



# Abhimanyu Susobhanan

## Areas of Interest

Gravitational Waves, Pulsars, Data Analysis Methods, Astrophysical Software

## Education

- Aug 2015– **Master of Science in Physics + Doctor of Philosophy in Astrophysics**, *Department of Astronomy & Astrophysics, Tata Institute of Fundamental Research, Mumbai, Maharashtra, India*  
Sep 2021 **Thesis Title:** Perspectives in nanohertz gravitational-wave astronomy  
**Advisor:** Prof. Achamveedu Gopakumar
- Aug 2008– **Bachelor of Technology in Physical Sciences**, *Department of Earth & Space System Sciences, Indian Institute of Space Science and Technology, Thiruvananthapuram, Kerala, India*  
May 2012 **CGPA:** 8.27/10

## Research & Professional Experience

- Apr 2024 – present **Postdoctoral Fellow**, *Max Planck Institute for Gravitational Physics (Albert Einstein Institute), Hannover, Lower Saxony, Germany*
- Development of the [Vela.jl](#) package for Bayesian pulsar timing & noise analysis.
  - Development of advanced data analysis methods for pulsar wideband timing datasets.
  - Leading the development team for the [PINT](#) pulsar timing package.
- 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 – Postdoctoral Fellow, National Centre for Radio Astrophysics, Tata Institute of Fundamental Research, Pune, Maharashtra, India  
Jan 2022  
● 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– Research Scholar, Department of Astronomy & Astrophysics, Tata Institute of Fundamental Research, Mumbai, Maharashtra, India  
Sep 2021  
● 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 [ophaa](#) 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 Anumarlapudi (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 Frontiers of Science events, and lectures to school and undergraduate students.

Sep 2012– Scientist/Engineer, Liquid Propulsion Systems Centre, Indian Space Research Organisation, Valiyamala, Thiruvananthapuram, Kerala, India  
Jun 2015  
● 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

- 2025 [1] **Abhimanyu Susobhanan**, “*Bayesian pulsar timing and noise analysis with Vela.jl: the wideband paradigm*”, Physical Review D, 112, 063023, DOI: [10.1103/n3ck-lfdy](https://doi.org/10.1103/n3ck-lfdy)
- 2025 [2] **Abhimanyu Susobhanan** and Rutger van Haasteren, “*Gaussian process representation of dispersion measure noise in pulsar wideband data sets*”, Monthly Notices of the Royal Astronomical Society, 542, 2892–2900, DOI: [10.1093/mnras/staf1422](https://doi.org/10.1093/mnras/staf1422)
- 2025 [3] **Abhimanyu Susobhanan**, “*Bayesian pulsar timing and noise analysis with Vela.jl: an overview*”, The Astrophysical Journal, 980, 165, DOI: [10.3847/1538-4357/adaaec](https://doi.org/10.3847/1538-4357/adaaec)
- 2024 [4] **Abhimanyu Susobhanan**, David Kaplan, Anne Archibald, et al., “*PINT: Maximum-likelihood estimation of pulsar timing noise parameters*”, The Astrophysical Journal, 971, 150, DOI: [10.3847/1538-4357/ad59f7](https://doi.org/10.3847/1538-4357/ad59f7)
- 2024 [5] 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](https://doi.org/10.1103/PhysRevD.109.103018)

- 2024 [6] 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](https://doi.org/10.3847/1538-4357/ad1f61)
- 2023 [7] 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](https://doi.org/10.1093/mnras/stad3122)
- 2023 [8] 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](https://doi.org/10.1103/PhysRevD.108.023008)
- 2023 [9] **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 [10] 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 [11] 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)
- 2022 [12] K Nobleson, ..., **Abhimanyu Susobhanan**, et al., "Low-frequency wideband timing of InPTA pulsars observed with the uGMRT", *Monthly Notices of the Royal Astronomical Society*, 512, 1234–1243, DOI: [10.1093/mnras/stac532](https://doi.org/10.1093/mnras/stac532)
- 2021 [13] 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 [14] 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 [15] **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 [16] **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 [17] **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 [18] 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 C++, Python, C, Julia, Java, JavaScript, PHP, Wolfram Language,  $\text{\LaTeX}$ ,  
 Languages bash

Astrophysical PINT, TEMPO2, ENTERPRISE, PSRCHIVE, DSPSR software

Telescope Giant Metre-wave Radio Telescope, Parkes Radio Telescope observations

Data analysis Bayesian inference, Data visualization

## Languages

Malayalam (native), English, Hindi

## Awards and Fellowships

2022-2024 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

### Dr. Rutger van Haasteren

Max Planck Institute for Gravitational Physics (Albert Einstein Institute),  
Hannover, Lower Saxony, Germany

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### Prof. David Kaplan

Center for Gravitation Cosmology and Astrophysics, University of Wisconsin-Milwaukee,  
Milwaukee, Wisconsin, USA

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