

# Jeongrak Son

Research Fellow - School of Physical and Mathematical Sciences - Nanyang Technological University

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## Education

Ph.D. in Physics

Nanyang Technological University (NTU)

 Aug. 2021 – Nov. 2025    Singapore, Singapore

Thesis: Quantum qomrades: catalysts in resource theories and memories in dynamic programming [Link]

Adviser: Nelly H. Y. Ng

B.Sc. in Physics Summa Cum Laude


Seoul National University (SNU)

 Mar. 2015 – Feb. 2021    Seoul, Korea

Military service (Rep. of Korea Air Force): Mar. 2018 – Feb. 2020

Exchange Student

Department of Physics and Astronomy - University of Manchester

 Sep. 2016 – Feb. 2017    Manchester, United Kingdom

## Languages

Korean   

English   

French   

## Hobby

 Passionate cineophile

Selected film reviews:

- [In Perfect Days \(2023\), It's Okay to Cry](#) (Featured in Asian Film Archive's [monthly newsletter](#))
- [Hong Sang-Soo before and after Kim Min-Hee](#) (Proof version; see Exposure Print (Issue 1) for the final version)

Check my other reviews [here](#)


## Research Interests

- Quantum algorithms: state-based algorithms, quantum recursions
- Catalysis in quantum information: catalysis in circuit compilation, state-oblivious catalysis
- Resource theories: compositional structures in resource theories

## Work Experiences

Project Officer / Research Fellow

with Nelly H. Y. Ng

 May. 2025 – Jan. 2026 / Feb. 2026 –    SPMS, Nanyang Technological University

My projects include hybrid resource theories, Gaussian phase-covariant operations, and complexity lower bound for imaginary-time algorithms among others.

IBS Student Trainee / Research Assistant

with Juzar Thingna and Peter Talkner

 Jul.2020 – Aug. 2020 / Jan. 2021 – May. 2021    PCS, Institute for Basic Science

My goal was to persuade the quantum thermodynamics community to explicitly consider measurement strategies in the operation of quantum thermal machines. I showcased that the appropriate measurement strategy enhances the performance of quantum Otto engines and battery charging processes.

## Preprints

1. R. Ganardi, J. Son, J. Czartowski, S. H. Lie, and N. H. Y. Ng, Manipulating heterogeneous quantum resources over a network, arXiv:2602.17801 (2026). [arXiv]
2. X. Hu, L. Lautenbacher, G. Spaventa, M. B. Plenio, N. H. Y. Ng, and J. Son, Gaussian time-translation covariant operations: structure, implementation, and thermodynamics, arXiv:2601.02471 (2026). [arXiv]  
*1/2 of Quantum Thermodynamics 2025 invited talk (speaker: Xueyuan Hu); selected as a Quantum Resources 2026 talk (speaker: Xueyuan Hu)*

3. S. H. Lie, **J. Son**, P. Boes, N. H. Y. Ng, and H. Wilming, Thermal operations from informational equilibrium, arXiv:2507.16637 (2025). [arXiv]  
*Kyoto Workshop of Quantum Thermodynamics and Stochastic Thermodynamics 2025 invited talk (speaker: Nelly Ng); selected as a Quantum Resources 2026 talk (speaker: Seok Hyung Lie)*
4. Y. Suzuki, M. Gluza, **J. Son**, B. H. Tiang, N. H. Y. Ng, and Z. Holmes, Grover's algorithm is an approximation of imaginary-time evolution, arXiv:2507.15065 (2025). [arXiv]  
*selected as an IPS meeting 2025 talk (speaker: Bi Hong Tiang)*
5. M. Robbiati, E. Pedicillo, A. Pasquale, X. Li, A. Wright, R. M. S. Farias, K. U. Giang, **J. Son**, J. Knörzer, S. T. Goh, J. Y. Khoo, N. H. Y. Ng, Z. Holmes, S. Carrazza, M. Gluza, Double-bracket quantum algorithms for high-fidelity ground state preparation, arXiv:2408.03987 (2024). [arXiv]

## Published Works

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1. **J. Son**, R. Ganardi, S. Minagawa, F. Buscemi, S. H. Lie, and N. H. Y. Ng, Catalytic Channels Are the Only Noise-Robust Catalytic Processes, Phys. Rev. Lett. **136**, 050202 (2026). [Link] [arXiv]  
*Quantum Resources 2025 invited talk (speaker: Nelly Ng); selected as an AQIS2025 talk (speaker: Seok Hyung Lie); selected as an IPS meeting 2025 talk*
2. M. Gluza, **J. Son**, B. H. Tiang, R. Zander, R. Seidel, Y. Suzuki, Z. Holmes, and N. H. Y. Ng, Double-Bracket Quantum Algorithms for Quantum Imaginary-Time Evolution, Phys. Rev. Lett. **136**, 020601 (2026). [Link] [arXiv]  
*selected as a QTD2025 talk; selected as an IPS meeting 2025 invited talk; CQT highlight article*
3. Y. Suzuki, B. H. Tiang, **J. Son**, N. H. Y. Ng, Z. Holmes, and M. Gluza, Double-bracket algorithm for quantum signal processing without post-selection, Quantum **9**, 1954 (2025). [Link]  
*selected as an IPS meeting 2025 talk (speaker: Marek Gluza)*
4. **J. Son**, M. Gluza, R. Takagi, and N. H. Y. Ng, Quantum Dynamic Programming, Phys. Rev. Lett. **134**, 180602 (2025). [Link] [arXiv]  
*honourable mentions for Top quantum algorithms papers in Spring 2024 by PennyLane (Xanadu); selected as an IPS meeting 2024 talk; CQT highlight article*
5. **J. Son** and N. H. Y. Ng, A hierarchy of thermal processes collapses under catalysis, Quantum Sci. Technol. **10**, 015011 (2024). [Link] [arXiv]  
*selected as 1/2 of AQIS2023 talk; selected as a Quantum Resources 2023 talk; selected as a Beyond IID 2024 talk*
6. A. de Oliveira Junior\*, **J. Son**\*, J. Czartowski, and N. H. Y. Ng, Entanglement generation from athermality, Phys. Rev. Research **6**, 033236 (2024). [Link] (\*: co-first authors)  
*selected as an IPS meeting 2024 talk; selected as a Quantum Resources 2025 talk*
7. **J. Son** and N. H. Y. Ng, Catalysis in action via elementary thermal operations, New J. Phys. **26**, 033029 (2024). [Link]  
*selected as a Quantum Resources 2022 talk; selected as 1/2 of AQIS2023 talk*
8. **J. Son**, P. Talkner, and J. Thingna, Charging quantum batteries via Otto machines: Influence of monitoring, Phys. Rev. A **106**, 052202 (2022). [Link] [arXiv]  
*selected as 1/2 of QTD2022 talk (speaker: Juzar Thingna); selected as a ICE-7 lightning talk*
9. **J. Son**, P. Talkner, and J. Thingna, Monitoring quantum Otto engines, PRX-Quantum **2**, 040328 (2021). [Link]  
*selected as 1/2 of QTD2022 talk (speaker: Juzar Thingna)*

## Talks and Seminars

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### 7 Conference Talks and 13 Seminar Talks

- Conference Talks: **Quantum resources**: from mathematical foundations to operational characterisation (Dec. 2022), **AQIS 2023** (Aug. 2023), **Quantum resources 2023** (Dec. 2023) (video), **Beyond IID 2024** (Jul. 2024), **Quantum resources 2025** (Mar. 2025), **Quantum Thermodynamics 2025** (Jul. 2025), **IPS meeting 2025** [invited] (Sep. 2025)
- Seminar Talks: **IBS PCS Seminar** (Jun. 2022) (video), **Majulab Seminar** (Dec. 2022), **Chaos and Quantum Info Seminar** [Jagiellonian U.] (Feb. 2023), **CQT Seminar** (May 2023), **QST Seminar** [Seoul Natl. U.] (Jul. 2023), **Informal Statistical Physics Seminar** [U. Maryland] (Aug. 2024) (abstract), **Q.InC Seminar** [A\*STAR] (Sep. 2024) (abstract), **KIAS Seminar** [KIAS] (Oct. 2024) (abstract), **AG Eisert group meeting** [FU Berlin] (Jan. 2025) (video), **Institut für Theoretische Physik group meeting** [Uni Ulm] (Jan. 2025), **bigQ - Center for Macroscopic Quantum States** [DTU] (Jan. 2025), **Q-DNA group** [Yonsei U.] (Dec. 2025), **CQT Lunch Seminar** (Jan. 2026)

### 1 Lightning Talk and 3 Short Talks (<20 mins)

- Lightning Talk: **ICE-7 Quantum Information and Quantum Technologies Conference** (May 2022)
- Short Talks: **IPS meeting 2024** [2 contributed talks] (Oct. 2024), **IPS meeting 2025** (Sep. 2024)

## Peer Review Contributions

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- IOP Trusted Reviewer (**credential**)
- Referee for **Phys. Rev. Lett.**, **Quantum**, **Quantum Sci. Technol.**, **Phys. Rev. A**, **Phys. Rev. E**, **J. Math. Phys.**, and **Phys. Scr.**
- Sub-reviewer for **TQC 2022**, **QIP2023**, **TQC 2025**, and **QCTiP 2026**

## Academic Visits

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- Yonsei University, Korea [host: **Daniel K. Park**] (Dec. 2025)
- Ulsan National Institute of Science and Technology (UNIST), Korea [host: **Seok Hyung Lie**] (Nov. 2025)
- Danmarks Tekniske Universitet (DTU), Denmark [host: **Jonatan Bohr Brask**] (Jan. 2025)
- Universität Ulm, Germany [host: **Martin Plenio**] (Jan. 2025)
- Freie Universität Berlin (FU Berlin), Germany [host: **Jens Eisert** and **Nathan Walk**] (Jan. 2025)
- Korea Institute for Advanced Study (KIAS), Korea [host: **Hyukjoon Kwon**] (Oct. 2024 and Mar. 2025)
- University of Maryland, Baltimore County, USA [host: **Sebastian Deffner**] (Aug. 2024)
- University of Maryland, College Park, USA [host: **Nicole Yunger Halpern**] (Aug. 2024)
- Nagoya University, Japan [host: **Francesco Buscemi**] (Jul. 2024)
- Jagiellonian University, Poland [host: **Kamil Korzekwa**] (Feb. 2023)
- PCS, Institute for Basic Science, Korea [host: **Dario Rosa**] (Jun. 2022)

## Teaching and Services

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Secretary (2023) and Treasurer (2024)

**Quantum Young Researchers Association (QYRA), Singapore**

📅 2023 – 2024

- Lead organiser of QYRA X Infocom Media Development Authority (IMDA) event **Careers in Quantum Communications**
- Organiser of **Quantum Energy Initiative (QEI) workshop 2023**
- Topical team member (w/ Masahito Ueda, Gentaro Watanabe, and Ariane Soret) representing one of the five workshop topics: “Fundamental thermodynamics of information” in the **Quantum Energy Initiative (QEI) workshop 2023**—moderated discussions throughout the workshop and presented the outcomes of the team’s deliberations
- Facilitator for the Townhall event **Building Singapore’s Quantum Future Together: A Multi-Stakeholder Townhall on the National Quantum Strategy and Entrepreneurship**
- Organiser (logistics) of QYRA’s End-of-Year event **What’s next for early-career Contributors in Singapore?**

Scientific Adviser for Korean Translation of the book series “for babies” by Chris Ferrie

**CHAEKSESANG, Korea**

📅 2023–2023

Advised translations for 12 books: Quantum Physics, Quantum Information, Quantum Entanglement, Quantum Computing, Optical Physics, Statistical Physics, Electromagnetism, General Relativity, Newtonian Physics, Nuclear Physics, Astrophysics, and Rocket Science

SINGA Ambassador

**Singapore International Graduate Award (SINGA), Singapore**

📅 2023 – 2023

### Teaching Experiences

- Tutorial for PH1107: Relativity and Quantum Physics, Nanyang Technological University, Singapore, AY22/23, 23/24, and 24/25
- Tutorial for International Students, Physics 1, Seoul National University, Korea, AY20
- Organizer/Tutor for Summer Science Camp, Korea Student Aid Foundation and Gyeongsang Girl’s High School, Korea, Jul. 2015

## Awards and Honours

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- **Singapore International Graduate Award (SINGA)** [The Agency for Science, Technology and Research (A\*STAR)] (2021 – 2025)
- **GE Foundation Scholar-Leaders Program (GEFSLP) Scholarship** [Fulbright Korea] (2016 – 2021)
- **Presidential Science Scholarship** [Korea Student Aid Foundation] (2015 – 2021)

- **OIA Outgoing Exchange Student Scholarship** [Office of International Affairs (OIA), Seoul National University] (2016)
- **Dean's List** [College of Natural Sciences, Seoul National University] (Autumn 2015, Spring 2020)