Hariprashad Ravikumar

PhD Candidate in Physics, specializing in HPC & Machine Learning for High-Dimensional Data
New Mexico State University (Las Cruces, NM)

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Education

PhD in Physics, New Mexico State University, USA *Aug 2021 – July 2026 (expected)*
MS in Physics, New Mexico State University, USA *Aug 2021 – May 2024*
MSc in Physics, National Institute of Technology Jalandhar, India *July 2019 – May 2021*
BSc in Physics, Dr. N.G.P. Arts and Science College, India *June 2015 – May 2018*

Technical Skills

Programming	Python, C++, CUDA, Bash, SQL, JavaScript, Lua, HTML/CSS, YAML
ML & APIs	TensorFlow, PyTorch, Scikit-learn, Pandas, Flask, FastAPI
Cloud & MLOps	Azure, AWS (Lambda, S3), CI/CD, Docker, Git
Methods & HPC	Regression, Monte Carlo methods, GPU acceleration

Technical Project Portfolio

- **AI-DataScience-Lab: Cloud-Hosted Forecasting App** GitHub Repository
  End-to-end forecasting platform: CSV upload, pandas cleaning, scikit-learn linear regression (R^2, MSE), GPT-3.5 summaries, and Matplotlib plots. Flask backend on Azure with GitHub Actions CI/CD; frontend on GitHub Pages. Modular design supports future polynomial, ridge, and time-series models. Frontend URL
- **Neural Network from Scratch with `NumPy`** GitHub Repository
  Two-layer NN in NumPy (ReLU hidden, softmax output); trained on 5 000 samples with lr=0.1 to achieve 80% accuracy in 60 epochs.
- $\mathbb{Z}_2$ **Lattice Gauge Monte Carlo Simulation** GitHub Repository
  Python MCMC simulation of $\mathbb{Z}_2$ gauge theory using Metropolis; measured Wilson loops and benchmarked against analytical predictions.

PhD Research

Doctoral Advisor: Dr. Michael Engelhardt (New Mexico State University, USA)

- **Lattice QCD Calculations of TMDs:** Developed parallelized Lua code for HPC clusters running on CPUs. Processed multi-terabyte lattice QCD data involving ∼30,000 correlator evaluations. Applied Monte Carlo methods with jackknife and bootstrap resampling to extract transverse momentum-dependent parton distribution functions (TMDs). Leveraged PySR symbolic regression - a machine learning technique to derive interpretable analytical models from high-dimensional simulation outputs.

External Research Collaborations

Collaborators: Dr. Rajan Gupta and Dr. Tanmoy Bhattacharya (Los Alamos National Laboratory, USA)

- **Lattice QCD Calculations of CP Violation Contributions to nEDM:** Developed and optimized parallelized C++/CUDA codes for GPU-accelerated HPC clusters (NERSC Perlmutter) to process multi-terabyte lattice QCD datasets across multiple computational stages. Designed and executed large-scale Monte Carlo simulations with advanced statistical analyses (Jackknife resampling and Chi-squared statistic with covariance matrices) to extract hadronic matrix elements, enabling precision studies of nucleon EDMs and supporting investigations of CP-violating operators in the Standard Model and Beyond the Standard Model physics.

Collaborator: Dr. Chueng-Ryong Ji (North Carolina State University, USA)

- **Interpolating Conformal Algebra:** Implemented Mathematica symbolic computation to analyze algebraic structures and symmetry constraints in interpolated Poincaré and conformal algebras.

Certifications

- (Jun 2025) Getting Started with Accelerated Computing in CUDA C/C++ by NVIDIA
- (Jun 2025) Supervised Machine Learning: Regression and Classification by DeepLearning.AI
- (Apr 2025) Google Advanced Data Analytics Professional Certificate

Awards

- **2025 NMC Collaboration Grant**, awarded by the New Mexico Consortium at Los Alamos.
- **2023 George and Barbara Goedecke Physics Excellence Fund Scholarship**, awarded by the NMSU Physics Department
- **2021 Graduate Success Scholarship**, awarded by the NMSU Graduate School

Selected Talks

- (Jun 3, 2025) *"First Principles Lattice QCD Calculations of nEDMs"*, T-2 Seminar, Theoretical Division, Los Alamos National Laboratory, USA
- (May 16, 2024) *"Lattice QCD Calculations of x Dependence of Sivers TMD"*, T-2 Seminar, Theoretical Division, Los Alamos National Laboratory, USA

Full list available at: hariprashad-ravikumar.github.io/talks