

# Koustav Chandra

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## RESEARCH INTERESTS

Gravitational-Wave Data Analysis — Development of modelled and machine-learning searches for binary black hole mergers, parameterised tests of General Relativity, black hole spectroscopy, likelihood acceleration and inference methods, and forecasting studies for next-generation detectors (Cosmic Explorer, Einstein Telescope).

## EDUCATION

<b>Indian Institute of Technology, Bombay</b> Ph.D. in Physics (Supervisor: Prof Archana Pai)	Mumbai, IN 2018–2023
— Thesis: “Hearing gravitational waves from intermediate-mass black hole binaries: Detection and Characterisation.”	
<b>National Institute of Technology, Rourkela</b> Integrated M.Sc. in Physics and Astronomy	Rourkela, IN 2013–2018
— Thesis: “An Algebraic Study of SO(10) Grand Unified Theory”	

## EXPERIENCE

<b>Max-Planck-Institut für Gravitationsphysik, Potsdam</b> Postdoctoral Scholar	Potsdam, DE 2025–Current
<b>Institute for Gravitation &amp; the Cosmos, The Pennsylvania State University</b> Postdoctoral Scholar	State College, US 2023–2025

## MENTORING

- Mr Leo Ng (Penn State University)  
*PhD candidate. Co-supervising a project on a modelled binary black hole search.* 2026 –Current
- Mr Giovanni Benetti (Università di Padova)  
*Master’s student. Supervised a project on the impact of systematics on golden dark siren cosmology. Preprint: arXiv: 2602.14898* 2025–2026
- Ms Akshita Mittal (Gran Sasso Science Institute, Italy)  
*PhD student (initially mentored as an undergraduate). Leading project on parameter estimation biases in eccentric compact binary mergers, focusing on spurious support for extremal spins in GW231123. Manuscript in preparation.* 2024–Current
- Ms Shiksha Pandey (Penn State University)  
*Undergraduate research assistant. Co-supervised project assessing the role of LIGO-India in multi-messenger astronomy for next-generation detectors. Resulted in publication: Astrophys. J. Lett. 985 (2025) L17.* 2024
- Mr Sayantan Ghosh (IIT Bombay)  
*PhD student. Developed coherence tests to distinguish noise transients from intermediate-mass black hole binary signals by assessing posterior consistency across detectors. Resulted in publication: Phys. Rev. D 109, 064015 (2024)* 2023–2024
- Ms Kritti Sharma (IIT Bombay)  
*Undergraduate student. Developed a transfer learning framework to detect mass-asymmetric black hole binaries in Advanced LIGO data. Resulted in publication: Phys. Rev. D 108 124061 (2023)* 2022–2023
- Mr Sagar Gupta (IIT Bombay)  
*Undergraduate student. Implemented a chirp-mass-based classifier for glitch identification in gravitational-wave data, improving transient search data-quality vetoes.* 2022–2023

## COLLOQUIA, INVITED TALKS AND SEMINARS

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- **GW231123: The Shape-Shifting Gollum** August 2025  
*School of Astrophysics, Presidency University, Kolkata, India*  
*School of Physical Sciences, Jawaharlal Nehru University, Delhi, India*
- **Too Many, Too Long, Too Loud: CBC Data Analysis Challenges in the XG Era** May 2025  
*PAX-X and CE Symposium, University of Illinois Urbana-Champaign, Urbana, USA*
- **Exploring the XG Era: Foreground Noise Impact & LIGO India's Role** November 2024  
*Detection and Analysis of Gravitational Waves in the Era of Multi-Messenger Astronomy, Banff, Alberta, Canada*
- **Preparing for a Gravitationally-Bright Tomorrow** August 2024  
*Department of Physics, Indian Institute of Technology Bombay, Mumbai, India*
- **Intermediate-Mass Binary Black Holes and How to Find Them** February 2023  
*Inference-Data-Experiments-Analysis (IDEA) Talks, TIFR, Mumbai, India*
- **Prospects of Observing Mass-Asymmetric IMBH Binaries with A+ Sensitivity** May 2023  
*Science with LIGO-India Meeting, IUCAA, Pune, India*
- **Hunting for IMBHs with the International Gravitational-Wave Observatory Network** February 2022  
*Chennai Symposium on Gravitation and Cosmology (Online), Chennai, India*

## SELECTED CONTRIBUTED TALKS/POSTERS

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- **Inspiral-Merger Informed Ringdown Analysis of Black-Hole Merger Remnants** April 2025  
*April APS Meeting 2025, Anaheim, USA*
- **Introduction to gwforge** June 2024  
*XG Mock Data Challenge Workshop, State College, USA*
- **Preparing for Tomorrow: Simulating the Scientific Challenges of Next-Generation Ground-Based Gravitational Wave Interferometers** April 2024  
*April APS Meeting, Sacramento, USA*
- **First Gravitational-Wave Search for Intermediate-Mass Black Hole Binaries with Higher-Order Harmonics** December 2022  
*32<sup>nd</sup> Meeting of Indian Association for General Relativity and Gravitation (IAGRG), Kolkata, India*
- **Searching for Gravitational-Wave Higher-Order Modes from Asymmetric Intermediate-Mass Black Hole Binaries** July 2022  
*23<sup>rd</sup> International Conference on General Relativity and Gravitation (Online), Beijing, China*
- **Are the Sources of GW190521 and ZTF19abanrhr the Same?** March 2022  
*40<sup>th</sup> Meeting of Astronomical Society of India*
- **An Optimized PyCBC Search for Gravitational Waves from Intermediate-Mass Black Hole Mergers** July 2021  
*14<sup>th</sup> Edoardo Amaldi Conference (Online), Melbourne, Australia*  
*16<sup>th</sup> Marcel Grossmann Meeting (Online), Rome, Italy*
- **NuRIA: Sensitivity Study of Generically Spinning Intermediate-Mass Black Hole Binaries in Advanced LIGO Data** December 2020  
*31<sup>st</sup> Meeting of the Indian Association for General Relativity and Gravitation (Online), India*

## OUTREACH TALKS

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- **Gravitational Wave Searches for Compact Binary Mergers** May 2023  
*Gravitational Wave Open Data Workshop (Online)*
- **How to Search for Gravitational Waves** January 2021  
*Krittika Winter Workshops, Techfest 2021 (Online), Indian Institute of Technology Bombay, Mumbai*
- **Gravitational Waves 101** May 2019  
*Vigyan Samagam, Nehru Science Centre, Mumbai, India*

## ACADEMIC AWARDS

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| • <b>Naik and Rastogi Excellence in Ph. D. Thesis</b> , Indian Institute of Technology, Bombay             | 2024 |
| • <b>Department Prize for Outstanding Student Performance</b> , National Institute of Technology, Rourkela | 2016 |

## REFERENCES

- **Prof. Alessandra Buonanno**  
Max Planck Institute for Gravitational Physics  
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- **Prof. Archana Pai**  
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archanap@iitb.ac.in
- **Prof. Ian Harry**  
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- **Prof. B. Sathyaprakash**  
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Penn State University, State College, PA, USA-16802  
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- **Prof. Juan Calderón Bustillo**  
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University of Santiago de Compostela, Spain-15782  
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## SHORT AUTHOR PUBLICATIONS

- [1] J. Calderón Bustillo, A. del Rio, N. Sanchis-Gual, K. Chandra, and S. H. W. Leong, “Testing Mirror Symmetry in the Universe with LIGO-Virgo Black-Hole Mergers”, *Phys. Rev. Lett.*, vol. 134, no. 3, p. 031 402, 2025. arXiv: 2402.09861 [gr-qc].
- [2] K. Chandra, “gwforge: a user-friendly package to generate gravitational-wave mock data”, *Class. Quant. Grav.*, vol. 42, no. 2, p. 025 003, 2025. arXiv: 2407.21109 [gr-qc].
- [3] K. Chandra and J. Calderón Bustillo, “Black-hole ringdown analysis with inspiral-merger informed templates and limitations of classical spectroscopy”, Sep. 2025. arXiv: 2509.17315 [gr-qc].
- [4] K. Chandra, R. Gamba, and D. Chiaramello, “From Source Properties to Strong-Field Tests: a multipronged analysis of GW250114 with an effective one-body model for generic orbits”, Dec. 2025. arXiv: 2512.04593 [gr-qc].
- [5] D. Chiaramello, N. Cibrario, J. Lange, K. Chandra, R. Gamba, R. Bonino, and A. Nagar, “A parametrized model for gravitational waves from eccentric, precessing binary black holes: theory-agnostic tests of General Relativity with pTEOBResumS”, Nov. 2025. arXiv: 2511.19593 [gr-qc].
- [6] I. Gupta, K. Chandra, and B. S. Sathyaprakash, “Foreground signals minimally affect inference of high-mass binary black holes in next-generation gravitational-wave detectors”, *Phys. Rev. D*, vol. 111, no. 10, p. 104 013, 2025. arXiv: 2410.22302 [gr-qc].
- [7] S. Pandey, I. Gupta, K. Chandra, and B. S. Sathyaprakash, “The Critical Role of LIGO-India in the Era of Next-generation Observatories”, *Astrophys. J. Lett.*, vol. 985, no. 1, p. L17, 2025. arXiv: 2411.10349 [gr-qc].
- [8] A. Rashti, R. Gamba, K. Chandra, D. Radice, B. Daszuta, W. Cook, and S. Bernuzzi, “Binary black hole waveforms from high-resolution gr-athena++ simulations”, *Phys. Rev. D*, vol. 111, no. 10, p. 104 078, 2025. arXiv: 2411.11989 [gr-qc].
- [9] E. Shukla, A. Rashti, R. Gamba, D. Radice, and K. Chandra, “GR-Athena++ Simulations of Spinning Binary Black Hole Mergers”, Oct. 2025. arXiv: 2510.13963 [gr-qc].
- [10] K. Chandra, I. Gupta, R. Gamba, R. Kashyap, D. Chattopadhyay, A. Gonzalez, S. Bernuzzi, and B. S. Sathyaprakash, “On the Origins, Remnant, and Multimessenger Prospects of the Compact Binary Merger GW230529”, *Astrophys. J.*, vol. 977, no. 2, p. 167, 2024.
- [11] K. Chandra, A. Pai, S. H. W. Leong, and J. Calderón Bustillo, “Impact of Bayesian priors on the inferred masses of quasicircular intermediate-mass black hole binaries”, *Phys. Rev. D*, vol. 109, no. 10, p. 104 031, 2024, †. arXiv: 2309.01683 [gr-qc].

- [12] S. Ghosh, K. Chandra, and A. Pai, “Unmasking noise transients masquerading as intermediate-mass black hole binaries”, *Phys. Rev. D*, vol. 109, no. 6, p. 064015, 2024, †. arXiv: 2312.01211 [gr-qc].
- [13] S. Ronchini *et al.*, “Constraining Possible  $\gamma$ -Ray Burst Emission from GW230529 Using Swift-BAT and Fermi-GBM”, *Astrophys. J. Lett.*, vol. 970, no. 1, p. L20, 2024. arXiv: 2405.10752 [astro-ph.HE].
- [14] J. Calderon Bustillo, N. Sanchis-Gual, S. H. W. Leong, K. Chandra, A. Torres-Forne, J. A. Font, C. Herdeiro, E. Radu, I. C. F. Wong, and T. G. F. Li, “Searching for vector boson-star mergers within LIGO-Virgo intermediate-mass black-hole merger candidates”, *Phys. Rev. D*, vol. 108, no. 12, p. 123020, 2023. arXiv: 2206.02551 [gr-qc].
- [15] J. Calderon Bustillo, I. C. F. Wong, N. Sanchis-Gual, S. H. W. Leong, A. Torres-Forne, K. Chandra, J. A. Font, C. Herdeiro, E. Radu, and T. G. F. Li, “Gravitational-Wave Parameter Inference with the Newman-Penrose Scalar”, *Phys. Rev. X*, vol. 13, no. 4, p. 041048, 2023. arXiv: 2205.15029 [gr-qc].
- [16] K. Sharma, K. Chandra, and A. Pai, “Searching for massive black hole binaries with a transfer learning algorithm”, *Phys. Rev. D*, vol. 108, no. 12, p. 124061, 2023, †.
- [17] J. Calderón Bustillo, S. H. W. Leong, and K. Chandra, “GW190412: measuring a black-hole recoil direction through higher-order gravitational-wave modes”, Nov. 2022. arXiv: 2211.03465 [gr-qc].
- [18] K. Chandra, J. Calderón Bustillo, A. Pai, and I. W. Harry, “First gravitational-wave search for intermediate-mass black hole mergers with higher-order harmonics”, *Phys. Rev. D*, vol. 106, no. 12, p. 123003, 2022, †. arXiv: 2207.01654 [gr-qc].
- [19] K. Chandra, A. Pai, V. Villa-Ortega, T. Dent, C. McIsaac, I. W. Harry, G. S. C. Davies, and K. Soni, “Salient features of the optimised PyCBC IMBH search”, in *16th Marcel Grossmann Meeting on Recent Developments in Theoretical and Experimental General Relativity, Astrophysics and Relativistic Field Theories*, †, Oct. 2021. arXiv: 2110.01879 [gr-qc].
- [20] K. Chandra, V. Villa-Ortega, T. Dent, C. McIsaac, A. Pai, I. W. Harry, G. S. C. Davies, and K. Soni, “An optimized PyCBC search for gravitational waves from intermediate-mass black hole mergers”, *Phys. Rev. D*, vol. 104, p. 042004, 2021, †. arXiv: 2106.00193 [gr-qc].
- [21] N. Bose, A. Pai, K. Chandra, and V. Gayathri, “Chirp mass based glitch identification in long-duration gravitational-wave detection”, *Phys. Rev. D*, vol. 102, no. 8, p. 084034, 2020, †. arXiv: 2007.03623 [gr-qc].
- [22] K. Chandra, V. Gayathri, J. C. Bustillo, and A. Pai, “Numerical relativity injection analysis of signals from generically spinning intermediate mass black hole binaries in Advanced LIGO data”, *Phys. Rev. D*, vol. 102, no. 4, p. 044035, 2020, †. arXiv: 2002.10666 [astro-ph.CO].

† Papers co-authored with my PhD supervisor.

## SELECTED COLLABORATION-AUTHORED PUBLICATIONS

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- [1] “Black Hole Spectroscopy and Tests of General Relativity with GW250114”, Sep. 2025. arXiv: 2509.08099 [gr-qc].
- [2] “GW230814: investigation of a loud gravitational-wave signal observed with a single detector”, Sep. 2025. arXiv: 2509.07348 [gr-qc].
- [3] “GW231123: a Binary Black Hole Merger with Total Mass 190-265  $M_{\odot}$ ”, Jul. 2025. arXiv: 2507.08219 [astro-ph.HE].
- [4] R. Abbott *et al.*, “Search for intermediate-mass black hole binaries in the third observing run of Advanced LIGO and Advanced Virgo”, *Astron. Astrophys.*, vol. 659, A84, 2022. arXiv: 2105.15120 [astro-ph.HE].
- [5] R. Abbott *et al.*, “GWTC-2: Compact Binary Coalescences Observed by LIGO and Virgo During the First Half of the Third Observing Run”, *Phys. Rev. X*, vol. 11, p. 021053, 2021. arXiv: 2010.14527 [gr-qc].
- [6] R. Abbott *et al.*, “Population Properties of Compact Objects from the Second LIGO-Virgo Gravitational-Wave Transient Catalog”, *Astrophys. J. Lett.*, vol. 913, no. 1, p. L7, 2021. arXiv: 2010.14533 [astro-ph.HE].
- [7] R. Abbott *et al.*, “GW190521: A Binary Black Hole Merger with a Total Mass of  $150M_{\odot}$ ”, *Phys. Rev. Lett.*, vol. 125, no. 10, p. 101102, 2020. arXiv: 2009.01075 [gr-qc].