

Niharika Shrivastava

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● ABOUT ME

I am **Niharika Shrivastava**, a final-year BS–MS Physics student at the **Indian Institute of Science Education and Research (IISER) Bhopal**, with a strong research background in **data-driven astronomy, dark matter phenomenology, and astrophysical data analysis**. My research experience spans observational, computational, and theoretical astrophysics — from analyzing **MeV gamma-ray emissions in red dwarfs** (published in *JCAP*) to modeling **galaxy rotation curves using MCMC techniques** and studying **triplet extensions of the Standard Model for dark matter candidates**.

● EDUCATION AND TRAINING

26/12/2021 – CURRENT Bhopal, India
BS MS INTEGRATED Indian Institute of Science Education and Research

Website <https://www.iiserb.ac.in/> | **Field of study** Physics | **Final grade** 8.22/10 |

Thesis Dark Matter and Collider Phenomenology in Triplet Extensions of Standard Model

● PUBLICATIONS

2024

[**Search for MeV gamma-ray emission from TeV bright red dwarfs with COMPTEL**](#)

The SHALON atmospheric Cherenkov telescope has detected very high energy gamma-ray emission at TeV energies from eight red dwarfs, namely, V388 Cas, V547 Cas, V780 Tau, V962 Tau, V1589 Cyg, GJ 1078, GJ 3684 and GL 851.1. Consequently, these red dwarfs have been suggested as sources of ultra-high energy cosmic rays. In this work, we search for soft gamma-ray emission from these TeV bright red dwarfs between 0.75–30 MeV using archival data from the COMPTEL gamma-ray imaging telescope, as a follow-up to a similar search for GeV gamma-ray emission using the Fermi-LAT telescope. Although, *prima facie*, we detect non-zero photon flux from three red dwarfs with high significance, these signals can be attributed to contamination from nearby sources such as Crab and Cygnus, which are within the angular resolution of COMPTEL, and have been previously detected as very bright point sources at MeV energies. Therefore, we could not detect any statistically significant signal ($> 3\sigma$) from any of these eight red dwarfs from 0.75–30 MeV. We then report the 95% confidence level upper limits on the differential photon flux (at 30 MeV), integral photon flux and integral energy flux for all of the eight red dwarfs.

Authors: Niharika Shrivastava, Siddhant Manna, Shantanu Desai | **Journal Name:** Journal of Cosmology and Astroparticle Physics, | **Volume, Issue and Pages:** Volume 2024, September 2024 | **Publisher:** IOP Publishing Ltd

Link <https://iopscience.iop.org/article/10.1088/1475-7516/2024/09/029>

● PROJECTS

01/05/2025 – CURRENT

Masters' Project: Dark Matter and Collider Phenomenology in Triplet Extensions of Standard Model

Supervisor: Dr. Rahul Srivastava, Assistant Professor, IISER Bhopal

– Studying Beyond Standard Model (BSM) frameworks involving scalar and fermion triplet extensions of the Standard Model with hypercharge $Y = 2$, to identify viable dark matter candidates.

– Investigating the model's predictions for relic density, indirect detection, direct detection, and pair production cross sections at colliders.

– Conducting an in-depth review of the Standard Model of particle physics and identifying its limitations in explaining the particle nature of dark matter.

– Manuscript to be available online in the coming month.

– Tools and software used: SARAH, SPheno, MicrOmegas, MadGraph, Python

Observational Evidence of Evolving Dark Matter at z<1 using MAGPI survey

Supervisor: Dr. Gauri Sharma, Post Doctoral Researcher, Observatoire Astronomique de Strasbourg, France

- This study aims to find the dark matter core radius and density properties of galaxies at redshifts 0.2-0.5.
- Investigated the galaxy rotation curves of star forming galaxies at different redshifts using the data from MAGPI survey after their kinematic modeling using 3D BAROLO and pressure gradient correction.
- Used different models of dark matter halos and baryonic matter for Monte Carlo Markov Chain (MCMC) fitting of the observed velocities to find out parameters radius of DM halo radius, DM halo core density, stellar disk, stellar mass and bulge mass of galaxies.
- Python libraries : emcee, scipy, astropy.cosmology

15/05/2024 – 31/07/2024

Search for MeV gamma-ray emission from TeV bright red dwarfs with COMPTEL

Supervisor: Dr. Shantanu Desai, Professor, Indian Institute Of Technology, Hyderabad, Telangana, India

- Conducted systematic search for soft gamma-ray emission in range of 0.75-30 MeV from TeV bright 8 red dwarfs.
- Used the nine years of archival data from CGRO's COMPTEL from HEASARC (High Energy Astrophysics Science Archive Research Center) to achieve.
- Computed the Test Statistic (TS) at star coordinates and generated a TS map within 30° to assess gamma-ray signal significance.
- Analyzed Spectral Energy Distributions (SEDs) to find any detections or upper limits for the emissions in logarithmically equally spaced 16 energy bins. Reported 95 % confidence level upper limits on differential photon flux and integral energy flux.
- Tools & technologies used: ctools(built on C++ and python), DS9, FV
- Manuscript published in the Journal of Cosmology and Astroparticle Physics (JCAP 09 (2024) 029)

01/07/2023 – 09/2023

Photometric and Kinematic Study of Star Clusters

Supervisor: Dr. Neelam Panwar, Scientist-D, Aryabhatta Research Institute of Observational Sciences, Nainital

- Worked with an open star cluster, Dolidze 25, near the galactic plane of the Milky Way.
- Applied various constraints on distance, proper motion, parallax, and magnitudes of all stars to obtain the kinematic members of the star cluster. This includes the statistical analysis of these attributes and their errors.
- For photometric analysis, plotted the Color-Magnitude Diagram of all the kinematic members and fitted theoretical isochrones to predict its age.- Tools & technologies used: Jupyter Lab, Vizier, CMD 3.7 Input form, Asteca

01/12/2022 – 01/01/2023

Detection of Pulsars from Radio Data

Supervisor: Dr. Mayuresh Surnis, Assistant Professor, IISER Bhopal

- Installed PRESTO and RFIClean software from GitHub onto my home system.
- Used the command-line interface of LINUX to access these software by providing .fil files. Detected radio frequency interference in the data and identified potential intervals with their periods. Performed Fast Fourier transforms on the time series to search for periodic interference while removing atmospheric disturbances.
- De-dispersed signals on different attributes and attempted to find the periodic signals.
- Obtained time series of a pulsar with its dispersion measure and related plots using GBT and Parkes radio telescope data available online.
- Tools & technologies used: PRESTO & RFIClean software with programming languages C and Python

SKILLS

Operating Systems

Linux | Windows

Computing Languages

Python | C | MySQL | Matlab | Wolfram Mathematica

Developer Tools

Git | Latex | Visual Studio Code | JupyterLab | Vim

Data Skills

Data Visualisation | Dataframe handling | Statistics | Machine learning

Soft Skills

Teamwork | Leadership | Critical Thinking | Communication and interpersonal skills | Public Speaking | Creativity | Event management

CONFERENCES AND SEMINARS

01/01/2025 – 03/01/2025 BITS Pilani, India

33rd Indian Association of General Relativity and Gravitation

The **Indian Association of General Relativity and Gravitation (IAGRG)** is an Indian organization of scientists working in Gravitational Physics, Cosmology, Astronomy, and related fields with an aim to promote interest and to facilitate research in the related areas. One of the most prestigious events organized by the IAGRG at the national level is the eponymous meeting, which takes place approximately every two years in various venues across the country. I had the opportunity to present talk on my publication, "Search for MeV gamma-ray emission from TeV bright red dwarfs with COMPTEL" and also attend all the talks given by esteemed scientists.

Link <https://web.bits-pilani.ac.in/IAGRG33/>

24/07/2023 – 28/07/2023 University of Minnesota, Twin Cities (Online)

Zwicky Transient Facility Summer School 2023, University of Minnesota

The ZTF summer school is designed to provide young astronomers (graduate level and above) with hands-on experience and training in data processing of ZTF and other transient survey data using modern data science techniques such as Bayesian inference, time-series analysis, and machine learning. During the school, students will use Python Jupyter notebooks and work on multiple assignments under the guidance of experts in the field.

Link <https://www.ztf.caltech.edu/summer-school-2023.html>

LANGUAGE SKILLS

Mother tongue(s): **HINDI**

Other language(s):

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken production	Spoken interaction	
ENGLISH	C1	C1	C1	C1	C1

Levels: A1 and A2: Basic user; B1 and B2: Independent user; C1 and C2: Proficient user

CERTIFICATIONS

International Astronomy and Astrophysics Competition, 26/06/2023

Gold Honour

The International Astronomy and Astrophysics Competition is an educational science competition that enables students from all countries to test their skills in astronomy and astrophysics. Participants can receive certificates, awards, cash prizes, and global recognition.

Mode of learning: Work based

Link <https://drive.google.com/file/d/11JxII3XvB8ByKoRjfo02ScU0hKW1Sfe/view>

University of Sydney, 06/07/2023

Coursera Course on Data-Driven Astronomy

Explored applications of Python, data analysis, and machine learning techniques to large astronomical datasets and sky surveys.

Mode of learning: Online

Link <https://www.coursera.org/account/accomplishments/certificate/9DCEE36ULA7J>

VOLUNTEERING

01/04/2022 – 30/04/2024 Indian Institute of Science Education and Research, Bhopal

Coordinator and Core member

I have actively contributed to the IISER Bhopal Astronomy Club since my sophomore year, first as a core member and later as a coordinator. This experience helped me develop leadership, teamwork, and communication skills while engaging in discussions and activities centered around astronomy. I also learned to operate a Dobsonian telescope and regularly participated in stargazing sessions. These experiences have not only deepened my appreciation for observational astronomy but also strengthened my commitment to pursuing physics as a lifelong endeavor.

Links https://sites.google.com/view/astronomyiiserb/home?fbclid=PAZXh0bgNhZW0CMTEAAafVY3fV-5sk759n5AAaeTr5Vs472oq7G5sYzQyVFrfrRyf27IKiF0bj7IM1Cw_aem_KLRASAWlvzXsSmyL2SY1XA

| https://www.instagram.com/ibac_official/