

Hanbyul Kim

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EDUCATION

Mar.2019

Aug.2024

Undergraduate in Physics Department at Hanyang University

- Cumulative G.P.A : 3.97/4.0, **Summa Cum Laude**

- Early graduation in August of 2024

Sep.2024 -

Master's Program in Physics Department at Hanyang University

RESEARCH INTEREST

My research focuses on theoretical condensed matter physics, particularly topological phases, quantum geometry, and magnetoelectric responses in correlated and van der Waals systems. I am interested in microscopic modeling and symmetry-based theory for emergent electronic and magnetic phenomena.

PUBLICATIONS

[1] **Hanbyul Kim**, Moon Jip Park^{*} *et al.* (2026). *Odd-Parity Magnetism and Gate-Tunable Edelstein Response in van der Waals Heterostructures* arXiv:2602.11251 (Under review at *Physical Review Letters*).

[2] Seik Pak, **Hanbyul Kim**, Moon Jip Park^{*} *et al.* (2025). *Eta-pairing state in flatband lattice: Interband coupling effect on entanglement entropy logarithm.* arXiv:2504.17845 *Physical Review B*, published.

[3] Chan Bin Bark, **Hanbyul Kim**, *et al.* (2025). *Stacking-dependent topological electronic structures in honeycomb-kagome heterolayers.* arXiv:2502.14861 *npj 2D Materials and Applications*, published.

[4] **Hanbyul Kim**, Taewon Yuk, Sang-Jin Sin^{*} . (2025). *Percolation of the Berry curvature as topological transition.* arXiv:2407.21098v2 *Journal of Physics: Condensed Matter*, published.

RESEARCH EXPERIENCE

2024 - 2026

Condensed matter study

- Advisor : Prof. Moon Jip Park
- Topic : p wave in van der Waals Heterostructures
Led this first-author project by deriving the Landau free energy and constructing a tight-binding model for a van der Waals heterostructure that stabilizes odd-parity magnetic order.
- Topic : Stacking-dependent Topological Electronic Structures in Honeycomb-kagome Heterolayers.

Calculate spectrum of low-angle moiré Honeycomb-Kagome lattice and discovered a Higher-order topological insulator phase under specific symmetric conditions

- Topic : Many-body quantum physics in Strongly correlated system Eta-pairing state in flatband lattice

Investigated how interband coupling in flatband lattices modifies the logarithmic entanglement entropy scaling of eta-pairing states.

2024

Quantum Geometry Tensor Research

- Advisor : Prof. Sang-Jin Sin
- Topic : Berry-curvature percolation in two-dimensional topological insulators
Demonstrated novel idea that Berry curvature percolation plays a key role in determining topological phases in materials
- Topic : Extended Holographic Mean Field Theory to study strongly interacting fermion systems, focusing on symmetry-breaking phenomena and spectral functions.
Analyzed and classified system by topology in Holography using the Hamiltonian method.

2022 - 2023

Particle Experiment Simulation Research with CERN-CMS

- Advisor: Prof. Tae-Jeong Kim
- Topic : Searching for the di-Higgs ($t\bar{t}HH$) in di-lepton state from HL-LHC at $\sqrt{s} = 14TeV$
Used Monte Carlo simulations of Phase-II CMS data for background modeling $t\bar{t}HH$ process
Implemented Deep Neural Networks (DNNs) to enhance the identification of b-tagged jets and classify $t\bar{t}HH$ signals from background events, improving signal detection accuracy.

CONFERENCE

03. 2026

American Physical Society March meeting 2026

- Presentation in poster session
- Topic : p-wave magnetism in van der Waals Heterostructures

05. 2024

Korean Physical Society Fall meeting 2024/ Spring meeting 2025

- Presentation in oral session
- Topic : Holographic Quantum Geometry Tensor

05. 2024

Intercontinental Binodal Workshop

on Flat Bands and high-order Van Hove singularities

04. 2024

Korean Physical Society spring meeting 2024

- Presentation in oral session
- Topic : Percolation of the Berry curvature as topological transition

01. 2024

Workshop on Strongly Correlated Systems and DoS Singularity

07. 2023

2023 QUC Summer School on A.I. in High Energy Physics

06. 2023

2023 KCMS(Korea CMS collaboration) Workshop

WORK EXPERIENCE

2024 - present

Assistant Instructor, General Physics Laboratory

Independently managed all aspects of the laboratory course
designed and delivered instruction, supervised experiments, and grading
(2024): General Physics Experiment 2 (English only class)
(2025): General Physics Experiment 1

2022 - 2024

Teaching Assistant

(2024): Thermal and Statistical Physics TA
(2023): Mathematical physics TA

2019 - 2024 **Private tutoring**
(2019-present) : Provided private tutoring in mathematics and physics to over 15 students(most of them was high school student).

AWARDS AND HONORS

Fall 2024 **Han Ki-su Scholarship** Hanyang University
Merit-based support for top-ranked incoming graduate student

2022 - 2023. **Hanyang Academic Excellence Award Recipient** a prize of excellence (4.0/4.0)
Only **1%** of the students in the College of Natural Sciences. (2023, 2022)

2021 - 2024. **Academic Excellence Award:Merit-based Scholarship** only for **1st, 2nd** place
Tuition waiver for the semester in Hanyang University (2021, 2022, 2023)

Spring 2024 **Outstanding Paper Presentation Award** in Hanyang university
Awarded for Excellence in Graduation Thesis Presentation

Fall 2023 **Outstanding Presentation Award** in conference at Hanyang University
Awarded for exceptional presentation and Academic Activities Scholarship

SKILLS AND QUALIFICATIONS

Programming Python, Mathematica, Root(CERN), Unix, Linux, Matlab, C , Julia