Nastaran Farhang

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Current Position

Postdoctoral Research Associate, University of Sydney

Areas of Specialisation

Physics; Solar Physics; Signal Processing; Complex Systems; Plasma Physics; Data Analysis

Academic Appointments

Education:

2014–2018	PH.D. in Solar Physics, University of Zanjan
2011–2013	M.SC. in Astrophysics, University of Zanjan
2007–2011	B.SC. in Physics, Isfahan University of Technology

Teaching Experience:

2016–2017	Visiting Lecturer: Fundamental Physics, University of Zanjan
2016–2017	Teaching Assistant: Quantum Mechanics, University of Zanjan
2014–2015	Led orientation sessions at the observatory, University of Zanjan

Thesis Supervision:

2021–2024	Ph.D. Advisor: "Investigation of Solar Magnetic Network's Properties"
2020–2023	Ph.D. Advisor: "SOC vs. Chaotic Systems Using HVG Methodology"
2018–2020	Ph.D. Advisor: "Structure of Solar Flare Energy Network: Hybrid Model Approach"
2017–2018	M.Sc. Advisor: "Oscillations and Weak Damping of Solar Coronal Loops"
2017–2018	M.Sc. Advisor: "The Complex Network of Solar Active Regions"
2017–2018	M.Sc. Advisor: "3D Simulation of Coronal Magnetic Field and Solar Flare Models"

Research Experience:

2023–PRESENT	Postdoctoral Research Associate, University of Sydney
2021–2022	Postdoctoral Researcher, Isfahan University of Technology
2018–2024	Visiting Scholar, University of Zanjan
2018	Visiting Student, University of Sydney

Books

2018	Translation of *Magnetohydrodynamics of the Sun - Volume 1* by *Eric Priest* into Persian, in collaboration with Prof. Safari et al., ISBN: 978-622-95156-5-5.
2019	Translation of *Magnetohydrodynamics of the Sun - Volume 2* by *Eric Priest* into Persian, in collaboration with Prof. Safari et al., ISBN: 978-622-95156-9-3.

Top Publications

2024	Complex Network View of the Sun's Magnetic Patches. I. Identification The Astrophysical Journal Supplement Series https://doi.org/10.3847/1538-4365/ad4642
2022	Evidence of SOC in Time Series by HVG Approach Scientific Reports https://doi.org/10.1038/s41598-022-20473-4
2022	Do Cellular Automaton Avalanche Models Simulate QPPs? The Astrophysical Journal https://doi.org/10.3847/1538-4357/ac85ba
2020	Solar Flare Modified Complex Network The Astrophysical Journal https://doi.org/10.3847/1538-4357/ab8301
2019	Resonant absorption of a solar coronal loop Iranian Journal of Astronomy and Astrophysics https://doi.org/10.22128/ijaa.2018.328.1047
2019	Energy Balance in Avalanche Models for Solar Flares The Astrophysical Journal Letters https://doi.org/10.3847/2041-8213/ab40c3
2018	Principle of Minimum Energy in Magnetic Reconnection The Astrophysical Journal https://doi.org/10.3847/1538-4357/aac01b
2014	Automated Tracking of Solar Coronal Loops and Detection of their Oscillations Iranian Journal of Physical Research https://ijpr.iut.ac.ir/article$_1$067.*html?lang* = *en*

Research Presentations

2024 University of Melbourne, Australia (Oral)
2023 University of Sydney, Australia (Oral)
2022 5th (Virtual) Workshop on Transient Events and Multi-Messenger Astrophysics, INO & IUT Joint Workshop, Iran (Oral)
2022 15th National Conference on Astronomy and Astrophysics of Iran, Iran (Oral)
2021 Isfahan University of Technology, Iran (Oral)
2020 Isfahan University of Technology, Iran (Oral)
2020 13th National Conference on Astronomy and Astrophysics of Iran, Iran (Oral)
2019 12th National Conference on Astronomy and Astrophysics of Iran, Iran (Poster)
2018 University of Sydney, Australia (Oral)
2017 20th Meeting on Research in Astronomy, IASBS, Iran (Poster)
2017 4th SOLARNET Meeting, Spain (Oral)
2013 17th Meeting on Research in Astronomy, IASBS, Iran (Poster)

Skills

Programming: Python, MATLAB

Digital Adaptability: Proficient in leveraging AI tools to streamline workflow

Professional Skills: Communication, Collaboration, Leadership

Grants

2021 INSF grant for research on "Solar Atmospheric Features" (Grant No. 99012824).

References

Professor Michael S. Wheatland
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Professor Andrew Melatos
School of Physics, University of Melbourne
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Professor Hossein Safari
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Background

I earned my Ph.D. in Astronomy/Solar Physics from the University of Zanjan on October 17, 2018. Since then, I have been actively involved in research and academic activities as a visiting scholar and postdoctoral researcher. My work spans a broad range of topics within solar and plasma physics, and I have engaged in multiple international collaborations with leading institutions, including the University of Sydney, the University of Melbourne, the University of Helsinki, Texas A&M University, the Isfahan University of Technology, the University of Zanjan, and the University of Maragheh.

Selected collaborative research projects include:

- Oscillation and damping of solar coronal loops in EUV emissions (2019)
  [with Texas A&M University, University of Maragheh, and University of Zanjan]
- Statistical methods for analyzing deviations from ideal power-law distributions (2019)
  [with the University of Sydney, University of Helsinki, and University of Zanjan]
- Network-based study on solar flare (2020)
  [with the University of Zanjan]
- Characterizing chaotic, self-organized critical, and random systems using network theory (2021)
  [with the University of Zanjan]
- Complex network analysis of magnetic patch evolution on the solar surface (2022)
  [with the University of Zanjan]
- Development of a "CLEAN" flare catalog for spatio-temporal correlation studies (since 2023)
  [with the University of Sydney and the University of Melbourne]

Current Research Focus

My ongoing research at the University of Sydney centers on the statistical characterization and modeling of solar flaring activity, with a focus SXR and EUV data. The project integrates observational data analysis, time series modeling, and machine learning techniques to improve flare detection and event classification. A key area of development is the application of a Hidden Markov Model (HMM) to identify the underlying magnetic states, i.e., background, rise, and decay phases, based on observations. The project extends to the use of Bayesian inference, Viterbi decoding, and parameter learning methods (including EM, GMM, and Dynamic Hamiltonian Monte Carlo) to improve HMM predictions. Synthetic data generation and injection-recovery tests are employed to validate the robustness of detection techniques.

Parallel efforts include:

- Temporal and spatial correlation analysis of EUV emission across active regions.
- Application of local extrema algorithms and continuous wavelet transforms for flare onset identification.
- Time series modeling using methods such as LOWESS, ARIMA, NIF, and RMSF to better capture flare dynamics.

This research contributes to a more refined understanding of solar flare statistics and aims to support the development of reliable, automated flare prediction frameworks with potential implications for space weather forecasting.