Riya

Curriculum Vitae

(+91) 84549-30220
160100097@iitb.ac.in

Research Interests

Astro-Particle Physics: Detector Development, Dark Matter, Cosmic Neutrinos

Education

2016–2020 **Bachelor of Technology**

Department of Mechanical Engineering, Indian Institute of Technology Bombay, India

CGPA: 9.33/10

Minor: Physics.

Conference Talks and Publications

1. **Riya**, V. Rentala (preprint - in prep)
   "Resolution of discrepancy in SFR at Cosmic Noon using Diffuse Supernova Neutrino Background"
2. **Riya**, S. Chirame et al. (preprint)
   "Closed Loop Simulation for Attitude Control of Nano-Satellite", (ebook ISBN 978-981-15-1724-2)
   International Conference on Small Satellites and Systems 2019, Hyderabad, India
3. *"Star Formation Rate using Diffused Supernova Neutrino Background"*, (Oral Presentation)
   20^{th} National Space Science Symposium 2019, Pune, India

Research Experience

2018-Present **Star Formation Rate using Diffuse Supernova Neutrino Background** [1]

Supervisor *Prof. Vikram Rentala, Department of Physics, Indian Institute of Technology (IIT), Bombay*

Introduction Peak values of the Global Star Formation Rate inferred from two different sets of probes (UV+IR and H_α) are in disagreement. The project involves the analysis of the use of Diffuse Supernova Neutrino Background (DSNB) in the **resolution of discrepancy**.

- Reviewed the existing probes for measuring the star formation rate and analyzed the best-fit models
- Simulated expected positron spectrum at **Hyper-Kamiokande** neutrino detector due to DSNB
- Using χ^2 **test**, concluded the exclusion of H_α-SFR at 100% confidence level if UV+IR SFR is true
- After consideration of various backgrounds using the **likelihood test**, inferred the exclusion of H_α-SFR at 81% confidence level if UV+IR SFR is actual

2019 **Scintillator Material Characterisation for SABRE Dark Matter Detector**

Supervisor *Dr Lindsey Bignell, Department of Nuclear Physics, Australian National University (ANU)*

Introduction SABRE is a direct detection experiment to search an annual modulation in signal for verifying the claim of **WIMP** (Weakly Interacting Massive Particles) detection by DAMA/LIBRA. **Liquid scintillator veto** is being used for detection of gamma-rays enabling improved background rejection.

- Verified **absence of degradation** in scintillator (Linear alkylbenzene) properties after exposure to detector materials by conducting weekly measurements of relative **light yields** of scintillator samples
- Measured charge distribution due to ^{22}Na decay in BaF_2 and LAB and fitted an exponential to time-delay to obtain the **scintillation decay time** (a parameter needed for simulation of detectors)
- Assisted in purification and storage of scintillator and detector-materials for setting-up the experiments

Spring 2018 **Big Bang Nucleosynthesis** (Course Project: Astrophysics)

Prof. Vikram Rentala, Department of Physics, IIT Bombay

- Obtained an overview of big bang nucleosynthesis, searched the open problems and further studied the problem of **discrepancy** between predicted and measured amount of **lithium**
- Reviewed the prediction of H, D, He and Li abundances in the universe using currently accepted Maxwell Boltzmann distribution and then compared them to **Tsallis nonextensive statistics** model

Academic Achievements

2019 Awarded **Undergraduate Research Award** for analysis of potential use of diffuse supernova neutrino background for resolution of discrepancy in the global star formation rate [1]

2019 Recipient of **Future Research Talent** award to pursue research at ANU for 11 weeks

2019 Ranked $\mathbf{12^{th}}$ amongst 160 students in the Mechanical Engineering Department

2016 Secured an **All India Rank 621** in JEE-Advanced out of 0.2 million shortlisted candidates

2016 Among 2500 students to be selected for prestigious **Kishore Vaigyanik Protsahan Yojna** (KVPY) fellowship out of 97500 candidates

IIT Bombay Student Satellite Project

2017-Present **Advitiy - Second Generation Student Satellite of IIT Bombay**

IIT Bombay's largest student run initiative to convert the institute to a Center of Excellence of Satellite and Space Technology; An interdisciplinary team of 40+ members across 4 subsystems

Subsystem Leader, Attitude Determination and Control Subsystem

- Spearheaded a team of **8 members** to develop quality assured **simulation framework** to determine the in-orbit attitude deviation of satellite for the ground-verification of chosen control-algorithms [2]
- Contributed to Satellite 101 wiki - a pro bono outreach effort as a part of the social goal of the team to facilitate knowledge sharing; **47.1k** pageviews and **18.4k** users around the globe within 1.5 years
- Executed three-step recruitment process to select **8** students for the subsystem from **50+** applicants evaluating their technical ability, practical approach and teamwork

Payload Subsystem

- Explored different applications of **CubeSat based telescope** such as studying sun's chromosphere, correlating solar-flares and energetic particles; and inspected their implementation-feasiblity
- Analyzed the electrical, mechanical and control requirements of **star-tracker** to determine the feasibility of its application as an attitude sensor for CubeSats as per the guidelines of **ISRO**
- Worked on the design of **electron emission circuit** of tether - a cable used for deorbiting a satellite
- Coordinated a **team of 4** to select a payload for GLEE - a mission to send **chip-satellites to moon**
- Evaluated the use of photovoltaic modules (used in solar panels) for the sun vector measurement; **Rejected the idea** as improvement in mass and power budget is negligible compared to the increase in failure probability of satellite due to increased complexity of the required electric circuit

Internship

Winter 2017 **Aerostat for Military Surveillance**

Manastu Space Technologies Private Limited

- Developed two-dimensional **gore-profile** for construction of 3D envelope for given design of aerostat
- Manufactured a **prototype** using Low-Density Polyethylene to experimentally determine the increase in the lift for **kytoon** which is a combination of heavier than air kite and lighter than air balloon

Workshops

2018 **GROWTH Winter School** - *A three-day intense program with short lectures followed by interactive hands-on sessions to introduce students to techniques and strategies for multiwavelength observations*

- Acquainted with analysis of X-ray and radio data, lightcurve analysis and optical and IR spectroscopy
- Planned the **observing run** and observed various **supernovae** using GROWTH-India telescope; Processed the obtained raw images and performed photometric analysis to discover transients

2017 & 2018 **Summer of Science** - *Maths and Physics Club, IIT Bombay*

Relativity Studied **special theory of relativity** and **tensor analysis** to lay the foundation of general relativity

Cosmology Studied basics such as Friedmann equation, Fluid equation etc., and used them to understand higher concepts such as **dark matter, neutrino cosmology**, inflation, nucleosynthesis, baryogenesis etc.

Positions of Responsibility

Summer 2018 **Teaching Assistant - Engineering Mechanics**

Prof. D M Dewaikar, Department of Civil Engineering, IIT Bombay

- Entrusted with responsibility of tutoring **35** undergraduate students having a backlog in the course

Autumn 2017 - Spring 2018 **Associate Secretary**

Department of Mechanical Engineering, IIT Bombay

- Responsible for facilitating the interaction of **140+ freshmen** with department faculties and seniors
- Successfully organized events like convocation, department trip etc. catering to **500+ students**

Technical Skills

Python, C++, MATLAB, Simulink, LaTeX, HTML

Relevant Courses

Physics Astrophysics, Methods in Experimental and Nuclear Physics, Statistical Physics, Quantum Mechanics, Classical Mechanics, Data Analysis & Interpretation, Basics of Electricity and Magnetism

Mathematics Introduction to Numerical Analysis, Linear Algebra, Ordinary Differential Equations, Calculus

Mechanical Heat Transfer, Thermodynamics, Fluid Mechanics, Nuclear Reactor, Mechanical Measurements

Extra-Curricular

- Taught **basic mathematics** to 6^{th} - 9^{th} grade students at Abhyasika, an NGO which provides free and quality education to underprivileged children of nearby slums, for **4 months**
- Organized and conducted a **Ground Station Workshop** under Advitiy attended by **50+** students and presented the use and working of rotor and rotor-interface for precise alignment of the antenna
- Exhibited satellite model of Pratham in engineers' conclave held at sixth **Inter-IIT Technical Meet**
- Attended Football Girls Camp and won institute girls' **football** tournament participated by 30+ girls
- Enthusiastic **trekker** - Have trekked to Kalsubai, the highest point in the state of Maharashtra
- Visited Giant Metrewave Radio Telescope (GMRT), India and Mount Stromlo Observatory, Australia

References

Prof. Vikram Rentala, Department of Physics, IIT Bombay
email: rentala@phy.iitb.ac.in
Dr. Lindsey Bignell, Department of Nuclear Physics, Australian National University
email: lindsey.bignell@anu.edu.au
Prof. Prabhu Ramachandran, Department of Aerospace Engineering, IIT Bombay
email: prabhu@aero.iitb.ac.in