YIN LIN 林胤

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Center for Theoretical Physics, Massachusetts Institute of Technology, Cambridge, MA 02139 USA

EMPLOYMENT

Postdoctoral Associate 2021 - 2024
– Center for Theoretical Physics
Massachusetts Institute of Technology, Cambridge, MA USA
– The NSF AI Institute for Artificial Intelligence and Fundamental Interactions

EDUCATION

Ph.D. in Theoretical Physics 2015 - 2021
Advisor: Andreas S. Kronfeld
The University of Chicago, Chicago, IL USA

B.Sc. in Physics 2011 - 2015
Arnold Nordsieck Award, Physics Highest Academic Honors, Valedictorian
University of California Santa Barbara, Santa Barbara, CA USA

RESEARCH INTERESTS

artificial intelligence, high-performance computing, particle physics

SKILLS

Python (NumPy, SciPy, PyTorch, SQLAlchemy, pandas), C, C++, bash, OpenMP, MPI, Julia

RESEARCH PROJECTS

Lattice Quantum Chromodynamics (LQCD) and Machine Learning 2021 - present
Center for Theoretical Physics, Massachusetts Institute of Technology
– Proposed neural-network–based preconditioners to accelerate the Dirac equation solve in lattice gauge theory.
– Applied the contour deformation technique with the coupling-layer architecture to reduce the statistical noises of observables from Monte Carlo calculations.

LQCD and Nucleon Physics 2017 - present
Fermilab/University of Chicago
– Solved the long-standing theoretical issues with simulating nucleons with staggered fermion discretization in LQCD, which enabled more efficient Monte Carlo simulations.
– Optimized the software performance in systems with GPU accelerators with OpenMP and MPI.
– Analyzed data generated from Monte Carlo simulations to infer the internal structure of nucleons crucial to future neutrino scattering experiments.

Theoretical Cosmology 2014 - 2015
Advisor: Siang Peng Oh, University of California Santa Barbara
– Performed 21cm simulations during the cosmic reionization to understand the morphology of ionized intergalactic medium.
– Compared different schemes in characterizing the bubble sizes and proposed a new method, the watershed algorithm, based on the image segmentation technique to properly capture their physical size distribution.

Experimental Astrophysics 2013 - 2014
Advisor: Ben Mazin, University of California Santa Barbara
– Designed and implemented an astrometry library in Python to calibrate telescope position using reference images, so the

captured images can be properly aligned and passed to the next stage in the processing pipeline.

PREPRINTS AND PUBLICATIONS

[1] S. Calì, D. C. Hackett, **Y. Lin**, P. E. Shanahan, and B. Xiao, *"Neural-network preconditioners for solving the Dirac equation in lattice gauge theory,"* (2022), arXiv:2208.02728 [hep-lat] .

[2] D. Boyda, S. Calì, S. Foreman, L. Funcke, D. C. Hackett, **Y. Lin**, *et al.*, *"Applications of Machine Learning to Lattice Quantum Field Theory,"* in *2022 Snowmass Summer Study* (2022) arXiv:2202.05838 [hep-lat] .

[3] **Y. Lin**, A. S. Meyer, S. Gottlieb, C. Hughes, A. S. Kronfeld, J. N. Simone, and A. Strelchenko, *"Computing Nucleon Charges with Highly Improved Staggered Quarks,"* Phys. Rev. D **103**, 054510 (2021), arXiv:2010.10455 [hep-lat] .

[4] **Y. Lin**, A. S. Meyer, C. Hughes, A. S. Kronfeld, J. N. Simone, and A. Strelchenko, *"Nucleon mass with highly improved staggered quarks,"* Phys. Rev. D **103**, 034501 (2021), arXiv:1911.12256 [hep-lat] .

[5] **Y. Lin**, C. Hughes, and A. S. Meyer, *"Nucleon and Ω Baryon Masses with All-HISQ Fermions at the Physical Point,"* in *37th International Symposium on Lattice Field Theory* (2019) arXiv:1912.00028 [hep-lat] .

[6] **Y. Lin**, S. P. Oh, S. R. Furlanetto, and P. M. Sutter, *"The Distribution of Bubble Sizes During Reionization,"* Mon. Not. Roy. Astron. Soc. **461**, 3361 (2016), arXiv:1511.01506 [astro-ph.CO] .

[7] J. C. van Eyken, M. J. Strader, A. B. Walter, S. R. Meeker, P. Szypryt, C. Stoughton, K. O'Brien, D. Marsden, N. K. Rice, **Y. Lin**, and B. A. Mazin, *"The ARCON Pipeline: Data Reduction For MKID Arrays,"* The Astrophysical Journal Supplement Series **219**, 14 (2015).

SELECTED PRESENTATIONS

Accelerating Dirac equation solves in Lattice QCD with Neural-Network Preconditioners 2022
Machine Learning for Nuclear Theory, Institute of Nuclear Physics, University of Washington
https://archive.int.washington.edu/talks/WorkShops/int_22_1/People/Lin_Y/Lin.pdf

Staggering Nucleon Matrix Elements 2020
2020 MIT Virtual Lattice Field Theory Colloquium
http://ctp.lns.mit.edu/latticecolloq/

Nucleon Mass and Omega Mass with All-HISQ Fermions at the Physical Point 2019
The 37th International Symposium on Lattice Field Theory, Wuhan, China
https://indico.cern.ch/event/764552/contributions/3420488/

TEACHING AND OUTREACH

Data Visualization Workshop 2020
Lecturer for data visualization of COVID-19 data with Python for Chicago public high-school students.
https://github.com/ylin910095/Data_visualization_2020

Analog and Digital Electronics 2017
Teaching assistant for the undergraduate analog and digital electronics lab at the University of Chicago. Held two lab sessions weekly.

Introductory Physics 2015-2016
Teaching assistant for the introductory physics classes at the University of Chicago. Held weekly discussion sessions and office hours.

AWARDS AND HONORS

URA Visiting Scholars 2017 & 2021
Fermilab

Arnold Nordsieck Award 2015
University of California Santa Barbara

Physics Highest Academic Honors 2015
University of California Santa Barbara

CCS Summer Undergraduate Fellowship 2014
University of California Santa Barbara

Worster Summer Research Fellowship 2014
University of California Santa Barbara

COMPUTING RESOURCE USAGE

The ASCR Leadership Computing Challenge 2022-2023
https://science.osti.gov/ascr/Facilities/Accessing-ASCR-Facilities/ALCC
Project: High Precision Hadronic Vacuum Polarization Contribution to the Muon Anomalous Magnetic Moment using Highly Improved Staggered Quarks
– 100K node-hours on the Polaris supercomputer at Argonne Leadership Computing Facility.

USQCD Type-A Allocation 2022-2023
https://www.usqcd.org/
Project: Nucleon Axial Charge with All-Staggered Lattice QCD
– 6M Skylake core-hours on the Fermilab cluster.

Project: Scale Setting Studies on the MILC HISQ Ensembles
– 7.75M KNL-core-hours on Brookhaven National Laboratory cluster.
– 7.25M KNL-core-hours on the Thomas Jefferson National Accelerator Facility cluster.

The Extreme Science and Engineering Discovery Environment 2022-2023
https://www.xsede.org/
Project: Nucleon Axial Charge with All-Staggered Lattice QCD
– 1.8M KNL-node-hours on the Stampede2 supercomputer at Texas Advanced Computing Center.

Energy Research Computing Allocations Process 2022-2023
https://www.nersc.gov/users/accounts/allocations/overview/
Project: Nucleon Axial Charge with All-Staggered Lattice QCD
– 100K KNL-node-hours on the Theta supercomputer at Argonne Leadership Computing Facility.

USQCD Type-A Allocation 2021-2022
https://www.usqcd.org/
Project: Nucleon Axial Charge with All-Staggered Lattice QCD
– 3.5M Skylake core-hours on the Brookhaven National Laboratory cluster.
– 84K K80-GPU-hours on the Brookhaven National Laboratory cluster.

Project: Scale Setting Studies on the MILC HISQ Ensembles
– 14.2M KNL-core-hours on the Brookhaven National Laboratory cluster.

The ASCR Leadership Computing Challenge 2020-2021
https://science.osti.gov/ascr/Facilities/Accessing-ASCR-Facilities/ALCC

Project: Nucleon Axial Charge with All-Staggered Lattice QCD
– 200K KNL-node-hours on the Theta supercomputer at Argonne Leadership Computing Facility.
– 870K KNL-node-hours on the Cori supercomputer at National Energy Research Scientific Computing Center.

USQCD Type-A Allocation 2020-2021
https://www.usqcd.org/
Project: Nucleon Axial Form Factor with HISQ Ensembles
– 1.1M Skylake core-hours on the Brookhaven National Laboratory cluster.
– 100K K80-GPU-hours on the Brookhaven National Laboratory cluster.

USQCD Type-A Allocation 2019-2020
https://www.usqcd.org/
Project: Nucleon Axial Form Factor with HISQ Ensembles
– 1M Skylake core-hours on the Fermilab cluster.
– 120K K80-GPU-hours on the Brookhaven National Laboratory cluster.

USQCD Type-A Allocation 2018-2019
https://www.usqcd.org/
Project: Nucleon Axial Form Factor with HISQ Ensembles
– 1.8M Skylake core-hours on the Brookhaven National Laboratory cluster.
– 105K K80-GPU-hours on the Brookhaven National Laboratory cluster.