

Riya

Curriculum Vitae

☎ (+91) 84549-30220

✉ riyasingh@iitb.ac.in

Research Interests

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

Education

2020–2022 **Purdue University**

Master of Science, Department of Physics and Astronomy

2016–2020 **Indian Institute of Technology Bombay**

Bachelor of Technology, GPA: 9.33/10

Major: Mechanical, Minor: Physics

Publications

1. Riya, S. Chirame et al., Closed-Loop Simulation for Attitude Control of Nano-satellite, *Advances in Small Satellite Technologies*, pp 87-97. Springer, Singapore (2020).

Conference Presentations

1. Resolution of discrepancy in SFR at Cosmic Noon using Diffuse Supernova Neutrino Background
Advances in Astroparticle Physics and Cosmology 2020, Kolkata, India
2. Closed Loop Simulation for Attitude Control of Nano-Satellite
International Conference on Small Satellites and Systems 2019, Hyderabad, India
3. Star Formation Rate using Diffused Supernova Neutrino Background
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 $H\alpha$) 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 $H\alpha$ 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 $H\alpha$ 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 BaF₂ and LAB due to ²²Na 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-feasibility
- 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

- 2017-2018 **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**
- 2020 **Summer of Science Mentor** | Maths and Physics Club, IIT Bombay
- Guided 4 students in learning various topics and tools of astrophysics and cosmology

Technical Skills

Python, R, C++, MATLAB, Simulink, L^AT_EX, HTML

Relevant Courses

- Physics** Astrophysics, Methods in Experimental and Nuclear Physics, Statistical Physics, Quantum Mechanics, Classical Mechanics, Electromagnetic Theory, Thermodynamics, Analytical and Geometric Dynamics
- Data Science** Data Analysis and Interpretation, Probability, Inference and Modeling
- Mathematics** Introduction to Numerical Analysis, Differential Geometry, Linear Algebra, Calculus
- Mechanical** Computational Tools for Modeling, Geophysical Fluid Dynamics, Cryogenics, Nuclear Reactor

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**
- Conducted a talk on **Dark Matter** to provide IIT Bombay students an essence about the topic
- 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