Prof. Parijat Thakur

Astronomy & Astrophysics Research Group

Department of Pure & Applied Physics
Guru Ghasidas Vishwavidyalaya (A Central University)
Koni, Bilaspur (C. G.) - 495009

Prof. Parijat Thakur

Professional Experience

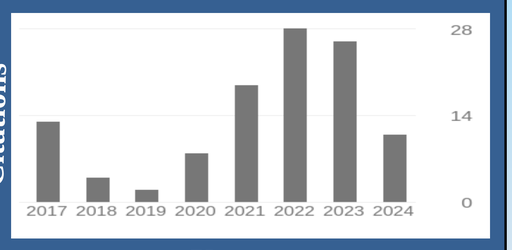
- **May 2022 - Present: Professor**, Dept. Of Pure & Applied Physics Guru Ghasidas Vishwavidyalaya, (A Central University), Bilaspur (C.G.), India
- **May 2011 - May 2022: Associate Professor**, Dept. Of Pure & Applied Physics Guru Ghasidas Vishwavidyalaya, (A Central University), Bilaspur (C.G.), India
- **Aug 2006 – April 2011: Postdoctoral Fellow**, Dept. of Physics and Institute of Astronomy National Tsing Hua Univ., Hsinchu, Taiwan
- **March 2005 - July 2006: Postdoctoral Fellow**, Institute of Astronomy National Central Univ., Chung-Li, Taiwan
- **Feb 2003 – March 2005: Postdoctoral Fellow**, Pusan National Univ., Pusan, South Korea

Membership/Fellowship of the Professional Bodies

- Life Member of International Astronomical Union (IAU), Paris, France
- Life Member of Astronomical Society of India (ASI)
- Visiting Associate of Inter-university centre for Astronomy and Astrophysics (IUCAA), Pune, India
- Associate of Committee on Space Research (COSPAR), France
- Indian Society for Particle Accelerators (ISPA)

Research Interest

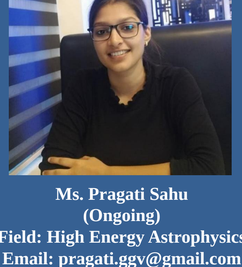
Astronomy & Astrophysics, Investigating Transiting Exoplanets, Exploring the Environment of the Black-hole and Neutron Star with the X-ray binaries, Galactic Structure and Dynamics, Galaxy Surface Photometry, Structure and Evolution of Barred Galaxies, NBODY PMSPH & TREESPH Simulations, Astronomical Image Processing.



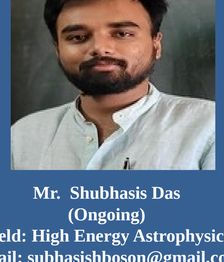
Ph.D. Students

Dr. Swadesh Chand (completed)
Field- High Energy Astrophysics,
Email: swdesh.chand@gmail.com
Post Doctoral Fellow,
Inter-University Centre for Astronomy and Astrophysics (IUCCA), Pune

Mr. Vineet Kumar Mannaday (Submitted)
Field- Extra solar planet,
Email: vm92ggu@gmail.com
Assistant Professor,
Dept. of Physics,
Govt. Niranjan Kesharwani College,
Kota, Bilaspur (C.G.)-495113, India



Ms. Pragati Sahu (Ongoing)
Field: High Energy Astrophysics
Email: pragati.ggv@gmail.com



Mr. Shubhasis Das (Ongoing)
Field: High Energy Astrophysics
Email: subhasishboson@gmail.com

Contact Address:

Prof. Parijat Thakur
Principal Investigator
(ISRO, AstroSat, AO Project),
Department of Pure and Applied Physics,
Guru Ghasidas Vishwavidyalaya
(A Central University),
Bilaspur (C. G.) - 495009
Phone no: 917587096051
Email: parijatthakur@yahoo.com,
parijat@associates.iucaa.in

High Energy Astrophysics

Black Hole X-ray Binary: Black hole X-ray binaries (BHXB) are captivating astronomical systems that involve a stellar black hole and a companion star. Due to the strong gravitational pull, material from the companion star accreted towards the black hole, which in turn results in the formation of an accretion disk around it. The intense gravitational forces and viscous friction within the accretion disk generate extreme temperatures, causing these objects to be bright in X-rays. Transient nature and variability in the X-ray emission make the black hole X-ray binaries ideal targets to understand valuable insights into the properties of black holes, as well as the complex interplay between black holes and their stellar counterpart.

Neutron Star X-ray Binary: Neutron star X-ray binaries (NSXB) consist of a compact neutron star in close orbit with a normal star, typically a low-mass companion. The neutron star, formed from the remnants of a massive stellar explosion, accretes material from its companion, creating a powerful X-ray-emitting binary system. As the material spirals onto the neutron star's surface, it releases a tremendous amount of energy in the form of X-rays, making these binaries detectable by X-ray telescopes. These systems serve as important laboratories for studying extreme physical conditions, including strong gravitational fields and intense magnetic fields near the neutron star. The study of neutron star X-ray binaries provides insights into astrophysical processes, such as accretion and the behavior of matter under extreme conditions, contributing to our understanding of the fundamental properties of compact objects in the universe.

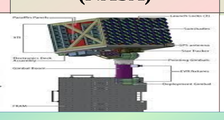
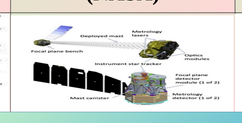
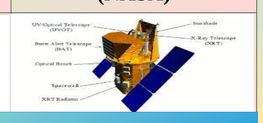
Objectives:

- Study of the physical geometry of the X-ray binaries during their outburst and quiescent periods using the data taken by several space telescopes.
- Study of the accretion flow mechanism surrounding the compact object (BHXB and NSXB) and accretion disk dynamics.
- Study the effect of general relativity at the immediate vicinity of the compact object (BHXB and NSXB) with broad iron line.
- Study of temporal properties such as PDSs and their variability such as the presence of QPOs, other aperiodic variability, and total variability power.

Data Reduction and Analysis Facilities

Computer System	Method	Software Packages
Linux Based Workstation and Computer systems with high-speed internet facility	Data Reduction	HEASoft, FTOOLS, SXTPIPELINE, LAXPCSoft, SAS, NUSTARDAS, XRTPIPELINE, DS9
	Timing Analysis	XRONOS, GHATS, XSPEC, ISIS
	Spectral Analysis	XSPEC & ISIS

Observation Facilities (Space based Telescopes)

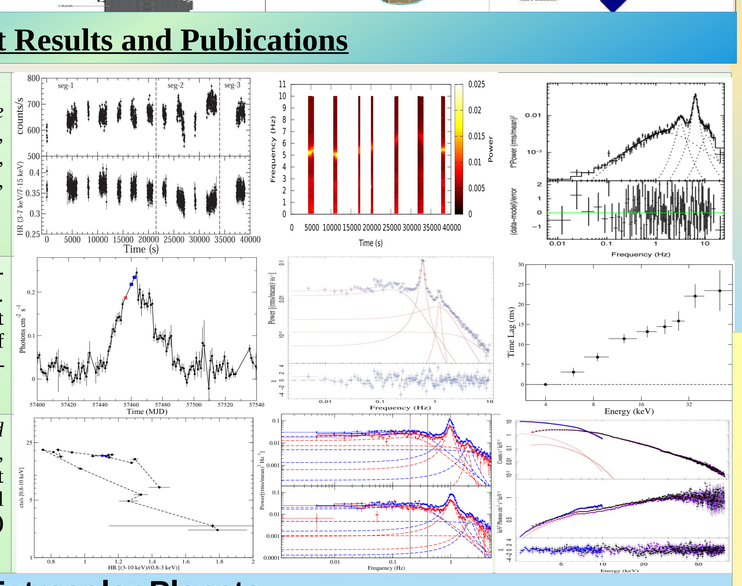
AstroSat (ISRO)	XMM-Newton (ESA)	NICER (NASA)	NuSTAR (NASA)	Swift (NASA)
				

Recent Results and Publications

1. *"AstroSat View of the Newly Discovered X-Ray Transient MAXI J1803–298 in the Hard-intermediate State"*, Chand, Swadesh, Dewangan, G. C., Thakur, Parijat(**Corresponding Author)**, Tripathi, Prakash, Agarwal, V. K., 2022, The Astrophysical Journal, 933, 69, **(Impact factor – 5.874)** https://doi.org/10.3847/1538-4357/ac7154

2. *"AstroSat observation of 2016 outburst of H 1743-322"*, Chand, Swadesh, Agarwal, V. K., Dewangan, G. C., and Tripathi, Prakash, Thakur, Parijat (**Corresponding Author)**, 2021, Journal of Astrophysics and Astronomy, 42, 38, **(Impact factor – 1.27)** https://doi.org/10.1007/s12036-020-09688-x

3. *"2016 Outburst of H 1743–322: XMM Newton and NuSTAR View"*, Chand, Swadesh, Agarwal, V. K., Dewangan, G. C., and Tripathi, Prakash, Thakur, Parijat (**Corresponding Author)**, 2020, The Astrophysical Journal, 893, 142, **(Impact factor – 5.874)** https://doi.org/10.3847/1538-4357/ab829a



Extrasolar Planets

Extrasolar Planets are the planets that orbit stars other than the Sun. The extrasolar planetary science is a new and burning field of research in astronomy and astrophysics. Since the discovery of first hot-Jupiter extrasolar planet (51 peg b) around a main sequence star more than 5500 extrasolar planets with diverse properties have been confirmed. Prior to extrasolar planet discovery, our solar system was the only source for understanding the planet formation and evaluation mechanisms. But now, a large number of extrasolar planetary systems have confirmed, whose follow-up observations may help us to better understand their chemical compositions, internal structure, formation and evaluation mechanisms.

Objectives: We are working on transiting Jupiter sized extrasolar planets (hot-Jupiters) with the following objectives:

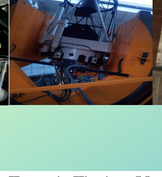
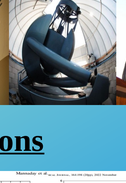
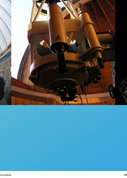
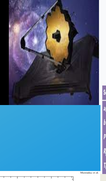
- Improve the estimates of physical and orbital parameters
- Refining the transit ephemeris required for future space missions
- Study the transit timing variation (TTV) of extrasolar planets. TTV study may enable us to:

➔ Probe the presence of **Additional Planet** in the known extrasolar planetary system, Test the theoretical predictions of **Orbital Decay** and **Apsidal Precession** phenomena, Search the presence of **Applegate mechanism**, Study **line-of-sight acceleration** of the systems to search the possibility of **wider orbit additional companion**

Data Reduction and Analysis Facilities

Computer System	Method	Software Packages
Linux Based Workstation and Computer systems with WiFi facilities	Data Reduction	Image Reduction and Analysis Facility (IRAF), AstroImageJ
	Transit Light Curve Analysis	Transit Analysis Package (TAP), Exofastv2, GP regressor, Pylightcurve, Transitfit, Juliet
	Transit Ephemeris, TTV Analysis	emcee, AstroML,SciPy, NumPy, Matplotlib,

Observation Facilities (Space based and Ground based Telescopes)

2-m Himalayan Chandra Telescope (HCT), Hanle, Ladakh, India	1.3-m J.C Bhattacharya Telescope, Tamil Nadu, India	1.3-m Devasthal Fast Optical Telescope, ARIES, Nainital, India	1.23-m Zeiss telescope, CAHA, Calar Alto, Spain	1.25-m AZT-11 telescope, CrAO, Nauchny, Crimea	1.5-m Palomar telescope (P60), California, USA	0.8-m telescope, Arizona, USA	0.6-m G2 telescope, G2 Pavilon, Slovakia	Transiting Exoplanet Survey Satellite (TESS)	James Webb Space Telescope (JWST)
									

Recent Results and Publications

"Revisiting the Transit Timing Variations in the TrES-3 and Qatar-1 systems with TESS data", Mannaday, V. K., Thakur, Parijat (**Corresponding Author),** Southworth, John, Jiang I.-G., Sahu, D., K., et al. 2022, Astronomical Journal, 164, 198, **(Impact Factor: 6.263)** https://doi.org/10.3847/1538-3881/ac91c2

"The Transit Timing and Atmosphere of Hot Jupiter HAT-P-37b", A-thano, Jiang I.-G., et al. 2022, AJ, 163, 77, (**Co-Author** :Mannaday, V. K., and Thakur, Parijat) , **(Impact Factor: 6.263)** https://doi.org/10.3847/1538-3881/ac416d

"Are There Transit Timing Variations for the Exoplanet Qatar–1b?", Su, L.-H., Jiang, I.-G., Lee, C.-Y., Yeh, L.-C., Mannaday, V. K., and Thakur, Parijat Sahu, D. K., et al. 2021, Astronomical Journal, 161, 108, **(Impact Factor: 6.263)** https://doi.org/10.3847/1538-3881/abd4d8

"Probing Transit Timing Variation and Its Possible Origin with 12 New Transits of TrES-3b", Mannaday, V. K., Thakur, Parijat (**Corresponding Author),** et al. 2020, Astronomical Journal, 160, 47, **(Impact Factor: 6.263)** https://doi.org/10.3847/1538-3881/ab9818

Accepted Observational Proposals

In the Field of High-enrgy Astrophysics

➔ AstroSat Target of Opportunity (ToO) observation of the newly discovered X-ray transient source MAXI J1803–298 entitled "Following up a new X-ray transient MAXI J1803–298 with AstroSat" accepted and observed on May 11, 2021 from 01:09 UTC to and 11:59 UTC (P.I.: Swadesh Chand, Co-Is: G.C. Dewangan, Parijat Thakur, Prakash Tripathi and V. K. Agrawal).

➔ AstroSat Target of Opportunity (ToO) observation of X-ray transient source V4641 Sgr entitled "AstroSat observation of X-ray brightening from the black hole X-ray binary V4641 Sgr" accepted and observed from October 19 at 17:52:01 UTC to October 22 at 18:13:33 UTC, 2021. (P.I.: Swadesh Chand,Co-Is: G. C. Dewangan, Parijat Thakur, V. K. Agrawal, Prakash Tripathi and Pragati Sahu).

In the Field of Extrasolar Planets:

➔ For 2017 (Cycle A) our observational research proposal entitled "Investigating Close-in Extra-solar Planets through Photometric Follow-up of their Transits" (PI: Parijat Thakur, Co-Is: Vineet Kumar Mannaday, Ramakant Yadav, Ing-Guey Jiang, Devesh P. Sariya, Li-Hsin Su) was accepted by the 1.3-m DFOT Joint Time Allocation Committee, Aryabhatta Research Institute of Observational Sciences (ARIES), Nainital, Uttrakhand, India.

➔ For 2022 (Cycle 1), 2020 (Cycle 2-3), and 2019 (Cycle 1-3) our observational research proposals entitled "Investigating Close-in Extra-solar Planetary systems through Photometric Follow-up of their Transits" (PI: Parijat Thakur,Co-Is: Vineet Kumar Mannaday, D. K. Sahu, Ing-Guey Jiang) were accepted by the 2-m HCT Time Allocation Committee, Indian Astronomical Observatory (IAO), Hanle, Indian Institute of Astrophysics (IIA), Bangalore, India.

Research Collaborations

In the Field of Extrasolar Planets:

➔ Department of Physics and Institute of Astronomy, National Tsing-Hua University, Hsinchu, **Taiwan**
➔ Institute of Computational and Modeling Science, National Tsing-Hua University, Hsinchu, **Taiwan**
➔ Basic Science Research Institute, Pusan National University, Busan**, South Korea.**
➔ Indian Institute of Astrophysics (IIA), Bangalore, **India**
➔ Aryabhatta Research Institute of Observational Sciences (ARIES), Nainital**, India**
➔ Astrophysics Group, Keele University, Staffordshire, **UK**
➔ Department of Physics, University of Rome Tor Vergata, Rome, **Italy**

In the Field of High-enrgy Astrophysics

➔ Inter-University Centre for Astronomy and Astrophysics (IUCAA)**, Pune, India**
➔ Indian Space Research Organisation (ISRO)**, India**

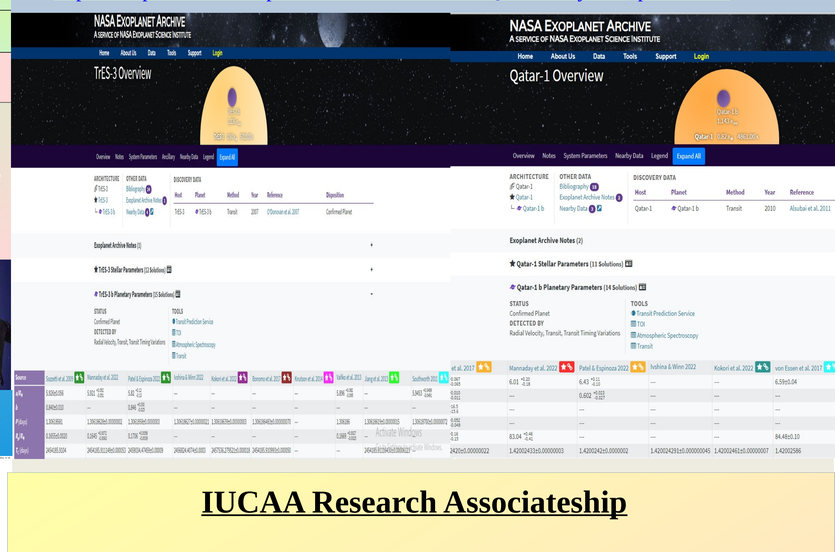
Major Research Projects Completed: 02

Project Title	Funding Agency	Sanctioned Amount (in Lakhs)	Duration of Project
Investigating Close-in Extra-solar Planets through Photometric Follow-up of their Transits	UGC University Grants Commission	10.025	01/07/2015 to 30/06/2018
Exploring the Environment of Black hole with X-ray Binaries using Archival Data of AstroSat	इसरो isro	19	07/08/2019 to 30/06/2022

Achievements

- Planetary Parameters of Extrasolar Planet TrES-3b derived precisely in year of 2022 by Mr. Vineet Kumar Mannaday, who is Ph.D. Student of Prof. Parijat Thakur, are now appeared in the **NASA Exoplanet Archive** https://exoplanetarchive.ipac.caltech.edu/overview/TrES-3%20b#planet_TrES-3-b_collapsible

- Planetary Parameters of Extra-solar Planet Qatar-1b derived precisely in year of 2022 by Mr. Vineet Kumar Mannaday, who is Ph.D. Student of Prof. Parijat Thakur, are now appeared in the **NASA Exoplanet Archive** https://exoplanetarchive.ipac.caltech.edu/overview/Qatar-1b#system_parameters



IUCAA Research Associateship

✱ Since August 2012, I have been continuing as a "Visiting Associate" of the Inter-university Centre for Astronomy and Astrophysics (IUCAA), Pune, India, which is an autonomous institution set up by the University Grants Commission (UGC), New Delhi to promote the teaching, research and development in Astronomy and Astrophysics at Guru Ghasidas Vishwavidyalaya (A Central University), Bilaspur (C.G.). As an associate of IUCAA, I can visit IUCAA to utilize the following facilities available there for the research in Astronomy and Astrophysics:

(1) Advanced Computer Centre (2) Astronomical Data Centre, (3) PC-cluster for the High Performance Computing (4) Modern Library (5) 2-metre Optical Telescope Near Pune (6) Observational Facilities at Southern African Large Telescope (SALT) at Southernland (7) IUCAA-NCRA Radio Astronomy Lab. (8) Virtual Observatory (9) Mirror Sites.

All these above mentioned facilities will also be given to the Ph.D. students registered under me at the Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.).