

Neelanchal Joshi

Curriculum Vitae

Profile

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🌐 neelanchaljoshi

Physics PhD (MPS Göttingen, defended June 2026) with a BE in Electrical and Electronics Engineering. Four years building production scientific software for large-scale astronomical data – parallelised HPC pipelines, spectral analysis tools, and instrument characterisation software for ESA missions. Experienced bridging scientific requirements and software implementation across multi-disciplinary, international research teams.

Education

PhD (Physics)

International Max Planck Research School for Solar System Science

Thesis: Measuring multiscale solar flows using Local Correlation Tracking

Professional Development: Practical Project Management for Scientists, MPS, 2023–24

MPI for Solar System Research, Uni. Göttingen

Aug 2022 – Jun 2026

MSc (Physics), BE (Electrical and Electronics Engineering)

Dual degree, CGPA: 8.28/10

Master's Thesis: Solar Magnetogram Generation using Deep Learning

Bachelor's Thesis: Estimating structural and dynamical parameters for Red Giants using MCMC Simulations

BITS Pilani

Aug 2017 – May 2022

Research Experience

Max Planck Institute for Solar System Research

Doctoral Researcher, Astrophysicist

Aug 2022 – Present

Göttingen, Germany

- Architected and maintained a parallelised **Python/MPI** pipeline processing **~1 TB/year** of solar image data on HPC clusters
- Built and validated **PSF/Airy-disk** models to characterise the sensitivity and resolution limits of ESA's **Vigil/PMI** instrument
- Developed characterisation frameworks for Vigil/PMI performance across scientific outcomes, informing operations design
- Coordinated data, analysis and publications across an international team at MPS, Stanford, and several European institutions
- Maintained **version-controlled, reproducible** codebases (Git/GitHub) with automatic **unit-testing** through GitHub Actions

Tata Institute of Fundamental Research

Graduate Researcher

Aug 2021 – Jun 2022

Mumbai, India

- Implemented cGANs to perform automated **image-to-image translation** on a century-scale dataset of full-disk solar images
- Generated long-term solar magnetograms from Ca II K spectroheliograms to study polar field evolution and dynamo activity
- Applied Bayesian inference via **MCMC** to optimize probabilistic models of the stellar frequency spectra from the **Kepler** data

Team Anant – ISRO Student Satellite Programme

Lead, On-Board Computing Subsystem

Mar 2018 – May 2020

Pilani, India

- Led the OBC team of a **3U CubeSat** designed to monitor ocean phytoplankton, under the ISRO Student Satellite Programme
- Implemented the **CCSDS-123** lossless compression algorithm on a **Zynq-7000 FPGA** in Verilog under resource constraints
- Designed the TTC-OBC interface over **UART** and integrated the payload camera over **SPI** at the hardware-software boundary

Institute of Seismological Research

Research Intern

May 2019 – Jul 2019

Gandhinagar, India

- Rewrote a legacy **FORTRAN** codebase in **MATLAB** to efficiently compute earthquake source parameters for seismic analysis
- Applied probabilistic seismic scaling relations to verify and assess earthquake forecasting across vulnerable zones in Gujarat
- Developed a **standalone MATLAB package** with interactive data visualisation tools to map seismic activity across Gujarat

Technical Skills

Languages

Python, C, C++, Verilog, MATLAB, Julia, Linux/Unix Shell, LaTeX

Libraries & Tools

NumPy, SciPy, Astropy, PyTorch, Matplotlib, HDF5, FITS, Git, GitHub Actions, unittest, HPC/SLURM

Lab Instruments

Oscilloscopes, Spectrum analyzers, Signal analyzers, Multimeters, Signal generators

Techniques

Object-oriented design, instrument characterisation, signal processing, DSP, hardware interfacing, distributed computing, numerical algorithms

Journal Publications

- **Joshi, N.**, Liang, Z.-C., Fournier, D., Mandowara, Y., Bogart, R. S., Mukhopadhyay, S., & Gizon, L., “[Horizontal velocity eigenfunctions of solar inertial modes using local correlation tracking of magnetic features](#)”, *Astronomy & Astrophysics* (accepted), 2026.
- **Joshi, N.**, Liang, Z.-C., & Gizon, L., “A synthetic parameter analysis of correlation tracking of granulation and magnetic features for the PMI instrument”, *Astronomy & Astrophysics* (in prep), 2026.

Selected Presentations and Conference Proceedings

- **Joshi, N.**, Kalgaonkar, P., “Implementation of CCSDS Hyperspectral Image Compression Algorithm on FPGA on-board a nanosatellite”, *European Conference on AeroSpace Sciences (EUCASS), Madrid, Spain, 2019.*
- **Joshi, N.** and Mandowara, Y., “Solar Inertial Modes: Observed Mode Shapes”, **Invited Talk** at the *International Workshop on Low-Frequency Oscillations of the Sun and Stars, Berlin, Germany, 2025.*
- **Joshi, N.**, “Assessing the capability of Vigil/PMI (and SO/PHI-FDT) to infer horizontal flows using feature tracking methods”, **Invited Talk** at the *SO/PHI Science and Team Meeting, Instituto de Astrofísica de Canarias, Tenerife, Spain, 2025.*
- **Joshi, N.**, Liang, Z.-C., Fournier, D., & Gizon, L., “Observing solar inertial modes using local correlation tracking”, *SDO 2025 Science Workshop: A Gathering of the Helio-hive!, Boulder, CO, USA, 2025.*
- **Joshi, N.**, Liang, Z.-C., Fournier, D., & Gizon, L., “Observations of eigenfunctions of solar inertial modes using local correlation tracking of magnetic features”, *WAVES 2024 – International Conference on Mathematical and Numerical Aspects of Wave Propagation, Berlin, Germany, 2024.*
- Prasad, A., Jain, Y., **Joshi, N.**, Gupta, N., Singhanian, V., & Sreedharan, Y., “Interfacing Architecture between Telemetry and On-Board Computer for a Nanosatellite”, *IEEE AeroSpace Conference, Montana, USA, 2020.*

Leadership and Outreach

PhDNet Student Representative Coordinator, APOGEE	Represented interests of MPS PhD students at society-level talks	2024–25
	Organised paper presentation and lecture series for 750+ students	2019–20

Schools and Workshops

Oct 2022	ANTS Workshop on Computational Helioseismology, University of Pau and Pays de l’Adour
Mar 2023	WHOLE SUN Workshop, Institut Pascal, Université Paris-Saclay
Aug 2023	Carl-Zeiss Stiftung Summer School on Machine Learning in Astrophysics, IWR Heidelberg

Teaching

Solar System Science: The Central Star Numerical Analysis and Data Visualisation for Dark Matter Halos	Teaching Assistant, MPS Göttingen	2023–24
	Teaching Assistant, Uni. Göttingen	2024–25

Awards and Scholarships

Sakura Science Scholar Letter of Commendation INSPIRE Scholar Travel Grant	Government of Japan	2016
	Department of Human Resource Development, Government of India	2017
	Department of Science and Technology, Government of India	2017–22
	Carl-Zeiss Stiftung Summer School on Machine Learning in Astrophysics	2023