

# Pranav Satheesh

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Indian Institute of Technology Madras, India

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**RESEARCH INTERESTS** Gravitational wave astronomy and astrophysics, Formation and evolution of compact objects, Post-Newtonian theory and Numerical Relativity, Tests of general relativity using gravitational waves.

**EDUCATION** **Indian Institute of Technology Madras, Chennai, India** 2017 - 2022 (expected)  
**BS-MS Dual Degree Physics**  
CGPA: 9.19/10  
Physics GPA: 9.44/10

**RESEARCH EXPERIENCE** **Modelling subdominant harmonic modes from eccentric binary black hole mergers** Jul 2021 - Present  
*Advisors: Dr. Prayush Kumar, ICTS-TIFR and Dr. Chandra Kant Mishra, IIT Madras*

Working on improving an Inspiral-Merger-Ringdown gravitational waveform model for binary black holes in eccentric orbits known as **ENIGMA**. My work involves extending the waveform from to include higher order modes that will play a crucial role in the search for eccentric binaries in future gravitational wave searches.

**Ready-to-use frequency domain waveform model for eccentric binary black holes including non-quadrupole modes** Aug 2019 - Sep 2021  
*Advisor: Dr. Chandra Kant Mishra, IIT Madras*

Developing a ready-to-use frequency domain waveform model for eccentric binary black holes that includes non-quadrupole terms and considers periastron effects. The waveform will be used to construct an Inspiral-Merger-Ringdown waveform model in frequency domain.

**Polarimetric method for predicting gravitational wave polarization of LISA verification binaries** May 2020 - Aug 2020  
*Advisor: Prof. Prasenjit Saha, University of Zurich*

Developed a method utilizing Polarimetry to measure the orientation and inclination of the binary system (HP Lib). Such binaries are sure candidates for the Laser Interferometer Space Antenna (LISA) mission. My work was presented at the **237th American Astronomical Society meeting**.

**Studying primordial gravitational waves from inflation and reheating phase** Aug 2021 - Present  
*Advisor: Prof. L. Sriramkumar, IIT Madras*

Studying the evolution of primordial gravitational waves during the inflationary era and the reheating phase of the universe.

**Signal detection and parameter estimation using LIGO O1 and O2 data** May 2019 - Jul 2019  
*Advisor: Prof. Rajesh Nayak, IISER Kolkata*

The project involved learning the basics of gravitational waves data analysis and parameter estimation using LIGO's publicly available data from O1 and O2 run.

**PUBLICATIONS** • (In preparation) Tamal RoyChowdhury, Abhishek Chattaraj, **Pranav Satheesh**, Chandra Kant Mishra  
*Eccentric time domain and frequency domain Inspiral-Merger-Ringdown hybrid waveforms*

**PRESENTATIONS AND POSTERS** • Tamal RoyChowdhury, Abhishek Chattaraj, **Pranav Satheesh**, Chandra Kant Mishra, **14th Amaldi 2021, 19-23 July (online)**, *Elements of modelling binary black holes in eccentric orbits through inspiral, merger and ringdown stages*

• Tamal RoyChowdhury, Abhishek Chattaraj, **Pranav Satheesh**, Chandra Kant Mishra, **8th KAGRA International Workshop, 2021**, *Modelling Frequency Domain Inspiral-merger-ringdown Wave-forms for Eccentric Binary Black Hole Mergers*

- **Pranav Satheesh**, Prasenjit Saha, Hans Martin Schmid , **237th American Astronomical Society meet, 2021**, *A spectropolarimetric method for predicting the gravitational wave polarization of LISA verification binaries*
- **Pranav Satheesh**, **RAS Career Poster Exhibition, 2020**, *Frequency Domain Gravitational Waveform Modelling for Eccentric Black Hole Binaries*

SCHOLARSHIPS AND AWARDS

- Selected among top 8 students in India for ThinkSwiss Research Scholarship 2020
- Receptient of the INSPIRE-DST Scholarship for Higher Education 2017 - Present

PROFESSIONAL MEMBERSHIPS

- Member, **LIGO Scientific Collaboration** 2021 - Present
- Undergraduate Member, **American Astronomical Society** 2020-2021

TEACHING EXPERIENCE

- **Teaching Assistant, Complex Networks (ID5080)** Aug 2021 - Present  
*Graduate level course at IIT Madras*
- **Teaching Assistant, Code Astro 2021** June 2021  
*Virtual Software Engineering Workshop for Astronomy supported by the Heising-Simons Foundation.*

SCHOOLS AND WORKSHOPS

- **School on Black Holes and Gravitational Waves**, IITM, Chennai Jan 2022
- **LISC Continous Gravitational Wave Workshop** (Online) Oct 2021
- **Physics and Astrophysics at the Extreme (PAX-VII) Workshop** (Online) Aug 2021
- **ICTS Summer School on Gravitational Wave Astronomy** (Online) Jul 2021
- **IPTA Student Workshop** (Online) June 2021
- **Mathematical and Computational Approaches for solving source-free Einstein Field Equations** ICERM, Brown University (online) Oct 2020
- **Physics of the Early Universe**, ICTS (Online) Sep 2020
- **ICTS Summer School on Gravitational Wave Astrophysics** May 2020

RELEVANT COURSEWORK

General Relativity and Cosmology, Advanced General Relativity, Methods of Computational Physics, Numerical Methods and Programming lab, Classical Field Theory, Advanced Particle Physics, High Energy Physics, Statistical Physics, Quantum Mechanics, Classical Mechanics, Mathematical Physics, Differential Equations

TECHNICAL SKILLS

**Programming Languages** - Python, C, C++, Shell script  
**Softwares** - Mathematica, SAO DS9  
**Tools/Frameworks** - L<sup>A</sup>T<sub>E</sub>X, Git

OUTREACH

**Service**

- Head, **Horizon: The Physics and Astronomy Club of IIT Madras** 2019-2020  
I headed the student run physics and astronomy club at IIT Madras under the Center of Innovation (CFI). We engage the student community in the campus though various projects, lectures, workshops and competitive events.

**Articles**

- Undergraduate Research summary in *Astrobites*  
*UR: A spectropolarimetric method for predicting the gravitational wave polarisation of LISA verification*

**Talks**

- *Python for Astronomy*, A Youtube lecture series offered by me as part of Horizon Jul 2020
- *Relativity and Gravitation*, Horizon-IITM Summer School July 2021
- Tutor, *Analysis of Globular Clusters Using Colour-Magnitude Diagrams*, Shaastra IITM Jan 2020