Pavan Hebbar

Detailed Résumé

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Research Interests

- Using X-rays and gamma rays to study compact objects especially neutron stars and supernovae
- Understanding the origin and large scale structure of the universe using correlation techniques and anisotropies in Cosmic Microwave Background Radiation
- Studying the distribution and properties of dark matter in galaxies and clusters.
- Modelling and simulating plasma flows to understand astrophysical systems
- Studying the structure of stars using asteroseismology
- Analysing stability and evolution of Multi-body systems

Education

2013 – Present
B.Tech Aerospace Engineering,
Indian Institute of Technology, Bombay, *Grade – **9.56/10***.
- **Department Rank 1** among the class of 2017
- Awarded **AP** grade (for exceptional performance) in Spaceflight Mechanics
- Completed Honors, *Honors' Grade – **10.0/10***
- Minor: Computer Science, Physics

2011 – 2013 **Intermediate Examination**,
Srichaitanya Narayana Junior College, Hyderabad, *Percentage – **96.7%***.

2010 – 2011 **Matriculation**,
Atomic Energy Central School, Kaiga, Karnataka, *Grade – **10.0/10.0***.

Publications

- R. Mishra, S. Shahane, P. Hebbar, S. Jain, Manmohan
  Designing and Analysis Using ANSYS for 'Pratham' Student Satellite IIT Bombay", 65th International Astronautical Congress 2014, Toronto, Canada
- R. Mishra, S. Shahane, P. Hebbar, S. Jain, Manmohan
  "Structural Dynamics-Modeling and Simulation of IITB Student Satellite-Pratham",
  National Seminar on Aerospace Structures 2014

Relevant Skills

Languages C/C++, Python, Shell Scripting, Matlab, HTML, LaTeX

Software ANSYS, NASTRAN, OpenFOAM, SolidWorks CAD, AutoCAD

Packages Python packages:NumPy, SciPy, Matplotlib, GNUPlot and Astropy; WARP, Chandra Interactive Analysis of Observations (CIAO), XSPEC

Research Experience

July 2016 – Present
Redshift estimation through correlation techniques,
Prof. Subhbrata Majumdhar, Tata Institute of Fundamental Research, Mumbai.
- Studying ways to determine redshifts of galaxies photometrically using correlation schemes.
- Understanding the concepts related to implementing these theories to real data.
- Aim to develop codes that can be used to analyse data from Erosita Satellite once it is launched.

May 2016 – July 2016
47 Tuc W: X-ray Variable star,
Prof. Craig Heinke, Department of Physics, University of Alberta.
- Selected as a part of University of Alberta Research Experience program
- Learnt methods to reprocess and analyse data from Chandra X-ray Observatory using CIAO Package
- Understood the concepts related to the neutron stars and evolution of millisecond pulsars in detail.
- Analysed the X-ray light curve of 47 Tuc W in order to check for transits observed in 2002 ACIS-I observations but not in HRC observations of 2004 - 2015
- Performed the spectral analysis of data to understand the source of the X-ray emission and to look for any changes as compared to the previous observations

January 2016 – April 2016
Detecting Short γ-ray Bursts in Astrosat CZTI Data,
Prof. Vikram Rentala, Indian Institute of Technology Bombay.
- Understood the spectral and temporal distribution of gamma ray bursts and their possible sources.
- Studied the methods of detection γ rays and the challenges in the detection of short γ ray bursts
- Analysed and obtained the light curve of GRB160119A using CZTI equipment of ASTROSAT and showed that using only peak detection might give false signals

December 2015
B-mode spectrum and Inflation Models,
National Initiative of Undergraduate Research - Astronomy,
N. Malsawmtluangi and Prof. P. K. Suresh, School of Physics, University of Hyderabad.
- Understood the different kinds of anisotropies in the Cosmic Microwave Backgorund Radiation.
- Studied the concepts related to the theory of inflation of the universe
- Analysed the validity of various inflation models using the covarience of B-mode polarizations.

May 2015 – Present
Numerical Simulation of Collisionless Shocks,
Prof. Bhooshan Paradkar, Centre for Excellence in Basic Sciences, University of Mumbai.
- Studied the basics of plasma theory and its magnetohydrodynamic relations
- Used Particle-in-Cell approach through WARP open source code
- Numerically simulated plasma particles to calculate shock parameters
- Analysed the variation of shock parameters for different plasma particles
- Worked on parallel programming to reduce the simulation time

May 2015 – December 2015
Computational Modelling of Hall Thrusters,
Prof. Kowsik Bodi, Department of Aerospace, Indian Institute of Technology Bombay.
- Studied different rocket propulsion systems and analysed their efficiency
- Numerically simulated the motion of plasma particles to calculate the exhaust velocity of the gas
- Analysed the variation of specific thrust with changing axial electric and radial magnetic fields
- Optimized the electric and magnetic fields to achieve maximum efficiency

December 2014
Using OH Mega-Masers To Verify Galaxy Evolution Theories,
National Initiative for Undergraduate Science – Physics,
Dr. Nissim Kanekar, National Centre for Radio Astronomy.
- Studied the properties of different types of astronomical masers in detail
- Understood the different aspects related to radio astronomy, interference and synthesis imaging
- Aimed at analysing variation in number density & mass with redshift to verify evolution theories

December 2013
Gamma Ray Detection Through Čerenkov Radiation,
National Initiative for Undergraduate Science – Astronomy,
Dr. K K Yadav, Bhabha Atomic Research Center, Mumbai.
- Studied the various concepts involved in the detection of gamma rays though Čerenkov emission.
- Designed programs to differentiate between Čerenkov emission shower due to cosmic and gamma rays
- Analysed data collected from the TACTIC to study the properties of Crab Nebula and MRK 421

Technical Experience

2013 – Present **Mechanical Subsystem, Pratham – Student Satellite Team of IIT Bombay**.
- Performed Vibrational Analysis, Harmonic Analysis, Modal Analysis, Response Spectrum of the satellite
- Performed steady-state and transient thermal analysis to determine the temperature distribution
- Proposed SNAP model to switch the satellite on when it is launched with minimum power
- Optimized satellite models used for analysis to minimize simulation time and maximize accuracy
- Implemented ways to access the server remotely and perform parallel processing on ANSYS
- Worked in the payload subsystem and suggested payloads for the next student satellite

June 2014 **Sky Teller – Institute Technical Summer Project**.
- Involved in the design of an Android app to show the stars in the given direction
- Used the data catalogued in Stellarium Planetarium for the position of celestial objects at a given time
- Used accelerometer of the phone to know the direction being pointed

Mentoring and Work Experience

March 2016 – Present **Institute Student Mentor**.
- Selected among a team of 81 mentors out of 368 participants to mentor and first year students
- Involved in guiding a solving academic and social problems of twelve mentees alloted to me.
- Volunteered in the organization of welcome programs for freshmen
- Attended a one day workshop organized by Tata Institute of Social Service (TISS) to learn different skills required for mentoring.

2015 – 16 & 2016 – Present **Department Academic Mentor**.
- Selected twice into a team of 25 mentors to help sophomores of aerospace department academically
- Involved in guiding and solving academic problems of four mentees in 2015 – 16, one of whom secured the department rank one of their batch for that year.
- Presently involved in inspiring and motivating three mentees under the Academic Rehabilation Program to perform academically well.

July 2015 **Academic Committee Member – International Physics Olympiad 2015**.
- Selected as a student grader for the theory round of the olympiad
- Involved in the critical discussion of theory questions
- Evaluated the answer scripts of students from 89 different countries

June 2015 **Resource Person and Student Facilitator**.
- Selected as a resource person for the Indian Astronomy Olympiad OCSC (Orientation-Cum-Selection Camp) for mentoring students, handling academic arrangements and aiding in evaluations
- Involved in the selection and training of Indian team which won 3 gold medals and 2 silver medals at International Olympiad for Astronomy and Astrophysics 2015.

2014 – 2016 **Teaching Assistants for IITB courses** .

PH 107: Quantum Physics and Application	Autumn 2014, Summer 2015, Autumn 2015
BB 101: Biology	Spring 2015
MA 214: Introduction to Numerical Analysis	Spring 2016

- Held tutorials where doubts of students were addressed and applications and problems related to the concepts learnt in lectures were discussed
- Evaluated the answer scripts of students in various exams

March 2015 – March 2016 **Manager, Krittika – Astronomy Club of IIT Bombay**.
- Planned a budget of 2.25 lakhs for club activities including lectures, documentary screenings, night-sky observations and workshops, field trips and competitions
- Organized Institute Technical Summer Project 2015 which had a budget of 8 lakhs
- Planned and organized the Inter IIT Messier Marathon 2014-15
- Selected college level teams to participate in intercollegiate events
- Awarded the Institute Technical Organization Color for exceptional performance

2014 – 2015 **Coordinator, Abhyudhay – Social Festival of IIT Bombay**.
- Worked under the Events Division and managed the logistics of various events including lectures, competitions and Interactive sessions
- Planned and implemented urban farming in the hostels of the institute

Achievements

International Representations

2012   **Bronze Medal, International Olympiad on Astronomy and Astrophysics**,
Rio De Janeiro, Brazil.

2011   **Silver Medal, International Astronomy Olympiad**,
Almaty, Kazakhstan.

2013   **Prof. Harry Messel International Science School**,
University of Sydney, Australia.
One of the 5 students to represent India and awarded a medal

2012   **IGNOU UNESCO Science Olympiads for SAARC countries**.
Awarded medal for being among the top 40 participants

Other Achievements

2010 – 2012   **Olympiad Orientation Cum Selection Camps**.
- Astronomy Camps (2010, 2011 & 2012) among top 30 students in India
- Awarded **Best Theory** Solution in 2012 and **Best Observer** in 2011 Astronomy Camps
- Awarded Certificates of Merit in the National Standard Examinations in Astronomy (2010) and Junior Science (2011) for being in top 1% of the participants.

2011   **Kishore Vaigyanik Protsahan Yojana Scholarship**,
Indian Institute of Science, Banglore.
- Awarded by Government of India for students interested in research
- Ranked 24 at national level

2009   **National Talent Search Examinations**, *NCERT*, Delhi.
- Awarded by Government of India for students interested in research
- Ranked 2nd at national level and 1st at state level

2011 & 2012   **Infosys Award for Olympiad Medalists**.

2010 & 2011   **Young Scientist Award**.
Honoured by Education Minister of Karnataka state

2013   **Inter IIT Messier Marathon**.
Secured IIT Bombay the second position by putting on board 72 Messier objects including the entire Virgo cluster of galaxies

Relevant Courses Undertaken

Physics and Maths   Astrophysics, General Theory of Relativity, Quantum Mechanics I, Quantum mechanics and Aplications, Electricity and Magnetism, Classical Mechanics, Condensed Matter Physics. Introduction to Nuclear and Particle Physics, Nonlinear Dynamics, Differential Equations, Linear Algebra, Calculus, Introduction to Numerical Analysis

Aerospace Engineering   Introduction to Plasma, Particle methods to simulate fluid flows, Vibrations and Structural Dynamics, Aerospace Structures, Solid Mechanics, Continuum Mechanics, Compressible and Incompressible Fluid Mechanics, Thermodynamics and Propulsion, Engineering Design Optimisation

Computer Sciences   Computer Graphics, Image Processing, Data Structures and Analysis, Logic for Computer Programming, Introduction to Computer Science

Other Interests and Extra - curricular Activities

Trekking
- Attended Basic Mountaineering Camp in Summer 2014 and learnt different techniques of rock climbing, river crossing, climbing in snowy and icy terrains, glicading etc.
- Successfully ascended Mt. Balachanda (Altitude 15500ft) and other forts of Western Ghats

Basketball   Selected for NSO Basketball and proficient in all tricks and game play

Others   Interested in cycling in my free time and would like to participate in adventure sports