

PAUL MENCZEL

RESEARCH OBJECTIVE

To understand the interaction of quantum systems with their environment, learn about the laws of thermodynamics on the quantum scale and to explore and optimize the performance of nanoscopic thermal devices.

PROFESSIONAL EXPERIENCE

Postdoc	RIKEN, Theoretical Quantum Physics Laboratory (Japan) Studying the thermodynamics of strongly coupled open quantum systems and contributing to the development of QuTiP (Quantum Toolbox in Python). Since 2022 as a fellow of the Japan Society for the Promotion of Science (JSPS). <i>Group leader:</i> Prof. Franco Nori	Jan 2021 — today
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EDUCATION

PhD	Aalto University, Department of Applied Physics (Finland) Graduated as Doctor of Science (Technology) on December 16, 2020. <i>Thesis:</i> Coherent Thermal Machines: Fluctuations and Performance <i>Advisor:</i> Prof. Christian Flindt, Aalto University <i>Opponent:</i> Prof. Eric Lutz, University of Stuttgart	Aug 2016 — Dec 2020
	Research visit: RIKEN (Japan) With financial support by the CMMP network.	Sep 2019 — Dec 2019
MSc	Heidelberg University, Institute for Theoretical Physics (Germany) <i>Thesis:</i> Model Building in F-Theory Using Hypercharge Fluxes <i>Advisor:</i> Dr. Eran Palti <i>Grade:</i> 1.0 (highest achievable grade)	Sep 2012 — Mar 2016
	Student Exchange, University of Helsinki (Finland) With financial support by the Erasmus exchange program.	Sep 2013 — Jun 2014
BSc	University of Stuttgart, Faculty of Mathematics and Physics (Germany) Double degree in Physics and Mathematics. <i>Thesis:</i> Modelling Open Quantum Systems with Coherent States <i>Advisors:</i> Profs. Udo Seifert and Marcel Griesemer <i>Grades:</i> Physics: 1.2, Mathematics: 1.3 on a scale from 5 (worst) to 1 (best)	Sep 2008 — Sep 2012

SCHOLARSHIPS

JSPS Postdoctoral Fellowship for Research in Japan (Nominated by the Alexander von Humboldt-Foundation).

Host researcher: Prof. Franco Nori, RIKEN.

Fellowship tenure: 24 months. Could not be realized due to COVID entry restrictions in Japan.

JSPS Postdoctoral Fellowship for Research in Japan (Short-Term).

Host researcher: Prof. Franco Nori, RIKEN.

Fellowship tenure: 12 months (June 2022 - June 2023).

JSPS Postdoctoral Fellowship for Research in Japan (Standard).

Host researcher: Prof. Franco Nori, RIKEN.

Fellowship tenure: 24 months (since October 2023).

PUBLICATIONS

Non-Hermitian Pseudomodes for Strongly Coupled Open Quantum Systems: Unravelings, Correlations and Thermodynamics

P. Menczel, K. Funo, M. Cirio, N. Lambert, and F. Nori.

arXiv:2401.11830 [quant-ph] (2024).

Fixing detailed balance in ancilla-based dissipative state engineering

N. Lambert, M. Cirio, J.-D. Lin, P. Menczel, P. Liang, and F. Nori.

arXiv:2310.12539 [quant-ph] (2023).

Pseudofermion method for the exact description of fermionic environments: From single-molecule electronics to the Kondo resonance

M. Cirio, N. Lambert, P. Liang, P.-C. Kuo, Y.-N. Chen, P. Menczel, K. Funo, and F. Nori.

Phys. Rev. Research **5**, 033011 (2023).

QuTiP-BoFiN: A bosonic and fermionic numerical hierarchical-equations-of-motion library with applications in light-harvesting, quantum control, and single-molecule electronics

N. Lambert, T. Raheja, S. Cross, P. Menczel, S. Ahmed, A. Pitchford, D. Burgarth, and F. Nori.

Phys. Rev. Research **5**, 013181 (2023).

Cooper-Pair Box Coupled to Two Resonators: An Architecture for a Quantum Refrigerator

A. Guthrie, C. D. Satrya, Y.-C. Chang, P. Menczel, F. Nori, and J. P. Pekola.

Phys. Rev. Appl. **17**, 064022 (2022).

Thermodynamic uncertainty relations for coherently driven open quantum systems

P. Menczel, E. Loisa, K. Brandner, and C. Flindt.

J. Phys. A **54**, 314002 (2021).

Quantum jump approach to microscopic heat engines

P. Menczel, C. Flindt, and K. Brandner.

Phys. Rev. Research **2**, 033449 (2020).

Thermodynamics of cyclic quantum amplifiers

P. Menczel, C. Flindt, and K. Brandner.

Phys. Rev. A **101**, 052106 (2020).

Limit cycles in periodically driven open quantum systems

P. Menczel and K. Brandner.

J. Phys. A **52**, 43LT01 (2019). Selected as featured article.

Two-stroke optimization scheme for mesoscopic refrigerators

P. Menczel, T. Pyhäranta, C. Flindt, and K. Brandner

Phys. Rev. B **99**, 224306 (2019).

Universal First-Passage-Time Distribution of Non-Gaussian Currents

S. Singh, P. Menczel, D. S. Golubev, I. M. Khaymovich, J. T. Peltonen, C. Flindt, K. Saito, É. Roldán, and J. P. Pekola.

Phys. Rev. Lett. **122**, 230602 (2019).

Photon counting statistics of a microwave cavity

F. Brange, P. Menczel, and C. Flindt.

Phys. Rev. B **99**, 085418 (2019).

CONFERENCES

TALKS

Invited talk: *Unravelings of time-local quantum master equations*

RIKEN-KAIST-NCTS Joint Workshop on QIS at NCTS, Tainan, Taiwan (Dec 2023).

Seminar talk: *Unravelings of time-local quantum master equations*

Center for Quantum Technology at NTHU, Hsinchu, Taiwan (Dec 2023).

Invited talk: *Quantum Thermal Machines at Weak and Strong Coupling*

Hatano Lab Seminar at the University of Tokyo, Tokyo, Japan (Oct 2023).

Invited talk: *From Pistons to Qubits: The Thermodynamics of Quantum Systems*

Keynote Talk at RIKEN CPR Workshop for Graduate Students (Dec 2022).

Contributed talk: *Pseudomode Description of the Strongly Coupled Caldeira-Leggett Model*

Spring Workshop on Quantum Thermodynamics, Siegen, Germany (Mar 2022).

Contributed talk: *Thermodynamics of Cyclic Quantum Amplifiers*

Heraeus-Seminar “Quantum Thermodynamics for Young Scientists”, Bad Honnef, Germany (Feb 2020).

Invited talk: *Limit cycles in periodically driven open quantum systems*

Yagami Statistical Physics Seminar at Keio University, Yokohama, Japan (Sep 2019).

Seminar talk: *Two-Stroke Optimization Scheme for Mesoscopic Refrigerators*

Aalto Quantum Physics Seminar at Aalto University, Espoo, Finland (Jun 2019).

Contributed talk: *Thermodynamic Bounds on Dissipation in Open Quantum Systems*

DPG Spring Meeting, Berlin, Germany (Mar 2018).

Seminar talk: *Thermodynamic Bounds on Dissipation in Open Quantum Systems*

LTL Quantum Physics Seminar at Aalto University, Espoo, Finland (Nov 2017).

POSTER CONTRIBUTIONS

Non-Hermitian Pseudomode Description of Strongly Coupled Open Quantum Systems, Statphys 28, Tokyo, Japan (Aug 2023).

Non-Hermitian Pseudomode Description of Strongly Coupled Open Quantum Systems, QTD2023, Vienna, Austria (Jul 2023).

Two-Stroke Optimization Scheme for Mesoscopic Refrigerators, Quantum ThermoDynamics Conference, Espoo, Finland (Jun 2019).

Thermodynamic Bounds on the Precision of Quantum Machines, SPICE-Workshop on Quantum Thermodynamics and Transport, Mainz, Germany (May 2018).

Limitations on coherent work extraction in open quantum systems, Arctic School on Open Quantum Systems, Kevo, Finland (Sep 2017).

Limitations on coherent work extraction in open quantum systems, 28th International Conference on Low Temperature Physics, Gothenburg, Sweden (Aug 2017).

Limitations on coherent work extraction in open quantum systems, Seminar on Quantum Systems in and out of Equilibrium, Granada, Spain (Jun 2017).

Limitations on coherent work extraction in open quantum systems, Heraeus-Seminar “Non-Markovianity and Strong Coupling Effects in Thermodynamics”, Bad Honnef, Germany (Apr 2017).

TEACHING**SUPERVISED STUDENTS**

Gerardo Suarez – RIKEN internship	Oct 2023
<i>Project goal:</i> Improving the HEOM implementation in QuTiP.	Dec 2023
Patrick Hopf – RIKEN internship	Sep 2023
<i>Project goal:</i> Extending the quantum optimal control libraries of QuTiP.	Nov 2023
Eetu Loisa – Summer internship	Jun 2019
<i>Project title:</i> “Thermodynamic Precision in Open Quantum Systems”	Aug 2019
Tuomas Pyhäranta – Summer internship and subsequent Bachelor’s Thesis	Jun 2017
<i>Project title:</i> “Optimal Control of a Quantum Refrigerator”	Apr 2018

TEACHING ASSISTANCE

Open Quantum Systems and Quantum Thermodynamics, Aalto University <i>Assisted in the development of the course and of the lecture notes</i>	Fall ’18
Quantum Field Theory in Condensed Matter Physics, Aalto University <i>Gained experience with modern teaching methods, including an escape room exam</i>	Spring ’18
Theoretical Physics 4 (Quantum Mechanics), Heidelberg University	Spring ’15
Theoretical Physics 3 (Electrodynamics), Heidelberg University	Fall ’14
Theoretical Physics 2 (Analytical Mechanics), Heidelberg University	Spring ’13
Theoretical Physics 1 (Mechanics), Heidelberg University	Fall ’12
Linear Algebra and Analytical Geometry 1, University of Stuttgart	Fall ’11

PEDAGOGICAL TRAINING

Completed course “Teaching assistant as a learning instructor” (Aalto University) | Fall '17

PEER REVIEW

Referee of npj Quantum Information (1), Physical Review Letters (2), Physical Review Applied (2), Physical Review Research (4), PRA (3), PRB (2), PRE (5), PRX Quantum (1), New Journal of Physics (2), Journal of Physics A (3), Journal of Low Temperature Physics (2), Scientific Reports (2).

OTHER EXPERIENCES AND SKILLS**Open Source Software Development:**

Current member of the QuTiP admin team (<https://qutip.org>).

Skills: team-based software development, development in Python

Sep 2023

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today

Voluntary Work for AEGEE – European Students' Forum:

Vice president of AEGEE-Heidelberg, Treasurer of AEGEE-Helsinki

Skills: intercultural communication, team leading, public communication, bookkeeping

Aug 2015

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Dec 2018

Student Assistant at the DKFZ (German Cancer Research Center):

Assisted with organizing an international online lecture and maintained educational software

Skills: software development in Java, administrating and recording virtual seminars

Nov 2014

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Aug 2015

IT SKILLS

Recently used programming languages: Python, Mathematica, C#, lean.

In addition, familiar with Java, JavaScript, PHP, Scala, shell scripting and more.

Experienced with Unix server administration.

Github profile: <https://github.com/pmenczel>.

LANGUAGES

German	Native language
English	Full professional proficiency (CEFR Level C2)
Spanish	Basic proficiency (CEFR Level A2)
Finnish	Basic proficiency (CEFR Level A2)
Japanese	Beginner (CEFR Level A1)