Nuri Kang

+82-10-7291-5265 | Email : n.r.kang.quantum@gmail.com, T23297@kist.re.kr

Nuri Kang | Nuri Kang (0009-0008-4376-236X)

Center for Quantum Technology, Korea Institute of Science and Technology (KIST CQT), Seoul, Republic of Korea

Research Interest

Quantum Error Correction, **Continuous Variable Systems**, Open Quantum Systems, Quantum Foundations

Education

- **M.S. in physics, Korea university** — *Mar. 2023 - Feb. 2025*
  *Cumulative GPA : **4.33/4.50** (37 credits)* — Seoul, Republic of Korea
- **B.S. in applied physics, Kyunghee university** — *Mar. 2016 - Feb. 2023*
  *Cumulative GPA : **4.18/4.50** (144 credits)* | *Major GPA : **4.27/4.50** (116 credits)* — Suwon, Republic of Korea

Publications

P=In Progress, J=Journal, T=Thesis

[P.1] **Linear optical fault-tolerant quantum computation with bosonic multi-head cat qubit**.
N Kang, J Lee, R Alexander, SW Lee.
Manuscript in progress, to be submitted to *PRX Quantum*.

[P.2] **All linear optical memoryless repeater with bosonic multi-head cat qubit**.
N Kang, J Lee, D Lee, SW Lee.
Manuscript in progress, to be submitted to *npj Quantum Information*.

[P.3] **Operationally hidden or lost information in quantum measurement**.
J Shin, S Bagchi, **N Kang**, HT Lim, SW Lee.
Manuscript in progress.

[J.1] **Fault-tolerant quantum computation by hybrid qubits with bosonic cat code and single photons.**
J Lee, **N Kang**, SH Lee, H Jeong, L Jiang, SW Lee, *PRX Quantum* **5**, 030322 (2024).
DOI : 10.1103/PRXQuantum.5.030322
News : Phys.org, The Quantum Insider, Link of other news

[J.2] **Encoded-fusion-based quantum computation for high thresholds with linear optics.**
W Song, **N Kang**, YS Kim, SW Lee, *Phys. Rev. Lett*, **133**, 050605 (2024).
DOI : 10.1103/PhysRevLett.133.050605
News : Phys.org, Link of other news

[T.1] **Linear optical quantum computing with multi-head cat qubits**.
N Kang, master's dissertation, Korea University, Seoul, Republic of Korea (2024).
DOI : 10.23186/korea.000000292497.11009.0001894

Conferences

C=Conference

[C.1] **Fault-tolerance analysis of photonic hybrid quantum computation**.
N Kang, J Lee, SW Lee, 23rd Asian Quantum Information Science (AQIS) Conference (2023).
Poster presentation.

[C.2] **Teleportation-based error correction with stabilizer code**.
N Kang, SW Lee, Optical Society of Korea (OSK) Optics and Photonics Congress (2022).
Poster presentation, awarded Best Poster Presentation.

[C.3] **Teleportation-based error correction with stabilizer code**.
N Kang, SW Lee, Optical Society of Korea (OSK) 5th Quantum Information Conference (2022).
Poster presentation, awarded Best Poster Presentation.

Research Experience

- **Quantum Information Theory Group, KIST CQT | Advisor : Dr. Seung-Woo Lee** *Mar. 2022 - Present*
  LINK+ Field Training Program → Research Assistant → Research Intern Seoul, Republic of Korea
  - **Defined hybrid qubits by integrating the four-head cat qubits with dual-rail single photon qubits and developed a high-success all-linear optical hybrid fusion operation [J.1].**
    *This work was conducted in collaboration with **Prof. Liang Jiang** at the **University of Chicago**.*
    * Performed fault-tolerance threshold calculations for measurement-based quantum computing (MBQC) architecture and analyzed resource overhead using Monte Carlo simulations with the PyMatching package.
    * Designed unit resource generation schemes and conducted a detailed analysis of resource overhead.
  - **Developed and analyzed an encoded fusion-based quantum computing (FBQC) architecture using active (n,m)-Shor code encoded fusions [J.2].**
    * Calculated error probabilities for encoded fusion under the photon loss errors to estimate thresholds.
    * Optimized encoded fusion parameters to achieve the highest fault-tolerance thresholds and calculated the associated overhead and thresholds.
  - **Developed an all-linear optical Bell measurement for general multi-head cat qubits.**
    These projects were led by me as the first author, including conceptualization, analysis, and manuscript preparation.
    * Analyzed fault-tolerance thresholds and resource overhead in the MBQC architecture, designing unit resource generation schemes with a focus on Raussendorf-Harrington-Goyal (RHG) lattice and bias-tailoring foliated XZZX lattice as outer codes (**[P.1]**, **[T.1]**).
      *This work was conducted in collaboration with **Xanadu's architecture team**.*
    * Developed a memoryless one-way repeater scheme and analyzed the secret key rate and resource overhead **[P.2]**.

- **Quantum Optics Group, KIST CQT | Advisor : Dr. Hyang-Tag Lim** *Dec. 2020 - Feb. 2021, Jul. 2021 - Aug. 2021*
  LINK+ Field Training Program | UST internship Suwon, Republic of Korea
  - **Quantum State Tomography (QST) and Quantum Process Tomography (QPT).**
    * Converted Maximum Likelihood Estimation (MLE)-based QST and QPT codes from Mathematica to Python, achieving an average runtime optimization of 40x.
    * Implemented a linear regression-based method, achieving a speedup of 3-4 orders of magnitude over the MLE-based approach.

Honors and Awards

- **Best Poster Presentation Award** *Jul. 2022*
  Optical Society of Korea (OSK) Optics and Photonics Congress Jeju, Republic of Korea
- **Best Poster Presentation Award** *Jun. 2022*
  Optical Society of Korea (OSK) 5th Quantum Information Conference Seoul, Republic of Korea
- **Excellent Poster Award for Undergraduate Thesis** *Dec. 2021*
  Department of applied physics, Kyunghee university Suwon, Republic of Korea
  - Topic : Quantum Optimization – Modern Portfolio Theory
- **Excellence award, Quantum Hackathon Korea - Team Leader** *Jun. 2021*
  IonQ | Quantum Information Research Support Center | Ministry of science and ICT Seoul, Republic of Korea
  - Topic : Variational Quantum Algorithm (VQA) for portfolio optimization problem.
  - Ranked TOP 3 out of 27 teams.
  - Featured in the Kyunghee University campus newspaper (20. Sep. 2021) for this achievement.

Activities

- **Teaching Assistant - General Physics (English-taught)** *Sep. 2023 - Dec. 2023, Mar. 2024 - Jun. 2024*
  Department of Physics, Korea university Seoul, Republic of Korea
  - Led practice sessions and designed as well as assessed assignments, midterm exams, and final exams.
- **Military service, Republic of Korea Army - Social Service Agent** *Nov. 2017 - Oct. 2019*
  Security screening unit, Busan high court Busan, Republic of Korea
  - Served as a social service agent, responsible for security screening at the Busan High Court.

Additional Information

- **Languages:** Korean (Native), English (Fluent)
- **Programming:** Python, Mathematica, LabVIEW