



Abhimanyu Susobhanan

Areas of Interest

Gravitational Waves, Pulsars, Binary Systems, Astrophysical Software

Education

Aug 2015–
Sep 2021 **Master of Science in Physics + Doctor of Philosophy in Astrophysics**, *Department of Astronomy & Astrophysics, Tata Institute of Fundamental Research, Mumbai, Maharashtra, India*

Thesis Title: [Perspectives in nanohertz gravitational-wave astronomy](#)

Advisor: Prof. Achamveedu Gopakumar

Aug 2008–
May 2012 **Bachelor of Technology in Physical Sciences**, *Department of Earth & Space System Sciences, Indian Institute of Space Science and Technology, Thiruvananthapuram, Kerala, India*

CGPA: 8.27/10

Research & Professional Experience

Apr 2024 –
present **Postdoctoral Fellow**, *Max Planck Institute for Gravitational Physics (Albert Einstein Institute), Hanover, Lower Saxony, Germany*

Jun 2022 –
Feb 2024 **Postdoctoral Fellow**, *Center for Gravitation Cosmology and Astrophysics, University of Wisconsin-Milwaukee, Milwaukee, Wisconsin, USA*

- Leading the development team for the [PINT](#) pulsar timing package. Frequentist pulsar timing noise characterization using PINT.
- Efficient methods for computing pulsar timing array signals due to supermassive eccentric binaries, implemented in the [GWecc.jl](#) package.
- A pilot all-sky single-pulsar Bayesian search for supermassive eccentric binaries using [GWecc.jl](#) in the NANOGrav 12.5-year data of PSR J1909–3744.
- Multi-messenger targeted search for a supermassive eccentric binary in the radio galaxy 3C 66B in the NANOGrav 12.5-year dataset.
- The [chimera](#) pipeline to reduce pulsar data obtained using the CHIME telescope, used for integrating CHIME data into NANOGrav.
- Pulsar timing array signals induced by hyperbolic encounters of supermassive black hole pairs, implemented in the [GW_hyp](#) package.
- Extension of the wideband timing technique to combine simultaneous multi-band observations.
- Noise characterization of the InPTA Data Release 1.
- Substitute instructor for *Survey of Astronomy*.
- Mentored three students
 - Mr Subhajit Dandapat (Doctoral student, Tata Institute of Fundamental Research)
 - Mr Aman Srivastava (Doctoral student, Indian Institute of Technology Hyderabad)
 - Mr Avinash Kumar Paladi (Master's student, Indian Institute of Space Science and Technology)

Sep 2021 –
Jan 2022 **Postdoctoral Fellow**, *National Centre for Radio Astrophysics, Tata Institute of Fundamental Research, Pune, Maharashtra, India*

- Led the [InPTA Data Release 1](#) project during its initial stages.
 - Mentored one student
 - Mr Neel Kohle (Master's student, St Xavier's College, Mumbai)
- Aug 2015–
Sep 2021 **Research Scholar**, *Department of Astronomy & Astrophysics, Tata Institute of Fundamental Research, Mumbai, Maharashtra, India*
- The [pinta](#) pipeline to reduce pulsar data obtained using the GMRT telescope.
 - Modeling pulsar timing array signals induced by supermassive eccentric binaries.
 - The *ELL1k* timing model for nearly circular pulsar binaries experiencing significant advance of periastron.
 - A new phasing approach to modeling the optical outbursts of the blazar OJ 287 using its binary black hole central engine model, implemented in the [opha](#) package.
 - An analytic solution to the third post-Newtonian-accurate Kepler equation.
 - Characterization of the 2021 chromatic timing event in PSR J1713+0747.
 - Modeling the jet position angle variations of the blazar OJ 287 using its binary central engine model.
 - Mentored two students
 - Ms Nikita Agarwal (Undergraduate student, Manipal Institute of Technology)
 - Mr Akash Anumalapudi (Undergraduate student, Indian Institute of Technology Bombay)
 - Conducted training sessions on Linux, Python, pulsar data reduction, and pulsar timing at multiple workshops.
 - Teaching assistant for *Astronomy & Astrophysics I*, *Astronomy & Astrophysics II*, and *Electrodynamics II*
 - Public outreach activities including organizing National Science Day and and Frontiers of Science events, and lectures to school and undergraduate students.
- Sep 2012–
Jun 2015 **Scientist/Engineer**, *Liquid Propulsion Systems Centre, Indian Space Research Organization, Valiyamala, Thiruvananthapuram, Kerala, India*
- A searchable internal repository for quality assurance reports named PEARL-DB.
 - Managed a team of junior developers.
 - An internal secure file-sharing service named BHANDAAR.
 - Development and maintenance of the center website, employees' portal, and recruitment portal.

Selected Publications

- 2024* [1] **Abhimanyu Susobhanan**, David Kaplan, Anne Archibald, et al., “*PINT: Maximum-likelihood estimation of pulsar timing noise parameters*”, Submitted to The Astrophysical Journal, arXiv: [2405.01977](#)
- 2024 [2] Subhajit Dandapat, **Abhimanyu Susobhanan**, et al., “*Efficient prescription to search for linear gravitational wave memory from hyperbolic black hole encounters and its application to the NANOGrav 12.5-year dataset*”, Physical Review D, 109, 103018, DOI: [10.1103/PhysRevD.109.103018](#)
- 2024 [3] Gabriella Agazie, ..., **Abhimanyu Susobhanan**, et al., “*The NANOGrav 12.5-year data set: A computationally efficient eccentric binary search pipeline and constraints on an eccentric supermassive binary candidate in 3C 66B*”, The Astrophysical Journal, 963, 144, DOI: [10.3847/1538-4357/ad1f61](#)
- 2023 [4] Avinash Kumar Paladi, ..., **Abhimanyu Susobhanan**, et al., “*Multi-band Extension of the Wideband Timing Technique*”, Monthly Notices of the Royal Astronomical Society, 527, 213–231, DOI: [10.1093/mnras/stad3122](#)
- 2023 [5] Aman Srivastava, ..., **Abhimanyu Susobhanan**, et al., “*Noise analysis in the Indian Pulsar Timing Array Data Release I*”, Physical Review D, 108, 023008, DOI: [10.1103/PhysRevD.108.023008](#)

- 2023 [6] **Abhimanyu Susobhanan**, “*Post-Newtonian-accurate pulsar timing array signals induced by inspiralling eccentric binaries: accuracy, computational cost, and single-pulsar search*”, *Classical and Quantum Gravity*, 40, 155014, DOI: [10.1088/1361-6382/ace234](https://doi.org/10.1088/1361-6382/ace234)
- 2023 [7] Subhajit Dandapat, Michael Ebersold, **Abhimanyu Susobhanan**, et al., “*Gravitational Waves from Black-Hole Encounters: Prospects for Ground- and Galaxy-Based Observatories*”, *Physical Review D*, 108, 024013, DOI: [10.1103/PhysRevD.108.024013](https://doi.org/10.1103/PhysRevD.108.024013)
- 2022 [8] Pratik Tarafdar, ..., **Abhimanyu Susobhanan**, et al., “*The Indian Pulsar Timing Array: First data release*”, *Publications of the Astronomical Society of Australia*, 39, E053, DOI: [10.1017/pasa.2022.46](https://doi.org/10.1017/pasa.2022.46)
- 2021 [9] Jaikhomba Singha, ..., **Abhimanyu Susobhanan**, et al., “*Evidence for profile changes in PSR J1713+0747 using the uGMRT*”, *Monthly Notices of the Royal Astronomical Society: Letters*, 507, L57–L61, DOI: [10.1093/mnrasl/slab098](https://doi.org/10.1093/mnrasl/slab098)
- 2021 [10] Lankeswar Dey, ..., **Abhimanyu Susobhanan**, et al., “*Explaining temporal variations in the jet position angle of blazar OJ 287 using its binary black hole central engine model*”, *Monthly Notices of the Royal Astronomical Society*, 503, 3, 4400–4412, DOI: [10.1093/mnras/stab730](https://doi.org/10.1093/mnras/stab730)
- 2021 [11] **Abhimanyu Susobhanan**, Yogesh Maan, Bhal Chanda Joshi, et al., “*pinta: The uGMRT Data Processing Pipeline for the Indian Pulsar Timing Array*”, *Publications of the Astronomical Society of Australia*, 38, E017, DOI: [10.1017/pasa.2021.12](https://doi.org/10.1017/pasa.2021.12)
- 2020 [12] **Abhimanyu Susobhanan**, Achamveedu Gopakumar, George Hobbs, and Stephen Taylor, “*Pulsar timing array signals induced by black hole binaries in relativistic eccentric orbits*”, *Physical Review D*, 101, 043022, DOI: [10.1103/PhysRevD.101.043022](https://doi.org/10.1103/PhysRevD.101.043022)
- 2018 [13] **Abhimanyu Susobhanan**, Achamveedu Gopakumar, Bhal Chanda Joshi, and Ranjan Kumar, “*Exploring the effect of periastron advance in small-eccentricity binary pulsars*”, *Monthly Notices of the Royal Astronomical Society*, 480, 5260–5271, DOI: [10.1093/mnras/sty2177](https://doi.org/10.1093/mnras/sty2177)
- 2017 [14] Yannick Boetzel, **Abhimanyu Susobhanan**, Achamveedu Gopakumar, Antoine Klein, and Philippe Jetzer, “*Solving post-Newtonian accurate Kepler equation*”, *Physical Review D*, 96, 044011, DOI: [10.1103/PhysRevD.96.044011](https://doi.org/10.1103/PhysRevD.96.044011)

Skills

Programming Languages	C++, Python, C, Julia, Java, JavaScript, PHP, Wolfram Language, \LaTeX , bash
Astrophysical software	PINT, TEMPO2, ENTERPRISE, PSRCHIVE, DSPSR
Telescope observations	Giant Metre-wave Radio Telescope, Parkes Radio Telescope
Data analysis	Bayesian inference, Data visualization

Languages

Malayalam (native), English, Hindi

Awards and Fellowships

2022-present NANOGrav NSF Physics Frontier Center Postdoctoral Fellowship

- 2019 **Ratanbai Jerajani Award** for the best seminar in the area of Astronomy and Astrophysics at TIFR
- 2019 **Sarojini Damodaran Fellowship** for international travel
- 2006-2012 **National Talent Search Scholarship**

References

Prof. David Kaplan

Center for Gravitation Cosmology and Astrophysics, University of Wisconsin-Milwaukee,
Milwaukee, Wisconsin, USA
Email: kaplan@uwm.edu

Prof. Sarah Vigeland

Center for Gravitation Cosmology and Astrophysics, University of Wisconsin-Milwaukee,
Milwaukee, Wisconsin, USA
Email: vigeland@uwm.edu

Prof. Achamveedu Gopakumar

Department of Astronomy & Astrophysics, Tata Institute of Fundamental Research,
Mumbai, Maharashtra, India
Email: gopu@tifr.res.in