Jaewon Jung

+82 010-3732-4092 | physics2020@snu.ac.kr | https://jaewonjung.info/

Research Interests

Experimental quantum information processing

- Designing and realizing novel, programmable quantum devices for fault-tolerant quantum computing.
- Investigating dynamic phenomena in complex, strongly correlated quantum many-body systems out of equilibrium.

Interface of many-body physics and quantum information theory

Bridging theories and techniques from many-body physics and quantum information—such as information scrambling and many-body localization—for applications in benchmarking quantum systems, error-correcting codes, or exploring exotic non-equilibrium phases.

Education

Seoul National University — Seoul, Republic of Korea

Bachelor of Science, Physics — *Mar. 2020 – Feb. 2025*

The period includes military service during Dec. 2021 – Jun. 2023

Publication

(*: equal contribution)

H. Sohn*, **J. Jung***, J. Park*, H. Jang, L. E. A. Stehouwer, D. D. Esposti, G. Scappucci, and D. Kim, *Application of zero-noise extrapolation-based quantum error mitigation to a silicon spin qubit*, submitted for publication, preprint: arxiv:2410.10339

Conferences

- **J. Jung**, D. Ohm, M. Kim, J. Lee, and E. Kim, *Scalable Benchmarking Protocol for Mid-circuit Measurements*, Poster Presentation at *Adaptive Quantum Circuits 2024*, Brewster, United States, 2024
- **J. Jung**, J. Yu, D. Ohm, M. Kim, J. Lee, and E. Kim, *Scalable Benchmarking Protocol for Mid-circuit Measurements*, Poster Presentation at *International Conference on Quantum Simulation 2024*, Seoul, Korea 2024
- **J. Jung**, H. Sohn, J. Park, H. Jang, L. E, A. Stehouwer, D. Degli Esposti, G. Scappucci and D. Kim, *Implementation of Zero-noise Extrapolation in 28Si/SiGe Spin Qubits*, Oral Presentation at *The 31st Korean Conference on Semiconductors*, Gyeongju, Korea 2024

Research Projects

Building a Scalable Benchmarking Protocol for Mid-circuit Measurements *Oct. 2023 – Present*

Advisor: Prof. Eunjong Kim

- Built a randomized benchmarking (RB) based protocol to characterize and measure the diverse errors of mid-circuit measurement using **pyGSTi** and **Qiskit**.
- Simulated the protocol with physical errors such as relaxation errors, depolarizing errors, crosstalks, and stark shift errors and showed the capability of the protocol both in measuring the error rates and the types of errors of mid-circuit measurements and tested on superconducting qubits system using IBM's real backend.

Quantum Error Mitigation using Zero-Noise Extrapolation in a Silicon Spin qubit *Aug. 2023 – Oct. 2024*

Advisor: Prof. Dohun Kim

- Implemented zero-noise extrapolation technique with three different noise amplification methods on randomized benchmarking and quantum state tomography in silicon spin qubits along with readout error mitigation.
- In presence of time-correlated noise in silicon spin qubits, analyzed the results on randomized benchmarking to find best performing noise amplification techniques and implemented gate set tomography to measure non-markovianity in the silicon spin qubits.

Preparing the ground state of a Heisenberg spin-1/2 Hamiltonian on a Kagome lattice using the Variational Quantum Eigensolver (VQE) *Feb. 2023 – Apr. 2023*

- In IBM open science prize 2022, built Hamiltonian variational ansatz (HVA) based on adiabatic theorem and trotterization.
- Calculated ground state energy of Heisenberg spin-1/2 Hamiltonian (12 qubits) using 16-qubit *ibmq_guadalupe* system along with readout error mitigation and zero-noise extrapolation with relative error rate below 0.15%

Quantum ensemble learning for classification with various quantum classifiers *Sep. 2022 – Feb. 2023*
Advisor: Prof. Junbeom Kim (Business School)

- Built quantum classifiers both in kernel-based method and parametrized quantum circuit-based method, quantum support vector machine (QSVM), variational quantum classifier (VQC), and data re-uploading classifier.
- Using above three quantum classifiers with superconducting qubits and trapped ion qubits, implemented ensemble learning to solve binary classification problems using **Torch**, **Pennylane**, and **Qiskit** and compared with 8 different classical algorithms.

Constructing and Optimizing Microwave Pulses defined Arbitrary Unitary Gates using Neural Ordinary Differential Equations *Jun. 2021 – Jun. 2022*
Advisor: Prof. Dohun Kim

Under IBM Researchers program, built neural network that can learn both environment and signal Hamiltonian and constructed pulse-defined arbitrary unitary gate both in simulation and IBM's real backend using **Qiskit** and **Torch**.

Honors and Awards

Best TA Award *Seoul National University*
Physics Laboratory 2 *Jan. 21, 2025*

1st place, MIT iQuHACK *Massachusetts Institute of Technology*
MIT iQuHACK 2025, Crack the Code with Quantum Factorization, team of 3 *Jan. 31 - Feb. 2 , 2025*

Developed a highly optimized Shor's algorithm capable of factoring up to 26-bit semiprime number without any classical optimizations.

Special Award, IBM Quantum *Quantum Information Research Support Center*
2024 Korea Quantum information Competition, team of 4 *Jun. 21-23, 2024*

Developed a Python module for a surface code including initialization of logical states, logical operations, syndrome measurements, and a decoder based on the look-up table (PRA **90**. 062320) using **Qiskit**.

2nd place *Xanadu Quantum Technologies*
QHack 2024 Coding Challenge, team of 4 *Feb. 12-16, 2024*

Solved 21 advanced coding challenges in quantum computing, covering areas such as cryptography, teleportation, and molecular simulation using **Pennylane**.

Ministry of Science and ICT Minister's Award *Quantum Information Research Support Center, IonQ*
2023 IonQ Quantum challenge, individual *Nov. 7 - Dec. 5. 2023*

Solved problems such as discrete quantum random walk, image classification with compressed and efficient encoding scheme, and Yang-Baxter Equation (YBE)-Powered circuit compression scheme (PRA **106**. 012412).

Scholarship, Semiconductor–Specialized University *Korea Institute for Advancement of Technology*
Semiconductor track, the first cohort scholarship recipient *Oct. 2023*

Quantum Information Research Support Center Director's Award *Quantum Information Research Support Center*
2023 Korea Quantum information Competition, team of 4 *Jun. 21-23, 2023*

- Developed optimal qubit layout algorithm and implemented active readout error mitigation (PRA **105**, 012419), putting together, constructed 4-qubit GHZ state and achieved error rate below 0.025% on 27-qubit *ibm_canberra*.
- Developed a Python module for a multi-hop bidirectional quantum communication protocol (Appl. Sci. 2020, 10(16), 5500) using **Qiskit**.

Leadership

Seoul National University Quantum Research Team (SQRT) **Seoul National University**
President Jun. 2023 – Aug. 2024
Vice President Mar. 2023 – Jun. 2023

- Led and grew the SQRT academic organization to over 90 members from diverse academic backgrounds spanning more than 10 different departments.
- Formed and supervised study groups covering quantum information theory, quantum mechanics, quantum machine learning, fundamentals of qiskit and pennylane, ran a journal club, and formed research projects teams in collaboration with professors across the disciplines.
- Hosted a quantum computing event, Qiskit Fall fest 2023, in collaboration with IBM Quantum, featuring diverse sessions, a hackathon with custom-made problems, and a coding competition.

KATUSA-Korean Augmentation To the United States Army **Republic of Korea Army**
Sergeant, 92A Automated Logistical Specialist Dec. 2021 – Jun. 2023

- Discharged as KATUSA Motor sergeant of the Headquarters and Headquarters Detachment, 94th Military Police Battalion, 19th Expeditionary Sustainment Command.
- Led a maintenance section consisting of 5-8 personnel, responsible for the maintenance of trucks, weapons, and all the other equipment of the company, using a logistics-based program called Global Combat Support System-Army (GCSS-Army).

Teaching Experience

Physics Laboratory — **Seoul National University**
Teaching Assistant, Physics Laboratory 2 — Sep. 2024 – Dec. 2024
Teaching Assistant, Physics Laboratory 1 — Mar. 2024 – Jun. 2024

- Taught the fundamentals of physics experiments and instructed how to write scientific reports.
- Led and supervised bi-weekly lab sessions for two classes (Physics Lab 1) and four classes (Physics Lab 2), each consisting of 20 students; graded lab notes and reports.

Basic Physics 2 — **Seoul National University**
Tutor — Sep. 2024 – Dec. 2024

- Tutored a group of 4 students for the "Basic Physics 2" course, aimed at supporting students enrolled in Physics 2 who need foundational reinforcement to smoothly transition into university-level physics.
- Facilitated weekly study sessions focused on reinforcing core topics from the Physics 2 curriculum, helping students solidify understanding of advanced principles and problem-solving techniques.

Foundation of Physics — **Seoul National University**
Tutor, Foundation of Physics 1 — Mar. 2024 – Jun. 2024
Tutor, Foundation of Physics 2 — Sep. 2023 – Dec. 2023

- Led a group of 3-4 students in the "Foundation of Physics" course, designed for first-year university students who had not studied physics in high school.
- Conducted weekly tutoring sessions to build fundamental physics skills, enabling students to progress confidently through foundational topics and adjust smoothly to university-level coursework.

Technical Skills

Computer Skills: Extensive experience in Python; proficient with LabVIEW, Julia, and LaTeX.

Language: Korean (native), English (fluent)

Quantum Simulation: Extensive experience in Qiskit, Pennylane, pyGSTi, and Qutip

Qiskit Advocate, IBM Certified Associate Developer–Quantum Computation using Qiskit v0.2X