

Mario Krenn

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Research Profile

We are excited about the potential of artificial intelligence-inspired and -augmented science, and how we can use algorithms in a more "creative" way. We are convinced that intelligence is not sufficient to be a great scientist. There, to make progress, it will be important to learn what humans mean by crucial scientific concepts such as **surprise**, **creativity**, **understanding**, and **interest**. We have created **AIs for designing physics experiments** and hardware, several of which were actually built in laboratories, as well as **systems for inspiring novel ideas** for science.

Professional Experience

- 06.2025–Present **Full Professor (W3) for Machine Learning in Science**
University of Tübingen
Artificial Scientist Lab, Department for Computer Science, Faculty of Science.
- 09.2021–05.2025 **Independent W2 Research Group Leader**
Max Planck Institute for the Science of Light
Artificial Scientist Lab, Erlangen, Germany.
- 01.2019–08.2021 **FWF Erwin Schrödinger Postdoctoral Fellow**
University of Toronto
Group of Alán Aspuru-Guzik, Department of Chemistry and Department of Computer Science; Vector Institute for Artificial Intelligence, Toronto, Canada.
- 12.2017–12.2018 **Postdoctoral Fellow**
University of Vienna
Group of Anton Zeilinger, Faculty of Physics; IQOQI Vienna, Austria.
- 10.2012–11.2017 **Graduate Research Assistant (Pre-Doc)**
University of Vienna
Group of Anton Zeilinger, Faculty of Physics; IQOQI Vienna, Austria.

Education

- 10.2012–11.2017 **PhD in Quantum Physics**
University of Vienna
Group of Anton Zeilinger. Topic: quantum experiments with spatial modes of photons in large real and Hilbert spaces. Finished with distinction.
- 09.2009–09.2012 **Master Studies: Technical Physics**
Vienna University of Technology
Master thesis in the group of Anton Zeilinger. Topic: investigation of complex spatial mode structures of photons. Finished with distinction.
- 10.2006–06.2009 **Bachelor Studies: Technical Physics**
Vienna University of Technology

Funding, Awards, and Honors

- 07.2024 **ERC Starting Grant**
European Research Council
Artificial Scientific Discovery of advanced Quantum Hardware with high-performance Simulators. EUR 1,499,000.
- 10.2020 **IOP Quantum 2020 International Quantum Technology Emerging
Researcher Award**
Institute of Physics
Highly Commended, in recognition of significant achievement and exceptional promise for future contributions to quantum science and technology.
- 03.2019 **Erwin Schrödinger Fellowship**
FWF Austrian Science Fund
Project: *Complex Computer-Designed Quantum Experiments* [J4309]. EUR 164,480.
- 03.2019 **PNAS Cozzarelli Prize 2018**
Proceedings of the National Academy of Sciences
Physical and Mathematical Sciences; recognizes outstanding contributions to the scientific disciplines represented by the National Academy of Sciences.
- 11.2018 **Loschmidt Prize 2018**
Chemical-Physical Society Austria
Awarded for an outstanding dissertation in the field of physics or chemistry at Austrian universities.
- 03.2018 **Doc.Award 2018**
University of Vienna
Awarded for outstanding doctoral theses at the University of Vienna.

Publications

2026:

- Carlos Ruiz-Gonzalez, [Mario Krenn](#), Xuemei Gu
Automated experimental design for high-probability entanglement generation
[arXiv:2605.02721](#).
- [Mario Krenn](#), Heather Champion
Philosophy of Autonomous Science: Ten Questions for the Coming Age of Artificial Scientists
Dædalus **155** (1–2), 335–349 (2026).
- Sören Arlt, [Mario Krenn](#), Xuemei Gu
Automated discovery of nonlocal photonic gates
Phys. Rev. Research **8**, L022031 (2026).
- Sören Arlt, Haonan Duan, Felix Li, Sang Michael Xie, Yuhuai Wu, [Mario Krenn](#)
Meta-Designing Quantum Experiments with Language Models
Nature Machine Intelligence **8**, 148 (2026).

2025:

- Carlos Ruiz-Gonzalez, Sören Arlt, Sebastian Lehner, Arturs Berzins, Yehonathan Drori, Rana X Adhikari, Johannes Brandstetter, [Mario Krenn](#)
Neural surrogates for designing gravitational wave detectors
[arXiv:2511.19364](#).
- Xuemei Gu, Carlos Ruiz-Gonzalez, [Mario Krenn](#)
Analytical Fock Representation of Two-Mode Squeezing for Quantum Interference
[arXiv:2511.16529](#).

- Sören Arlt, Xuemei Gu, [Mario Krenn](#)
Towards autonomous quantum physics research using LLM agents with access to intelligent tools
[arXiv:2511.11752](#).
- Sören Arlt, [Mario Krenn](#), Xuemei Gu
Automated discovery of high-dimensional multipartite entanglement with photons that never interacted
[arXiv:2510.10707](#).
- Giovanni Acampora, Andris Ambainis, Natalia Ares, Leonardo Bianchi, Pallavi Bhardwaj, Daniele Binosi, G. Andrew D. Briggs, Tommaso Calarco, Vedran Dunjko, Jens Eisert, Olivier Ezratty, Paul Erker, Federico Fedele, Elies Gil-Fuster, Martin Gärttner, Mats Granath, Markus Heyl, Iordanis Kerenidis, Matthias Klusch, Anton Frisk Kockum, Richard Kueng, [Mario Krenn](#), Jörg Lässig, Antonio Macaluso, Sabrina Mascalco, Florian Marquardt, Kristel Michielsen, Gorka Muñoz-Gil, Daniel Müssig, Hendrik Poulsen Nautrup, Evert van Nieuwenburg, Roman Orus, Jörg Schmiedmayer, Markus Schmitt, Philipp Slusallek, Filippo Vicentini, Christof Weitenberg, Frank K. Wilhelm
Quantum computing and artificial intelligence: status and perspectives
[arXiv:2505.23860](#).
- Tareq Jaouni, Xuemei Gu, [Mario Krenn](#), Alessio D’Errico, Ebrahim Karimi
Tutorial: Hong-Ou-Mandel interference with Structured Photons
Nanophotonics **14** (23), 4163 (2025).
- Kai Wang, Zhaohua Hou, Kaiyi Qian, Leizhen Chen, [Mario Krenn](#), Markus Aspelmeyer, Anton Zeilinger, Shining Zhu, Xiao-Song Ma
Violation of Bell inequality with unentangled photons
Science Advances **11** (31), eadr1794 (2025).
- Xuemei Gu, [Mario Krenn](#)
Forecasting high-impact research topics via machine learning on evolving knowledge graphs
Machine Learning: Science and Technology **6** (2), 025041 (2025).
- [Mario Krenn](#), Yehonathan Drori, Rana X Adhikari
Digital Discovery of interferometric Gravitational Wave Detectors
Phys. Rev. X **15**, 021012 (2025).
- Felix Frohnert, Xuemei Gu, [Mario Krenn](#), Evert van Nieuwenburg
Discovering emergent connections in quantum physics research via dynamic word embeddings
Machine Learning: Science and Technology **6**, 015029 (2025).
- Tareq Jaouni, Lukas Scarfe, Frédéric Bouchard, [Mario Krenn](#), Khabat Heshami, Francesco Di Colandrea, Ebrahim Karimi
Predicting atmospheric turbulence for secure quantum communications in free space
Optics Express **33** (5), 10759 (2025).

2024:

- Xuemei Gu, [Mario Krenn](#)
Generation and human-expert evaluation of interesting research ideas using knowledge graphs and large language models
[arXiv:2405.17044](#).
- Kai Wang, Zhaohua Hou, Kaiyi Qian, Leizhen Chen, [Mario Krenn](#), Shining Zhu, Xiao-Song Ma
Entangling Independent Particles by Path Identity
Phys. Rev. Lett. **133**, 233601 (2024).
- Carla Rodríguez, Sören Arlt, Leonhard Möckl, [Mario Krenn](#)
Automated discovery of experimental designs in super-resolution microscopy with XLuminA
Nature Communications **15** (1), 10658 (2024).

- Sören Arlt, Carlos Ruiz-Gonzalez, [Mario Krenn](#)
Emulating Multiparticle Emitters with Pair-Sources: Digital Discovery of a Quantum Optics Building Block
Quantum Science and Technology **10** (1), 015042 (2024).
- Philipp Schmidt, Sören Arlt, Carlos Ruiz-Gonzalez, Xuemei Gu, Carla Rodríguez, [Mario Krenn](#)
Virtual Reality for Understanding Artificial-Intelligence-driven Scientific Discovery with an Application in Quantum Optics
Machine Learning: Science and Technology **5** (3), 035045 (2024).
- Tareq Jaouni, Sören Arlt, Carlos Ruiz-Gonzalez, Ebrahim Karimi, Xuemei Gu, [Mario Krenn](#)
Deep Quantum Graph Dreaming: Deciphering Neural Network Insights into Quantum Experiments
Machine Learning: Science and Technology **5** (1), 015029 (2024).
- Johannes Pseiner, Manuel Erhard, [Mario Krenn](#)
Quantum interference between distant creation processes
Phys. Rev. Research **6** (1), 013294 (2024).

2023:

- Tareq Jaouni, Xiaoqin Gao, Sören Arlt, [Mario Krenn](#), Ebrahim Karimi
Experimental Solutions to the High-Dimensional Mean King's Problem
Optica Quantum **1** (2), 49 (2023).
- Carlos Ruiz-Gonzalez, Sören Arlt, Jan Petermann, Sharareh Sayyad, Tareq Jaouni, Ebrahim Karimi, Nora Tischler, Xuemei Gu, [Mario Krenn](#)
Digital Discovery of 100 diverse Quantum Experiments with PyTheus
Quantum **7**, 1204 (2023).
- [Mario Krenn](#), Lorenzo Buffoni, Bruno Coutinho, Sagi Eppel, Jacob Gates Foster, Andrew Gritsevskiy, Harlin Lee, Yichao Lu, Joao P. Moutinho, Nima Sanjabi, Rishi Sonthalia, Ngoc Mai Tran, Francisco Valente, Yangxinyu Xie, Rose Yu, Michael Kopp
Forecasting the future of artificial intelligence with machine learning-based link prediction in an exponentially growing knowledge network
Nature Machine Intelligence **5** (11), 1326 (2023).
- K. Y. Bliokh, E. Karimi, M. J. Padgett, M. A. Alonso, M. R. Dennis, A. Dudley, A. Forbes, S. Zahedpour, S. W. Hancock, H. M. Milchberg, S. Rotter, F. Nori, Ş. K. Özdemir, N. Bender, H. Cao, P. B. Corkum, C. Hernández-García, H. Ren, Y. Kivshar, M. G. Silveirinha, N. Engheta, A. Rauschenbeutel, P. Schneeweiss, J. Volz, D. Leykam, D. A. Smirnova, K. Rong, B. Wang, E. Hasman, M. F. Picardi, A. V. Zayats, F. J. Rodríguez-Fortuño, C. Yang, J. Ren, A. B. Khanikaev, A. Alù, E. Brasselet, M. Shats, J. Verbeeck, P. Schattschneider, D. Sarenac, D. G. Cory, D. Pushin, M. Birk, A. Gorlach, I. Kaminer, F. Cardano, L. Marrucci, [M. Krenn](#), F. Marquardt
Roadmap on structured waves
Journal of Optics **25**, 103001 (2023).
- Alston Lo, Robert Pollice, AkshatKumar Nigam, Andrew D. White, [Mario Krenn](#), Alán Aspuru-Guzik
Recent advances in the Self-Referencing Embedding Strings (SELFIES) library
Digital Discovery **2**, 897 (2023).
- Kaiyi Qian, Kai Wang, Leizhen Chen, Zhaohua Hou, [Mario Krenn](#), Shining Zhu, Xiao-song Ma
Multiphoton non-local quantum interference controlled by an undetected photon
Nature Communications **14**, 1480 (2023).
- Lan-Tian Feng, Ming Zhang, Di Liu, Yu-Jie Cheng, Guo-Ping Guo, Dao-Xin Dai, Guang-Can Guo, [Mario Krenn](#), Xi-Feng Ren
On-chip quantum interference between the origins of a multi-photon state
Optica **10** (1), 105–109 (2023).
- [Mario Krenn](#), Jonas Landgraf, Thomas Foesel, Florian Marquardt
Artificial Intelligence and Machine Learning for Quantum Technologies
Phys. Rev. A **107**, 010101 (2023).

2022:

- [Mario Krenn](#), Qianxiang Ai, Senja Barthel, Nessa Carson, Angelo Frei, Nathan C. Frey, Pascal Friederich, Théophile Gaudin, Alberto Alexander Gayle, Kevin Maik Jablonka, Rafael F. Lameiro, Dominik Lemm, Alston Lo, Seyed Mohamad Moosavi, José Manuel Nápoles-Duarte, AkshatKumar Nigam, Robert Pollice, Kohulan Rajan, Ulrich Schatzschneider, Philippe Schwaller, Marta Skreta, Berend Smit, Felix Strieth-Kalthoff, Chong Sun, Gary Tom, Guido Falk von Rudorff, Andrew Wang, Andrew White, Adamo Young, Rose Yu, Alán Aspuru-Guzik
SELFIES and the future of molecular string representations
Cell Patterns **3** (10), 100588 (2022).
- [Mario Krenn](#), Robert Pollice, Si Yue Guo, Matteo Aldeghi, Alba Cervera-Liarta, Pascal Friederich, Gabriel dos Passos Gomes, Florian Häse, Adrian Jinich, AkshatKumar Nigam, Zhenpeng Yao, Alán Aspuru-Guzik
On scientific understanding with artificial intelligence
Nature Reviews Physics **4**, 761 (2022).
- Alba Cervera-Liarta, [Mario Krenn](#), Alán Aspuru-Guzik
Design of quantum optical experiments with logic artificial intelligence
Quantum **6**, 836 (2022).
- Luca A. Thiede, [Mario Krenn](#), AkshatKumar Nigam, Alán Aspuru-Guzik
Curiosity in exploring chemical spaces: intrinsic rewards for molecular reinforcement learning
Machine Learning: Science and Technology **3** (3), 035008 (2022).
- Armin Hochrainer, Mayukh Lahiri, Manuel Erhard, [Mario Krenn](#), Anton Zeilinger
Quantum indistinguishability by path identity and with undetected photons
Rev. Mod. Phys. **94**, 025007 (2022).
- Daniel Flam-Shepherd, Tony C. Wu, Xuemei Gu, Alba Cervera-Liarta, [Mario Krenn](#), Alán Aspuru-Guzik
Learning interpretable representations of entanglement in quantum optics experiments using deep generative models
Nature Machine Intelligence **4**, 544 (2022).
- Alba Cervera-Liarta, [Mario Krenn](#), Alán Aspuru-Guzik, Alexey Galda
Experimental high-dimensional Greenberger-Horne-Zeilinger entanglement with superconducting transmon qutrits
Phys. Rev. Applied **17**, 024062 (2022).

2021:

- Thomas Adler, Manuel Erhard, [Mario Krenn](#), Johannes Brandstetter, Johannes Kofler, Sepp Hochreiter
Quantum Optical Experiments Modeled by Long Short-Term Memory
Photonics **8** (12), 535 (2021).
- [Mario Krenn](#), Jakob S. Kottmann, Nora Tischler, Alán Aspuru-Guzik
Conceptual understanding through efficient automated design of quantum optical experiments
Phys. Rev. X **11** (3), 031044 (2021).
- Cynthia Shen, [Mario Krenn](#), Sagi Eppel, Alán Aspuru-Guzik
Deep Molecular Dreaming: Inverse machine learning for de-novo molecular design and interpretability with surjective representations
Machine Learning: Science and Technology **2** (3), 03LT02 (2021).
- Jakob S. Kottmann, [Mario Krenn](#), Thi Ha Kyaw, Sumner Alperin-Lea, Alán Aspuru-Guzik
Quantum Computer-Aided design of Quantum Optics Hardware
Quantum Science and Technology **6** (3), 035010 (2021).
- Pascal Friederich, [Mario Krenn](#), Isaac Tamblyn, Alán Aspuru-Guzik
Scientific intuition inspired by machine learning-generated hypotheses
Machine Learning: Science and Technology **2** (2), 025027 (2021).

- AkshatKumar Nigam, Robert Pollice, [Mario Krenn](#), Gabriel dos Passos Gomes, Alán Aspuru-Guzik
Beyond generative models: superfast traversal, optimization, novelty, exploration and discovery (STONED) algorithm for molecules using SELFIES
Chemical Science **12** (20), 7079 (2021).
- Robert Pollice, Gabriel dos Passos Gomes, Matteo Aldeghi, Riley J. Hickman, [Mario Krenn](#), Cyrille Lavigne, Michael Lindner-D'Addario, AkshatKumar Nigam, Cher Tian Ser, Zhenpeng Yao, Alán Aspuru-Guzik
Data-Driven Strategies for Accelerated Materials Design
Accounts of Chemical Research **54** (4), 849–860 (2021).

2020:

- Xuemei Gu, [Mario Krenn](#)
View & Perspective: Compact Greenberger-Horne-Zeilinger state generation via frequency combs and graph theory
Frontiers of Physics **15** (6), 1–4 (2020).
- Jaroslav Kysela, Manuel Erhard, Armin Hochrainer, [Mario Krenn](#), Anton Zeilinger
Experimental High-Dimensional Entanglement by Path Identity
PNAS **117** (42), 26118 (2020).
- [Mario Krenn](#), Manuel Erhard, Anton Zeilinger
Computer-inspired Quantum Experiments
Nature Reviews Physics **2**, 649 (2020).
- [Mario Krenn](#), Florian Häse, AkshatKumar Nigam, Pascal Friederich, Alán Aspuru-Guzik
Self-Referencing Embedded Strings (SELFIES): A 100% robust molecular string representation
Machine Learning: Science and Technology **1** (4), 045024 (2020).
- Xiaoqin Gao, Manuel Erhard, Anton Zeilinger, [Mario Krenn](#)
Computer-inspired concept for high-dimensional multipartite quantum gates
Phys. Rev. Lett. **125** (5), 050501 (2020).
- Manuel Erhard, [Mario Krenn](#), Anton Zeilinger
Advances in High Dimensional Quantum Entanglement
Nature Reviews Physics **2**, 365 (2020).
- [Mario Krenn](#), Art I. Melvin, Anton Zeilinger
How can a computer find autonomously new, surprising or creative solutions or insights? (in Perspective: The sounds of science)
Physica Scripta **95** (6), 062501 (2020).
- Xuemei Gu, Lijun Chen, [Mario Krenn](#)
Quantum Experiments and Hypergraphs: Multi-Photon Sources for Quantum Interference, Quantum Computation and Quantum Entanglement
Phys. Rev. A **101** (3), 033816 (2020).
- AkshatKumar Nigam, Pascal Friederich, [Mario Krenn](#), Alán Aspuru-Guzik
Augmenting Genetic Algorithms with Deep Neural Networks for Exploring the Chemical Space
International Conference on Learning Representations (ICLR-2020).
- Xuemei Gu, Lijun Chen, [Mario Krenn](#)
Phenomenology of complex structured light in turbulent air
Optics Express **28** (8), 11033 (2020).
- [Mario Krenn](#), Anton Zeilinger
Predicting Research Trends with Semantic and Neural Networks with an application in Quantum Physics
PNAS **117** (4), 1910 (2020).

- Mario Krenn
Viewpoint: Physics Insights from Neural Networks
APS Physics **13**, 2 (2020).

2019:

- Mario Krenn, Manuel Erhard
Quantenteleportation in höheren Dimensionen
Physik in unserer Zeit **50** (6), 269–270 (2019).
- Yi-Han Luo, Han-Sen Zhong, Manuel Erhard, Xi-Lin Wang, Li-Chao Peng, Mario Krenn, Xiao Jiang, Li Li, Nai-Le Liu, Chao-Yang Lu, Anton Zeilinger, Jian-Wei Pan
Quantum teleportation in high dimensions
Phys. Rev. Lett. **123** (7), 070505 (2019).
- Mario Krenn, Xuemei Gu, Daniel Soltész
Questions on the Structure of Perfect Matchings inspired by Quantum Physics
Proceedings of the 2nd Croatian Combinatorial Days, 57–70 (2019).
- Xuemei Gu, Lijun Chen, Anton Zeilinger, Mario Krenn
Quantum Experiments and Graphs III: High-Dimensional and Multi-Particle Entanglement
Phys. Rev. A **99** (3), 032338 (2019).
- Xuemei Gu, Manuel Erhard, Anton Zeilinger, Mario Krenn
Quantum Experiments and Graphs II: Quantum interference, Computation, and State Generation
PNAS **116** (10), 4147 (2019).
- Xiaoqin Gao, Mario Krenn, Jaroslav Kysela, Anton Zeilinger
Arbitrary d-dimensional Pauli X-Gates of a flying Qudit
Phys. Rev. A **99** (3), 023825 (2019).

2018:

- Manuel Erhard, Mehul Malik, Mario Krenn, Anton Zeilinger
Experimental Greenberger-Horne-Zeilinger entanglement beyond qubits
Nature Photonics **12**, 759 (2018).
- Mario Krenn, Anton Zeilinger
On Small Beams with Large Topological Charge II: Photons, Electrons and Gravitational Waves
NJP **20** (6), 063006 (2018).
- Manuel Erhard, Robert Fickler, Mario Krenn, Anton Zeilinger
Twisted photons: new quantum perspectives in high dimensions
Light: Science & Applications **7**, 17146 (2018).
- Xuemei Gu, Mario Krenn, Manuel Erhard, Anton Zeilinger
Gouy Phase Radial Mode Sorter for Light: Concepts and Experiments
Phys. Rev. Lett. **120** (10), 103601 (2018).
- Alexey A. Melnikov, Hendrik Poulsen Nautrup, Mario Krenn, Vedran Dunjko, Markus Tiersch, Anton Zeilinger, Hans J. Briegel
Active learning machine learns to create new quantum experiments
PNAS **115** (6), 1221 (2018).
- Robert Fickler, Mario Krenn, Anton Zeilinger
Mit Lichtschrauben ans Quantenlimit
Physik in unserer Zeit **49** (1), 12 (2018).

2017:

- Mario Krenn, Xuemei Gu, Anton Zeilinger
Quantum Experiments and Graphs: Multiparty States as coherent superpositions of Perfect Matchings
Phys. Rev. Lett. **119** (24), 240403 (2017).
- Feiran Wang, Manuel Erhard, Amin Babazadeh, Mehul Malik, Mario Krenn, Anton Zeilinger
Generation of the complete four-dimensional Bell basis
Optica **4** (12), 1462 (2017).
- Amin Babazadeh, Manuel Erhard, Feiran Wang, Mehul Malik, Rahman Nouroozi, Mario Krenn, Anton Zeilinger
High-Dimensional Single-Photon Quantum Gates: Concepts and Experiments
Phys. Rev. Lett. **119** (18), 180510 (2017).
- Sahar Alipour, Mario Krenn, Anton Zeilinger
Quantum gate description for induced coherence without induced emission and its applications
Phys. Rev. A **96** (4), 042317 (2017).
- Paul Erker, Mario Krenn, Marcus Huber
Quantifying high dimensional entanglement with two mutually unbiased bases
Quantum **1**, 22 (2017).
- Mario Krenn, Mehul Malik, Manuel Erhard, Anton Zeilinger
Orbital angular momentum of photons and the entanglement of Laguerre-Gaussian modes
Phil. Trans. R. Soc. A **375** (2087), 20150442 (2017).
- Mario Krenn, Armin Hochrainer, Mayukh Lahiri, Anton Zeilinger
Entanglement by Path Identity
Phys. Rev. Lett. **118** (8), 080401 (2017).

2016:

- Mario Krenn, Mehul Malik, Thomas Scheidl, Rupert Ursin, Anton Zeilinger
Quantum Communication with Photons
Optics in Our Time, chapter 18, 455 (2016).
- Mario Krenn, Johannes Handsteiner, Matthias Fink, Robert Fickler, Rupert Ursin, Mehul Malik, Anton Zeilinger
Twisted light transmission over 143 km
PNAS **113** (48), 13648 (2016).
- Nora Tischler, Mario Krenn, Robert Fickler, Xavier Vidal, Anton Zeilinger, Gabriel Molina-Terriza
Quantum optical rotatory dispersion
Science Advances **2** (10), e1601306 (2016).
- Florian Schlederer, Mario Krenn, Robert Fickler, Mehul Malik, Anton Zeilinger
Cyclic transformation of orbital angular momentum modes
NJP **18** (4), 043019 (2016).
- Mario Krenn, Mehul Malik, Robert Fickler, Radek Lapkiewicz, Anton Zeilinger
Automated Search for new Quantum Experiments
Phys. Rev. Lett. **116** (9), 090405 (2016).
- Mario Krenn, Nora Tischler, Anton Zeilinger
On Small Beams with Large Topological Charge
NJP **18** (3), 033012 (2016).
- Mehul Malik, Manuel Erhard, Marcus Huber, Mario Krenn, Robert Fickler, Anton Zeilinger
Multi-photon entanglement in high dimensions
Nature Photonics **10** (4), 248 (2016).

2015:

- William N. Plick, [Mario Krenn](#)
Physical meaning of the radial index of Laguerre-Gauss beams
Phys. Rev. A **92** (6), 063841 (2015).
- [Mario Krenn](#), Johannes Handsteiner, Matthias Fink, Robert Fickler, Anton Zeilinger
Twisted photon entanglement through turbulent air across Vienna
PNAS **112** (46), 14197 (2015).

2014:

- [Mario Krenn](#), Robert Fickler, Matthias Fink, Johannes Handsteiner, Mehul Malik, Thomas Scheidl, Rupert Ursin, Anton Zeilinger
Communication with spatially modulated light through turbulent air across Vienna
NJP **16** (11), 113028 (2014).
- [Mario Krenn](#), Marcus Huber, Robert Fickler, Radek Lapkiewicz, Sven Ramelow, Anton Zeilinger
Generation and confirmation of a (100 x 100)-dimensional entangled quantum system
PNAS **111** (17), 6243 (2014).

2013:

- Robert Fickler, [Mario Krenn](#), Radek Lapkiewicz, Sven Ramelow, Anton Zeilinger
Real-time imaging of quantum entanglement
Sci. Rep. **3**, 1914 (2013).
- William N. Plick, [Mario Krenn](#), Robert Fickler, Sven Ramelow, Anton Zeilinger
Quantum orbital angular momentum of elliptically symmetric light
Phys. Rev. A **87** (3), 033806 (2013).
- [Mario Krenn](#), Robert Fickler, Marcus Huber, Radek Lapkiewicz, William Plick, Sven Ramelow, Anton Zeilinger
Entangled singularity patterns of photons in Ince-Gauss modes
Phys. Rev. A **87** (1), 012326 (2013).

2012:

- Robert Fickler, Radek Lapkiewicz, William N. Plick, [Mario Krenn](#), Christoph Schaeff, Sven Ramelow, Anton Zeilinger
Quantum entanglement of high angular momenta
Science **338** (6107), 640 (2012).

Panel Discussions

2025

- 2025.06.16 Roundtable talk, Santa Fe Institute / DeepMind, London, UK. *Against a Dystopia of Science without Understanding.*
- 2025.05.30 Invited Talk & Panel, SciFM25 – Scientific Discovery in the Age of AI, Ann Arbor, MI, USA. *AI discovery in physics.*

2024

- 2024.04.26 EU-LIFE Utopia Conference 2024, CeMM, Vienna (Austria), talk and panel discussion. *Predicting and suggesting future ideas in science.*

2023

- 2023.11.28 University of Vienna, panel discussion. *AI/GPT in Research & Higher Education.*
- 2023.10.12 National Academy of Sciences AI for Scientific Discovery Workshop, Washington DC (USA), invited talk and panel discussion. *AI for scientific discovery.*

2023.06.26 Participating at panel discussion "AI for Science", International Conference for Science of Science and Innovation, Chicago, USA, invited talk. *AI as a source of inspiration in physics.*

2022

2022.12.03 Panel discussion on "Philosophy of Science in the AI Era", ML&Physical Science Workshop, NeurIPS 2022.

Scientific Talks

2026

2026.05.13 Special Colloquium, Center for Data Science and Complexity, University of Münster, Münster (Germany). *Towards an Artificial Muse for New Ideas in Physics.*

2026.05.07 Colloquium, Leibniz-Institut für Analytische Wissenschaften – ISAS, Dortmund (Germany) & online. *Towards an Artificial Muse for new Ideas in Science.*

2026.03.25 Future 3D Additive Manufacturing 2026, Bildungshaus Kloster Schöntal, Schöntal (Germany), invited talk. *Towards an Artificial Muse for New Ideas in Physics.*

2025

2025.12.18 Gravitational Physics Literature Seminar, University of Vienna, Vienna (Austria). *Towards an Artificial Muse for new ideas in Physics.*

2025.12.18 ML Seminar, TU Vienna, Vienna (Austria). *Artificial Muse for new ideas in Physics.*

2025.12.01 Science Week conference of the ORIGINS Excellence Cluster, Kloster Seon, Seon (Germany), invited talk. *Towards an Era of Artificial Scientists.*

2025.10.28 MPInat-Seminar, Max Planck Institute for Multidisciplinary Sciences, Göttingen (Germany). *Towards an artificial muse for new ideas in Physics.*

2025.10.15 Physics Colloquium, University of Tübingen, Tübingen (Germany). *Towards an Artificial Muse for new Ideas in Physics.*

2025.09.30 ML4Science Cluster Conference, University of Tübingen, Tübingen (Germany). *Towards an Artificial Muse for new Ideas in Science.*

2025.09.09 AIMat Summer School 2025 ML4Materials, KIT, Karlsruhe (Germany). *AI-driven idea generation.*

2025.08.22 Keynote HAMLET-Physics, Copenhagen, Denmark. *Towards an Artificial Muse for new Ideas in Science.*

2025.07.31 Keynote talk Fifth Workshop on Scholarly Document Processing at ACL 2025, Vienna, Austria. *Towards an Artificial Muse for new Ideas in Science.*

2025.07.17 Seminar (Autonomous Vision Group), University of Tübingen, Germany. *Towards an Artificial Muse for new Ideas in Science.*

2025.07.10 Invited Talk, IQST Workshop, Karlsruhe Institute of Technology, Germany. *Towards an Artificial Muse for new Ideas in Physics.*

2025.07.09 Colloquium Talk, University of Stuttgart, Germany. *Towards an Artificial Muse for new Ideas in Science.*

2025.07.08 Keynote talk, Symposium Machine Learning to Advance Quantum Technologies, Heilbronn, Germany. *Towards an Artificial Muse for new Ideas in Physics.*

2025.06.19 Plenary Talk, EuCAIFCon, Cagliari, Italy. *Towards an Artificial Muse for new Ideas in Physics.*

- 2025.06.16 Roundtable talk, Santa Fe Institute / DeepMind, London, UK. *Against a Dystopia of Science without Understanding.*
- 2025.06.04 Physics Colloquium, University of Duisburg-Essen, Germany. *Artificial muses in Physics.*
- 2025.06.02 Seminar, University of Oxford, United Kingdom. *AI for physics.*
- 2025.05.30 Invited Talk & Panel, SciFM25 – Scientific Discovery in the Age of AI, Ann Arbor, MI, USA. *AI discovery in physics.*
- 2025.05.22 Anton Zeilinger 80th Birthday Symposium, Vienna, Austria. *New ideas from machines for physics.*
- 2025.05.19 Workshop "AI meets Photonics", Aston University, Birmingham, UK. *De-novo design of physics experiments.*
- 2025.05.13 Keynote, Quantum Photonic Messe 2025, Erfurt, Germany. *AI-driven quantum photonics.*
- 2025.04.28 Bristol Quantum Information Technology Workshop, University of Bristol, UK. *De-novo design of experiments.*
- 2025.04.23 Quantum Machine Learning Workshop, University of Vienna, Austria. *Designing new physics experiments with AI.*
- 2025.04.03 Optics Seminar, University of Warsaw, Poland. *AI-inspired optical experiment design.*
- 2025.03.26 Virtual Seminar, First Principles. *AI-driven discovery in physics.*
- 2025.03.24 Colloquium, Vienna Center for Quantum Science & Technology (VCQ), Austria. *AI-driven experimental design.*
- 2025.03.18 Keynote, 2025 AI in Science & Engineering Symposium, University of Michigan, USA. *Artificial muses in science.*
- 2025.03.13 Liverpool Virtual Seminar Series on Data Intensive Science. *Artificial muses in Physics.*
- 2025.03.10 Wissenschaftsrat (Fokusgruppe Künstliche Intelligenz), Germany. *AI in physics and science.*
- 2025.03.04 QTLabs Seminar, Vienna (virtual). *Automated design of physics experiments.*
- 2025.01.29 CIRSS Speaker Series, University of Illinois at Urbana-Champaign (virtual). *Generative AI and the future of research (Artificial Scientists).*
- 2024**
- 2024.11.29 Connecting Physics and Computer Science: A Workshop on Data-Driven Approaches" at University Augsburg, Germany. *AI-inspired quantum (and gravitational wave) physics experiments.*
- 2024.11.26 Physics Colloquium, Muenster, Germany. *AI-inspired quantum (and gravitational wave) physics experiments.*
- 2024.11.21 AI and the Future of Science, Lingnan University, Hong Kong, China. *Artificial muses in physics.*
- 2024.11.14 Physics Colloquium, Greifswald, Germany. *Artificial muses in physics.*
- 2024.11.07 ML4QT Workshop, Erlangen, Germany , Spain. *Artificial muses in physics.*
- 2024.10.25 Mini symposium on AI and quantum physics, Gothenburg, Sweden. *Artificial muses in physics.*

- 2024.10.16 AI goes MAD², Madrid, Spain. *Artificial muses in physics.*
- 2024.09.24 MODE Workshop for ML for experimental design, Valencia, Spain. *AI-inspired quantum (and gravitational wave) physics experiments.*
- 2024.09.20 Croatian Combinatorial Days, University of Zagreb, Croatia, invited talk. *A Problem of Colored Perfect Matchings inspired by Quantum Physics.*
- 2024.09.04 Gutenberg Workshops in Life Sciences: AI for Scientific Discovery, University of Mainz (Germany), invited talk. *Artificial muses in physics.*
- 2024.09.02 Lake Como Summer School: Machine Learning Photonics invited lecture. *Artificial muses in physics.*
- 2024.07.05 Department for Quantum Technology, University of Münster (Germany), invited talk. *AI-designed quantum experiments.*
- 2024.06.26 Future of Materials Discovery, London (UK), invited talk. *Artificial muses in science.*
- 2024.06.13 STER Summer School, Warsaw (Poland), invited lecture. *Artificial muses in science.*
- 2024.05.22 Konferenz der Fachbereiche Physik (KFP), invited talk. *AI in physics.*
- 2024.05.13 Tübingen AI Symposium, invited talk. *Artificial muses in physics.*
- 2024.04.26 EU-LIFE Utopia Conference 2024, CeMM, Vienna (Austria), talk and panel discussion. *Predicting and suggesting future ideas in science.*
- 2024.04.25 University of Vienna/University of Wuppertal Philosophy Series, "Digitality and Transcendental Philosophy", invited talk. *Artificial muses in science.*
- 2024.03.27 ML for Quantum Physics Workshop, Obergurgl (Austria), invited talk. *Artificial muses in science.*
- 2024.03.18 DPG Condensed Matter Section, Berlin (Germany), invited talk. *AI for designing physics experiments.*
- 2024.03.15 DPG Atom, Molecules, Quantum Optics & Photonics, Freiburg (Germany), invited talk. *AI for designing physics experiments.*
- 2024.02.28 Workshop for Epistemological Issues of Machine Learning in Science, Dortmund (Germany), invited talk. *Artificial muses in physics.*
- 2024.01.24 Workshop for Scientific Understanding and AI, Leiden (Netherlands), invited talk. *Artificial muses in physics.*
- 2023**
- 2023.12.07 Google Research Science & AI Seminar, invited talk. *AI-driven discovery of new physics experiments, specifically new super-resolution microscopes.*
- 2023.12.01 Lingnan-Cambridge Workshop on AI in Science, Cambridge (UK), invited talk. *Concrete AI-inspired scientific discoveries.*
- 2023.12.01 Artificial Intelligence for Science of Science (AI4SciSci) Workshop, IEEE ICDM 2023 (virtual), keynote talk. *Predicting and suggesting future research directions with knowledge graphs and semantic networks.*
- 2023.11.15 MIT Optics and Quantum Electronics Seminar, invited talk. *AI-driven design of new (quantum) experiments.*
- 2023.10.12 National Academy of Sciences AI for Scientific Discovery Workshop, Washington DC (USA), invited talk and panel discussion. *AI for scientific discovery.*

- 2023.10.06 CIFAR Quantum Information Science Meeting, Banff (Canada), invited talk. *Artificial muses in quantum physics.*
- 2023.09.22 IEEE Quantum Week: Quantum Algorithm Design Automation, invited talk. *AI-based design of quantum optics.*
- 2023.09.13 European Optical Society Annual Meeting 2023, Dijon (France), invited talk. *AI-designed quantum experiments.*
- 2023.07.18 Theoretical physics seminar, University of Augsburg (Germany), invited talk. *AI as a source of inspiration in physics.*
- 2023.07.06 Annual Conference of the British Society for the Philosophy of Science, Bristol, UK, invited talk. *AI as a source of inspiration in physics.*
- 2023.06.30 "Machine Learning Summer School on applications in Science" in Krakau, Poland. Invited lecture. *AI as a source of inspiration in physics.*
- 2023.06.26 International Conference for Science of Science and Innovation, Chicago, USA, invited talk. *AI as a source of inspiration in physics.*
- 2023.05.04 Vienna Bio Center (Max Perutz Labs), Biophysics Seminar, invited talk. *AI as a source of inspiration in physics.*
- 2023.04.21 Philosophy of Contemporary and Future Science (Lingnan, Hongkong), invited online talk. *AI as a source of inspiration in physics.*
- 2023.04.10 ML and (Quantum) Physics WS, Obergurgl (Austria), invited talk. *AI as a source of inspiration in physics.*
- 2023.03.17 Tampere University (Finland), inaugural Physics Colloquium talk. *AI as a source of inspiration in physics.*
- 2023.01.27 ICFO Barcelona (Spain), invited Talk. *AI as a source of inspiration in physics.*
- 2023.01.19 aQa Leiden (Netherlands), invited Talk. *AI as a source of inspiration in physics.*
- 2023.01.11 ELLIS unconference (La Palma, Spain), invited Talk. *AI as a source of inspiration in physics.*
- 2022**
- 2022.12.15 Quantum Info & Tech Seminar, University of Stuttgart, invited Talk. *Computer-Designed Quantum Experiments.*
- 2022.11.23 New Frontiers in Machine Learning and Quantum, Waterloo Canada, invited talk. *Towards an Artificial Muse for new Ideas in Quantum Physics.*
- 2022.11.11 QTML 2022, Naples, Italy, invited talk. *Towards an Artificial Muse for new Ideas in Quantum Physics.*
- 2022.09.27 ML workshop, Galileo Galilei Institute (Florence), invited talk. *Towards an Artificial Muse for new Ideas in Quantum Physics.*
- 2022.09.22 ML4Science workshop, University Hamburg, invited talk. *Towards an Artificial Muse for new Ideas in Quantum Physics.*
- 2022.09.04 DFG Tagung, invited talk. *Towards an Artificial Muse for new Ideas in Quantum Physics.*
- 2022.07.06 Friedrich-Alexander-Universität Erlangen-Nürnberg, Physics Colloquium. *Towards an Artificial Muse for new Ideas in Quantum Physics.*
- 2022.07.06 University of Exeter (Quantum Non-Equilibrium) Seminar. *Towards an Artificial Muse for new Ideas in Quantum Physics.*

- 2022.06.24 ESA's Advanced Concepts Team Seminar. *Towards an Artificial Muse for new Ideas in Quantum Physics.*
- 2022.05.26 Bayer AG, Seminar, virtual. *Can androids dream of scientific understanding?*
- 2022.05.26 Meeting of young German Physical Society, Germany. *From Artificial Intelligence to Artificial Scientists.*
- 2022.05.26 Photonics North 2022, invited talk, Canada. *Getting inspirations and ideas from Artificial Intelligence for Quantum Optics.*

2021

- 2021.12.10 Perimeter ML Seminar, Canada. *Predicting and Suggesting research trends with Semantic and Neural Networks with an application in Quantum Physics.*
- 2021.12.01 Quantum Theory Group Seminar, FAU, Erlangen, Germany. *On computer-inspired Quantum Experiments and scientific understanding.*
- 2021.11.11 Bavarian Graduate School of Comp. Engineering, FAU, Germany. *Predicting and Suggesting research trends with Semantic and Neural Networks.*
- 2021.11.10 Guest lecture, University of Rochester, USA. *SELFIES: A 100% robust molecular representation for ML in chemistry.*
- 2021.11.02 IBM Zurich Seminar, Switzerland. *SELFIES: A 100% robust molecular representation for ML in chemistry.*
- 2021.07.07 Machine Learning for Quantum X workshop, KIT, Germany. *On computer-inspired Quantum Experiments and scientific understanding.*
- 2021.06.30 Artificial Scientific Discovery workshop, MPL, Germany. *On computer-inspired Quantum Experiments and scientific understanding.*
- 2021.04.30 ETH Zurich, Switzerland. *On computer-inspired Quantum Experiments.*
- 2021.04.23 4th University of Florida Drug Discovery Symposium (online). *A 100% robust molecular string representation for ML in Chemistry.*
- 2021.03.04 Carnegie Mellon University, Scientific ML Webinar Series. *A 100% robust molecular string representation for ML in Chemistry.*
- 2021.02.23 Max Planck Research Group Symposium, Germany. *On computer-inspired Quantum Experiments.*
- 2021.02.17 Max Planck Institute for the Science of Light, Seminar (online), Germany. *On computer-inspired Quantum Experiments.*

2020

- 2020.11.24 Q-Turn 2020, online. *Conceptual understanding through efficient inverse-design of quantum optical experiments.*
- 2020.11.18 National University of Singapore, Quantum Machine Learning Seminar, online. *Predicting and Suggesting research trends with Semantic and Neural Networks with an application in Quantum Physics.*
- 2020.11.12 TU Delft, Quantum Nanoscience Seminar, online. *Towards Computer-Inspired Quantum Physics Research.*
- 2020.11.10 Quantum Techniques in Machine Learning (QTML) 2020, online. *Conceptual understanding through efficient inverse-design of quantum optical experiments.*
- 2020.10.19 Quantum 2020, online. *Conceptual understanding through efficient inverse-design of quantum optical experiments.*

- 2020.09.19 NetSci MMXX, Machine Learning In Network Science Symposium. *Predicting research trends with semantic and neural networks with an application in quantum physics.*
- 2020.08.20 Matter lab Seminar, University of Toronto, Canada, online. *Conceptual understanding through efficient inverse-design of quantum optical experiments.*
- 2020.06.30 A.I. Socratic Circles - AISC, online. *Conceptual understanding through efficient inverse-design of quantum optical experiments.*
- 2020.06.25 Photonics Online Meetup #POM20Ju. *Conceptual understanding through efficient inverse-design of quantum optical experiments.*
- 2020.06.19 Max Planck Institute for the Science of Light, Seminar (online), Germany. *Conceptual understanding through efficient inverse-design of quantum optical experiments.*
- 2020.04.23 A.I. Socratic Circles - AISC, online. *SELFIES: A 100% robust representation of semantically constrained Graphs, for deep generative models.*
- 2019**
- 2019.11.14 Chemistry Postdoc Seminar, University of Toronto, Canada. *SELFIES: A robust representation for chemistry and beyond.*
- 2019.08.16 Matter lab Seminar, University of Toronto, Canada. *SELFIES: A robust representation for chemistry and beyond.*
- 2019.07.14 FQMT19, Prague, Czech Republic - invited. *On Computer inspired Science.*
- 2019.06.20 ICOAM19, Ottawa, Canada - invited. *On Computer inspired Science.*
- 2019.01.17 Matter lab Seminar, University of Toronto, Canada. *On Computer inspired Quantum Experiments.*
- 2018**
- 2018.12.19 IQOQI Vienna Seminar, Vienna, Austria. *Towards Predicting and Suggesting Quantum Physics Research.*
- 2018.12.18 Machine Learning Seminar, University of Linz, Austria. *On computer-inspired Quantum Experiments.*
- 2018.12.14 SFB Meeting, Vienna University of Technology, Austria - invited. *On Computer-designed Quantum Experiments.*
- 2018.11.27 Loschmidt-Prize Talk, University of Vienna, Austria. *On computer-inspired Experiments for Quantum Physics.*
- 2018.11.22 ÖAW A.I. Initiative, Vienna, Austria. *On Computer-inspired Quantum Experiments.*
- 2018.09.28 Croatian Combinatorial Days, University of Zagreb, Croatia - invited. *A conjecture about Perfect Matchings motivated by Quantum Mechanics.*
- 2018.09.03 PHOTON18, Birmingham, United Kingdom - invited. *On Computer-inspired Quantum Experiments.*
- 2018.02.22 Highlight-Talk at FÖP, Faculty for Physics, University of Vienna, Austria) - invited. *On Computer inspired Quantum Experiments.*
- 2018.01.17 IQOQI Vienna Seminar, Vienna, Austria. *Quantum Experiments and Graphs.*
- 2017**
- 2017.09.20 ICOAM17, Anacapri, Italy. *On Computer-designed Quantum Experiments.*
- 2017.07.14 FQMT17, Prague, Czech Republic – invited. *On Computer-designed Quantum Experiments.*

2017.05.30 Budapest-Vienna Quantum Meeting, Vienna, Austria – invited. *On Computer-designed Quantum Experiments.*

2017.05.17 IQOQI Vienna Seminar, Vienna, Austria. *Entanglement by Path Identity.*

2016

2016.09.29 ÖPG Meeting 2016, University of Vienna, Austria. *Automated Search for new Quantum Experiments.*

2016.04.08 SFB Meeting, Vienna University of Technology, Austria. *Automated Search for new Quantum Experiments.*

2016.03.18 APS March Meeting, Baltimore, USA - invited. *Twisted photon entanglement through turbulent air across Vienna.*

2015

2015.12.14 Quantum Optics Lab Seminar, University of Warsaw, Poland Automated Search for new Quantum Experiments

2015.12.09 Quantum Information Seminar, University of Stockholm, Sweden. *Automated Search for new Quantum Experiments.*

2015.11.11 Institute for Theoretical Physics Seminar, University of Innsbruck, Austria. *Automated Search for new Quantum Experiments.*

2015.09.02 ÖPG Meeting 2015, Vienna, Austria. *Twisted photon entanglement through turbulent air across Vienna.*

2015.08.04 ICOAM 2015, New York, USA. *Twisted photon entanglement through turbulent air across Vienna.*

2015.07.27 FQMT 2015, Prague, Czech Republic – invited. *Twisted photon entanglement through turbulent air across Vienna.*

2015.06.03 IQOQI Vienna Seminar, Vienna, Austria. *Automated Search for new Quantum Experiments.*

2014

2014.04.02 IQOQI Vienna Seminar, Vienna, Austria. *OAM meets Free-Space.*

2013

2013.09.05 ÖPG Meeting 2013, Linz, Austria. *Studies of Quantum Entanglement in 100 Dimensions.*

2013.05.08 Quantum Theory Seminar, UAB, Barcelona, Spain. *Quantum-Experiments in high-dimensional Hilbert-Spaces.*

2013.05.07 Quantum Theory Seminar, ICFO, Barcelona, Spain. *Quantum-Experiments in high-dimensional Hilbert-Spaces.*

2013.03.20 IQOQI Vienna Seminar, Vienna, Austria. *Spatial mode structures of photons.*

2012

2012.03.20 IQOQI Vienna Seminar, Vienna, Austria. *Entanglement of complex Structures of Photons.*

2012.03.15 International OAM Workshop, Vienna, Austria. *Entanglement of complex Structures of Photons.*

2012.03.12 APS March Meeting, Boston, USA. *Entanglement of complex Structures of Photons.*

Teaching

University of Tübingen

- SS 2026 Course, University of Tübingen. *Introduction to Quantum Computing* (6 ECTS).
- SS 2026 Seminar, University of Tübingen. *Artificial Intelligence for Scientific Discovery II* (3 ECTS).
- WS 2025 Seminar, University of Tübingen. *Artificial Intelligence for Scientific Discovery I* (3 ECTS).

FAU Erlangen

- SS 2024 Course, FAU Erlangen. *From Artificial Intelligence to Artificial Scientists* (2.5 ECTS).
- WS 2022 Seminar, FAU Erlangen. *Modern Methods in Nonlinear Optics and Machine Learning for Optics* (2 ECTS).

Service

- Since 2026 Member of Wissenschaftsrat, Arbeitsgruppe KI und Wissenschaft.
- Since 2026 Associate Editor of APS's *PRX Intelligence*.
- Since 2024 Editorial Board, *Machine Learning: Science & Technology*.
- Since 2023 Action Editor, *Data-centric Machine Learning Research*.