Nishkal Rao

Indian Institute of Science Education and Research, Pune
Main Academic, Dr Homi Bhabha Rd, Pashan, Pune, Maharashtra

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Research Interests

Gravitational Wave Transients, Quantum Foundations and Quantum Information, General Relativity, Mathematical Physics, Cosmology & Astrophysics, Big Data & Machine Learning

Education

Indian Institute of Science Education and Research (IISER) Pune — Pune, India

BS-MS Dual Degree Program (Physics major, Mathematics minor) — 2021 – *present*

GPA: 9.3/10 | Expected completion: July 2026

Mount Carmel Central School — Mangalore, India

Class XII CBSE All India Secondary School Examination 2021 — 2019 – 2021

Percentage: 97.2% | PHY : 98, MATH : 99

Sharada Vidyalaya — Mangalore, India

Class X CBSE All India Secondary School Examination 2019 — 2009 – 2019

Percentage: 97.4% | SCIENCE : 100

Master's Thesis

Quasi-Local Black Hole Horizons

Dr. Badri Krishnan, Dr. Sukanta Bose — June 2025 - *present*

Albert Einstein Institute, Washington State University — Germany, USA

By introducing the notion of a quasi-local isolated horizon, we can construct the spacetime in the vicinity of a black hole horizon. This approach overcomes the limitations of event horizons and provides a natural framework for investigating near-horizon phenomena, which includes perturbative analyses of tidal deformability and post-merger dynamics.

Undergraduate Research Projects

Post-merger emission of non-circular binary mergers

Dr Gregorio Carullo — Jan 2025 - *present*

University of Birmingham — UK

Comprehensive study of non-circular encounters in the context of gravitational wave ringdowns, through fitting techniques and the reconstruction of waveforms that capture the physics of eccentric, non-circular mergers.

Quantum Superpositions: Entanglement and Decoherence through Black Holes

Dr. Gautam Satishchandran — Jan 2025 - *present*

Princeton Gravity Institute, Princeton University — USA

Study of decoherence of stationary superpositions in any spacetime with a Killing horizon. Analysis of studies with black holes decohering quantum superpositions and extension further described in terms of the local two-point function of the quantum fields.

On detectability of non-linear modes in ringdown through Parameter Estimation

Dr. Badri Krishnan Dec 2024 - *present*

Albert Einstein Institute Germany

Implementation and testing quadratic mode injections, developing appropriate parameter estimation strategies and analysing the detectability of these modes.

Improved Reduced-order-quadrature model for BNS merger parameter estimation

Dr. Sebastiano Bernuzzi May 2024 - July 2024

Theoretisch-Physikalisches Institut, Friedrich-Schiller-Universität, Jena Germany

Improved reduced order quadrature method for parameter estimation in mergers. Gained experience in algorithm development, and advanced data analysis in gravitational wave astronomy.

Enhancing IMR Consistency Tests for Gravitational Wave Transients

Dr. Aditya Vijaykumar, Dr. Apratim Ganguly September 2023 - *present*

Canadian Institute for Theoretical Astrophysics (CITA) Canada

Enhancing inspiral-merger-ringdown (IMR) consistency tests for gravitational wave transients. Employing time-domain analyses, improving the algorithms, refining SNR thresholds, and investigating higher modes' impact on general relativity tests.

Comprehensive analysis of time-domain Overlapping Gravitational Wave Transients

Dr. Anupreeta More, Dr. Apratim Ganguly July 2022 - *present*

Inter University Centre for Astronomy and Astrophysics (IUCAA) Pune India

Addressing challenges of overlapping compact binary coalescences in future gravitational wave detectors. Developing techniques for identification and characterization to enhance parameter estimation accuracy. Gained expertise in matched filtering (`PyCBC`), unmodeled analysis (`cWB`), and Bayesian parameter estimation (`bilby`).

Reconstruction of the Universe from the DESI Survey using Neural Networks

Prof. Tamara Davis, Dr. Khaled Said June 2023 - August 2023

The University of Queensland Australia

Constructing high-resolution density and peculiar velocity field maps using DESI galaxy survey data and neural networks. Aim to facilitate velocity field reconstruction for cosmological analyses of dark matter and energy.

Presentations

Degeneracies between Overlapping and Lensing GWs Online

LVK Lensing Group Meeting Feb 25, 2025

Scholastic Excellence

DAAD WISE Fellowship for a three-month funded research internship in Theoretisch-Physikalisches

Institut, FSU Jena, Germany

Kishore Vaigyanik Protsahan Yojana (KVPY) SB Fellowship 2021 (AIR 93) and SX Fellowship 2020 (AIR 911) from the Department of Science and Technology, India.

National Initiative on Undergraduate Sciences (NIUS) Astrophysics Fellow 2022 at HBCSE.

Other notable achievements in academic contests/exams: JEE Mains 2021 (99.73 percentile), JEE Advanced 2021 (Rank 1739), ISI LIMIT (International Rank 1), Gramoly Fizika (International Rank 4), IISER Aptitude Test (AIR 46), and Karnataka Common Entrance Test (AIR 35), Regional Math Olympiad qualifier.

Co-Scholastic Achievements

Tulu Script Revival: Led a project to develop and design the first computerized font for the nearly extinct script of Tulu, under the guidance of Dr. Prabhakar Adiga and with support from Dr. K.P. Rao, my brother Nishchith. Developed variations and different styles of the fonts and made them available for free download on a website I built: https://www.thetulufont.in. Within a year of its release, I co-authored a book titled Sriharistuthi, consisting of familiar hymns for studying the script. Invited to the World Tulu Convention in Dubai to publicize and raise awareness about its propagation.

Conferences, Workshops & Schools

ICTS Summer School on Gravitational-Wave Astronomy 2025 — Offline
ICTS-TIFR, Bangalore — July 2025

QIQG 2025: Quantum Information in Quantum Gravity — Online
Perimeter Institute for Theoretical Physics, Canada — June 2025

Masterclass by Edward Witten, Invitation to Black Hole Thermodynamics — Online
DESY Hamburg & University of Hamburg, Hamburg — Jan 2025

A Hundred Years of Quantum Mechanics Discussion Meeting — Online
ICTS-TIFR, Bangalore — Jan 2025

EOB@Work24 Conference — Offline
Theoretisch-Physikalisches Institut, FSU Jena — June 2024

ICTS Summer School on Gravitational-wave Astronomy 2023 — Online
ICTS-TIFR, Bangalore — July 2023

Computation Skills

Programming Languages	**Proficient**	: Python, Mathematica
	Familiar	: Bash, C++, HTML, Julia
Version Control	Git, GitHub, Gitlab	
Others	LaTeX, Microsoft Word, PowerPoint, Excel	

Interests and Hobbies

Photography, Cooking, Visual effects

Languages

English, Hindi, Kannada, Tulu