

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

Indian Institute of Technology, Bombay 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.”	
National Institute of Technology, Rourkela Integrated M.Sc. in Physics and Astronomy	Rourkela, IN 2013–2018
— Thesis: “An Algebraic Study of SO(10) Grand Unified Theory”	

EXPERIENCE

Max-Planck-Institut für Gravitationsphysik, Potsdam Postdoctoral Scholar	Potsdam, DE 2025–Current
Institute for Gravitation & the Cosmos, The Pennsylvania State University 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

- **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

- **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
32nd 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
23rd International Conference on General Relativity and Gravitation (Online), Beijing, China
- **Are the Sources of GW190521 and ZTF19abanrhr the Same?** March 2022
40th Meeting of Astronomical Society of India
- **An Optimized PyCBC Search for Gravitational Waves from Intermediate-Mass Black Hole Mergers** July 2021
14th Edoardo Amaldi Conference (Online), Melbourne, Australia
16th Marcel Grossmann Meeting (Online), Rome, Italy
- **NuRIA: Sensitivity Study of Generically Spinning Intermediate-Mass Black Hole Binaries in Advanced LIGO Data** December 2020
31st Meeting of the Indian Association for General Relativity and Gravitation (Online), India

OUTREACH TALKS

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

REFERENCES

• Prof. Alessandra Buonanno

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• Prof. Archana Pai

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• Prof. Ian Harry

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• Prof. Juan Calderón Bustillo

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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. 031402, 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. 025003, 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] 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. 104013, 2025. arXiv: 2410.22302 [gr-qc].
- [5] 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].
- [6] 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. 104078, 2025. arXiv: 2411.11989 [gr-qc].
- [7] 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.
- [8] 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. 104031, 2024, †. arXiv: 2309.01683 [gr-qc].
- [9] 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].
- [10] S. Ronchini et al., “Constraining Possible γ -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].

- [11] 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. 123 020, 2023. arXiv: 2206.02551 [gr-qc].
- [12] 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. 041 048, 2023. arXiv: 2205.15029 [gr-qc].
- [13] 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. 124 061, 2023, †.
- [14] 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].
- [15] 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. 123 003, 2022, †. arXiv: 2207.01654 [gr-qc].
- [16] 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].
- [17] 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. 042 004, 2021, †. arXiv: 2106.00193 [gr-qc].
- [18] 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. 084 034, 2020, †. arXiv: 2007.03623 [gr-qc].
- [19] 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. 044 035, 2020, †. arXiv: 2002.10666 [astro-ph.CO].

† Papers co-authored with my PhD supervisor.

SELECTED COLLABORATION-AUTHORED PUBLICATIONS

- [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 $190\text{--}265 M_{\odot}$ ”, 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. 021 053, 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. 101 102, 2020. arXiv: 2009.01075 [gr-qc].