

Ritesh Bachhar

Graduate Student, University of Rhode Island

Email : riteshbachhar@uri.edu, riteshbachhar@gmail.com

Website: www.riteshbachhar.com

RESEARCH INTEREST

General relativity, Surrogate models of gravitational waves, Gravitational wave modeling and Inference, Black hole merger phenomenology

EDUCATION

- **University of Rhode Island, Department of Physics** RI, USA
Ph.D. Candidate (third-year); GPA: 3.99/4.00 September, 2021 - Present
- **Indian Institute of Technology Bombay** Mumbai, India
Master's in Physics; CPI: 9.17/10 July 2018 - June, 2020
- **Scottish Church College** Kolkata, India
B.Sc. Physics; University of Calcutta; 61.5% July 2014 - April 2017

PUBLICATIONS

- A surrogate model for spinning comparable to intermediate mass-ratio binary black hole gravitational wave signals
Ritesh Bachhar, Katie Rink, Tousif Islam *et al.*
In preparation
- Binary Black Hole Coalescence Phenomenology from Numerical Relativity
Richard Price, **Ritesh Bachhar**, Gaurav Khanna
arXiv:2312.15885; December 2023
- Angular Momentum for Black Hole Binaries in Numerical Relativity
Ritesh Bachhar, Richard Price, Gaurav Khanna
PRD 108,064019; September 2023
- Timing and spectral studies of Cen X-3 in multiple luminosity states using AstroSat
Ritesh Bachhar, Gayathri Raman, Varun Bhalariao *et al.*
MNRAS, 517, 4138; October 2022

RESEARCH EXPERIENCE

Current Projects

- **Surrogate model for gravitational waveforms from black hole coalescences**
Mentor: Dr. Gaurav Khanna (URI) and Dr. Scott Field (UmassD)
Utilizing methodologies analogous to machine learning, I focus on developing reduced-order surrogate models for gravitational waves from binary black holes. These innovative models are not only rapid in computation but also play a pivotal role in enhancing the efficiency of future gravitational wave detections. Their fast evaluation capability significantly contributes to advancing our search and understanding of gravitational waves.
September 2021 - Present
- **Black hole merger phenomenology**
Mentor: Dr. Richard Price (MIT) and Dr. Gaurav Khanna (URI)
Our research delves into the intricate process of black hole coalescence, tackling various physical phenomena involved. We employ numerical relativity data and integrate other approximate method to study black hole mergers. This multifaceted approach allow us to construct a comprehensive understanding of the underlying physical process governing these cosmic events.
October 2022 - Present

- **Gravitational Waveform Uncertainty: Its Influence on Theoretical and Observational Inferences**

Mentor: Dr. Michael Pürrer (URI)

Inaccuracies in the modeling of gravitational waves (GW) can introduce systematic errors in the Bayesian parameter estimation for compact binary coalescences, especially with the advent of next-generation GW detectors. To address this, we utilize a variety of advanced techniques aimed at reducing waveform uncertainties during the inference process. These methods are crucial for ensuring more accurate and reliable gravitational wave inference analysis.

October 2022 - Present

Past Projects

- **Pulse phase resolved analysis of a High mass X-ray Binary Cen X-3**

Mentor: Prof. Varun Bhalerao (IIT Bombay) and Dr. Gayathri Raman (Penn State)

I analysed Indian satellite Astrosat's data and performed high precision timing and spectral analysis of the source.

August 2019 - April 2021

CONFERENCE TALKS

- **Gravitational wave inference with marginalization over waveform uncertainty**

APS April Meeting, 2024

- **Building surrogate model of spinning binary black hole coalescence using perturbation theory waveforms**

23rd Eastern Gravity Meeting, 2023

- **Surrogate model for gravitational waveforms from spinning binary black hole coalescence using perturbation theory**

APS April Meeting, 2023

ACADEMIC ACHIEVEMENTS

- Awarded **Bhavesh Gandhi Memorial Prize**(2019-20), IIT Bombay, for best M.Sc. thesis.
- Qualified **CSIR NET** June 2019 with **AIR 66** and eligible for Junior Research Fellowship.
- Achieved **All India Rank 61** in JEST 2018 Physics for Integrated Ph.D.

TEACHING EXPERIENCE

- TA for PHY204, Elementary Physics II (Fall 2023), with Dr. Rob Coyne
Assisted students with their homework assignments and prepared them for exams by providing guidance and support to enhance there of the subject matter.
- TA for AST 108 and AST118H (Spring 2022) with Prof. Douglas Gobeille.
- TA for AST108 and AST118 (Fall 2021) with Prof. Douglas Gobeille.
Helped students to solve their doubts, conducted multiple observations (daytime and night-time).

PROGRAMMING SKILLS

- **Languages** : Python(NumPy, SciPy, SymPy, AstroPy and Pandas), C, Fortran
- **Statistical Packages** : emcee, xspec-emcee
- **Software** : Matlab, Mathematica, HEASOFT, XSPEC, and LaTeX
- **Microcontroller** : Arduino

WORKSHOP AND ONLINE COURSE

- Attended Primordial Black Holes confront GW data workshop at Sapienza University of Rome (Feb 8-12, 2021)(virtual)
- **Machine Learning**, successfully completed the machine learning course taught by **Andrew Ng**

POSITION OF RESPONSIBILITY

Student Companion ISCP, IIT Bombay

Mentored 12 students from M.Sc. physics and assisted them on various academic and non-academic fronts.

- 147 student companion were selected out of 256 applicant based on SOP, interview and peer review.
- Helped in organizing institute orientation program for 1867 students and parent orientation for 600 parents.

June 2019 - June 2020