.1109/TIT.2019.2908646](#).
- [14] Péter Vrana and Máté Farkas. Homological codes and abelian anyons. *Reviews in Mathematical Physics*, 31(10):1950038, 2019. [arXiv:1505.01001](#), [doi:10.1142/S0129055X19500387](#).
- [15] Asger Kjørulff Jensen and Péter Vrana. The asymptotic spectrum of LOCC transformations. *IEEE Transactions on Information Theory*, 66:155–166, 2019. [arXiv:1807.05130](#), [doi:10.1109/TIT.2019.2927555](#).

- [16] Matthias Christandl, Péter Vrana, and Jeroen Zuiddam. Asymptotic tensor rank of graph tensors: beyond matrix multiplication. *computational complexity*, 2018. [arXiv:1609.07476](#), [doi:10.1007/s00037-018-0172-8](#).
- [17] Christian Schilling, Carlos L Benavides-Riveros, and Péter Vrana. Reconstructing quantum states from single-party information. *Physical Review A*, 96(5):052312, 2017. [arXiv:1703.01612](#), [doi:10.1103/PhysRevA.96.052312](#).
- [18] Máté Farkas and Péter Vrana. Qudit homological product codes. *Quantum Information & Computation*, 17(11&12):0948–0958, sep 2017. [arXiv:1505.07787](#), [doi:10.26421/QIC17.11-12-2](#).
- [19] Péter Vrana and Matthias Christandl. Entanglement distillation from Greenberger–Horne–Zeilinger shares. *Communications in Mathematical Physics*, 352(2):621–627, 2017. [arXiv:1603.03964](#), [doi:10.1007/s00220-017-2861-6](#).
- [20] Michael Kech, Péter Vrana, and Michael M Wolf. The role of topology in quantum tomography. *Journal of Physics A: Mathematical and Theoretical*, 48(26):265303, 2015. [arXiv:1503.00506](#), [doi:10.1088/1751-8113/48/26/265303](#).
- [21] Péter Vrana and Matthias Christandl. Asymptotic entanglement transformation between W and GHZ states. *Journal of Mathematical Physics*, 56(2):022204, 2015. [arXiv:1310.3244](#), [doi:10.1063/1.4908106](#).
- [22] Péter Vrana, David Reeb, Daniel Reitzner, and Michael M Wolf. Fault-ignorant quantum search. *New Journal of Physics*, 16(7):073033, 2014. [arXiv:1307.0771](#), [doi:10.1088/1367-2630/16/7/073033](#).
- [23] Andrea Blunck, Péter Lévay, Metod Saniga, and Péter Vrana. Invertible symmetric  $3 \times 3$  binary matrices and  $GQ(2,4)$ . *Linear and Multilinear Algebra*, 60(10):1143–1154, 2012. [arXiv:1009.1768](#), [doi:10.1080/03081087.2011.651725](#).
- [24] Péter Vrana. On the algebra of local unitary invariants of pure and mixed quantum states. *Journal of Physics A: Mathematical and Theoretical*, 44(22):225304, 2011. [arXiv:1101.2514](#), [doi:10.1088/1751-8113/44/22/225304](#).
- [25] Péter Vrana. Local unitary invariants for multipartite quantum systems. *Journal of Physics A: Mathematical and Theoretical*, 44(11):115302, 2011. [arXiv:1007.0163](#), [doi:10.1088/1751-8113/44/11/115302](#).
- [26] Metod Saniga, Richard M Green, Péter Lévay, Péter Vrana, and P Pracna. The Veldkamp space of  $GQ(2,4)$ . *International Journal of Geometric Methods in Modern Physics*, 7(07):1133–1145, 2010. [arXiv:0903.0715](#), [doi:10.1142/S0219887810004762](#).
- [27] Péter Vrana and Péter Lévay. The Veldkamp space of multiple qubits. *Journal of Physics A: Mathematical and Theoretical*, 43(12):125303, 2010. [arXiv:0906.3655](#), [doi:10.1088/1751-8113/43/12/125303](#).
- [28] Péter Vrana and Péter Lévay. Special entangled quantum systems and the Freudenthal construction. *Journal of Physics A: Mathematical and Theoretical*, 42(28):285303, 2009. [arXiv:0902.2269](#), [doi:10.1088/1751-8113/42/28/285303](#).

- [29] Péter Lévay, Metod Saniga, Péter Vrana, and Petr Prajna. Black hole entropy and finite geometry. *Physical Review D*, 79(8):084036, 2009. [arXiv:0903.0541](#), [doi:10.1103/PhysRevD.79.084036](#).
- [30] Péter Lévay, Metod Saniga, and Péter Vrana. Three-qubit operators, the split Cayley hexagon of order two, and black holes. *Physical Review D*, 78(12):124022, 2008. [arXiv:0808.3849](#), [doi:10.1103/PhysRevD.78.124022](#).
- [31] Péter Lévay and Péter Vrana. Three fermions with six single-particle states can be entangled in two inequivalent ways. *Physical Review A*, 78(2):022329, 2008. [arXiv:0806.4076](#), [doi:10.1103/PhysRevA.78.022329](#).

## Preprints

- [32] Dávid Bugár and Péter Vrana. Interpolating between Rényi entanglement entropies for arbitrary bipartitions via operator geometric means. 2022. [arXiv:2208.14438](#).
- [33] Milán Mosonyi, Gergely Bunnth, and Péter Vrana. Geometric relative entropies and barycentric Rényi divergences. 2022. [arXiv:2207.14282](#).
- [34] Tamás Tasnádi and Péter Vrana. Asymptotic equipartition property for a Markov source having ambiguous alphabet. 2022. [arXiv:2207.13789](#).
- [35] Péter Vrana. Noncommutative extensions of parameters in the asymptotic spectrum of graphs. 2022. [arXiv:2207.10483](#).
- [36] Péter Vrana. A family of multipartite entanglement measures. 2020. [arXiv:2008.11108](#).
- [37] Péter Vrana. The algebra of local unitary invariants of identical particles. 2011. [arXiv:1107.2438](#).

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