HYUNWOO OH

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RESEARCH INTERESTS

Sign and signal-to-noise problems in Monte Carlo calculations, Machine learning applications in physics, Quantum simulation of field theories

EDUCATION

University of Maryland College Park, MD
Ph.D. Candidate in Physics (Advisors: Paulo Bedaque, Thomas Cohen) Sep. 2020 – Present

Yonsei University Seoul, Korea
B.S. in Physics, B.S. in Mathematics 2013 – 2019
Graduated with Highest Honors, Valedictorian

PAPERS

[10] Hyunwoo Oh, *Training neural control variates using correlated configurations*, Phys. Rev. D **112**, 074501 (2025), arXiv:2505.07719 [hep-lat]

[9] Thomas D. Cohen, Andrew Li, Hyunwoo Oh, and Maneesha Sushama Pradeep, *On the utility of the switching theorem for adiabatic state preparation*, arXiv:2502.06534 [quant-ph]

[8] Thomas D. Cohen and Hyunwoo Oh, *Asymptotic errors in adiabatic evolution*, Phys. Rev. A **111**, 042612 (2025), arXiv:2501.10641 [quant-ph]

[7] Thomas D. Cohen, Hyunwoo Oh, and Veronica Wang, *Numerical study of computational cost of maintaining adiabaticity for long paths*, arXiv:2412.08626 [quant-ph]

[6] Thomas D. Cohen and Hyunwoo Oh, *Corrections to adiabatic behavior for long paths*, Phys. Rev. A **110**, 062601 (2024), arXiv:2405.10294 [quant-ph]

[5] Paulo F. Bedaque and Hyunwoo Oh, *Leveraging neural control variates for enhanced precision in lattice field theory*, Phys. Rev. D **109**, 094519 (2024), arXiv:2312.08228 [hep-lat]

[4] Thomas D. Cohen and Hyunwoo Oh, *Efficient vacuum-state preparation for quantum simulation of strongly interacting local quantum field theories*, Phys. Rev. A **109**, L020402 (2024), arXiv:2310.19229 [hep-lat]

[3] Thomas D. Cohen and Hyunwoo Oh, *Optimizing the rodeo projection algorithm*, Phys. Rev. A **108**, 032422 (2023), arXiv:2305.19952 [quant-ph]

[2] Andrei Alexandru, Paulo F. Bedaque, Andrea Carosso, and Hyunwoo Oh, *Infinite variance problem in fermion models*, Phys. Rev. D **107**, 094502 (2023), arXiv:2211.06419 [hep-lat]

[1] Scott Lawrence, Hyunwoo Oh, and Yukari Yamauchi, *Lattice scalar field thoery at complex coupling*, Phys. Rev. D **106**, 114503 (2022), arXiv:2205.12303 [hep-lat]

PROCEEDINGS

[2] Hyunwoo Oh, *Control variates with neural networks*, PoS LATTICE2024 051, arXiv:2501.14614 [hep-lat]

[1] Hyunwoo Oh, Andrei Alexandru, Paulo F. Bedaque, and Andrea Carosso, *A solution for infinite variance problem of fermionic observables*, PoS LATTICE2023 021, arXiv:2311.16074 [hep-lat]

TALKS

[7] *Neural control variates for variance reduction* (Poster), USQCD All-Hands Meeting 2025 , College Park, MD, March 2025

[6] *Control variates with neural networks*, Lattice 2024 at Liverpool, UK, July 2024

[5] *State preparation of local quantum field theories using projection*, HEP-QIS Forum at Fermilab, Batavia, IL, October 2023

[4] *State preparation of local quantum field theories using quantum Zeno effect*, Nuclear Theory Seminar at UMD, College Park, MD, October 2023

[3] *A solution for infinite variance problem of fermionic observables*, Lattice 2023 at Fermilab, Batavia, IL, August 2023

[2] *Infinite variance problem in lattice fermions*, Nuclear Theory Seminar at UMD, College Park, MD, November 2022

[1] *Lattice scalar field theory at complex coupling*, Fall 2022 Meeting of the APS Division of Nuclear Physics, New Orleans, LA, October 2022

RESEARCH EXPERIENCE

Nuclear Theory Group College Park, MD
Research Assistant Sep. 2020 – Present

- Improved Monte Carlo (MC) calculation stability and efficiency by addressing complex numerical issues, utilizing a diverse set of techniques including machine learning
  - Resolved the infinite variance problem caused by zeros of determinant in MC sampling through the novel approach of adding auxiliary variables and applying a reweighting scheme
  - Tackled the sign problem in physical systems by developing and implementing contour deformation methods with machine learning
  - Developing a control variates method integrated with machine learning to mitigate signal-to-noise problems in studying physical systems
- Developed and analyzed efficient quantum algorithms for preparing ground states
  - Mitigated exponential variance in the Rodeo projection algorithm, resulting in over $2\times$ improvement in projection speed
  - Developed a state preparation method that achieves a quadratic speedup compared to adiabatic state preparation and methods based on the quantum Zeno effect
  - Analyzed the scaling and dynamics of errors in adiabatic state preparation in the context of simulating quantum field theories

WORK EXPERIENCE

Samsung Electronics Hwaseong, Korea
Process Integration Engineer Mar. 2019 – Mar. 2020

- Designed and managed the process integration flow for DRAM manufacturing
- Contributed to a project focused on the development and integration of a next-generation DRAM product

Military Service in Republic of Korea Air Force Seongnam, Korea
Staff Sergeant Sep. 2016 – Sep. 2018

- Managed and operated military vehicles, strictly adhering to safety protocols and maintenance schedules
- Served as a representative and counselor for mandatory service personnel, addressing administrative needs and providing essential support

MENTORING EXPERIENCE

- Veronica Wang (High School Student, Summer 2024), now attending Stanford University
  Mentored on a research project on adiabatic state preparation; resulting in a publication

- Andrew Li (High School Student, Summer 2024), now attending the University of Maryland
  Mentored on a research project on the switching theorem; resulting in a publication

HONORS AND AWARDS

Dean's Fellowship, University of Maryland	2020 – 2022
Kwanjeong Domestic Scholarship, Kwanjeong Educational Foundation	2015 – 2019
National Science & Technology Scholarship, Korea Student Aid Foundation	Fall 2014
Truth Scholarship (Merit based), Yonsei University	Spring 2014, Fall 2013
Dean's List, Yonsei University	All semesters

SKILLS

Programming	Python, Mathematica, C++
Software & Tools	JAX, Numpy, Scipy, Pandas, scikit-learn, Git, Linux

Last updated: October 10, 2025