

Harsh Mathur

Postdoctoral Research Fellow (MSCA Researcher)

Rosseland Centre for Solar Physics (RoCS), at the Institute of Theoretical Astrophysics at the University of Oslo, 0315, Oslo, Norway

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Unified Astronomy Thesaurus keywords: Solar magnetic fields (1503); Radiative transfer (1335); Solar chromosphere (1479)

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Education

- 2019 – 2024  **Ph.D.**, in Astronomical Instrumentation
Indian Institute of Astrophysics (IIA), Bengaluru, India
Thesis title: *Probing Chromospheric Magnetic Field Through Multi-Line Spectropolarimetry*
Supervisor: Dr K. Nagaraju (IIA).
- 2017 – 2019  **M.Tech.**, in Astronomical Instrumentation
University of Calcutta, Kolkata, India
Thesis title: *Single Shot Spectroscopic Design Aspects*
Supervisor: Dr K. Nagaraju (IIA).

Research Interests

-  Inference of magnetic field through spectropolarimetric observations.
-  Non-local Thermodynamic Equilibrium Radiative Transfer, Forward modeling and inversions.
-  Application of machine learning techniques in solar-data analysis.
-  Chromospheric and coronal magnetism and its implications to the coronal heating problem.
-  Instrument techniques for UV/VIS/NIR spectropolarimetry.
-  Adaptive optics and Telescope control systems.

List of Publications

Journal Articles

-  Mathur, H., Joshi, J., Moe, T. E., Pereira, T. M. D., & Nagaraju, K. (2025). The H α Line as a Probe of Chromospheric Magnetic Fields. *Astrophys. J. Lett.*, 987(2), L39.
 doi:10.3847/2041-8213/ade8ea. arXiv: 2506.19510 [astro-ph.SR]
-  Mathur, H., Anusha, L. S., & Agnihotri, D. (2025). Clustering Analysis of Ca I 4227 Line Polarization Using Magnetohydrodynamic Simulations of the Solar Atmosphere. *Astrophys. J.*, 983(1), 84.  doi:10.3847/1538-4357/adbe76. arXiv: 2503.07380 [astro-ph.SR]

- 3 Khan, R., Dharmadhikari, R., Mathur, **H.**, Nagaraju, K., Jain, S. R., Phanindra, D. V. S., & Sagayanathan, K. (2024). Design requirements of a spectropolarimeter for solar extreme-ultraviolet observations and characterization of a K-mirror based on Brewster's angle. *Applied Optics*, 63(34), 8738. [doi:10.1364/AO.537460](https://doi.org/10.1364/AO.537460)
- 4 Mathur, **H.**, Nagaraju, K., Yadav, R., & Joshi, J. (2024). Simultaneous Spectropolarimetric Observations in the H α and Ca II 8662 Å Lines of an Active Region. *Astrophys. J.*, 971(1), 30. [doi:10.3847/1538-4357/ad54ba](https://doi.org/10.3847/1538-4357/ad54ba). arXiv: 2406.02083 [astro-ph.SR]
- 5 Mathur, **H.**, Nagaraju, K., Pruthvi, H., & Sagaynathan, K. (2024). Measurements of seeing-induced crosstalk in tip-tilt corrected solar polarimetry. *Applied Optics*, 63(15), 4088. [doi:10.1364/AO.519245](https://doi.org/10.1364/AO.519245)
- 6 Vishnu, M., Nagaraju, K., & Mathur, **H.** (2023). Solar mean magnetic field of the chromosphere. *Journal of Astrophysics and Astronomy*, 44(2), 56. [doi:10.1007/s12036-023-09944-w](https://doi.org/10.1007/s12036-023-09944-w). arXiv: 2302.06924 [astro-ph.SR]
- 7 Mathur, **H.**, Nagaraju, K., Joshi, J., & de la Cruz Rodríguez, J. (2023). Do H α Stokes V Profiles Probe the Chromospheric Magnetic Field? An Observational Perspective. *Astrophys. J.*, 946(1), 38. [doi:10.3847/1538-4357/acbf49](https://doi.org/10.3847/1538-4357/acbf49). arXiv: 2302.13118 [astro-ph.SR]
- 8 Mathur, **H.**, Thulasidharen, K. C., Pruthvi, H., Nagaraju, K., & Rajalingam, M. (2023). An Image Auto Guider System for Kodaikanal Tower Tunnel Telescope. *Journal of Astronomical Instrumentation*, 12(2), 2350003–222. [doi:10.1142/S2251171723500034](https://doi.org/10.1142/S2251171723500034)
- 9 Mathur, **H.**, Joshi, J., Nagaraju, K., Rouppe van der Voort, L., & Bose, S. (2022). Properties of shock waves in the quiet-Sun chromosphere. *Astron. Astrophys.*, 668, A153. [doi:10.1051/0004-6361/202244332](https://doi.org/10.1051/0004-6361/202244332). arXiv: 2210.01045 [astro-ph.SR]
- 10 Mumford, S., Freij, N., Christe, S., Ireland, J., Mayer, F., Hughitt, V., ... Murray, S. (2020). SunPy: A Python package for Solar Physics. *The Journal of Open Source Software*, 5(46), 1832. [doi:10.21105/joss.01832](https://doi.org/10.21105/joss.01832)

Technical Reports

- 1 Mathur, **H.** (2025, March). *Probing Chromospheric Magnetic Field Through Multi-line Spectropolarimetry*. Indian Institute of Astrophysics, Bengaluru (Ph.D. Dissertation). Retrieved from <https://ui.adsabs.harvard.edu/abs/2025PhDT.....8M>
- 2 Mathur, **H.** (2020, January). *Single Shot Spectroscopic Design Aspects*. Indian Institute of Astrophysics, Bengaluru (M.Tech. Dissertation). [doi:10.48550/arXiv.2001.03307](https://doi.org/10.48550/arXiv.2001.03307). arXiv: 2001.03307 [astro-ph.IM]

Fellowships

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| 2021 |  Senior Research Fellowship at the Indian Institute of Astrophysics, Bengaluru. |
| 2019 |  Junior Research Fellowship at the Indian Institute of Astrophysics, Bengaluru. |

Fellowships (continued)

2017  M.Tech Fellowship at the Indian Institute of Astrophysics, Bengaluru.

Miscellaneous Experiences

Presentations

-  Oral presentation on "*Unraveling the stratification of the chromospheric magnetic field using the $H\alpha$ line*" in the Sun, Space Weather and Solar-Stellar Connections at the Indian Institute of Astrophysics, Bangalore, India from January 20–24, 2025.
-  Oral presentation on "*Unraveling the stratification of the chromospheric magnetic field using the $H\alpha$ line*" in the HINODE - 17 / IRIS - 15 / SPHERE - 3 joint science meeting at Montana State University, Bozeman, Montana, USA from July 23–27, 2024.
-  Poster presentation on "*Simultaneous spectropolarimetric observations in the $H\alpha$ and $\text{Ca II } 8662 \text{ \AA}$ lines of an active region*" in IIA in-house symposium from March 26–28 2024.
-  Poster presentation on "*Properties of shock waves in the quiet-Sun chromosphere*" at Confronting numerical models of the solar chromosphere and corona with high-resolution observations - a RoCS/MUSE/IRIS workshop from 27th Feb to 2nd March 2023.
-  Poster presentation on "*Properties of shock waves in the quiet-Sun chromosphere*" in IIA in-house symposium from March 30–31 2023.
-  Oral presentation on "*Do $H\alpha$ Stokes V profiles probe the chromospheric magnetic field? An observational perspective*" in the Solar Polarization Workshop - 10 at Kyoto University, Kyoto, Japan from November 7–11, 2022.

Conferences Attended

-  HINODE - 17 / IRIS - 15 / SPHERE - 3 joint science meeting at Montana State University, Bozeman, Montana, USA from July 23–27, 2024.
-  Solar Polarization Workshop - 10 at Kyoto University, Kyoto, Japan from November 7–11, 2022
-  16th European Solar Physics Meeting, organized by the board of the European Solar Physics Division (ESPD), as a virtual online meeting, from September 6–10, 2021.
-  IIA50 Solar Conference on Advances in Observations and Modelling of Solar Magnetism and Variability, conducted by IIA Bengaluru, India, from March 01–04, 2021.

Schools and Workshops Attended

-  5th NCSP DKIST Data-Training Workshop - He I Diagnostics in the Solar Atmosphere, organized by National Solar Observatory (NSO), as a virtual online meeting, from January 31 – February 4, 2022.
-  4th NCSP DKIST Data-Training Workshop - An Introduction to Chromospheric Diagnostics, organized by National Solar Observatory (NSO), as a virtual online meeting, from July 19–23, 2021.
-  Solar spectro-polarimetry: From virtual to real observations, organized by SOLARNET at Istituto Ricerche Solari Locarno (IRSOL), Lugano, Switzerland September 9–14, 2019.

Miscellaneous Experiences (continued)

Service and Outreach

- Conducted a hands-on session on the analysis of high-resolution spectropolarimetric observations at the Regional Workshop on Solar Science and Aditya-L₁ (Bengaluru Region), organized jointly by St. Joseph's University, Bangalore and Indian Space Research Organisation (ISRO), from January 02–06, 2023.
- Conducted Hands-on sessions on spectroscopy, polarimetry, and associated data analysis techniques in Kodaikanal Winter School, an annual school organized by the Indian Institute of Astrophysics, from 2019 to 2023.
- Co-supervised a Master's student in Physics at the Department of Physics, Sardar Vallabhbhai National Institute of Technology, for her thesis titled "Detection of Coronal Mass Ejections from K-Coronagraph Images Using Principal Component Analysis."