Kian Maleki — Academic CV | Physics PhD | Research Scientist

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Academic Profile

Physicist and computational researcher with a Ph.D. in physics and research experience spanning solid-state quantum systems, noncollinear magnons, molecular and defect-mediated transport, dark matter phenomenology, numerical simulation, and applied machine learning. Current research interests include quantum materials, scientific computing, model evaluation, and the development of machine-learning methods for uncertainty, ambiguity, learning-curve prediction, and document intelligence.

Education

Ph.D. in Physics, University of Iowa, Iowa City, IA Aug 2025

GPA: 4.03
Dissertation topic: Quantum coherent interaction of molecular and defect spin with phonons and magnons

M.S. in Physics, Creighton University, Omaha, NE Aug 2017

GPA: 4.00
Thesis topic: The MSSM neutralino as the dark matter candidate

B.S. in Physics, Fergusson College, University of Pune, Pune, India Oct 2008

Research Interests

My research interests span quantum materials, molecular and defect-mediated transport, spin–phonon–magnon interactions, noncollinear antiferromagnets, crystal-field theory, open quantum systems, and dark matter phenomenology. More recently, I have expanded this research direction into machine learning, with a focus on model evaluation, classifier ambiguity, uncertainty diagnostics, calibration, threshold-dependent performance analysis, and finite-horizon learning-curve prediction for gradient boosting. My current machine-learning work develops ambiguity-aware metrics for operational evaluation of binary classifiers and connects my background in mathematical modeling and scientific computing to applied AI, document intelligence, and trustworthy model assessment.

Research Experience

University of Iowa, Department of Physics and Astronomy, Iowa City, IA Aug 2018 – Aug 2025

- Analyzed site symmetry and crystal fields of erbium oxide using Stevens operators.
- Developed theoretical tools to calculate noncollinear magnon dispersion and applied them to erbium oxide.
- Modeled transport through molecular defects, including VOPc, using Fowler–Nordheim field electron emission.
- Formulated transport in the cotunneling regime using Lindblad equations.
- Studied transport properties of defects in hexagonal boron nitride.
- Worked on dynamical projective connections and gravity.

Creighton University, Department of Physics, Omaha, NE Aug 2015 – Aug 2018

- Determined MSSM neutralino densities, cross sections, and expected direct and indirect detection rates using DarkSUSY, Fortran, and Python.
- Designed and developed an N-body planetary simulation in Python.
- Developed numerical simulations for the inclination of binary stars.
- Designed a Python-based molecular dynamics code with a graphical interface for local execution.
- Parallelized molecular dynamics workflows for execution on Open Science Grid high-performance computing resources.

Fergusson College, Department of Physics, Pune, India Jul 2005 – Jun 2006

- Studied the solution to the twin paradox in compact space.

Selected Machine Learning and AI Research Projects

Sequence Acceleration Benchmark for Gradient Boosting

- Developed a reproducible benchmark for finite-horizon learning-curve prediction in gradient boosting.
- Evaluated 51 sequence-acceleration methods from 13 families across 18 synthetic convergence regimes, multiple noise levels, prediction horizons, seeds, and observation depths.
- Studied regime dependence, failure detection, perturbation diagnostics, adaptive method selection, and conservative extrapolation rules for reliable learning-curve forecasts.

Ambiguity Range Framework

- Developed a model-agnostic diagnostic framework for post-hoc evaluation of binary classifiers.
- Introduced ambiguity-focused metrics to characterize local probability mass near decision boundaries and threshold-dependent degradation in classifier behavior.
- Built reproducible experiments across real-world and synthetic datasets, including calibration studies, bootstrap confidence intervals, entropy and margin baselines, and paired statistical testing.

PDF Document Intelligence Extractor

- Built an AI-powered document intelligence pipeline for extracting structured information from native PDF text layers.
- Developed the project as part of a broader document intelligence direction connected to advanced OCR, PDF parsing, information extraction, and evaluation workflows.

AG News Classifier

- Developed an end-to-end NLP classification project using TF-IDF features, scikit-learn models, MLflow experiment tracking, pytest testing, Docker support, and an optional LLM-powered explanation layer.

Publications

Peer-Reviewed Publications

- Maleki, K. et al. (2025). "A General and Modular Approach to Solid-State Integration of Zero-Dimensional Quantum Systems." *Nano Letters*. doi: 10.1021/acs.nanolett.5c03125.
- Maleki, K. and Flatté, M. E. (2025). "Crystal fields, exchange and dipolar interactions, and noncollinear magnons of erbium oxide." *Physical Review B*, 112(6), 064434. doi: 10.1103/v6n3-srt5.

Submitted and Under Review

- Maleki, K. (2026). "Finite-Horizon Learning-Curve Prediction for Gradient Boosting: Regime Dependence, Failure Detection, and Conservative Extrapolation Rules." *Machine Learning*, submitted.
- Maleki, K. (2026). "The Ambiguity Range Framework: A Diagnostic Toolkit for Operational Evaluation of Binary Classifiers." Manuscript under review.

Intellectual Property

- Co-inventor, "Methods of modular construction of 0D-state tunnel junction devices and methods of use thereof." Application filed December 4, 2023.

Conference Presentations and Invited Talks

- Maleki, K. "Site symmetry analysis and magnonic dispersion of Er_2O_3 including the dipolar interaction." APS March Meeting, Minneapolis, MN, 2024; APS Global Physics Summit, Anaheim, CA, 2025.
- Maleki, K. "Site symmetry analysis and magnonic dispersion of Er_2O_3 including the dipolar interaction." University of Chicago, 2023; Cornell University, 2023.
- Maleki, K. "Magnonic dispersion of Er_2O_3." APS March Meeting, Las Vegas, NV, 2023; Magnetism and Magnetic Materials Conference, Minneapolis, MN, 2022.
- Maleki, K. "Theoretical limit of MSSM neutralino as a dark matter candidate." Poster presentation, APS April Meeting, Washington, DC, 2017; MARAC, University of Kansas, 2017.

Teaching Experience

Assistant Professor of Physics, Creighton University, Omaha, NE Aug 2025 – Present

- Teach graduate-level statistical mechanics and undergraduate physics courses.
- Develop syllabi, examinations, assignments, laboratory materials, and new lab manuals for undergraduate optics and electronics laboratories.
- Use animation, visualization, and interactive tools to support learning objectives and student engagement.
- Supervise teaching assistants and support laboratory safety, equipment usage, and conceptual understanding.
- Collaborate with faculty on curriculum changes aligned with departmental expectations and educational standards.

Adjunct Faculty in Physics, Creighton University, Omaha, NE Jan 2018 – Apr 2018

- Taught introductory physics laboratory courses for large-enrollment sections.
- Prepared lecture materials, wrote examinations and assignments, supervised teaching assistants, and supported laboratory instruction.

Instructor, Bellevue University, Science Department, Omaha, NE Aug 2017 – May 2018

- Taught general physics lecture and laboratory courses.
- Organized, revised, and updated course materials; wrote and modified syllabi; designed and reviewed laboratory experiments.
- Met with students to discuss progress and academic improvement.

Teaching Assistant, University of Iowa, Department of Physics and Astronomy Aug 2018 – Jan 2020

- Taught physics laboratory courses and supported undergraduate students in laboratory concepts, safety, measurement, uncertainty, and theoretical applications.
- Prepared lecture materials, administered quizzes, addressed student concerns, and reported student progress to faculty.

Teaching Assistant, Creighton University, Department of Physics Aug 2015 – Aug 2017

- Supported introductory physics laboratory courses, student instruction, grading, and laboratory operations.

Physics Lecturer, Creighton University, Department of Physics Jun 2017 – Jul 2017

- Taught introductory laboratory courses, conducted lectures, wrote examinations and assignments, and supervised teaching assistants.

Tutor, Chegg, Varsity Tutors, Wyzant, and In-Person Tutoring Nov 2017 – Dec 2020

- Provided one-on-one tutoring in physics, mathematics, and related science subjects using online whiteboards and interactive methods.

Academic Workshops and Schools

- Quantum Matter: Superconductivity, Topology and Correlations, Princeton Summer School on Condensed Matter Physics, 2025.
- Magnon Workshop, Cornell University, 2024.
- Fractionalization, Criticality, and Unconventional Quantum Materials, Princeton Summer School on Condensed Matter Physics, 2024.
- Artificial Intelligence in Fundamental Physics, SLAC Summer Institute, 2023.
- Electron-Phonon Physics from First Principles, University of Texas at Austin, 2022.
- The Almost Invisibles: Exploring the Weakly Coupled Universe, SLAC Summer Institute, 2020.
- Open Science Grid User School, University of Wisconsin–Madison, 2017.

Professional Development

- TripleTen AI and Machine Learning Program, 36-week professional training program, completed March 2026.
- Quantum Horizons Core Concepts and System Design, online non-credit course, April 2025.
- Introduction to Quantum Computing by QuantGates, online non-credit course, April 2025.

Technical Skills

- **Programming and Scientific Computing:** Python, Fortran, numerical simulation, scientific modeling, high-performance computing, Open Science Grid.
- **Machine Learning and Data Science:** scikit-learn, XGBoost, pandas, NumPy, model evaluation, calibration, uncertainty and ambiguity diagnostics, learning-curve prediction, NLP, MLflow, pytest.
- **Physics and Modeling:** quantum materials, magnonics, crystal-field theory, open quantum systems, molecular transport, dark matter phenomenology, molecular dynamics.
- **Document Intelligence:** PDF parsing, information extraction, OCR-aware workflows, structured extraction, evaluation of extraction quality.

Awards

- Graduate Student Support Fund, University of Iowa, 2020.
- AAPT Outstanding Physics Teaching Assistant, Creighton University, 2017.

Academic Service and Community Involvement

- Senior graduate mentor for incoming graduate students, University of Iowa.
- Graduate Student Advisory Committee, University of Iowa, 2019–2021.
- Iranian team leader, International Tournament of Young Mathematicians, Jacobs University, Bremen, Germany, 2014.
- Member, Big Brothers Big Sisters of America.

Cross-Cultural and Professional Training

- Student First Amendment Training, 2024.
- LGBTQ Safe Zone and Trans Awareness training, 2023.
- Online Harassment Prevention and Response for Academic Administrative Officers / Supervisors, 2022.
- Microaggression course, University of Iowa, 2021.
- Engaging Across Cultures, University of Iowa, 2020.
- Building Global Community: Navigating Intercultural Conflicts, 2019.