Hanieh Karimi

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Education

University of New Hampshire, Durham, NH   2022 - Present
Ph.D. Physics, Space Science Center
Supervisor: Dr. Matthew Argall
Expected graduation: 2026

Relevant Coursework: Plasma Physics, Heliospheric Physics, Magnetohydrodynamics, Particle-In-Cell Simulation, Statistical Physics

Isfahan University of Technology, Isfahan, Iran   2018 - 2022
B.S. Physics
Supervisor: Dr. Soroush Shakeri
Undergraduate Thesis: Dark Matter Effects on Neutron Star Properties

Relevant Coursework: Computer Application in Physics, Astrophysics, Cosmology I

Experience

University of New Hampshire, Durham, NH   May 2023 - Present
Graduate Research Assistant / Advisor: Dr. Matthew Argall
Relative Entropy in Reconnection and Turbulence: Quantifying its characteristics and the influence of electromagnetic fields:
- Using PyMMS to calculate relative entropy, with model distributions for which entropy can be determined analytically.
- Conducting statistical analysis on 22 known Electron Diffusion Region (EDR) events, focusing on energy transfer and non-Maxwellianity measures using Python and Pandas for data processing and analysis.
- Validating results by comparing MMS data with Particle-in-Cell (PIC) simulations.
- Enhancing look-up tables for detecting Maxwellian distributions and improving accuracy in identifying non-Maxwellian distributions.

Magnetospheric Beam Propagation Model   Sep 2023 - Present
- Determining the length of the magnetic field line on which electrons are injected and how it changes in time.
- Developing and enhancing the magneto-beam code to simulate particle pulses from accelerators as they evolve through Earth's magnetosphere using the relativistic Boris algorithm. Using Peabody cluster and UNH supercomputer to perform simulations on multiple nodes for enhanced speed and accuracy.
- Integrating calculations for incident flux, beam current, and beam return flux to improve system accuracy.

Entropy and Reversibility in Magnetic Reconnection   Aug 2024 - Present
- Investigating how coarse graining affects the reversibility of magnetic reconnection by comparing time-forward and time-reversed simulations using 1D Vlasov code. Proposing new comparative studies of entropy evolution in Vlasov and PIC simulations to better understand noise effects and the reversibility of magnetic reconnection.

University of New Hampshire, Durham, NH   Jan 2023 – May 2023
Graduate Research Assistant / Advisor Prof. Ben Chandran
- Reviewed scientific papers on Alfvén-driven outflows funded by the Class of 1944 Professorship Fund.
- Engaged in weekly discussions with Dr. Chandran, contributing insights on Alfvén wave theory and plasma dynamics.

Isfahan University of Technology, Isfahan, Iran   2018 - 2022
Undergraduate Research Assistant / Advisor Dr. Soroush Shakeri
- Completed undergraduate thesis titled "Dark Matter Effects on Neutron Star Properties," focusing on the equation of state (EOS) and tidal deformability of compact stars.
- Analyzed the influence of bosonic dark matter and anisotropic dark stars on gravitational wave signals using MATLAB and Mathematica.
- Investigated theoretical models to assess how dark matter alters neutron star structure and impacts gravitational wave detection.

Teaching Experience

University of New Hampshire, Durham, NH
Teaching Assistant, Department of Physics
- PHYS 401: Introduction to Physics I (algebra-based) laboratories, Fall 2022

Isfahan University of Technology, Isfahan, Iran
Teaching Assistant, Department of Physics
- Basic Physics II (algebra-based), Spring 2022
- Analytical Mechanics I (algebra-based), Spring 2021

Presentations and Publications

Hanieh Karimi, Matthew Argall, Hasan Barbhuyia, Paul Cassak, Haoming Liang. 2024. *Study and Comparison of Kinetic and Relative Entropy in Energy Conversion Processes in the Electron Diffusion Region (EDR) of Magnetic Reconnection Authors.* Washington DC: American Geophysical Union (AGU) Fall Meeting. Poster

Matthew Argall, **Hanieh Karimi**, Hasan Barbhuiya, Paul Cassak, Haoming Liang, Peera Pongkitiwanichakul, Alex Chasapis. 2024. *MMS Observations and Theory of Plasma and Magnetic Field Entropy Outside of Local Thermodynamic Equilibrium in Reconnection and Turbulence.* Washington DC: American Geophysical Union Fall Meeting. Poster

Karimi Hanieh. Nov 2024. *Investigating Energy Conversion during Magnetic Reconnection using Non Maxwellianity Measures.* Durham, NH: Space Science Center Seminar, University of New Hampshire. Oral presentation.

Karimi Hanieh et al. Sep 2024. *A Space Physics Virtual Reality Environment for Education and Outreach using 3D Reconstructions of Magnetic Reconnection from NASA's Magnetospheric Multiscale Mission.* Los Angeles CA: MMS 10th Community Workshop. Oral presentation and Poster

Karimi Hanieh et al. Sep 2024. Sep 2024. *Investigating Energy Conversion during Magnetic Reconnection using Non-Maxwellianity Measures.* Los Angeles, CA: MMS 10th Community Workshop. Oral presentation

Karimi Hanieh et al. June 2024. *Non-Maxwellianity measures for energy conversion and dissipation in reconnection.* Fort Collins, Colorado: Geospace Environment Modeling (GEM) workshop. Poster

Academic Activities

Executive Secretary, NASA Heliophysics Early Career Investigator Program (ECIP) and NASA Heliophysics Guest Investigator Open (HGIO) Review Pane,
Washington DC Area, Jan. 2025 and Oct. 2024
- Invited to Serve as Executive Secretary for multiple NASA Review Panels.
- Documented key discussions, tracked panel evaluation scores, and assisted with logistical support for the Panel Chair.
- Participated in scientific discussions on relevant topics and supported the Panel Chair in maintaining evaluation integrity.

Student/Early Career Convener: SH31E and SH54A. Multiscale Dynamics in Magnetized Turbulence Poster/Oral, *American Geophysical Union (AGU) Fall Meeting, Dec.2024, Washington DC*

Colloquium organizer, UNH Physics colloquium organizing committee, *May 2024 - Present*
- Assisted in inviting speakers and organized graduate student lunches with the speakers.
- Contact: Francois.Foucart@unh.edu

Team Member, Citizen Continental-America Telescope Eclipse (CATE) 2024,
Site 32, Pittsburg, NH, Apr. 2024
- Captured photometric and polarimetric data of the solar corona during the 2024 North American solar eclipse.
- Collaborated with citizen scientists along the eclipse's path of totality and engaged with local communities to promote eclipse science.
- Participated in the SWRI-led, NASA- and NSF-supported mission alongside other UNH Physics PhD students.

IAPS Delegate, International Association of Physics Students, *2021*
- IAPS delegate for the Isfahan University of Technology, physics department as one of the local committees.

Director, Quantum Mechanics Study Circle, *Isfahan University of Technology, 2021*
- Planned and organized weekly circles about quantum mechanics for undergraduate students.
- Established the first academic weekly circles in the entire university.

Director, IUT Astronomy Society, *Isfahan University of Technology, 2020*
- Developed high-impact creative projects from concept to completion, including lab experiments related to astrophysics for students.

Scholarships and Awards

National Physics Olympiad for University Students, *Iran, 2021*: Ranked 24th
University Physics Competition, *Colorado State University, Carroll College, 2020*: Silver Medal

Leadership, Volunteer Work

Space Physics Virtual Reality Environment for Education and Outreach, Presenter, *Sep 2024 – Present*
- Presenting an immersive virtual reality experience to educate and engage local communities in space physics. Venues include Boston Museum of Science (Boston, MA), Massachusetts Air & Space Museum (Hyannis, MA), NH Academy of Science (Lyme, NH), Dartmouth College (Hanover, NH), and the UNH Space Science Center (Durham, NH). Developed and presented with the supervision and guidance of Dr. Matthew Argall.

Founder and President, University of New Hampshire Running Club (UNH RC), *Sep 2024 – Present*
- Organize weekly runs, long-distance sessions, and specialized workouts based on student preferences.
- Lead trail running adventures and monthly themed races (e.g., New Year's, Halloween).
- Invite professional runners and coaches to hold workshops for members.

Graduate Housing Senator, UNH Graduate Student Senate (GSS), *School year 2024-2025*
- Represented graduate student interests in housing matters across UNH campuses (Durham, Manchester, Franklin Pierce School of Law).
- Advocated for student concerns and participated in shared governance on behalf of the graduate community.

Member, Graduate Student Senate Programming Committee, *School year 2024-2025*
- Developed and organized events for grad students. Organized and hosted 'First Thursday' event the first Thursday of every month; about 40 grad students attended including members from GSS.

Founder and President, Iranian Association of New Hampshire (IAN), *2023–2024*
- Organized cultural events for the Iranian community and students, including celebrations for Persian New Year (Nowruz), Persian dance performances, and other cultural gatherings.

Workshops and Conferences Attended

- American Geophysical Union (AGU) Fall Meeting, Washington DC, *December 2024*
- MMS 10th Community Workshop, UCLA, *September 2024*
- The Geospace Environment Modeling (GEM) workshop, *June 2024*
- Introduction to Plasma Simulation Methods, *Particle in Cell Consulting LLC,* (Certificate Awarded), *June 2023*
  - Developed C++ simulation codes using tools such as Ubuntu, Eclipse. Also employed Microsoft Visual Studio for Windows and ParaView for visualization and plotting.
- ICRANet-ISFAHAN Astronomy Meeting, Iran, *2021*
- 2nd workshop for the collaboration of Iranian universities with the CMS experiment at CERN, Iran, *2021*
- International Conference of Physics Students 2021 (ICPS), Copenhagen, *2021*
- 17th International Conference on Topics in Astroparticle and Underground Physics, Spain, *2021*
- Machine Learning for Particle Physics - Mainz Institute for Theoretical Physics, Johannes Gutenberg University, Germany, *2021*

Skills & Interests

Technical:
- **Programming Languages**: Python, C++, MATLAB, IDL
- **Software & Tools**: Mathematica, ParaView, PySPEDAS, PyMMS, Linux
- **High-Performance & Parallel Computing**: UNH Supercomputer Cluster, MPI (Message Passing Interface)
- **Modeling & Simulations**: 1D Vlasov Modeling, Particle-in-Cell (PIC) Simulations (Boris Algorithm)
- **Machine Learning & Data Analysis:** Neural Networks (Logistic Regression, Coordinate Ascent), Principal Component Analysis (PCA), Statistical Analysis

Mathematical Modeling:
- **Ordinary Differential Equations:** Stability, accuracy, stiff/non-stiff problems.
- **Numerical Algebra:** Linear/nonlinear model fitting, systems of equations.

Languages: Persian (Native), English

Interests: Running, Santoor (Persian Instrument)