

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

Supervisor: 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 [Letterboxd](#) profile!

Research Interests

- Catalysis in quantum physics: catalysts dynamics in resource theoretic operations, catalytic advantages beyond resource theories
- Quantum thermodynamics: measurements effects on quantum thermal machines, thermodynamics-inspired quantum algorithms
- General resource theories: resource broadcasting and catalytic replication

Research Experiences

PhD Study

w/ Prof. Nelly H. Y. Ng

 Aug. 2021 –  SPMS, Nanyang Technological University

I aim to understand the origin of catalytic advantages in quantum resource theories and harness them in practical scenarios, potentially extending beyond resource theories. The first two projects I undertook revealed the pivotal role of the memory effect in catalysis. Currently, I am exploring quantum dynamics that could benefit from catalysis.

IBS Student Trainee, Research Assistant

w/ Profs. 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. In particular, I showcased that the appropriate measurement strategy enhances the performance of quantum Otto engines and battery charging processes. The results are published in PRA and PRX-Quantum.

Publications

- 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](#)]
- J. Son**, M. Gluza, R. Takagi, and N. H. Y. Ng, Quantum Dynamic Programming, arXiv:2403.09187 (2024). [[arXiv](#)]
honourable mentions for Top quantum algorithms papers in Spring 2024 by PennyLane (Xanadu); selected as an IPS meeting 2024 talk

3. **J. Son** and N. H. Y. Ng, A hierarchy of thermal processes collapses under catalysis, arXiv:2303.13020 (2023). [[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
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

4 Conference Talks and 6 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)
- 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](#))

1 Lightning Talk

- **ICE-7** Quantum Information and Quantum Technologies Conference (May 2022)

Peer Review Contributions

- Referee for **Phys. Rev. Lett.**, **Phys. Rev. A**, **Phys. Rev. E**, and **J. Math. Phys.**
- Sub-reviewer for **TQC 2022** and **QIP2023**

Academic Visits

- 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

Secretary (2023) and Treasurer (2024)

[Quantum Young Researchers Association \(QYRA\)](#), Singapore

 2023 – 2024

- Lead organizer of QYRA X Infocom Media Development Authority (IMDA) event **Careers in Quantum Communications**
- Organizer 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 **Quantum Energy Initiative (QEI) workshop 2023** – moderated discussion throughout the workshop and presented the outcomes of the discussion at the end

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

[CHAEKSESANG](#)

 2023–2023

Advised on 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, AY23/24, and AY24/25
- 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
Declined for SINGA.

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 \(OIA\)](#)
📅 2016

Dean's List
[College of Natural Sciences, Seoul National University](#)
📅 Autumn 2015, Spring 2020
