

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

Ph.D. in Physics (Advisors: Paulo Bedaque, Thomas Cohen)

College Park, MD

Sep. 2020 – May 2026

Yonsei University

B.S. in Physics, B.S. in Mathematics

Graduated with Highest Honors, Valedictorian

Seoul, Korea

Mar. 2013 – Feb. 2019

PAPERS

- [11] Ali Siahkoohi, Hyunwoo Oh, *Conditional neural control variates for variance reduction in Bayesian inverse problems*, arXiv:2602.21357 [stat.ML]
- [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, *Practical limitations of the switching theorem for adiabatic state preparation*, Eur. Phys. J. D **80**, 41 (2026), 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 theory 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

- [9] *Classical and quantum algorithmic developments in lattice field theory*, PhD Dissertation Defense, College Park, MD, March 2026

- [8] *Neural control variates for variance reduction* (Poster), KSEA DMV Regional Conference 2026, Baltimore, MD, March 2026
- [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, University of Maryland

Research Assistant

College Park, MD

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. [GitLab Link](#)
 - Developing a control variates method integrated with machine learning to mitigate signal-to-noise problems in studying physical systems. [Github Link](#)
- 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 while removing exponential fluctuations.
 - 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

Process Integration Engineer

Hwaseong, Korea

Mar. 2019 – Mar. 2020

- Developed end-to-end process integration flows for next-generation DRAM architectures, translating novel structural concepts into executable fabrication sequences through rigorous logic-based workflow design.
- Optimized prototype feasibility through iterative experimental campaigns (DoE), collaborating with module teams to analyze process variance and stabilize integration recipes via statistical validation of metrology data.

Republic of Korea Air Force

Staff Sergeant

Seongnam, Korea

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 adiabatic switching theorem; resulting in a publication.

TEACHING EXPERIENCE

University of Maryland	College Park, MD
<i>Teaching Assistant</i> , Introductory General Relativity, Gravitation, and Cosmology	Spring 2026
<i>Teaching Assistant</i> , General Physics: Mechanics, Vibrations, Waves, Heat (Laboratory)	Spring 2026

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 Languages	Python, Bash, Mathematica, C++, SQL (PostgreSQL, BigQuery)
Software & Libraries	JAX, NumPy, SciPy, Pandas, scikit-learn, PyTorch, XGBoost, LightGBM, Optuna, MLflow, pytest
Developer Tools	Git, Linux, Docker, Kubernetes, Terraform, Github Actions (CI/CD), Make

Last updated: April 23, 2026