RAMAN MUKUNDAN

U.S. Citizen (720) 270-8182

EDUCATION

University of New Hampshire Anticipated 2026
Doctor of Philosophy in Physics

University of New Hampshire 2023

Master of Science in Physics

University of Colorado Boulder 2019

Bachelor of Arts in Physics (summa cum laude)

RESEARCH

Geomagnetic Disturbance Modeling

2020 - Present

University of New Hampshire - Research advisor: Dr. Amy Keesee

Developing space weather forecasting models to predict geomagnetically induced currents (GICs) and to explain the spatially localized nature of ground-level magnetic perturbations. I implement neural networks and other machine learning algorithms for high-cadence multivariate timeseries analysis. For my dissertation work, I am focused on the degree to which geomagnetic disturbances are localized, and seek to explain the characteristics of localized disturbances in terms of their magnetospheric and ionospheric drivers.

Frontier Development Lab

2023

Trillium Technologies in partnership with NASA, Google Cloud, and NVIDIA

Elevated the DAGGER geomagnetic perturbation forecasting model to a higher Technology Readiness Level. As part of this upgrade, I worked to create the SHEATH model to forecast solar wind at L1 given only solar imagery. I used a variety of cloud platforms to train and integrate machine learning components into an operational pipeline.

Later, in 2024, I advised the next iteration of the research team on both solar wind prediction and on the spatial interpolation of ground magnetic field perturbations.

Neutron Ground Level Enhancement Analysis

2019

University of Colorado Boulder - Research advisors: Dr. Daniel Baker and Dr. Thomas Berger

I independently studied theoretical ground-level enhancement precursor signals in neutron monitor data. I applied solar physics, time series analysis, and machine learning techniques. As part of an honors thesis, I wrote a final paper and defended my work before a committee. I was awarded *summa cum laude*.

Variable Star Astronomy

2016 - 2019

University of Colorado Boulder - Research advisor: Dr. Guy Stringfellow

I conducted regular observations using the 0.5m ARCSAT telescope at Apache Point Observatory. I used photometric and spectroscopic data in concert to study luminous blue variable stars and supernova impostors.

PEER-REVIEWED PUBLICATIONS

• Mukundan, R., Keesee, A., Marchezi, J. P., Pinto, V. A., Coughlan, M., and Hampton, D. (2025) Localized geomagnetic disturbances: a statistical analysis of spatial scale. Frontiers in Astronomy and Space Sciences. 12:1610276. https://doi.org/10.3389/fspas.2025.1610276

- Coughlan, M., Keesee, A., Pinto, V., **Mukundan, R.**, Marchezi, J. P., Johnson, J., Connor, H., & Hampton, D. (2023). Probabilistic forecasting of ground magnetic perturbation spikes at mid-latitude stations. Space Weather. https://doi.org/10.1029/2023sw003446
- Pinto, V. A., Keesee, A. M., Coughlan, M., **Mukundan, R.**, Johnson, J. W., Ngwira, C. M., & Connor, H. K. (2022). Revisiting the ground magnetic field perturbations challenge: A machine learning perspective. Frontiers in Astronomy and Space Sciences. https://doi.org/10.3389/fspas.2022.869740

CONFERENCE PRESENTATIONS AND INVITED TALKS

- Connecting Localized Geomagnetic Disturbances to the Solar Wind: A Survey of Model Architectures, AGU Annual Meeting, December 2024, Washington D.C. (poster)
- The 2024 Solar Eclipse: Chasing the Sun with Citizen Science, New England Fall Astronomy Festival, October 2024, Durham, NH (invited)
- Uncovering the Relationships between Localized Geomagnetic Disturbances and the Solar Wind, GEM Summer Workshop, June 2024, Fort Collins, CO (poster)
- Multiscale Geoeffectiveness Forecasting: Upgrading the DAGGER Pipeline, AGU Fall Meeting, December 2023, San Francisco, CA (poster)
- Characterizing the Spatial Scales of Localized Ground-Level Magnetic Perturbations, AGU Fall Meeting, December 2023, San Francisco, CA (poster)
- Localized Geomagnetic Storm Forecasting from Sun to Mud, UNH EOS Space Science Seminar, October 2023, Durham, NH (invited)
- A Regional dB/dt Forecast Using Deep Learning and Spherical Elementary Current Systems, GEM Summer Workshop, June 2023, San Diego, CA (poster)
- The Influence of Inner Magnetosphere Data on a Regional Geomagnetically Induced Current Forecasting Model, AGU Fall Meeting, December 2022, Chicago, IL (poster)
- Investigating Localized Geomagnetic Perturbations with a Spherical Elementary Current Systems Approach, GEM Summer Workshop, June 2022, Honolulu, HI (poster)
- Optimizing a Neural Network for Regional Forecasting of Ground Magnetic Perturbations Using Spherical Elementary Current Systems, Machine Learning in Heliophysics Conference, March 2022, Boulder, CO (poster)
- Forecasting Ground-Level Magnetic Perturbations Using a Spherical Elementary Current System Method, AGU Fall Meeting, December 2021, New Orleans, LA (invited)
- Forecasting Geomagnetically Induced Currents with a Global Machine Learning Model, GEM Summer Workshop, June 2021, held virtually (poster)

PROJECTS

Citizen CATE 2024

Took photometric and polarimetric data of the solar corona during the 2024 solar eclipse over North America. I was part of a large collaboration of citizen scientists that imaged the eclipse from sites strategically paced along the path of totality, and engaged with members of local communities to inform them about eclipse science.

Participated in the NASA-run hackathon. I contributed to the "Develop the Oracle of DSCOVR" challenge with an automated approach to clean a problematic in-situ dataset, using it to virtualize another instrument through generative machine learning.

Colorado Space Grant Consortium: Project Chimera

2017-2018

Created a lightweight, low-cost stratospheric cosmic ray detector as part of a student-led team. I collaboratively designed and built a multi-channel CsI(Tl) scintillator, supporting hardware and software, and data analysis algorithms. This project was funded by an Undergraduate Research Opportunity Program (UROP) grant.

COMMUNITY OUTREACH

UNH Space Science Center Seminar Organizer

2024-Present

Collaborated to convene University of New Hampshire's Space Science Seminar Series. We hosted weekly seminars open to the public and invited speakers from various subdomains of space physics and plasma physics. As the graduate student member of the organizing committee, my job was to ensure student engagement and to invite other graduate researchers to share their work.

UNH Machine Learning in Space Physics Journal Club Organizer

2024-Present

Coordinated a journal club for space physics graduate students interested in applying machine learning techniques. I created focused code and conceptual tutorials, invited guest speakers, and led weekly discussion.

New England Fall Astronomy Festival

2024

Volunteered at the bi-annual, education-focused astronomy fair. I led members of the public through solar observation with a tripod-mounted telescope and answered their questions about astronomy and astrophysics. I communicated the importance and relevance of research in the space sector.

HONORS AND AWARDS

Professor James M. E. Harper Fellowship

2020

Graduate scholarship awarded by the University of New Hampshire Department of Physics and Astronomy for academic merit and strong research performance.

President Joseph A. Sewall Award

2016-2019

Undergraduate scholarship awarded by the University of Colorado Esteemed Scholars Program for extraordinary academic achievement.

SELECTED WORKSHOPS ATTENDED

Institute for AI and Fundamental Interactions Summer School, Boston, Massachusetts	2024
Operational Space Weather Fundamentals, L'Aquila, Italy	2024
Machine Learning in Heliophysics, Boulder, Colorado	2022
Space Weather Workshop, Boulder, Colorado	2019