Jeongrak Son

Project Officer - School of Physical and Mathematical Sciences - Nanyang Technological University

@ jeongrak.son@gmail.com Singapore Personal Website

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 cinephile
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

with Nelly H. Y. Ng

May. 2025 – SPMS, Nanyang Technological University

I am employed as a Project Officer between the transition from PhD Student to Postdoc. 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 – 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. 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)
2. 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)

3. **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, accepted in Phys. Rev. Lett. **[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
4. M. Gluza, **J. Son**, B. H. Tiang, Y. Suzuki, Z. Holmes, and N. H. Y. Ng, Double-bracket quantum algorithms for quantum imaginary-time evolution, accepted in Phys. Rev. Lett. **[arXiv]**
   selected as a QTD2025 talk; selected as an IPS meeting 2025 invited talk
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

1. 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)
2. **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
3. **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 a part of AQIS2023 talk; selected as a Quantum Resources 2023 talk; selected as a Beyond IID 2024 talk
4. 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
5. **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 a part of AQIS2023 talk
6. **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 a part of QTD2022 talk (speaker: Juzar Thingna); selected as a ICE-7 lightning talk
7. **J. Son**, P. Talkner, and J. Thingna, Monitoring quantum Otto engines, PRX-Quantum **2**, 040328 (2021). **[Link]**
   selected as a part of QTD2022 talk (speaker: Juzar Thingna)

Talks and Seminars

7 Conference Talks and 12 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)

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

- 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**, and **TQC 2025**

Academic Visits

- 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 Universtiy, 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

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 Qontributors 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 Classes for PH1107: Relativity and Quantum Physics, Nanyang Technological University, Singapore, AY22/23, 23/24, and 24/25
- Tutorial Class 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

- **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)