Seok-Hyung Lee

PERSONAL INFORMATION

- **E-mail**: seokhyunglee@skku.edu
- **Personal Website**: https://seokhyung-lee.github.io
- **Google Scholar**: https://scholar.google.com/citations?user=NURGJAwAAAAJ
- **ORCID**: 0000-0002-1207-2752

EMPLOYMENT

Sep 2025 – Present | **Assistant Professor** | **Sungkyunkwan University (SKKU)**

Department: Department of Quantum Information Engineering, College of Engineering
Location: Suwon-si, Gyeonggi-do, Republic of Korea

Mar 2023 – Sep 2025 | **Postdoctoral Associate** | **University of Sydney**

Group: Quantum Theory Group, School of Physics
Location: Sydney, New South Wales, Australia
Mentor: Prof. Stephen D. Bartlett

EDUCATION

Mar 2017 – Feb 2023 | **Ph. D. in Physics** | **Seoul National University**

Group: SNU Quantum Information Science Group, Department of Physics and Astronomy
Location: Seoul, Korea
Advisor: Prof. Hyunseok Jeong
Thesis: Universal Resource-Efficient Topological Measurement-Based Quantum Computing
(Awarded the *BK Excellent Thesis Award*)
GPA: 3.93 / 4.30

Mar 2013 – Feb 2017 | **Bachelor in Physics** | **Seoul National University**

Location: Seoul, Korea
GPA: 3.89 / 4.30 (*Graduated with Honours)*

MENTORSHIP

- **(2024)** *Andrew Li,* Honours Student at The University of Sydney
  Thesis: *Decoding twist defects on the color code*
  (Awarded the University Medal)

PUBLICATIONS

2025

- **[Preprint]** SHL, L. English, S. D. Bartlett,
  Efficient Post-Selection for General Quantum LDPC Codes, arXiv:2510.05795 (2025).
- **[Preprint]** J. Lee, S. Omkar, Y. S. Teo, SHL, H. Kwon, M. S. Kim, H. Jeong,
  Photonic Hybrid Quantum Computing, arXiv:2510.00534 (2025).
- SHL, F. Thomsen, N. Fazio, B. J. Brown, S. D. Bartlett,
  Low-Overhead Magic State Distillation with Color Codes, PRX Quantum 6, 030317 (2025).

- SHL, A. Li, and S. D. Bartlett,
  Color code decoder with improved scaling for correcting circuit-level noise, Quantum 9, 1609 (2025).

2024

- **[Magazine]** SHL,
  색 부호를 활용한 결함허용 양자컴퓨팅 (Fault-Tolerant Quantum Computing with the Color Code), 물리학과 첨단기술 (Physics and High Technology) 33, 17 (2024).

- J. Lee, N. Kang, SHL, H. Jeong, L. Jiang, and S.-W. Lee,
  Fault-Tolerant Quantum Computation by Hybrid Qubits with Bosonic Cat Code and Single Photons, PRX Quantum 5, 030322 (2024).

2023

- SHL and H. Jeong,
  Graph-theoretical optimization of fusion-based graph state generation, Quantum 7, 1212 (2023).

- **[Conference]** H. Jeong, SHL, S. Omkar, Y. S. Teo,
  Highly fault-tolerant quantum computing using both discrete and continuous variables of light, in Optica Quantum 2.0 Conference and Exhibition (Optica Publishing Group, 2023) p. QTu4A.6.

- SHL, S. Omkar, Y. S. Teo, and H. Jeong,
  Parity-encoding-based quantum computing with Bayesian error tracking, npj Quantum Inf. 9, 39 (2023).

- Y. S. Teo, S. Shin, H. Kwon, SHL, and H. Jeong,
  Virtual distillation with noise dilution, Phys. Rev. A 107, 022608 (2023).

2022

- S. Omkar, SHL, Y. S. Teo, S.-W. Lee, and H. Jeong,
  All-photonic architecture for scalable quantum computing with Greenberger-Horne-Zeilinger States, PRX Quantum 3, 030309 (2022).

- SHL and H. Jeong,
  Universal hardware-efficient topological measurement-based quantum computation via color-code-based cluster states, Phys. Rev. Research 4, 013010 (2022).

2021

- SHL, S.-W. Lee, and H. Jeong,
  Loss-tolerant concatenated Bell-state measurement with encoded coherent-state qubits for long-range quantum communication, Phys. Rev. Research 3, 043205 (2021).

2020

- S. Choi, SHL, and H. Jeong,
  Teleportation of a multiphoton qubit using hybrid entanglement with a loss-tolerant carrier qubit, Phys. Rev. A 102, 012424 (2020).

SOFTWARE DEVELOPMENTS

- *ldpc-post-selection*: Python package for decoding quantum LDPC codes with cluster-based post-selection (2025),
  https://github.com/seokhyung-lee/ldpc-post-selection
- *ConcatMatching*: Python package implementing the generalised concatenated matching decoder for decoding arbitrary stabiliser codes (2024),
  https://github.com/seokhyung-lee/ConcatMatching
- *color-code-stim*: Python module for simulating and decoding color code circuits (2024),
  https://github.com/seokhyung-lee/color-code-stim
- *OptGraphState*: Python package for graph-theoretical optimization of fusion-based graph state generation (2023),
  https://github.com/seokhyung-lee/OptGraphState

PATENTS

- **[Application]** H. Jeong, SHL, Y. S. Teo, S. Omkar,
  METHOD AND APPARATUS FOR LINEAR OPTICAL QUANTUM COMPUTING,
  US Patent, App. 18/075327 (2024) & KR Patent, App. 1020220120561 (2024)

PRESENTATIONS

(Date format: YYYY/MM/DD)

Invited talks

- Basics of Quantum Error Correction,
  IBM Quantum Leadership Program Korea, IBM Korea, Seoul, Korea (2025/11/26)
- 양자 오류 정정 입문: 노이즈로부터 양자 정보를 지키는 법,
  Qiskit Fall Fest 2025, Sungkyunkwan University, Suwon, Korea (2025/11/18)
- 색 코드를 활용한 오류 내성 양자 컴퓨팅,
  8th Korea Quantum Information Science Conference (K-QIS), Korea Institute for Advanced Study (KIAS), Seoul, Korea (2025/11/14)
- 광자 기반 오류 내성 양자컴퓨팅의 현황: *Fusion-Based Quantum Computing*을 중심으로,
  SAIT Seminar, Samsung Advanced Institute of Technology, Suwon, Korea (2025/11/05)
- *Efficient Post-Selection for General Quantum LDPC Codes,*
  SNU SQuIS Group Seminar, SNU Quantum Information Science Group, Department of Physics and Astronomy, Seoul National University, Seoul, Korea (2025/11/04)
- *Efficient Post-Selection for General Quantum LDPC Codes,*
  31st QISK Regular Workshop, Quantum Information Society of Korea, Seoul, Korea (2025/10/31)
- *Low-Overhead Magic State Distillation with Color Codes,*
  IQM QEC Journal Club, IQM Quantum Computers, München, Germany, online (2025/07/10)
- **[Tutorial Series]** *Toward Fault-Tolerant Photonic Quantum Computing 2*,
  SAIT Seminar, Samsung Advanced Institute of Technology, Suwon, Korea, online
  (Part 1: 2025/06/20, Part 2: 2025/07/18, Part 3: 2025/08/22)
- *Challenge of Decoding 2D Color Codes,*
  PsiQuantum-USYD Workshop, PsiQuantum, Palo Alto, California, USA (2025/06/11)

- *Low-overhead magic state distillation with color codes,*
  KIST Seminar, Center for Quantum Technology, Korea Institute of Science and Technology, Seoul, Korea (2025/05/19)
- *Challenge of Decoding 2D Color Codes*,
  Post-QCTiP Workshop, Freie Universität Berlin, Berlin, Germany (2025/04/28)
- *Towards resource-efficient fault-tolerant quantum computing with error correction,*
  SKKU Seminar, Qcenter, Sungkyunkwan University, Suwon, Korea (2025/01/02)
- *Low-overhead magic state distillation with color codes,*
  KAIST Seminar, Korea Advanced Institute of Science and Technology (KAIST), Daejeon, Korea (2024/12/23)
- *Low-overhead magic state distillation with color codes*,
  Joint PsiQuantum-USYD Workshop, University of Sydney, Sydney, Australia (2024/09/25)
- *Graph-theoretical optimization of fusion-based graph state generation*,
  Foxconn Quantum Computing Center Weekly Seminar, Hon Hai Quantum Computing Research Center, Taipei, Taiwan, online (2024/05/17)
- **[Tutorial Series]** *Toward Fault-tolerant Photonic Quantum Computing*,
  SAIT Seminar, Samsung Advanced Institute of Technology, Suwon, Korea
  (Part 1: 2024/04/18, Part 2: 2024/06/05 online, Part 3: 2024/07/12 online)
- *Color code decoder with improved scaling for correcting circuit-level noise*,
  CMQC Seminar, Center for Macroscopic Quantum Control, Seoul National University, Seoul, Korea (2024/04/15)
- *Color code decoder with improved scaling for correcting circuit-level noise*,
  KIST Seminar, Center for Quantum Information, Korea Institute of Science and Technology, Seoul, Korea (2024/04/11)
- *Color code decoder with improved scaling for correcting circuit-level noise*,
  KIAS Seminar, School of Computational Sciences, Korea Institute for Advanced Study, Seoul, Korea (2024/04/09)
- *Color code decoder with improved scaling for correcting circuit-level noise*,
  Coogee'24 Sydney Quantum Information Theory Workshop, Sydney, Australia (2024/04/03)
- *Low-overhead Lattice-surgery-based Quantum Computing with the Color Code*,
  QST Seminar, Research Institute of Mathematics, Seoul National University, Seoul, Korea (2024/03/15)
- *Pauli-product-measurement-based Quantum Computing with Two-dimensional Color Codes*,
  CMQC Seminar, Center for Macroscopic Quantum Control, Seoul National University, Seoul, Korea (2023/09/04)
- *Parity-encoding-based linear-optical quantum computing with graph-theoretical optimization of cluster state generation*,
  KIST Workshop on Quantum Information Theory 2022, Center for Quantum Information, Korea Institute of Science and Technology, Seoul, Korea (2022/12/19)
- *Parity-encoding-based linear-optical quantum computing with Bayesian error tracking*,
  Quantum Information Science Strategy, KOFST 2022 BrainLink X-Lab Day, Yeosu, Korea (2022/12/15)
- *Universal hardware-efficient topological measurement-based quantum computing via color-code-based cluster states*,

KIST Seminar, Center for Quantum Information, Korea Institute of Science and Technology, Seoul, Korea (2022/05/30)

- *Universal resource-efficient topological measurement-based quantum computation via color-code-based cluster states*,
  QST Seminar, Research Institute of Mathematics, Seoul National University, Seoul, Korea (2021/11/12)

Contributed conference talks

- *Low-overhead magic state distillation with color codes*,
  Quantum Computing Theory in Practice (QCTiP), Berlin, Germany (2025/04/24)
- **[Long talk]** *Color code decoder with improved scaling for correcting circuit-level noise*,
  24th Asian Quantum Information Science Conference, Sapporo, Japan (2024/08/26)
- *Linear optical quantum computing tolerant to non-ideal fusions and photon losses*,
  15th Asia Pacific Physics Conference, Gyeongju, Korea, online (2022/08/24)
- *Loss-tolerant optical measurement-based quantum computing with incomplete fusion operations*,
  Optics and Photonics Congress 2022, Jeju, Korea (2022/07/03)
- *Universal hardware-efficient topological measurement-based quantum computation via color-code-based cluster states*,
  33rd Optical Society of Korea Winter Conference, Daejeon, Korea (2022/02/17)

Posters

- *Low-Overhead Magic State Distillation with Color Codes,*
  7th International Conference on Quantum Error Correction (QEC25), New Haven, Connecticut, USA (2025/08/11)
- *Low-Overhead Magic State Distillation with Color Codes,*
  EQUS 2024 Annual Workshop, Noosa Heads, QLD, Australia (2024/12/11)
- *Low-Overhead Lattice-Surgery-Based Quantum Computing with the Color Code,*
  Quantum Information Processing 2024, Taipei, Taiwan (2024/01/16)
- *Low-Overhead Lattice-Surgery-Based Quantum Computing with the Color Code*,
  EQUS 2023 Annual Workshop, Perth, WA, Australia (2023/11/21)
- *Graph-theoretical optimization of fusion-based graph state generation*,
  6th International Conference on Quantum Error Correction (QEC23), Sydney, NSW, Australia (2023/10/31)
- *Graph-theoretical optimization of fusion-based graph state generation*,
  Asian Quantum Information Science Conference 2023, Seoul, Korea (2023/08/31)
- *Parity-encoding-based linear optical quantum computing with graph-theoretical optimization*,
  Bolder Boulder Quantum Workshop 2023, Boulder, Colorado, USA (2023/06/20)
- *Loss-tolerant all-optical quantum computing architecture using parity-state-encoded multiphoton qubits*,
  Quantum Information Processing 2023, Ghent, Belgium (2023/02/06)
- *Loss-tolerant multiphoton-qubit-based linear optical quantum computation with nonideal fusions*,
  Single Photon Workshop 2022, Seoul, Korea (2022/11/03)

- *Loss-tolerant linear optical quantum computation with non-ideal fusion operations*,
  5th Quantum Information Conference, Seoul, Korea (2022/06/28)
- **[Awarded]** *Universal resource-efficient topological measurement-based quantum computation via color-code-based cluster states,*
  21st Asian Quantum Information Science Conference, Tokyo, Japan, online (2021/09/02)
- *Loss-tolerant concatenated Bell-state measurement with coherent-state qubits,*
  20th Asian Quantum Information Science Conference, Sydney, Australia, online (2020/12/08)

AWARDS

(Date format: YYYY/MM/DD)

- *Graduate Student Research Award*
  by Department of Physics and Astronomy, Seoul National University (2023/02/24)
- *Best Student Poster Award*
  in 21st Asian Quantum Information Science Conference (2021/09/04)
- *Graduated with Honours*
  by Department of Physics and Astronomy, Seoul National University (2017/02/24)

CONTRIBUTIONS

- I am an active reviewer of the following journals: *Quantum*, *PRX Quantum*, *Physical Review Letters*, *Physical Review A, Quantum Information Processing,* and *IEEE Transactions on Network Science and Engineering*.
- I was a member of the scientific organising committee for the **Coogee'25 Sydney Quantum Information Theory Workshop** (2025/02/10–13, Coogee, Sydney, NSW, Australia).