

# Aditya Vijaykumar

aditya.vijaykumar@utoronto.ca • Website • Canadian Institute for Theoretical Astrophysics (CITA)

RESEARCH INTERESTS      Gravitational Wave Astronomy and Astrophysics, Tests of General Relativity and Cosmology, Scientific Computing

## EMPLOYMENT CITA Postdoctoral Fellow

**Canadian Institute for Theoretical Astrophysics (CITA), Toronto**

*Independent research fellowship*

Sep 2023 - Present

*Member of the LIGO Scientific Collaboration*

## Graduate Student

**International Centre for Theoretical Sciences (ICTS-TIFR), Bengaluru**

*Mentored by Prof. Parameswaran Ajith*

Aug 2018 - Aug 2023

*Member of the LIGO Scientific Collaboration and the LIGO-India Scientific Collaboration*

## Fulbright-Nehru Doctoral Research Fellow

**Department of Physics, The University of Chicago**

*Mentored by Prof. Daniel Holz*

Aug 2022 - Mar 2023

## SN Bhatt Fellow

**International Centre for Theoretical Sciences (ICTS-TIFR), Bengaluru**

*Mentored by Prof. Parameswaran Ajith*

May 2018 - July 2018

*Topic - Cosmological Large-scale Structure probes using gravitational-wave observations*

## Summer Research Intern

**The Inter-University Centre for Astronomy and Astrophysics (IUCAA), Pune, India**

*Mentored by Prof. Raghunathan Srianand*

May 2016 - July 2016

*Topic - Analysis of Quasar Absorption Lines from SDSS Photometric Data*

## Summer Research Intern

**The National Centre for Radio Astrophysics (NCRA-TIFR), Pune, India**

*Mentored by Prof. Yashwant Gupta*

May 2015 - July 2015

*Topic - Testing the fast transient detection pipeline of the GMRT*

## EDUCATION International Centre for Theoretical Sciences (ICTS-TIFR), Bengaluru

**Research Scholar and Graduate Student in Physics**

2018 - 2023

**Birla Institute of Technology and Science (BITS), Pilani**

**M.Sc. (Hons.) Physics and B.E. (Hons.) Mechanical Engineering**

2013 - 2018

## SEMINARS AND TALKS

- *Accelerating gravitational wave sources* at **Joint CITA-PI Gravitational waves meeting**, October 2023 (Contributed talk)
- *Fast Likelihood Evaluation with Relative Binning* at **IUCAA, Pune**, July 2023 (Invited seminar)
- *Testing General Relativity with Gravitational Waves: Opportunities and Challenges* at **IIT-Gandhinagar**, June 2023 (Invited seminar)
- *Fast Likelihood Evaluation with Relative Binning* at **Seoul National University**, October 2022 (Invited online seminar)

- *Standard Sirens and Large Scale Structure* at **The Quest for Precision Gravitational-wave Cosmology, The University of Chicago**, September 2022 (Invited Talk)
- *Gravitational-wave probes of astrophysics and cosmology: Large Scale Clustering and Lensing* at **IGC, Pennsylvania State University**, August 2022 (Invited Seminar)
- *Constraints on the time variation of the gravitational constant using binary neutron star observations* at **Second Chennai Symposium on Gravitation and Cosmology**, February 2022 (Invited online Seminar)
- *Probing Large Scale Structure using Binary Black Hole Observations* at **Instituut-Lorentz for Theoretical Physics, Leiden University**, June 2020 (Invited online seminar)
- *Constraints on Black Hole Mimickers using GWTC-1* at **ICTS In-house Symposium**, February 2020 (Contributed Poster)
- *Probing Large Scale Structure using Binary Black Hole Observations* at **ICTS In-house Symposium**, ICTS, Bengaluru, India, February 2020 (Contributed Talk)
- *Probing Large Scale Structure using Binary Black Hole Observations* at **International Conference on Gravitation & Cosmology**, IISER, Mohali, India, December, 2019 (Contributed Talk)
- *Probing Large Scale Structure using Binary Black Hole Observations* at **The Inter-University Centre for Astronomy and Astrophysics (IUCAA)**, Pune, India, September 2019 (Invited Talk)
- *Probing Large Scale Structure using Binary Black Hole Observations* at **Max Planck Institute for Gravitational Physics**, Hannover, Germany, June 2019 (Invited Talk)
- *Probing Large Scale Structure using Binary Black Hole Observations* at **GR22 and Amaldi13**, Valencia, Spain, July 2019 (Contributed Talk)
- *Gravitational Lensing from Orbiting Binary* at the **Paper Presentation competition of APOGEE 2017**, BITS Pilani, India (*Contributed Talk, First runner-up*)

#### TEACHING

- Instructor and organizer, **LIGO-Virgo Collaboration Gravitational-Wave Open Data Workshop #5 and #6** at ICTS.
- Tutor for the **Numerical Relativity** graduate course, ICTS, Jan-April 2022.
- Co-organizer and tutor, **ICTS Workshop on Parameter Estimation with bilby**, ICTS, Bengaluru, India, August 2020 (Online)
- Tutor, **Light and Beyond—Summer Course for Undergraduate Students** by Prof. **Rajaram Nityananda**, June 2020 (Online)
- Tutor, **LIGO-Virgo Collaboration Gravitational-Wave Open Data Workshop #3**, May 2020 (Online)
- Tutor for the following mini-courses, **ICTS Summer Schools on Gravitational Wave Astronomy**, ICTS, Bengaluru, India:
  1. *Compact binary evolution, rates and population modelling*, June 2022.
  2. *Astrophysical Stochastic GW Foreground*, July 2021.
  3. *Numerical Hydrodynamics*, May 2020.
  4. *Advanced General Relativity*, July 2019.

MENTORSHIP	• Kaustubh Gupta (IISER, Pune)	May 2022 - <i>Present</i>
	• Adhrit Ravichandran (IIT Roorkee → UMass Dartmouth)	Sep 2021 - Aug 2022
	• Kruthi Krishna (IISc → Radboud University)	Sep 2020 - Aug 2021
	• Harsh Narola (IISER, Tirupati → Utrecht University)	Sep 2020 - Aug 2021
OTHER CONFERENCES AND MEETINGS	• Semester Participant, <b>Advances in Computational Relativity</b> , ICERM, Brown University, USA. September 2020 - December 2020 (Online)	
	• Participant, <b>Discussion Meeting - Astrophysics of Supermassive Black Holes</b> , ICTS, Bengaluru, India, December 2019	
	• Participant, <b>Discussion Meeting - Future of Gravitational Wave Astronomy</b> , ICTS, Bengaluru, India, August 2019	
	• Participant, <b>ICTS Summer School on Gravitational Wave Astronomy</b> , ICTS, Bengaluru, India, July 2017, July 2018, July 2019, May 2020, July 2021, May 2022.	
OUTREACH	• Co-PI of the <i>IndiaBioscience Outreach Grant</i> to communicate science using stage theatre.	
	• Panelist at the <i>Bengaluru: The Astronomy City</i> , a Q&A event organized for <b>National Science Day</b> , February 2022.	
	• Mediator for the <b>Contagion Exhibition</b> , Science Gallery Bengaluru, April-July 2021.	
	• Moderated a discussion with Prof. Smitha Vishveshwara on her collaborative science theatre project <i>Quantum Voyages</i> as a part of <b>Cosmic Zoom Online Exhibition</b> , April 2021	
	• Articles on the <b>ICTS blog</b> :	
	1. <b>A Conversation with ICTS Scientists Studying the Indian Monsoon</b> , November 2019	
	2. <b>Summer School on Gravitational Wave Astronomy</b> , November 2019	
	• Talk titled <i>The Whats, Whys and Hows of Gravitational-wave Astronomy</i> , <b>BMS College of Engineering, Bengaluru</b> , November 2019	
TECHNICAL SKILLS	<b>Programming Languages</b> - Python, C, C++, Shell Script	
	<b>Softwares</b> - MATLAB, Mathematica	
	<b>Tools/Frameworks</b> - L <sup>A</sup> T <sub>E</sub> X, Git	
SCORES AND AWARDS	• <b>Fulbright-Nehru Doctoral Research Fellowship</b> 2023 (Host Institution: The University of Chicago)	
	• <b>ICTS Graduate Fellowship</b> 2018-2023	
	• Secured all-India rank 21 in the <b>Joint Entrance Screening Test (JEST)</b> , 2018 for admission into Physics PhD programmes in India	
	• Awarded the <b>ICTS S.N. Bhatt Memorial Excellence Fellowship</b> , 2018	
	• Scored 960/990 on the <b>Subject GRE in Physics</b> , October 2017	
	• Selected for the <b>Summer Research Fellowship</b> of the Indian Academy of Sciences in 2016	
	• Recipient of the <b>INSPIRE-DST Scholarship for Higher Education</b> for the period 2013 to 2018	

- REFERENCES
- Prof. Parameswaran Ajith, ICTS – [ajith@icts.res.in](mailto:ajith@icts.res.in)
  - Dr. Shasvath Kapadia, IUCAA – [shasvath.kapadia@icts.res.in](mailto:shasvath.kapadia@icts.res.in)
  - Prof. Bala Iyer, ICTS – [bala.iyer@icts.res.in](mailto:bala.iyer@icts.res.in)

PAPERS  
(SHORT  
AUTHORLIST)

15. Mukesh Kumar Singh, Shasvath J. Kapadia **Aditya Vijaykumar**, Parameswaran Ajith  
*Impact of higher harmonics of gravitational radiation on the population inference of binary black holes*  
Submitted to ApJ, [arXiv:2312.07376](https://arxiv.org/abs/2312.07376).
14. Kruthi Krishna, **Aditya Vijaykumar**, Apratim Ganguly, *et al*  
*Accelerated parameter estimation in Bilby with relative binning*  
[arXiv:2312.06009](https://arxiv.org/abs/2312.06009).
13. **Aditya Vijaykumar**, Maya Fishbach, Susmita Adhikari, Daniel E. Holz  
*Inferring host galaxy properties of LIGO-Virgo-KAGRA's black holes*  
Submitted to ApJL, [arXiv:2312.03316](https://arxiv.org/abs/2312.03316).
12. Divyajyoti, N.V. Krishnendu, Muhammed Saleem, Marta Colleoni, **Aditya Vijaykumar**, K.G. Arun, Chandra Kant Mishra  
*Effect of double spin-precession and higher harmonics on spin-induced quadrupole moment measurements*  
Accepted to Phys. Rev. D, [arXiv:2311.05506](https://arxiv.org/abs/2311.05506).
11. Avinash Tiwari, **Aditya Vijaykumar**, Shasvath J. Kapadia, Giacomo Fragione, Sourav Chatterjee  
*Accelerated binary black holes in globular clusters: forecasts and detectability in the era of space-based gravitational-wave detectors*  
*MNRAS*, **527**, 8586, [arXiv:2307.00930](https://arxiv.org/abs/2307.00930).
10. **Aditya Vijaykumar**, Avinash Tiwari, Shasvath J. Kapadia, K.G. Arun, Parameswaran Ajith  
*Waltzing binaries: Probing line-of-sight acceleration of merging compact objects with gravitational waves*  
*ApJ* **954** 105, [arXiv:2302.09651](https://arxiv.org/abs/2302.09651).  
*In press: Astrobites*
9. Adhrit Ravichandran, **Aditya Vijaykumar**, Shasvath J. Kapadia, Prayush Kumar  
*Rapid Identification and Classification of Eccentric Gravitational Wave Inspirals with Machine Learning*  
Submitted to *Physical Review D*, [arXiv:2302.00666](https://arxiv.org/abs/2302.00666).
8. Srashti Goyal, **Aditya Vijaykumar**, Jose Maria Ezquiaga, Miguel Zumalacarregui  
*Probing lens-induced gravitational-wave birefringence as a test of general relativity*  
*Phys. Rev. D* **108**, 024052, [arXiv:2301.04826](https://arxiv.org/abs/2301.04826).  
*In press: Astrobites*
7. Bikram Keshari Pradhan, **Aditya Vijaykumar**, Debarati Chatterjee  
*Impact of updated Multipole Love and f-Love Universal Relations in context of Binary Neutron Stars*  
*Phys. Rev. D* **107**, 023010, [arXiv:2210.09425](https://arxiv.org/abs/2210.09425).
6. **Aditya Vijaykumar**, Shasvath J. Kapadia, Parameswaran Ajith  
*Can a binary neutron star merger in the vicinity of a supermassive black hole enable a detection of a post-merger gravitational wave signal?*  
*MNRAS*, **513**, 3577, [arXiv:2202.08673](https://arxiv.org/abs/2202.08673).

5. **Aditya Vijaykumar**, Ajit Kumar Mehta, Apratim Ganguly  
*Detection and parameter estimation challenges of Type-II lensed binary black hole signals*  
Accepted to *Physical Review D*, [arXiv:2202.06334](#).
4. Sumit Kumar, **Aditya Vijaykumar**, Alexander H. Nitz  
*Detecting Baryon Acoustic Oscillations with third generation gravitational wave observatories*,  
*ApJ* 930 113, [arXiv:2110.06152](#).
3. M. Saleem et al. (including **Aditya Vijaykumar**)  
*The Science Case for LIGO-India*  
*Class. Quantum Grav.* 39 025004, [arXiv:2105.01716](#).
2. **Aditya Vijaykumar**, M. V. S. Saketh, Sumit Kumar, Parameswaran Ajith, Tirthankar Roy Choudhury  
*Probing the large scale structure using gravitational wave observations of binary black holes*,  
*Phys. Rev. D* 108, 103017, [arXiv:2005.01111](#).  
*In press: Astrobites*.
1. **Aditya Vijaykumar**, Shasvath J. Kapadia, Parameswaran Ajith  
*Constraints on the time variation of the gravitational constant using gravitational wave observations of binary neutron stars*,  
*Phys. Rev. Lett.* 126, 141104, [arXiv:2003.12832](#).  
*In press: phys.org*.

PAPERS  
(LONG  
AUTHORLIST,  
WITH  
SUBSTANTIAL  
CONTRIBUTION)

4. Abbott et al. (LIGO Scientific and Virgo Collaborations)  
*Tests of General Relativity with GWTC-3*,  
Accepted to *Physical Review D*, [arXiv:2112.06861](#).
3. Abbott et al. (LIGO Scientific and Virgo Collaborations)  
*Tests of General Relativity with Binary Black Holes from the second LIGO-Virgo Gravitational-Wave Transient Catalog*,  
*Phys. Rev. D* 103 (2021) 12, 122002, [arXiv:2010.14529](#).
2. Abbott et al. (LIGO Scientific and Virgo Collaborations)  
*GWTC-2: Compact Binary Coalescences Observed by LIGO and Virgo During the First Half of the Third Observing Run*,  
*Phys. Rev. X* 11 (2021) 021053, [arXiv:2010.14527](#).
1. P. Virtanen et al. (including **Aditya Vijaykumar** as *SciPy 1.0 Contributor*)  
*SciPy 1.0—Fundamental Algorithms for Scientific Computing in Python*,  
*Nat Methods* 17, 261–272 (2020), [arXiv:1907.10121](#).