

Abhishek Hegade K R

Contact Information

Address: Room No. 257, Department of Physics, University of Illinois, Urbana-Champaign.

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Citizenship: Indian

Profiles: [Personal website](#), [github](#) and [Linkedin](#).

Education

PhD in Physics, University of Illinois Urbana Champaign 2020 - 2025 (Expected)

Advisor : Nicolás Yunes, GPA : 4.0/4.0.

Teaching/Research Assistant alternating semesters.

BSc (Hons.) in Mathematics and Physics, Chennai Mathematical Institute 2017 - 2020

Advisors : K.G. Arun and Alok Laddha, GPA : 9.52/10.0.

Gold medal awarded for graduating top of my class.

Technical Skills

Modelling Skills

- Analytical skills: Solving partial differential equations and asymptotic methods for finding solutions to partial differential equations.
- Statistical skills: Bayesian analysis using Markov chain Monte Carlo (MCMC) methods and nested sampling methods for analyzing complex data.

Numerical Methods

Finite difference methods and finite volume methods. Nested sampling and MCMC methods for parameter estimation.

Programming Skills

Expert : Python.

Proficient : C++ and Mathematica.

Packages: Python - numpy, scipy, pandas, sklearn, statsmodels; C++: gsl, Eigen; Mathematica: xPert.

Awards

Illinois Center for Advanced Studies of the Universe - Physics Fellowship Fall 2024 - Spring 2025

Scott Anderson Award, University of Illinois Urbana Champaign Spring 2023

University Fellowship, University of Illinois Urbana Champaign Fall 2022

Medal of Excellence, Chennai Mathematical Institute 2020

KVPY Fellow, Department of Science and Technology of the Government of India 2017-2020

Indian Academy of Sciences, Summer Research Fellowship Summer 2019

National Talent Search Examination - State Scholar 2015

Research Interests

I am interested in using analytical and numerical techniques to understand the behavior of neutron stars and black holes in strongly gravitating regions of spacetime. I also utilize MCMC methods to understand gravitational wave data. I am currently interested in constraining transport properties such as shear and bulk viscosity of neutron stars using gravitational waves. In the past, I have worked on understanding the breakdown of effective field theories of gravity, the mathematical properties of black holes in and outside general relativity and measuring the Hubble constant using gravitational wave observations.

Talks

Invited talks

1. Probing dissipative effects in neutron stars using gravitational waves, ICTS Astrophysics Seminar, International Centre for Theoretical Sciences, January 2024.
2. Probing dissipative effects in neutron stars using gravitational waves, VandyGRAF Seminar, Vanderbilt University, November 2023.

Contributed talks

1. Probing internal dissipative processes of neutron stars with gravitational waves - II, APS April meeting, Sacramento, April 2024.
2. Where and why does Einstein-Scalar-Gauss-Bonnet theory breakdown? APS April meeting, Minneapolis, April 2023.
3. How Do Black Holes Grow Hair? APS April meeting, New York, April 2022.
4. How Do Black Holes Grow Hair? Midwest Relativity meeting, Urbana-Champaign, November 2021.

Publications

I have published 9 papers, with 6 as the first author and 3 as the second author. The publications can be accessed using my [Inspires](#) profile. Links to papers that use Bayesian analysis and MCMC methods have been highlighted in cyan below. I have also used finite difference methods to develop simulations of matter collapsing to black holes in general relativity and its extensions. I have experience with finite volume methods, although I have not published papers that use finite volume methods.

Highlights: One paper has been accepted for publication in Nature astronomy and one paper has been selected as an editor's suggestion in Physical Review D.

Preprints

1. **Abhishek Hegade K R**, Justin L. Ripley and Nicolás Yunes, “Dissipative tidal effects to next-to-leading order and constraints on the dissipative tidal deformability using gravitational wave data”, *accepted* in PRD, [arXiv:2407.02584 \[gr-qc\]](#).
2. Justin L. Ripley, **Abhishek Hegade K R**, Rohit S. Chandramouli and Nicolás Yunes, “First constraint on the dissipative tidal deformability of neutron stars”, *accepted* in Nature Astronomy, [arXiv:2312.11659 \[gr-qc\]](#).

Published

1. **Abhishek Hegade K R**, Justin L. Ripley and Nicolás Yunes, “Dynamical tidal response of non-rotating relativistic stars”, *Phys. Rev. D* **109**, 104064, [arXiv:2403.03254 \[gr-qc\]](#)
2. Justin L. Ripley, **Abhishek Hegade K R**, and Nicolás Yunes, “Probing internal dissipative processes of neutron stars with gravitational waves during the inspiral of neutron star binaries”, *Phys. Rev. D* **108**, 103037, [arXiv:2306.15633 \[gr-qc\]](#).
3. **Abhishek Hegade K R**, Justin L. Ripley, and Nicolás Yunes, “The non-relativistic limit of first-order relativistic viscous fluids”, *Phys. Rev. D* **107**, 124029, [arXiv:2305.09725 \[gr-qc\]](#).
4. **Abhishek Hegade K R**, Elias R. Most, Jorge Noronha, Helvi Witek, and Nicolás Yunes, “How Do Axisymmetric Black Holes Grow Monopole and Dipole Hair?”, *Phys. Rev. D* **107**, 104047, [arXiv:2212.02039 \[gr-qc\]](#).
5. **Abhishek Hegade K R**, Justin L. Ripley, and Nicolás Yunes, “Where and why does Einstein-scalar-Gauss-Bonnet theory break down?” *Phys. Rev. D* **107**, 044044, [arXiv:2211.08477 \[gr-qc\]](#).

6. **Abhishek Hegade K R**, Elias R. Most, Jorge Noronha, Helvi Witek, and Nicolás Yunes, “How do spherical black holes grow monopole hair?” [Phys. Rev. D 105, 064041](#), [arXiv:2201.055178 \[gr-qc\]](#).
7. ¹Deep Chatterjee, **Abhishek Hegade K R**, Gilbert Holder, Daniel E. Holz, Scott Perkins, Kent Yagi, and Nicolás Yunes, “Cosmology with Love: Measuring the Hubble constant using neutron star universal relations,” [Phys. Rev. D 104, 083528](#), [arXiv:2106.06589 \[gr-qc\]](#).

¹Editor’s Suggestion