Jeongrak Son

Ph.D. student - School of Physical and Mathematical Sciences - Nanyang Technological University

@ jeongrak.son@gmail.com Singapore Personal Website

Education

Ph.D. student

Division of Physics and Applied Physics - School of Physical and Mathematical Sciences - Nanyang Technological University

Aug. 2021 – Singapore

Adviser: Prof. Nelly H. Y. Ng

B.Sc. **Summa Cum Laude**

Department of Physics and Astronomy (physics major) - 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 Search of Flowing Time: From Ink to Memories (Best Piece of Oct/Nov 2023 in *Exposure*)
  - In Perfect Days (2023), It's Okay to Cry (Featured in Asian Film Archive's monthly newsletter)
- Check my other reviews here

Research Interests

- Quantum algorithms: quantum state-instructed circuits, interesting algorithmic subroutines
- Catalysis in quantum information: catalysis in circuit compilation, state-oblivious catalysis
- Resource theories: resource broadcasting, composition of free state sets and free operations

Work Experiences

Project Officer

with Nelly H. Y. Ng

May. 2025 – SPMS, Nanyang Technological University

I am employed as a Project Officer while waiting for my PhD defence. My role entails research on resource theories and quantum algorithms.

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.

Publications

1. 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]**
2. 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, arXiv:2504.01077 (2025). **[arXiv]**
3. **J. Son**, R. Ganardi, S. Minagawa, F. Buscemi, S. H. Lie, and N. H. Y. Ng, Robust Catalysis and Resource Broadcasting: The Possible and the Impossible, arXiv:2412.06900 (2024). **[arXiv]**
   Quantum Resources 2025 invited talk (speaker: Nelly Ng); selected as an AQIS2025 talk (speaker: Seok Hyung Lie)

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, arXiv:2412.04554 (2024). **[arXiv]**
   selected as a QTD2025 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]**
6. **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
7. **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
8. 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
9. **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
10. **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
11. **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

6 Conference Talks and 11 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)
- 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)

1 Lightning Talk and 2 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)

Peer Review Contributions

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

Academic Visits

- 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 –

KFAS Study Abroad Scholarship (candidate)

Korea Foundation of Advanced Studies

2020 – 2021

Opted to withdraw from full award status in favour of accepting the SINGA award at NTU.

GE Foundation Scholar-Leaders Program (GEFSLP) Scholarship

Fulbright Korea

2016 – 2021

Presidential Science Scholarship

Korea Student Aid Foundation

2015 – 2021

Best Group Project Presentation

KIAS-SNU Physics Winter Camp

2019

Topological Aspects of 1D SSH Model

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