Mingyu Kang

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Education

Duke University - Ph.D. in Physics 2020 - 2025
Dissertation: *Towards Quantum Advantage with Trapped Ions*
References: Profs. Kenneth R. Brown (Advisor), Jungsang Kim, David N. Beratan

Stanford University - B.S. Physics 2014 - 2020
with Distinction and Departmental Honors, GPA: 4.02 / 4.3

Research Experience

Duke Quantum Center, Duke Univ. Aug. 2020 - Now
with *Prof. Kenneth R. Brown*

- Developed pulse-optimization methods for mitigating noise in trapped-ion systems, leading to experimentally demonstrated improvement in two-qubit-gate fidelities
- Devised a quantum error correction scheme that exploits the types of errors in trapped ions, which significantly improves the error-correction threshold
- Designed ion-trap experiments on analog quantum simulation of energy transfer in molecular systems

Laboratory for Integrated Nano-Quantum Systems, Stanford Univ. Jan. 2019 - June 2020
with *Prof. Amir Safavi-Naeini*

- Optimized drive pulses for generating high-fidelity Bell states on nanomechanical quantum memory coupled to superconducting qubit

Professional Experience

Intern, QuEra Computing Jun. 2024 - Sep. 2024

- Analyzed two-qubit-gate errors on neutral atoms using detailed atomic physics and system noise models

Intern, IonQ (virtual) Mar. 2021 - Sep. 2021

- Developed efficient protocols for accurately characterizing the system parameters of trapped ions

Sergeant & Signal Analyst, SEC Security Lab of ROK Army Sep. 2016 - June 2018

- Developed GUI tool for encoding/decoding/finding convolutional codes of various types

Awards & Grants

Seed Grant, NSF Quantum Leap Challenge Institute for Robust Quantum Simulation 2023 - 2024
Simulating Dissipative Electron Transfer with Trapped-Ion Systems
$100,000 research funding, collaboration w/ four other PhD students

John T. Chambers Fellowship, Duke Fitzpatrick Institute for Photonics 2020 - 2021
$10,000, One of four awardees in Duke University

Kwanjeong Scholarship, Kwanjeong Educational Foundation 2014 - 2016, 2018 - 2020
$55,000 / yr, One of seven undergraduate awardees in South Korea

Mary Creason Memorial Award, Duke Department of Physics Aug. 2021
Outstanding teaching in the introductory physics laboratories

Publications

Manuscripts

- **MK***, Y. Zhang*, K. R. Brown, and T. Barthel *Non-Gaussian Phase Transition and Cascade of Instabilities in the Dissipative Quantum Rabi Model*, arXiv:2507.07092 (2025).
- **MK***, Y. Lin*, H. Yao, M. Gökduman, A. Meinking, and K. R. Brown, *QUITS: A modular Qldpc code circUIT Simulator*, arXiv:2504.02673 (2025).

Published Journal Articles

- K. Sun*, **MK***, H. Nuomin, G. Schwartz, D. N. Beratan, K. R. Brown, and J. Kim, *Quantum Simulation of Spin-Boson Models with Structured Bath*, Nat. Commun. **16**, 4042 (2025). arXiv:2405.14624
- **MK**, H. Nuomin, S. N. Chowdhury, J. L. Yuly, K. Sun, J. Whitlow, J. Valdiviezo, Z. Zhang, P. Zhang, D. N. Beratan, and K. R. Brown, *Seeking a Quantum Advantage with Trapped-Ion Quantum Simulations of Condensed-Phase Chemical Dynamics*, Nat. Rev. Chem. **8**, 340-358 (2024). arXiv:2305.03156
- Q. Liang, **MK**, M. Li, and Y. Nam, *Pulse Optimization for High-Precision Motional-Mode Characterization in Trapped-Ion Quantum Computers*, Quantum Sci. Technol. **9**, 035007 (2024). arXiv:2307.15841
- **MK**, W. C. Campbell, and K. R. Brown, *Quantum Error Correction with Metastable States of Trapped Ions using Erasure Conversion*, PRX Quantum **4**, 020358 (2023). arXiv:2210.15024
- K. Sun, C. Fang, **MK**, Z. Zhang, P. Zhang, D. N. Beratan, K. R. Brown, and J. Kim, *Quantum Simulation of Polarized Light-Induced Electron Transfer with a Trapped-Ion Qutrit System*, J. Phys. Chem. Lett. **14**, 6071-6077 (2023). arXiv:2304.12247
- Z. Jia, S. Huang, **MK**, K. Sun, R. F. Spivey, J. Kim, and K. R. Brown, *Angle-Robust Two-Qubit Gates in a Linear Ion Crystal*, Phys. Rev. A **107**, 032617 (2023). arXiv:2210.04814
- **MK**, Q. Liang, M. Li, and Y. Nam, *Efficient Motional-Mode Characterization for High-Fidelity Trapped-Ion Quantum Computing*, Quantum Sci. Technol. **8**, 024002 (2023). arXiv:2206.04212
- **MK**, Y. Wang, C. Fang, B. Zhang, O. Khosravani, J. Kim, and K. R. Brown, *Designing Filter Functions of Frequency-Modulated Pulses for High-Fidelity Two-Qubit Gates in Ion Chains*, Phys. Rev. Applied **19**, 014014 (2023). arXiv:2206.10850
- **MK**, Q. Liang, B. Zhang, S. Huang, Y. Wang, C. Fang, J. Kim, and K. R. Brown, *Batch Optimization of Frequency-Modulated Pulses for Robust Two-Qubit Gates in Ion Chains*, Phys. Rev. Applied **16**, 024039 (2021). arXiv:2104.06887

Dissertation

- **MK**, *Towards Quantum Advantage with Trapped Ions*, Duke University (2025)
- **MK**, *Optimal Control of Nanomechanical Quantum Memory Coupled to Superconducting Qubit*, Stanford University (2020)

Oral Presentations

Invited Talks

· Noise-robust analog quantum simulation of noisy quantum systems; **University of California, Berkeley** (virtual); Apr. 2025

· Towards quantum advantage with trapped ions; **Freie Universität Berlin**, Berlin, Germany; Mar. 2025

· Pulse optimization for trapped-ion operations and applications to chemical dynamics simulations; **University of Sydney**, Sydney, Australia; Nov. 2023

· Trapped-ion quantum simulations for condensed-phase chemical dynamics: seeking a quantum advantage; **Stellenbosch University** (virtual); Oct. 2023

· Trapped-ion quantum simulations for condensed-phase chemical dynamics: seeking a quantum advantage; **Sungkyunkwan University (SKKU)**, Suwon-si, South Korea; Aug. 2023

· Seed Grant: Simulating Dissipative Electron Transfer with Trapped-Ion Systems; Robust Quatnum Simulation Institute Workshop; **University of Maryland**, College Park, MD, USA; June 2023

· Mitigating Experimental Imperfections with Frequency-Modulated Pulses for High-Fidelity Two-Qubit Gates in Ion Chains; AMO Physics Seminar; **University of California, Los Angeles**, Los Angeles, CA, USA; July 2022

· Mitigating Experimental Imperfections with Frequency-Modulated Pulses for High-Fidelity Two-Qubit Gates in Ion Chains; EPiQC Tech Talk; **University of Chicago** (virtual); Apr. 2022

· Designing Control Pulses for High-Fidelity & Robust Two-Qubit Gates in Trapped Ion Systems; **Sungkyunkwan University (SKKU)**, Suwon-si, South Korea; July 2021

Contributed Talks in International Conferences

· Quantum simulation of spin-boson models with structured bath: Towards quantum advantage; **APS March Meeting 2025**; Anaheim, CA, USA; Mar. 2025

· Quantum Error Correction with Metastable States of Trapped Ions using Erasure Conversion; **6th International Conference on Quantum Error Correction**; Sydney, Australia; Nov. 2023

· Trapped-ion quantum simulations for condensed-phase chemical dynamics: seeking a quantum advantage; **Asian Quantum Information Science Conference 2023**; Seoul, South Korea; Aug. 2023

· Quantum Error Correction with Metastable States of Trapped Ions using Erasure Conversion; **APS March Meeting 2023**; Las Vegas, NV, USA; Mar. 2023

· Mitigating Experimental Imperfections with Frequency-Modulated Pulses for High-Fidelity Two-Qubit Gates in Ion Chains; **APS March Meeting 2022**; Chicago, IL, USA; Mar. 2022

Service

Student-postdoc council, Institute for Robust Quantum Simulation Oct. 2022 - Aug. 2024

· Organized topics, speakers, and timetables of two QSim Summer Schools (2023 & 2024)

· Invited quantum industry experts to Duke University for a career connection event

Journal referee

· *npj Quantum Information, Physical Review A, Physical Review Letters, Physical Review Research, Physical Review X, PRX Quantum, Quantum, Chinese Physics Letters*

Conference referee

· TQC 2024

Outreach Experience

Co-host, Youtube series *Quantum News Monthly* Sep. 2023 - Sep. 2024

· Reviewed selected papers published each month in the field of quantum physics and computing

Adminstrator, Facebook group *Quantum Computing KR* (South Korea) Apr. 2022 - Oct. 2022

· Posted introductory-level summary of a significant paper on quantum computing on a weekly basis

Translator, Sungkyunkwan University & IonQ Feb. 2021 - Jan. 2022

· Translated a technical talk on quantum computing by IonQ's expert for Korean students monthly

Teaching Experience

Teaching Assistant, Duke Univ. Aug. 2020 - May 2021
Physics 152L: *Introduction to Electromagnetism (Lab)* & Physics 142L: *General Physics II (Lab)*

Teaching Assistant, Stanford Univ. Sep. 2019 - Dec. 2019
Physics 61: *Mechanics and Special Relativity*