Philip Taranto

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ORCiD

Profile

I am enthusiastic, diligent, and passionate about learning and growing through experience and application. I thrive on solving complex problems, distilling key ideas and disseminating expertise broadly to stir interdisciplinary advancement. My research focuses on quantum physics and mathematics, through which I aspire to positively impact society. I am also interested in the arts — especially literature & music — and the intersection of culture, politics and society, and philosophy.

Commitment

I am committed to empowering historically excluded and marginalised groups, in particular those that face systemic oppression due to class, race, ethnicity, gender, sexuality, or disability (amongst others). I am an advocate for open science and climate justice, and am constantly working to improve structural and material conditions both within and beyond the academic landscape.

Academic Employment

Present—2025/01: **Lecturer (Assistant Professor)**
The University of Manchester (United Kingdom)

2025/01—2022/12: **Post-Doctoral Researcher**
Group of Prof. Mio Murao, The University of Tokyo (Japan)

2022/11—07: **Post-Doctoral Researcher**
Group of Prof. Marcus Huber, TU Wien (Austria)

Academic Service

Present—2024/07: **Editor:** Quantum journal

Present—2025/05: **Mentor:** Research Girl

Grants & Funding

2024 (offer declined): **Japan Society for the Promotion of Science JSPS Post-Doctoral Fellowship (~9m ¥)**
Higher-Order Quantum Information Processing in Space and Time:
Towards Robust Quantum Functions

2024/02—2023/03: **Japan Society for the Promotion of Science JSPS Post-Doctoral Fellowship (~4.5m ¥) + KAKENHI Grant-in-Aid for Scientific Research (~1m ¥)**
Characterizing and Controlling Complex Quantum Processes with Classical Memory

20219/03—2017/03: **Australian Government RTP Postgraduate Scholarship (~60k AUD)**
Monash University (Physics) J. L. Williams Postgraduate Top-up Scholarship (~15k AUD)
Stipend and tuition scholarship (plus top-up) for postgraduate students in Australia

Research

I currently lead the **Quantum Information & Spatiotemporal Phenomena (QuISP)** group at the University of Manchester. My research interests lie at the interface of quantum physics, mathematics, and information science:

— Quantum Information Theory
— Quantum Thermodynamics
— Quantum Foundations
— Quantum Computation & Simulation
— Open Quantum Dynamics
— Correlations & Entanglement
— Stochastic & Complex Processes
— Philosophy of Physics & Science

According to Google Scholar, my research has generated 529 citations, with an h-index of 11 (as of 20/07/2025). I pride myself on successful international collaboration, having worked with around 50 coauthors whose affiliations span at least 25 external institutions across academia and industry. I am also currently an editor for Quantum journal.

Present—2025/01:
QuISP Group Leader

Learning the Spectral Moments of Unknown Quantum Channels
Authors: Ryotaro Niwa, Philip Taranto, Zane Rossi, Mio Murao
Pre-print: arXiv:2506.24112

Higher-Order Quantum Operations
Authors: Philip Taranto, Simon Milz, Mio Murao, Marco Túlio Quintino, Kavan Modi
Pre-print: arXiv:2503.09693

2024/12—2022/07:
Post-doc (Murao)

★ **Exponential Separation for the Quantum Query Complexity of the Quantum Switch with Respect to Simulations with Standard Quantum Circuits**
Authors: Hlér Kristjánsson[1], Satoshi Yoshida[1], Tatsuki Odake[1], Philip Taranto, Jessica Bavaresco, Marco Túlio Quintino, Mio Murao
Pre-print: arXiv:2409.18420

Can the Quantum Switch be Deterministically Simulated?
Authors: Jessica Bavaresco, Satoshi Yoshida, Tatsuki Odake, Hlér Kristjánsson, Philip Taranto, Mio Murao, Marco Túlio Quintino
Pre-print: arXiv:2409.18202

Robust Error Accumulation Suppression for Quantum Computers
Authors: Tatsuki Odake, Philip Taranto, Nobuyuki Yoshioka, Toshinari Itoko, Kunal Sharma, Antonio Mezzacapo, Mio Murao
Published: Phys. Rev. Research 7, 033029 (2025)
Pre-print: arXiv:2401.16884

Universal Algorithm for Transforming Hamiltonian Eigenvalues
Authors: Tatsuki Odake, Hlér Kristjánsson, Philip Taranto, Mio Murao
Published: Phys. Rev. Research 7, 013331 (2025)
Pre-print: arXiv:2312.08848

Efficiently Cooling Quantum Systems with Finite Resources:
Insights from Thermodynamic Geometry
Authors: Philip Taranto[1], Patryk Lipka-Bartosik[1], Nayeli A. Rodríguez-Briones, Martí Perarnau-Llobet, Nicolai Friis, Marcus Huber, Pharnam Bakhshinezhad
Published: Phys. Rev. Lett. 134, 070401 (2025)
Pre-print: arXiv:2404.06649

Characterising the Hierarchy of Multi-time Quantum Processes with Classical Memory
Authors: Philip Taranto, Marco Túlio Quintino, Mio Murao, Simon Milz
Published: Quantum 8, 1328 (2024)
Pre-print: arXiv:2307.11905

2022/06—2019/07:
PhD (Huber)

Quantum Information Processing: Thermodynamics, Complexity, and Multi-Time Phenomena (PhD Dissertation)
Authors: Philip Taranto
Available: University of Vienna Library

★ **Hidden Quantum Memory: Is Memory There When Somebody Looks?**
Authors: Philip Taranto, Thomas J. Elliott, Simon Milz
Published: Quantum 7, 991 (2023)

Pre-print: arXiv:2204.08298

Connecting Commutativity and Classicality for Multi-Time Quantum Processes
Authors: Fattah Sakuldee, Philip Taranto, Simon Milz
Published: Phys. Rev. A 106, 022416 (2022)
Pre-print: arXiv:2204.11698

★ **Landauer vs. Nernst: What is the True Cost of Cooling a Quantum System?**
Authors: Philip Taranto[1], Faraj Bakhshinezhad[1], Andreas Bluhm[2], Ralph Silva[2], Nicolai Friis, Maximilian P. E. Lock, Giuseppe Vitagliano, Felix C. Binder, Tiago Debarba, Emanuel Schwarzhans, Fabien Clivaz, Marcus Huber
Published: PRX Quantum 4, 010332 (2023)
Pre-print: arXiv:2106.05151

Experimental Demonstration of Instrument-Specific Quantum Memory Effects and Non-Markovian Process Recovery for Common-Cause Processes
Authors: Yu Guo[1], Philip Taranto[1], Bi-Heng Liu, Xiao-Min Hu, Yun-Feng Huang, Chuan-Feng Li, Guang-Can Guo
Published: Phys. Rev. Lett. 126, 230401 (2021)
Pre-print: arXiv:2003.14045

Exponential Improvement for Quantum Cooling through Finite-Memory Effects
Authors: Philip Taranto, Faraj Bakhshinezhad, Philipp Schüttelkopf, Fabien Clivaz, Marcus Huber
Published: Phys. Rev. Appl. 14, 054005 (2020)
Pre-print: arXiv:2004.00323

★ **When is a Non-Markovian Quantum Process Classical?**
Authors: Simon Milz, Dario Egloff, Philip Taranto, Thomas Theurer, Martin B. Plenio, Andrea Smirne, Susana F. Huelga
Published: Phys. Rev. X 10, 041049 (2020)
Pre-print: arXiv:1907.05807

2019/03—2017/03: Masters (Modi)

Memory Effects in Quantum Processes (Masters Thesis)
Author: Philip Taranto
Published: Int. J. Quantum Inf. 18, 1941002 (2020)
Pre-print: arXiv:1909.05245

Non-Markovian Memory Strength Bounds Quantum Process Recoverability
Authors: Philip Taranto, Felix A. Pollock, Kavan Modi
Published: npj Quantum Inf. 7, 149 (2021)
Pre-print: arXiv:1907.12583

★ **Quantum Markov Order**
Authors: Philip Taranto, Felix A. Pollock, Simon Milz, Marco Tomamichel, Kavan Modi
Published: Phys. Rev. Lett. 122, 140401 (2019)
Pre-print: arXiv:1805.11341

The Structure of Quantum Stochastic Processes with Finite Markov Order
Authors: Philip Taranto, Simon Milz, Felix A. Pollock, Kavan Modi
Published: Phys. Rev. A 99, 042108 (2019)
Pre-print: arXiv:1810.10809

[1,2] Equal contributions.

★ Denotes 5 most important works.

| 2015/11—03:
Honours (Modi) | **Emergence of a Fluctuation Relation for Heat in Nonequilibrium Open Quantum Processes**
Authors: Philip Taranto, Felix A. Pollock, Kavan Modi
Published: Phys. Rev. E 97, 052111 (2018)
Pre-print: arXiv:1510.08219 |

Education

2022/06—2019/06	**University of Vienna — Doktor der Naturwissenschaften [PhD Equivalent] (Physics)** **Thesis:** Quantum Information Processing: Thermodynamics, Complexity, and Multi-Time Phenomena **Supervisor:** Prof. Marcus Huber **Assessors:** Prof. Nicolas Brunner & Prof. John Goold **Date of Defence:** 28/06/2022 **Grade:** 1.0 Distinction (Highest Possible)
2022/11—02	**Atominstitut, Technische Universität Wien (Vienna)**
2021/01—2019/07	**Institute for Quantum Optics and Quantum Information (IQOQI Vienna)**
2019/03—2017/03	**Monash University, Melbourne — Master of Science (Physics)** **Thesis:** Memory Effects in Quantum Processes **Supervisors:** Prof. Kavan Modi & Dr. Felix A. Pollock **Assessors:** Prof. G. Massimo Palma & Dr. Fabio Costa **Grade:** H1 (97%)
2015/11—03	**Monash University, Melbourne — Bachelor of Science (Honours)** **Thesis:** Landauer's Principle in Nonequilibrium Quantum Thermodynamics **Supervisors:** Prof. Kavan Modi & Dr. Felix A. Pollock **Assessors:** Prof. Peter Skands & Dr. Meera Parish **Grade:** H1 **/ GPA:** 4.000 (Highest Possible)
2014/11—2012/03	**Monash University, Melbourne — Bachelor of Science (Science Scholar Program)** **Majors:** Double Major in Applied Mathematics, Major in Physics **GPA:** 3.917
2011/12—2006/02	**De La Salle College, Melbourne** **ATAR Grade:** 99.35 (College Dux)

Supervision

Present—2025	**Main Supervisor** **PhD Thesis:** Maria Eduarda Filippetto, "Quantum Thermodynamics and Indefinite Causality: Exploring the Arrow of Time and Implications for Processing Quantum Information", The University of Manchester (Co-Supervisor: Ahsan Nazir).
Present—2025	**Main Supervisor** **PhD Thesis:** Tzu-Liang Hsu, "Designing Optimal Strategies for Controlling Complex Quantum Systems", The University of Manchester (Co-Supervisors: Mauricio Álvarez, Wei Pan).
Present—2025	**Main Supervisor** **PhD Thesis:** Irene Valladares Duque, "On the Interplay between Classicality and Memory in Complex Quantum Processes", The University of Manchester (Co-Supervisor: Ahsan Nazir).
Present—2024	**Co-Supervisor** **Master's Thesis:** Ryotaro Niwa, "Learning Properties of Unknown Quantum Dynamics", The University of Tokyo (Official Supervisor: Mio Murao).

Present—2023	**Co-Supervisor**
	PhD Thesis: Timothy Forrer, "Functional Quantum Circuits", The University of Tokyo (Official Supervisor: Mio Murao).
2025—2020	**Co-Supervisor**
	Master's Thesis: Felix Hubmann, "Open quantum evolution from thermodynamic collision models", University of Vienna (Co-supervisors: Simon Milz, Felix Binder; Official Supervisor: Marcus Huber).
2024—2023	**Co-Supervisor**
	Master's Thesis: Ludvig Lindström, "Probabilistic Exact Inversion of 2-qubit Bipartite Unitary Operations using Local Operations and Classical Communication", The University of Tokyo (Official Supervisor: Mio Murao).
2020—2019	**Co-Supervisor**
	Master's Thesis: Philipp Schüttelkopf, "Non-Markovian dynamics in quantum cooling", University of Vienna (Official Supervisor: Marcus Huber).
	Grade: 1.0 (Highest Possible)

Teaching

Present—2025/01	**Lecturer — University of Manchester**
	Lecturing undergraduate courses twice weekly to ~100+ students, holding office hours, grading assignments and exams, and responding to student queries.
Present—2025/10	**Unit Coordinator — Quantum Information & Computation:** Third Year Physics Option. New course design from scratch: 22 lectures / 6 problem sheets / exams.
Present—2025/01	**Tutor — University of Manchester**
	Tutoring undergraduate courses twice weekly to groups of ~20+ students, holding office hours, grading assignments and exams, and responding to student queries.
2025	**Semester 2:** Second Year Core Physics: Quantum mechanics, statistical mechanics & electromagnetism.
2018/11—2015/03	**Teaching Assistant — Monash University**
	Tutoring undergraduate courses twice weekly to groups of ~20+ students, holding office hours, grading assignments and exams, and responding to student queries.
2018	**Semester 2:** Second Year Core Physics: Optics, electromagnetism & quantum theory.
	Semester 1: Second Year Core Physics: Electromagnetism, thermodynamics & entropy.
2017	**Semester 2:** First Year Core Physics: The Area for Physics & Astronomy Study Tutor.
	Semester 1: Foundation Physics Laboratories: Mechanics & kinematics, electromagnetism, quantum physics.
2015	**Semester 2:** Advanced Engineering Maths: Complex analysis, integral transforms, statistics.
	Semester 1: Foundation Engineering Maths: Functions, coordinate geometry, complex numbers, calculus, vector analysis.
2018—2012	**Private Tutoring**
	Tutoring undergraduate and high school students with a range of abilities in topics of mathematics, physics and chemistry, both in a one-on-one and small class (~8 students) format.

International Conferences

| 2025/02 | **Quantum Information Processing (Raleigh NC, USA)** |
| | **Contributed Talk:** Universal Algorithm for Transforming Hamiltonian Eigenvalues (presented by Hlér Kristjánsson) |

2024/11	**From Quantum Materials to Quantum Information: Symposium on Trans-Scale Quantum Science and Quantum Materials Synthesis (OIST Okinawa, Japan)**

Contributed Talk: Characterising the Hierarchy of Multi-time Quantum Processes with Classical Memory

2024/10	**Quantum Innovation (Tokyo, Japan)**

Poster: Hidden Quantum Memory: Is Memory There When Somebody Looks?

2024/07	**Emergence of Classicality: New Perspectives on Measurements in Quantum Theory (Dublin, Ireland)**

Contributed Talk: Landauer vs. Nernst: What is the True Cost of Cooling a Quantum System?

2024/06	**Swiss-Japanese Quantum Symposium (Tokyo, Japan)**

Poster: Hidden Quantum Memory: Is Memory There When Somebody Looks?

2024/05	**Workshop on Stochastic Thermodynamics [WOST V] (Online)**

Contributed Talk: Cooling Quantum Systems with Finite Resources: Optimal and Attainable Protocols (presented by Pharnam Bakhshinezhad)

2024/01	**Quantum Information Processing (Taipei, Taiwan)**

Poster: Hidden Quantum Memory: Is Memory There When Somebody Looks?

2023/12	**Japanese-French Quantum Information Workshop (Tokyo, Japan)**

Invited Talk: Characterising the Hierarchy of Multi-time Quantum Processes with Classical Memory

2023/12	**International Conference on Quantum Energy (Melbourne, Australia)**

Contributed Talk: Characterising the Hierarchy of Multi-time Quantum Processes with Classical Memory

2023/11	**Quantum Innovation (RIKEN Tokyo, Japan)**

Poster: Characterising the Hierarchy of Multi-time Quantum Processes with Classical Memory

2023/06	**Quantum Information (Benasque, Spain)**

2023/02	**JSPS Japan—NUS Singapore Joint Seminar (NII Tokyo, Japan)**

Poster: Operational Characterisation of Quantum Memory Effects via Multi-Time Probing Schemes

2022/09	**Quantum Characterization and Control of Quantum Complex Systems (Lake Como, Italy)**

Poster: Operational Characterisation of Quantum Memory Effects via Multi-Time Probing Schemes

2022/09	**Quantum Intelligence (LOFAR Birr, Ireland)**

Invited Talk: Hidden Quantum Memory: Is Memory There When Somebody Looks?

2022/08	**Quantum Confessions (Mehedeby, Sweden)**

Contributed Talk: Hidden Quantum Memory: Is Memory There When Somebody Looks?

2022/07	**741. WE-Heraeus-Seminar. Quantum Measurement Theory: Foundations and Applications (Bad Honnef, Germany)**

Poster: Operational Characterisation of Quantum Memory Effects via Multi-Time Probing Schemes

2022/05	**Workshop on Stochastic Thermodynamics [WOST III] (Online)**

Poster: Landauer vs. Nernst: What is the True Cost of Cooling a Quantum System?

2022/04	**European Spring School for Quantum Science & Technology (Strasbourg, France)**

Poster: Landauer vs. Nernst: What is the True Cost of Cooling a Quantum System?

2021/10	**Quantum Thermodynamics [QTD] (Online)**

Contributed Talk: Landauer vs. Nernst: What is the True Cost of Cooling a Quantum System?

2021/04	**International Conference for Young Quantum Information Scientists VI [YQIS] (Online)**
	Contributed Talk: Exponential Improvement for Quantum Cooling through Finite-Memory Effects
2020/11	**Q-Turn (Online)**
	Contributed Talk: Exponential Improvement for Quantum Cooling through Finite-Memory Effects
2020/06	**Conference on the Theory of Quantum Computation, Communication and Cryptography [TQC] (Online)**
	Poster: Memory Effects in Quantum Processes
2019/09	**International Conference for Young Quantum Information Scientists V [YQIS] (Gdańsk, Poland)**
	Poster: Memory Effects in Quantum Processes
2019/06	**Quantum Information (Benasque, Spain)**

Invited Talks & Academic Seminars

2025/03	**University of York (York, United Kingdom)**
	Talk: Higher-Order Quantum Operations
	Host: Máté Farkas
2024/07	**Trinity College (Dublin, Ireland)**
	Talk: Characterising the Hierarchy of Multi-time Quantum Processes with Classical Memory
	Host: Felix Binder
2024/05	**University of Manchester (Manchester, United Kingdom)**
	Talk: Spatiotemporal Quantum Phenomena
	Host: Department of Physics & Astronomy
2024/02	**University of Edinburgh (Edinburgh, Scotland)**
	Talk: Characterising & Controlling Complex Quantum Processes with Classical Memory
	Host: Mina Doosti
2024/02	**Sorbonne University (Paris, France)**
	Talk: Characterising & Controlling Complex Quantum Processes with Classical Memory
	Host: Marco Túlio Quintino
2023/06	**University of Geneva (Geneva, Switzerland)**
	Talk: Hidden Quantum Memory: Is Memory There When Somebody Looks?
	Host: Nicolas Brunner
2023/05	**Centre for Quantum Technologies (Singapore, Singapore)**
	Talk: Describing Complex Multi-time Phenomena in the Quantum Realm
	Host: Ng Hui Khoon
2022/11	**University of Tokyo (Tokyo, Japan)**
	Talk: Hidden Quantum Memory: Is Memory There When Somebody Looks?
	Host: Mio Murao

Review & Community

| Present—2024/07 | **Editor:** Quantum Journal: I have overseen the editorial process for ~15 submissions (see Web of Science profile). |
| Present—2020 | **~40 verified Peer Reviews in 7 Journals:** Phys. Rev. Lett., PRX Quantum, Phys. Rev. Research, Phys. Rev. A, Quantum, Int. J. Quantum Inf., and ACM Trans. Quantum Comput. (see Web of Science profile). |

Present—2025	**Conference Scientific Committee:** YQIS2025 (Young Quantum Information Scientists)
Present—2024	**1 Conference Review:** CDC2024 (IEEE Conference on Decision and Control)
2023/02	**Masters Thesis External Examiner:** Macquarie University, Australia
2025/01—2023/02	**Qulink Seminar (International)** **Organiser:** Monthly seminar hosted between The University of Tokyo, NII, and OIST (all in Japan). Role includes inviting a diverse array of internationally renowned experts in fields related to quantum information science and computing, facilitating presentations, and chairing discussion sessions.
2020/07	**Huber Group Retreat (Hohentauern, Austria)** **Organiser:** 4 days, ~20 members, 8 invited talks, 4 workshops (Entanglement & Non-locality, Quantum Thermodynamics, Causality, Assessing & Reshaping Issues in the Academic Landscape)

Outreach

2020/07	**Nice to Know Podcast** **Episode 9:** Philosophy? Technology? Quantum Physics

Selected Awards & Grants

2024 (offer declined)	— Japan Society for the Promotion of Science (JSPS) Fellowship: Higher-Order Quantum Information Processing in Space and Time: Towards Robust Quantum Functions
2024—2023	— Japan Society for the Promotion of Science (JSPS) Fellowship: Characterizing and Controlling Complex Quantum Processes with Classical Memory
2018—2017	— Australian Government RTP Postgraduate Scholarship
	— Monash University (Physics) J. L. Williams Postgraduate Top-up Scholarship
2015	— Highly Commended Honours Student
2014—2012	— Dean's Honours List Fellow
	— Monash University Scholarship for Academic Excellence
2011	— Dux of De La Salle College

Languages

English	**German**
Native	Advanced (CEFR C1)
Italian	**Japanese**
Intermediate (CEFR B1)	Beginner (JLPT N4)

References

Dr. Marcus Huber	**Dr. Mio Murao**
Institute Director	Professor
Atominstitut, TU Wien	University of Tokyo
Vienna, Austria	Tokyo, Japan
marcus.huber@tuwien.ac.at	murao@phys.s.u-tokyo.ac.jp
Dr. Kavan Modi	**Dr. Felix Binder**
Professor	Assistant Professor
Monash University	Trinity College, University of Dublin
Melbourne, Australia	Dublin, Ireland
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