Sung-Min Park

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LinkedIn | Google Scholar | GitHub | Website

Research Interests

Quantum Many-Body Physics Theory | Machine Learning for Quantum Systems | Quantum Information | Tensor Networks | Computational Physics

Education

Integrated MS/PhD in Physics *Sep. 2022 – Present*
Korea Advanced Institute of Science and Technology (KAIST) Daejeon, Korea

- Research Focus: Quantum many-body physics, Quantum Information, Exotic magnetic orders (e.g., spin supersolids, skyrmions), and topological phases
- Advisor: Prof. Eun-Gook Moon
- Collaborator: Prof. Isaac H. Kim (UC Davis),

B.S. in Physics, *Summa Cum Laude* *Mar. 2019 – Aug. 2022*
Chungnam National University (CNU) Daejeon, Korea

- GPA: 4.47/4.5 (Top of College of Natural Sciences)
- Honors: Presidential Science Scholarship (2019–2022), Academic Excellence Award (-2022)

Experience

Military Science and Technology Soldier *Jan. 2025 – Nov. 2026*
Republic of Korea Army Daejeon, Korea

- **On-Device AI for Military Communication**: Developing lightweight neural network models for active noise reduction in military communication systems
- **Model Compression**: Optimized Facebook Denoiser using PyTorch for deployment on low-power edge devices (Raspberry Pi)
- **Technical Stack**: PyTorch, model quantization, pruning techniques, real-time audio processing
- **Impact**: Achieved [XX]% model size reduction while maintaining [YY]% denoising performance (update with real numbers if available)

Graduate Research Assistant *Sep. 2022 – Dec. 2024*
KAIST, Prof. Eun-Gook Moon's Group Daejeon, Korea

- **Quantum Entanglement Theory**: Developed novel geometric framework for multipartite entanglement using modular commutator (Published in Phys. Rev. B)
- **Supersolid Phase Transitions**: Investigated spin-orbit-induced instabilities in triangular-lattice supersolids using mean-field theory and numerical simulations
- **Collaboration**: Co-authored paper with UC Davis Prof. Isaac Kim on quantum information theory
- **Methods**: Analytical calculations, numerical simulations (Python, Mathematica), tensor network techniques

Undergraduate Research Intern *Aug. 2021 – Aug. 2022*
CNU, Strongly Correlated Material Design Lab (Prof. Chang-Jong Kang) Daejeon, Korea

- **Topological Material Search**: Systematically searched for topological insulator candidates using density functional theory (DFT)
- **Computational Methods**: Performed first-principles calculations using VASP to analyze electronic band structures and topological invariants

- **Results**: Identified 3 promising candidate materials with non-trivial topological properties for further experimental investigation

Capstone Project (Individual Research) *Mar. 2021 – Jul. 2021*
CNU, Theoretical Nuclear Physics Lab (Prof. Byung-Yoon Park) Daejeon, Korea
- **Project**: Faraday disk electromagnetic analysis using classical electrodynamics
- **Methods**: Analytical calculations and computational verification of electromagnetic field distributions

Selected Projects

Quantum Convolutional Neural Network (QCNN) Implementation *2024*

- Attempted to reproduce QCNN results for quantum state classification using PyTorch
- Gained hands-on experience with quantum circuit simulation and variational quantum algorithms
- Identified key challenges: limited documentation, computational efficiency of quantum simulators
- *Status*: Ongoing learning project; planning to revisit with stronger ML foundations

Facebook Denoiser Optimization for Edge Deployment *2025–Present*

- Lightweight implementation of state-of-the-art speech denoising model for military applications
- Applied model compression techniques (quantization, pruning) to reduce computational requirements
- *Status*: Active development during military service

Publications

[1] **Sung-Min Park**, Isaac H. Kim, and Eun-Gook Moon. "Geometric additivity of modular commutator for multipartite entanglement." *Physical Review B* **111**, 075167 (2025). [DOI]

[2] Seongjun Park†, **Sung-Min Park**†, Yun-Tak Oh, Hyun-Yong Lee, and Eun-Gook Moon. "Spin-orbit-induced instability and finite-temperature stabilization of a triangular-lattice supersolid." *arXiv:2601.20963* (2025), *submitted*. [arXiv]
†Equal contribution

Conference Presentations

- **Oral Presentation**, "Geometric additivity of modular commutator for multipartite entanglement," APS March Meeting, Anaheim, CA, USA, March 2025
- **Oral Presentation**, "Geometric additivity of modular commutator," Korean Physical Society Fall Meeting, Focus Session on Quantum Information Theory, 2024
- **Poster Presentation**, Korean Physical Society Fall Meeting, 2023

Technical Skills

Programming Languages: Python (advanced), MATLAB (proficient), Mathematica (proficient)
Machine Learning: PyTorch, neural network optimization, model compression (quantization, pruning)
Computational Physics: VASP (DFT calculations), tensor network methods, numerical simulations
Mathematics: Quantum information theory, linear algebra, group theory, differential geometry
Development Tools: Git, Linux, Jupyter, LaTeX
Languages: Korean (native), English (fluent, academic proficiency)

Workshops & Training

- Deep Learning Basics with PyTorch, KAIST IT Academy Summer Session, 2024
- KIAS Quantum Information Workshop, Korea Institute for Advanced Study, 2024
- KIAS Quantum Information Workshop, Korea Institute for Advanced Study, 2023
- 13th Summer School of Condensed Matter Physics, 2022

Honors & Awards

- **Presidential Science Scholarship**, Ministry of Science and ICT, Korea (2019–2022)
  Full tuition and stipend for distinguished undergraduate students in STEM
- **Academic Excellence Award (Valedictorian)**, College of Natural Sciences, CNU (2022)

Service & Outreach

- **Volunteer Tutor**, Educational support for socially disadvantaged children (2019, 2021)

References

Available upon request. Key references include:

Prof. Isaac H. Kim (Collaborative Research)
Assistant Professor, Department of Computer Science, UC Davis
Email: ikekim@ucdavis.edu
Prof. Eun-Gook Moon (PhD Advisor)
Associate Professor, Department of Physics, KAIST
Email: egmoon@kaist.ac.kr
Prof. Chang-Jong Kang (Undergraduate Research Advisor)
Assistant Professor, Department of Physics, Chungnam National University
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