Nelly NG Huei Ying

nelly-ng.github.io nelly.ng@ntu.edu.sg ORCID ID: 0000-0003-0007-4707 Google scholar profile

RESEARCH EXPERTISE

- Quantum Resource Theories Thermodynamic resource theories, finite-size effects in thermodynamics, quantum catalysis
- Thermodynamics and many-body physics Entanglement and quantum correlations in quantum thermal machines, modelling and reconstruction of 1d Bose gases
- Quantum Algorithms Quantum Dynamic Programming, double-bracket flows, imaginary-time evolution, quantum signal processing methods
- Quantum Networks and Cryptography Quantum key distribution, random number generation, entropic quantities and their mathematical properties, two-party protocols in the Noisy-Storage model etc

ACADEMIC QUALIFICATIONS

QuTech, Delft University of Technology, the Netherlands. Quantum thermodynamics	Doctorate (PhD), 2017
Nanyang Technological University, Singapore. Physics and Applied Physics (minor in Mathematics)	First class honours, 2012

Work Experience	
CQT FELLOW	Apr 2025 — Present
School of Physical and Mathematical Sciences, Nanyang Technological University	Singapore
NANYANG ASSISTANT PROFESSOR	Nov 2020 — Present
School of Physical and Mathematical Sciences, Nanyang Technological University	Singapore
POSTDOCTORAL RESEARCH FELLOW	Jan 2020 - Apr 2020
Free University of Berlin	Berlin, Germany
ALEXANDER VON HUMBOLDT FELLOW	Nov 2017 - Dec 2019
Free University of Berlin	Berlin, Germany
SENIOR RESEARCH OFFICER and GUEST RESEARCHER	APR 2017 — AUG 2017
Australian National University	Canberra, Australia
RESEARCH ASSISTANT	Jul 2012 — Dec 2016
Centre for Quantum Technologies	Singapore

Funding

National Quantum Safe Network 2.0 as co-PI, with Prof. Alexander Ling as lead, SGD 220k	Apr 2025-now
CQT Fellow, SGD 161k	Mar 2024- now
Nanyang Assistant Professorship start-up grant, SGD 1M	Nov 2020- now
National Quantum Safe Network as co-PI, with Prof. Alexander Ling as lead, $pprox$ SGD 1.3M	Nov 2021- now
Tier 2 grant "Circuit Quantum Electrodynamics with Spins: Expanding the Quantum Toolbox" as co-PI	Aug 2023 - now
Tier 1 grant on "Catalyzing Quantum Security: bridging between theory and practice	
in quantum communication protocols" as sole PI, $pprox$ SGD 162k	May 2024 - Apr 2027

TEACHING

Courses	
PH7021 Quantum Information, NTU	2021 - now
PH1107 Relativity and Quantum Physics, NTU	2021 - now
Advanced Quantum Mechanics, FU Berlin	2019
MOOC on Quantum Cryptography (writing of lecture materials), TU Delft	2015
Introduction to information theory, NUS	2012-2014

Supervision of graduate students

Jeongrak Son (NTU, PhD), Muhammad Taufiq Murtadho (NTU, PhD), Rebecca Chung Ru Byn (NTU, Msc), Qiu Kaiwei (NTU, PhD), Alexander zur Bonsen (FU Berlin, Msc)

Supervision of undergraduate students

Cristina Cirstoiu (NUS), Remco van der Meer (TU Delft), Tom Wessel (FU Berlin), Qiu Kaiwei (NTU), Rebecca Chung Ru Byn (NTU), Kim Sihyung (NTU), Nigel Lim (NTU), Junwoo Jung (KAIST)

SERVICE

Peer Review for Journals

Quantum, Nature Physics, International Journal of Theoretical Physics, IEEE Transactions on Information Theory, Europhysics Letters etc

Conferences	
Scientific Committee	

Scientific Committee	Quantum Energetic Initiative, 2023
Programme Committee	Quantum Information Processing (QIP) 2023
	Quantum Thermodynamics (QTD) 2022, 2025
	Theory of Quantum Computation, Communication and Cryptography (TQC) 2022, 2025
Sub-reviewer	QCrypt, QIP, TQC
Local Organizing Committee	Qcrypt (2012), QTD (2025)

PUBLICATIONS

Publication statistics as of Apr 2025 (Google Scholar)

Citation count: 1797, H-index: 15

Preprints

- 1. Yudai Suzuki, Bi Hong Tiang, Jeongrak Son, N.Ng, Zoë Holmes, Marek Gluza. Double-bracket algorithm for quantum signal processing without post-selection
- 2. RRB Chung, N.Ng, Y Cai. A Generalized Numerical Framework for Improved Finite-Sized Key Rates with Renyi Entropy. arXiv:2502.02319.
- 3. J Son, R Ganardi, S Minagawa, F Buscemi, SH Lie, N.Ng (2024). Robust Catalysis and Resource Broadcasting: The Possible and the Impossible. arXiv:2412.06900.
- 4. M Gluza, J Son, BH Tiang, Y Suzuki, Z Holmes, N.Ng (2024). Double-bracket quantum algorithms for quantum imaginary-time evolution. arXiv:2412.04554.
- Matteo Robbiati, Edoardo Pedicillo, Andrea Pasquale, Xiaoyue Li, Andrew Wright, Renato Farias, Khanh Uyen Giang, Jeongrak Son, Johannes Knörzer, Siong Thye Goh, Jun Yong Khoo, N.Ng, Zoë Holmes, Stefano Carrazza, Marek Gluza (2024). Double-bracket quantum algorithms for high-fidelity ground state preparation. arXiv:2408.03987.
- 6. R Ganardi, TV Kondra, <u>N.Ng</u>, A Streltsov (2024). Second Law of Entanglement Manipulation with Entanglement Battery. arXiv:2405.10599.

Selected Publications

- 1. Jeongrak Son, Marek Gluza, Ryuji Takagi, N.Ng. Quantum Dynamic Programming. Accepted in PRL (2025)
- 2. Muhammad Taufiq Mudharto, Marek Gluza, Sebastian Erne, Jörg Schmiedmayer, N.Ng (2025). "Systematic error analysis of relative phase extraction from matter-wave interference". SciPost Physics 18 (2), 065.
- 3. T Murtadho, F Cataldini, S Erne, M Gluza, M Tajik, J Schmiedmayer, N.Ng. "Measurement of total phase fluctuation in cold-atomic quantum simulators", accepted in Physical Review Research Letters (2025).
- 4. Alessandre de Oliveira Junior, Jeongrak Son, Jakub Czartowski, <u>N.Ng</u>. Entanglement generation from athermality. Phys. Rev. Research 6, 033236 (2024)
- 5. Jeongrak Son, N.Ng (2024). A hierarchy of thermal processes collapses under catalysis. Quantum Science and Technology 10 (1), 015011.
- 6. K. Qiu, J. Y. Haw, H. Qin, N.Ng, B. Sikdar, M. Kasper, Alexander Ling. Quantum-secured Data Centre Interconnect in a field environment. Accepted in Journal of Surveillance, Security and Safety (2024).
- 7. Seokhyung Lie, N.Ng (2024). The quantum state over time is unique. Phys. Rev. Research 6, 033144.

- 8. P.Lipka-Bartosik, H.Wilming, N.Ng (2024). Catalysis in Quantum Information Theory. Rev. Mod. Phys. 96, 025005.
- 9. Seokhyung Lie, N.Ng (2023). Catalysis always degrades external quantum correlations, Phys. Rev. A 108, 012417.
- 10. Jeongrak Son, N.Ng (2022). Catalysis in Action via Elementary Thermal Operations. Accepted for publication in New Journal Of Physics, Feb 2024.
- 11. P. Boes, N.Ng, H. Wilming (2022). Variance of Relative Surprisal as Single-Shot Quantifier. Phys. Rex. X Quantum 3, 010325.
- 12. R.Sweke, P.Boes, N.Ng, C.Sparaciari, J.Eisert, M.Goihl, (2022). Transparent reporting of research-related greenhouse gas emissions through the scientific CO2nduct initiative. Commun. Phys. 5, 150.
- 13. C. Sparaciari, M. Goihl, P. Boes, J. Eisert, <u>N.Ng</u> (2021). Bounding the thermal resources for many-body localization. Communications Physics 4, 3.
- 14. M.Gluza, J.Sabino, N.Ng (joint first author), G.Vitagliano, M.Pezzutto, Y.Omar, I.Mazets, M.Huber, J.Schmiedmayer, J.Eisert (2021). Quantum field thermal machines. Phys. Rex. X Quantum, 2, 030310.
- 15. P. Boes, R. Gallego, N.Ng, J. Eisert, H. Wilming (2020). By-passing fluctuation theorems. Quantum 4, 231.
- 16. G. Guarnieri, N.Ng, K. Modi, J. Eisert, M. Paternostro, J. Goold (2019). Quantum work statistics and resource theories: bridging the gap through Renyi divergences. Phys. Rev. E 99, 050101(R).
- 17. Mischa P. Woods, N.Ng, Stephanie Wehner (2019). The maximum efficiency of nano heat engines depends on more than temperature. Quantum 3, 177.
- 18. Resource theory of quantum thermodynamics: Thermal operations and Second Laws, Book Chapter 28 of Springer series "Thermodynamics in the Quantum Regime"
- 19. R. v.d.Meer*, N.Ng, S. Wehner (2017). Smooth Generalized Free Energies for Thermodynamics. Phys. Rev. A 96, 062135.
- 20. N.Ng, Mischa P. Woods, Stephanie Wehner (2017). Surpassing the Carnot efficiency by extracting imperfect work. New J. Phys. 19 113005.
- 21. N.Ng, L. Mancinska, C.Cirstoiu*, J.Eisert, S.Wehner (2015). Limits to catalysis in quantum thermodynamics. NJP 17, 085004.
- 22. F. Brandao, M. Horodecki, N.Ng, J. Oppenheim, S. Wehner (2015). The second laws of quantum thermodynamics. PNAS 112, 3275
- 23. (2015) J.Y.Haw, S.M.Assad, A.M.Lance, N.Ng, V.Sharma, P.K.Lam, T.Symul. Maximization of Extractable Randomness in a Quantum Random-Number Generator, Phys. Rev. Applied 3, 054004.
- 24. C. Erven, N.Ng, N. Gigov, R. Laflamme, S. Wehner, G. Weihs (2014). An Experimental Implementation of Oblivious Transfer in the Noisy Storage Model, Nature Communications 5, 3418.
- 25. N.Ng, Siddarth Koduru Joshi, Chen Ming Chia, Christian Kurtsiefer, Stephanie Wehner, Experimental implementation of bit commitment in the noisy-storage model. Nature Communications 3, 1326 (2012)
- 26. N.Ng, Mario Berta, Stephanie Wehner. A min-entropy uncertainty relation for finite size cryptography. PRA 86, 042315 (2012)

SELECTED PRESENTATIONS

Invited Talks (Conferences)

- 1. "Robust Catalysis and Resource Broadcasting: The Possible and the Impossible", Quantum Resources, March 2025
- 2. (Plenary) "Catalysis in Quantum Information Theory", Institute of Physics Singapore (IPS) meeting, September 2023
- 3. "Quantum Information meets Thermodynamics", IAPS Women in Physics Talk, August 2023
- 4. "Quantifying disorders in a quantum world", Conference in honour of Prof CN Yang's 100th Birthday, June 2022
- 5. "Quantum Field Thermal Machines", Workshop on stochastic thermodynamics, June 2022
- 6. "Quantum Information and Thermodynamics: Theory and Implementation", NITheP Online Workshop Quantum Thermodynamics, Nov 2020
- 7. "Quo Vadis", panelist, Quantum Thermodynamics, July 2023
- 8. Academic Panel, Quantum Bootcamp, Centre for Quantum Technologies 2023
- 9. Workshop on "Thermodynamics as Resource Theory" (University of Western Ontario, London, Canada, June 2018)
- 10. Quantum Innovators conference (Waterloo, Canada, Oct 2018)
- 11. Q-turn conference: changing paradigms in quantum information (Florianopólis, Brazil, Nov 2018)
- 12. Workshop on Entanglement and Quantum Information (Fudan University, Shanghai, Jan 2017)
- 13. "The second laws of quantum thermodynamics", at COST conference: Thermodynamics in the quantum regime (Berlin, Jan 2014), and Gordon Research Seminar on Quantum Science (Easton MA, Jul 2014)

Invited Talks (Outreach)

- 1. "Hasn't all mathematics been discovered? What do mathematicians then do?", International youth science forum, June 2022
- 2. "Forging Your Path from Postdoc to Tenure", Quantum Young Researchers Association, seminar, May 2022
- 3. "Information theory and thermodynamics" Odyssey seminar (Jan 2021), Plancks guest lecture (Feb 2021), Odyssey seminar (Oct 2021)
- Sharing session on research and academic career
 C.N.Yang Anniversary Symposium (June 2021), C.N.Yang Research Seminar (Nov 2021)
- 5. "Quantum information theory: from applications to cryptography to investigations in foundational physics", Centre for Quantum Technologies, Jul 2014

Invited Lectures (Workshops/Graduate Summer Schools)

- 1. "Resource theories, quantum thermodynamics and catalysis", ITAMP Winter School, Tuscon, Feb 2024
- 2. "Single-shot thermodynamics", ETH Quantum Thermodynamics Summer School, Aug 2021
- 3. "Where information meets thermodynamics", TiQUR summer school on quantum thermodynamics, July 2021
- 4. EQuS Winter School (Sunshine Coast, June 2017)

Contributed talks (Conferences)

- 1. "The second laws of quantum thermodynamics and its applications", MPQ-Kavli Workshop, Delft, Oct 2015
- 2. "A min-entropy uncertainty relation for finite-size cryptography", Qcrypt (Singapore, Sept 2012)
- 3. "First implementation of bit commitment in the Noisy-Storage Model", Quantum Communication, Measurement and Computing, Vienna, Aug 2012
- 4. "Surpassing the Carnot efficiency", Physics @ FOM Veldhoven (Veldhoven , Jan 2016), American Physical Society March Meeting (Baltimore, Mar 2016)
- 5. "Bypassing fluctuation relations with catalysts", Quantum Thermodynamics conference, Helsinki, June 2019

ACADEMIC AWARDS

Year	Academic Honour / Award
2024	Fellow, Centre for Quantum Technologies
2020	Nanyang Assistant Professorship, NTU
2019	Participation in Lindau Nobel Laureate Meeting (600 scientists chosen worldwide annually)
2017	Humboldt Research Fellowship, Alexander von Humboldt Foundation
2012	Koh Boon Hwee Scholar
2012	Shell Eastern Petroleum Gold Medal cum Cash Award