Riya
Curriculum Vitae

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Research Interests

Astroparticle Physics: Detector Development, Dark Matter, Cosmic Neutrinos, Cosmic Rays

Education

2016–Present **Indian Institute of Technology Bombay**
Bachelor of Technology, GPA: 9.33/10
Major: Mechanical, Minor: Physics
Department Rank: 12th amongst 160 students

Conference Talks and Publications

1. **Riya**, V. Rentala (preprint)
"Resolution of discrepancy in SFR at Cosmic Noon using Diffuse Supernova Neutrino Background"
Advances in Astroparticle Physics and Cosmology 2020, Kolkata, India
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)
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 Hα) 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
- Used χ^2 **test** to conclude the exclusion of Hα SFR at 100% confidence level if UV+IR SFR is true
- Performed the **likelihood test** to account for various backgrounds and inferred the exclusion of Hα SFR at 81% confidence level in the case that UV+IR SFR is true

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.*

- Measured **relative light yields** of scintillator samples to verify absence of degradation in scintillator properties after exposure to detector materials, implying no need for modification to detector design
- Measured charge distribution in BaF_2 and LAB due to ^{22}Na decay 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 (BBN)** (Course Project: Astrophysics)

Supervisor *Prof. Vikram Rentala, Department of Physics, IIT Bombay*

- Studied BBN to work on the **discrepancy** between predicted and measured amount of **Lithium**
- Analysed the predictions of H, D, He and Li abundances in the universe using Maxwell Boltzmann distribution in comparison 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 Australian National University

2016 Secured an **All India Rank 621** in IITJEE-Advanced among 200,000 shortlisted candidates

2016 Awarded **Kishore Vaigyanik Protsahan Yojna** (KVPY) fellowship given to talented basic science high-school students

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

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

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

2018 Studied **special theory of relativity** and **tensor analysis**

2017 Studied basics of **Cosmology** such as Friedmann equation, Fluid equation etc., and used them to understand higher concepts such as **dark matter, neutrino cosmology**, inflation, baryogenesis etc.

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

Teaching Experience

Summer 2018   **Teaching Assistant**

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

- Entrusted with responsibility of tutoring **Engineering Mechanics** to **35** undergraduate students

Autumn 2017   **Teaching Volunteer**

Abhyasika (NGO), IIT Bombay

- Taught **basic mathematics** to 6th - 9th grade underprivileged students for **4 months**

Positions of Responsibility

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

Miscellaneous

- Organized and conducted a **Ground Station Workshop** under Advitiy attended by **50+** students
- 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