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CURRICULUM VITAE

Research Interests

Fundamental Physics / Precision Measurement / Quantum Optics / Quantum Metrology / Light-Matter Interactions / Cavity QED / Quantum Simulation / Quantum Many-Body Physics / Quantum Information Science / and ***their applications***

Education

Bachelor of Science in Physics / Pusan National University
Mar. 2016 - Feb. 2023, Busan, Republic of Korea
GPA: 3.70 / 4.00 (major 3.79 / 4.00), *Magna Cum Laude*, and *Dean's List*

Publications

1. Tentative Title: ***Compact diode laser pumped two-mode squeezed state of light from four-wave mixing in hot rubidium vapor and quantum noise characteristics***
   Gisung Sim, Heewoo Kim, and Han Seb Moon*
   (expected to submit by early 2024)

2. Tentative Title: ***Sensitive electric field sensing based on a Rydberg atom***
   Kyungmin Joo, Heewoo Kim, Jinhyuk Bae, *Gisung Sim*, Han Seb Moon*
   (to be submitted)

3. Tentative Title: ***Quantum-enhanced electrometer based on a Rydberg atom with squeezed light***
   Gisung Sim, Kyungmin Joo, Heewoo Kim, Jinhyuk Bae, and Han Seb Moon*
   (in preparation)

Key Research Experiment

Generation of a Two-Mode Squeezed State of Light by Four-Wave Mixing in Hot Rubidium Vapor
Jun. 2022 – Present, Quantum Sensors Research Center
Accomplished the first in South Korea using rubidium vapor; generated a two-mode squeezed state of light from four-wave mixing in hot ^{85}Rb vapor cell and measured -6 dB of intensity difference squeezing; leading to subsequent researches:

- Quantum-Enhanced Electric Field Sensing Based on a Rydberg Atom
- Quantum-Enhanced Optical Magnetometry
- Covariant Quantum Measurement of a Two-Mode Squeezed State with Dual Homodyne Detection

expected to write three papers based on the findings of this experiment.

Covariant Quantum Measurement of a Two-Mode Squeezed State with Dual Homodyne Detection
Oct. 2023 – Present, Quantum Sensors Research Center
Completed the setup design; currently preparing to construct the setup.

Other Research Experience

Quantum Sensors Research Center (Atomic & Quantum Optics Lab)
Mar. 2023 – Present, Research Assistant

1. **Optimization of the two-mode squeezed state of light**
   Enhancing the squeezing by optimizing phase-matching conditions; improved detection efficiency; minimized optical loss; and reduced system noise.

2. **Generation of photon pairs from four-wave mixing with single beam**
   Generated photon pairs in strong coherence between two ground states from four-wave mixing in a hot ^{85}Rb vapor cell; achieved this with single beam system to minimize optical phase noise. This research has led to the

generation of squeezed states.

3. **Sensitive electric field sensing based on a Rydberg atom**
   Assisted in constructing and operating an ultra-low expansion (ULE) cavity system; operating a Pound-Drever-Hall (PDH) locking system; and reducing electronic noise.

4. **Frequency modulation & stabilization system**
   Constructed and operated a frequency modulation system by implementing an electro-optic modulator (EOM) and etalon filters. Currently developing a laser frequency stabilization system using a PID control system integrated with an acousto-optic modulator (AOM); preparing an ultra-stable Pound-Drever-Hall (PDH) laser frequency locking system utilizing a ULE cavity.

Atomic & Quantum Optics Lab
Jan. 2022 – Feb. 2023, Undergraduate Research Student

1. **Noise reduction**
   Successfully suppressed significant electronic noise in my quantum metrology experiment by over 99% using customized homemade noise filters.

2. **Generation of photon pairs from four-wave mixing with twin beams**
   Generated photon pairs in strong coherence between two ground states from four-wave mixing in hot ^{85}Rb vapor cell with two independent lasers.

3. **Laser power amplification**
   Amplified laser power from 20 mW to 1.5 W using a master oscillator power amplifier (MOPA) system, incorporating a tapered amplifier, to generate sufficient power for four-wave mixing. This system provided a stable, compact, and low-cost laser source.

4. **Spectroscopy**
   Implemented saturated absorption spectroscopy (SAS) as a basic technique for guaranteeing the accuracy of our lasers' wavelength.

5. **Sensitive electric field sensing based on a Rydberg atom**
   Supported as an assistant; tested lasers and optical components; made balanced detectors for saturated absorption spectroscopy and Helmholtz coil.

Heavy Ion Physics Experiment Lab
Jan. 2018 – Jun. 2018, Undergraduate Research Student

1. **ALICE project at CERN**
   Conducted electrical testing and visual inspection of new detectors for the ALICE project of the European Organization for Nuclear Research (CERN), ensuring their proper functionality.

2. **Particle Adventure**
   Translated "Particle Adventure" website of Lawrence Berkeley National Laboratory (LBNL) into Korean with studying, which was a small but long-term project in the lab.

Presentations

Oral Sessions

1. "Generation of two-mode squeezed light from four-wave mixing in hot ^{85}Rb vapor cell," Gisung Sim, Heewoo Kim, and Han Seb Moon*.
   Optics and Photonics Congress 2023 (OPC 2023), Jeju, Korea (Aug. 2023).

2. "Four-wave mixing in a double-lambda system of ^{85}Rb vapor cell towards generation of squeezed states," Gisung Sim, Heewoo Kim, and Han Seb Moon*,
   The 1st Joint Workshop for Young Physicist (Brain Korea 21), Muju, Korea (Jan. 2023).

Poster Sessions

1. "Towards squeezed states: Four-wave mixing in a double-Λ system of a hot ^{85}Rb vapor cell," Gisung Sim, Heewoo Kim, Jinhyuk Bae, and Han Seb Moon*. Awarded *Best Student Paper Award*.
   Advanced Lasers and Their Applications 2023, Jeju, Korea (May 2023).

2. "Towards quantum-enhanced sensing: generation of two-mode squeezed light from four-wave mixing in hot ^{85}Rb vapor," Gisung Sim, Heewoo Kim, and

Han Seb Moon*.
2023 KPS Fall Meeting, Changwon, Korea (Oct. 2023).

3. "Towards quantum-enhanced sensing: generation of two-mode squeezed light from four-wave mixing in hot 85Rb vapor," Gisung Sim, Heewoo Kim, and Han Seb Moon*.
2023 Quantum Sensor ITRC Workshop, Busan, Korea (Aug. 2023).

4. "Four-wave mixing in a double-Λ system of 85Rb vapor cell towards the generation of squeezed state," Gisung Sim, Heewoo Kim, Hansol Jeong, Jinhyuk Bae, and Han Seb Moon*.
34th Annual General Meeting and 2023 Winter Academic Conference, Busan, Korea (Feb. 2023).

Work Experience

Computing Academic Club Activities
Jan. 2017 – Jul. 2018, President & Team Leader

1. Python and Arduino study
Led a study group for learning Python and Arduino to improve academic skills for physics; resulted in participating in the department's OpenLab event.

2. Open Lab
Led a team in the department's academic event, OpenLab; created a visual simulation of a black hole, sparking interest in physics among participants.

Mentoring for first-year students of the department of physics
Mar. 2022 – Dec 2022, Mentor
Participated in the department-offered mentoring program for students who were struggling with physics; successfully supported five juniors over the course of a year, all of whom achieved good grades in their physics courses.

Incheon Welfare Center for the Blind
Jun. 2020 – May. 2021, Public Service Worker
Assisted staff and blind people at the welfare center; supported facility management; implemented COVID-19 prevention measures; aided in the operation of programs for the blind; delivered meals to blind individuals facing financial difficulties.

Republic of Korea Army
May. 2019 – Feb. 2020, Private First Class
Served as a foot soldier and an administration clerk; aided to prepare military training; participated in diverse military training exercises with comrades from various backgrounds.

Awards & Scholarship

Awards

1. Best Student Paper Award, Advanced Lasers and Their Applications, 2023
given by the chairman of the Quantum Electron Division of the Optical Society of Korea.

2. Academic Excellence Award, College of Natural Sciences at Pusan National University, 2023
given by the president of the alumni association of Pusan National University College of Natural Sciences.

3. Excellence Award, Department of Physics at Pusan National University, 2017
given by the dean of the Department of Physics at Pusan National University.

Scholarship

1. National Scholarship	Mar. 2016 – Dec. 2022
2. School Scholarship	Mar. 2016 – Dec. 2022
3. KT Group Hope Sharing Foundation Scholarship	Sep. 2017 – Dec. 2017
4. Short-Term Study Abroad Program	Sep. 2017 – Dec. 2017
5. University Innovation Support Project	Mar. 2022 – Dec. 2022
6. Gyeongdo Development Fund	Mar. 2022 – Dec. 2022

Skills & Others

- *Computing*
Python, Mathematica, TensorFlow, and AutoCAD.

- *Mathematics*
  Took courses and self-studied for Linear Algebra, Analysis, Abstract Algebra, and Group Theory to obtain profound understanding of mathematical concepts essential for physics.

- *Electronics*
  Network Analysis, Arduino, Soldering.

- *Hobby*
  Reading (mainly about anthropology, philosophy, and social science), Running, Camping, Barbecuing, Singing, Drumming.