Atreyi Dasgupta

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RESEARCH INTERESTS

Multi Messenger Astronomy
Gamma Ray Bursts, Electromagnetic Counterparts to Gravitational Waves, High-Energy Transients, Application of Statistics and Data Analysis to Astronomy

EDUCATION

Birla Institute of Science and Technology Pilani, Hyderabad Campus
Integrated MSc. Physics
CPI: 8.0/10

Indian Institute Of Technology, Bombay
Masters Thesis

OBSERVING EXPERIENCE

Published 13 GCNs: 6 first author and 6 second author GCNs. Few first author GCNS are as follows

1. Dasgupta, A. et al. (2024) "EP240913A / GRB 240913C: AstroSat CZTI detection"
2. Dasgupta, A. et al. (2024) "GRB 240807B: AstroSat CZTI detection of a short burst"
3. Dasgupta, A. et al. (2024) "GRB 240812B: AstroSat CZTI detection of a long burst"
4. Dasgupta, A. et al. (2024) "GRB 240730C: AstroSat CZTI detection of a long burst"

KEY PROJECTS

Study and Search for Electromagnetic Counterparts of Gravitational Waves   *2024*
Prof. Varun Bhalerao and Gaurav Waratkar — IIT Bombay

· Conducting a comprehensive study of various **spectral models** and examining how they are affecting **flux limits for transients** observed from different regions of the sky
· Investigating the detectability of notable **Gamma-Ray Bursts (GRBs)**, such as **GRB 170817A**, while utilizing the aforementioned spectral models to assess their effectiveness
· Expanding the scope of the research to include all **low-significance triggers from the O4 observing run**, thereby enhancing the sensitivity and breadth of transient detection across the observational data

Search for Gamma Ray Bursts using AstroSat CZTI   *Summer 2024*
Prof. Varun Bhalerao and Gaurav Waratkar — IIT Bombay

· Achieved proficiency in the Cadmium Zinc Telluride Imager (**CZTI**) interface for analysis of fast transients
· Developed an **automated monitoring bot** to facilitate triggered searches for **Gamma-Ray Bursts (GRBs)** and **LIGO-Virgo-Kagra (LVK) events**, ensuring prompt data acquisition
· Systematically **reorganized output files** and **resolved existing bugs within the analysis pipeline**, thereby improving data integrity and accessibility for further analysis and reporting
· **Authored** and **published 13 circulars** in the Generalised Coordinates Network (GCN)

Study of Solar Flares using XSM Catalog   *2024*
Arvind Bharathi— UC San Diego

· Engaged in the analysis of **X-ray light curves** obtained from state-of-the-art solar observation instruments aboard the **Chandrayaan-2 orbiter (XSM)**
· Conducted a thorough review of research papers on **High Temperature Flares (HTF) and Impulsive flares** to gain deeper insights into flare dynamics

- Performed background-subtracted **peak flux analysis** with power-law fits, utilizing a **Monte Carlo approach to evaluate the exponent** α in the power-law distribution $Ax^{-\alpha}$

Exploring Radiative processes using Radio Astronomy Data Analysis *Summer 2023*
Dr. Arvind Balasubramanian and Kunal Deshmukh — IIT Bombay, Krittika Club

- Analyzed **FITS** images of celestial jets at Radio, Infrared and Visible Wavelengths using the **CIRADA** data
- Mastered foundational **radio astronomy** concepts using **CASA software** for data analysis
- Developed proficiency in processing radio telescope data, generating informative plots for clear visualization
- Utilized **MCMC techniques** to extract the **afterglow of GW170817** and investigated **fast radio bursts (FRBs)** and dispersion measure (DM) values for insights into energetic bursts

Geometrical Extension of Einstein's General Relativity *2023*
Prof. Bivudutta Mishra — BITS Pilani, Hyderabad

- Conducting an in-depth study of the **Teleparallel formulation of Gravity**
- Utilizing advanced mathematical tools and theoretical frameworks to formulate and analyze the proposed extension, ensuring consistency with observational data and established principles of modern cosmology
- Applying **low-redshift data** to impose observational constraints on the free parameters of the $f(R, G) = R^n G^{1-n}$ model through the implementation of the **Markov Chain Monte Carlo (MCMC)** method

Pulsar Data Analysis using InPTA *2023*
Course Project: Radio Astronomy — BITS Pilani, Hyderabad

- Utilized the **'psredit'** subroutine from the **PSRCHIVE package** to extract relevant data from the early epoch data files.
- Employed the **'psrplot'** subroutine within the PSRCHIVE package to generate plots such as: frequency against phase and obtaining the intensity versus phase plot, which represented the average or integrated profile for the pulsar
- Used **'psredit'** to retrieve the **Dispersion Measure (DM)** and ascertain the DM correction status

Fundamentals of General Relativity *2023*
Reading Project: Prof. Rahul Nigam — BITS Pilani, Hyderabad

- Developed a **proficient understanding of special relativity**, including key concepts such as Lorentz transformations, time dilation, length contraction, and the concept of spacetime
- Gained skills in visualizing events using **Minkowski spacetime diagrams** and demonstrated comprehensive knowledge of the spacetime interval
- **Enhanced problem-solving skills** by applying general relativity principles to explain complex phenomena like **gravitational waves** and **black holes**

WORKSHOPS

ZTF Summer School *Summer 2024*
ZTF Facility Caltech and University of Minnesota

- Attended lectures on **Mixed Integer Linear Programming**, **Simulation-Based Inference**, and **Anomaly Detection**.
- Performed object detection using a **Region-Based Convolutional Neural Network (CNN)** and applied **MILP** for optimal scheduling of telescopes
- Trained a **VGG16 model** as a binary classifier to detect and analyze **light echoes** and **stars** in images and feature maps
- Developed and optimized **Machine Learning models** for binary black hole detection, incorporating domain-specific knowledge and robust simulations to enhance accuracy and performance

ACHIEVEMENTS

Selected among **60 students worldwide** to attend the **ZTF summer school 2024** on the topic AI in Time-Domain Astronomy

Invited to speak at a **TEDx Community Meet at BITS Hyderabad** to share experiences and inspire students with insights on **personal** and **professional growth**

Achieved the **Silver Honour** in the International Astronomy and Astrophysics Competition (**IAAC**)

Awarded the **Lifetime Achievement Award** by a student-run body at BITS Pilani, recognized as the **most accomplished female student** in the batch of 2021

Secured **Rank 1** in the course: **Atomic and Molecular Physics** in a class of **65+ students**

Invited to be a **guest speaker** in **VIT Chennai**

POSITION OF RESPONSIBILITY

Ad Astra: The Astronomy and Astrophysics Club of BITS Pilani Hyderabad   2023-24
President

· Led and managed a team of over **50 members**, effectively **delegating responsibilitie**s and fostering a **collaborative environment**
· Organized major events, including the **Chandrayaan 3 landing screening**, which attracted over **1,500 attendees**, and interactive stargazing sessions using a state-of-the-art **9.25-inch diffraction-limited Schmidt-Cassegrain telescope**
· Oversaw projects such as **constructing a horn antenna** to investigate the existence of dark matter and developing an **astronomy-based crypt hunt game**, *Galactrix* for people all over India

Mentor for Krittika Summer Project   Summer 2024
Krittika: The Astronomy club of IIT Bombay

· Led a **two-month-long project** for a group of **5 undergraduate** and **graduate students** from various universities across India
· Created resources to assist in the **theoretical** and **practical understanding of radio astronomy**
· **Organized regular weekly meetings** to address theoretical doubts and computational difficulties in assigned tasks

TECHNICAL SKILLS

Programming Languages	Python, SQL, Bash, C, MATLAB
Python Packages	NumPy, Matplotlib, SciPy, AstroPy, Pandas, HealPy, emcee, corner, BeautifulSoup, Jupyter
Software & Tools	HTML, LaTeX, Excel, Mathematica, Autocad, Linux(OS)

RELEVANT COURSES UNDERTAKEN

Physics	Mechanical Oscillation and Waves, Quantum Mechanics I and II, Electromagnetic Theory I and II, Classical Mechanics, Modern Physics Lab, Statistical Mechanics, Introduction to Radio Astronomy, Nuclear and Particle Physics, Cosmology, Electromagnetic and Optics Lab, Physics Lab, Advanced Physics Lab, Atomic and Molecular Physics, Computational Physics, Oprtics, Quantum Info and Computing*, Laser Science and Technology*, General Theory of Relativity and Cosmology*
Math	Mathematics 1: Calculus, Mathematics 2: Linear Algebra, Mathematics 3: Differential Equations, Probability and Statistics

* to be completed by December 2024

VOLUNTEERING

Guest Speaker for Underprivileged Schools   2024
Gnaanu Education

· Delivered talks at over five schools, engaging with students in **grades 9-10**
· Discussed pursuing a career in astronomy and provided suggested pathways for students interested in the field

Guest Speaker at VIT Chennai   2023
SEDS Antariksh: VIT Chennai

· Delivered a talk on Neutron Star Mergers, focusing on **GW170817**, attended by **over 80 participants**
· Discussed the **neutron star merger ejecta** and the **afterglow of the merger**

Website for Aspiring Astrophysicists   2023
Astrophysics by Atreyi

· Establishing a website as a central resource for aspiring astrophysicists, catering to all levels of learners
· Curating career guidance, educational content, and cosmic exploration, fostering an inclusive community of learners

GitHub Tutorials for Radio Astronomy   2023
Radio Astronomy Tutorials

· Developed open-source and accessible GitHub tutorials for data analysis in Radio Astronomy
· Provided the theory behind the concepts and the corresponding codes

EXTRACURRICULAR ACTIVITIES

Part of Editorial team of Spectrum: The Physics Club of BITS Pilani, Hyderabad campus

Part of Editorial team of MHSG: Mental Health and Support Group of BITS Pilani, Hyderabad campus

Trained in Bharatnatyam Classical Dance for 7+ years

Was a singer in various events such as, Teacher's Day and Science Day in BITS Pilani, Hyderabad Campus

Secured 2nd prize in a city-wide poetry competition