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Research Interests

- **Gravitational Waves (GW)**
  - Science with current and upcoming GW detectors
    - Sources and searches for persistent Stochastic GW Background (SGWB)
    - Efficient detection of Compact Binary Coalescence (CBC)
    - Characterisation and reduction of noise in laser interferometric detectors
  - LIGO-India: Various activities regarding proposal, site survey, data management etc.
  - Planning and design of future ground-based and space-based detectors
  - Training a new generation of interested researchers for GW astronomy
- **Cosmic Microwave Background (CMB)** : Systematic effects and analysis strategies
- **High Performance Computing (HPC) & AI** : Setting up of facilities and optimal usage for science

Positions Held

Professor (Scientist G), IUCAA, Pune, India, Jul 2020 - to date
Associate Professor (Scientist F), IUCAA, Pune, India, Jul 2015 - Jun 2020
Assistant Professor (Scientist E), IUCAA, Pune, India, Oct 2011 - Jun 2015
Planck Project Specialist, University of California Santa Barbara, US, Apr 2011 - Sep 2011
Post-doctoral Fellow, Jet Propulsion Laboratory, Caltech, US, Feb 2008 - Jan 2011
Post-doctoral Fellow, Observatoire de la Côte d'Azur, France, Jan 2007 - Oct 2007

Education

Ph.D. (Physics), IUCAA, Dec 2006 (Degree awarded by University of Pune in 2007)
M.Sc. (Physics), University of Calcutta, Kolkata, Jul 2001 (First Class)
B.Sc. (Physics), University of Calcutta, Kolkata, Jul 1999 (First Class)

Awards and Fellowships

2019	Giuseppe and Vanna Cocconi Prize awarded to the WMAP & Planck Collaborations by EPS
2018	Gruber Cosmology Prize for mapping the CMB anisotropies as part of the Planck Team
2018	Faculty Research Awards 2018 by Careers 360
2017	Princess of Asturias Award for Technical and Scientific Research as part of the LIGO Scientific Collaboration (LSC)
2016	SwarnaJayanti Fellowship by the Department of Science & Technology (DST)
2016	A Special Breakthrough Prize in Fundamental Physics for the detection of gravitational waves as part of the LIGO Scientific Collaboration
2016	Gruber Cosmology Prize for the detection of gravitational waves as part of the LSC
2011	JPL-NASA Team STAR Award for outstanding contribution to Planck
2010-11	Three NASA Group Achievement Awards for contribution to Planck
2007	LIGO thesis prize - Honorary mention
2002-06	Junior and Senior Research Fellowship awarded by CSIR, India

Synergistic Activities

- Member of LIGO Scientific Collaboration (LSC) since 2004
- Member of Planck Team as a Planck Scientist since 2008
- Member of the Indian Association for General Relativity and Gravitation (IAGRG)
- Member of the Astronomical Society of India (ASI)

Teaching and Mentoring

- Teaching
  - SPPU-IUCAA M.Sc. course: Relativistic Electrodynamics and Radiation Processes (2022)
  - Topical course on Gravitational Waves for IUCAA graduate students (2021)
  - Pune University M.Sc. course: General Relativity, four years (2013-15, 2018)
  - IUCAA graduate school: Mathematical Methods - II (2015, 2018)
  - Lectures on GW and CMB in several schools and workshops
- Ph.D. Students
  - Deepali Agarwal (Aug 2019 - present)
  - Kanchan Soni (Aug 2019 - present)
  - Shreejit Jadhav (Aug 2018 - Dec 2022, now PDF at Swinburne University of Technology)
  - Nikhil Mukund (Aug 2014 - Jul 2018, now PDF at MIT)
  - Abhishek Parida, JMI (Aug 2013 - Jul 2019, Co-advised with Prof. Sanjay Jhingan)
  - Bhooshan Gadre (Aug 2013 - Jul 2018, now PDF at Utrecht University)
  - Anirban Ain (Aug 2012 - Jul 2017, now PDF at INFN, Pisa)
- Post-doctoral Fellows (PDFs)
  - Sajal Mukherjee (Jul 2019 - March 2021, now PDF at Astronomical Institute of the CAS, Prague)
  - Santosh Roy (Aug 2018 - May 2021)
  - T R Saravanan (Aug 2019 - October 2020, now Scientific Officer at IUCAA)
  - Sheelu Abraham (Sep - Dec 2018, now Assistant Professor at Marthoma College)
  - Jishnu Suresh (Jul 2016 - Jan 2019, now PDF at UCLouvain, Belgium)
- A number of long term undergraduate project students

High Performance Computing

- Lead the effort to set up the present 530TF LIGO Data Analysis System (LDAS) at IUCAA (2011-23)
- Have been a "top user" of the NERSC super computing facility at LBL, Berkeley (2014)
- Set up and administration of a 16 node Pentium 4 Beowulf cluster at IUCAA (2004)

Administrative Responsibilities

- LIGO-India Science Spokesperson [August 2022 - present]
- LIGO-India Project Coordinator, IUCAA [August 2022 - present]
- Head, Computing Facilities, IUCAA [April 2022 - present]
- In charge, Gravitational Wave Data Centre at IUCAA [August 2016 - present]
- Lead the proposal and Project Coordinator, Teaching Learning Centre (TLC) for higher education in Astronomy funded by the MHRD under the PMMMNMTT scheme [December 2017 - September 2018]
- Chair, Interim sub-committee for LIGO-India EPO activities [September 2017 - March 2021]
- Chair, IUCAA SciPOP Committee [November 2014 - April 2019]
- Chair, IUCAA Press Committee [November 2014 - December 2015]
- Chair, IUCAA Standing Local Organising Committee [October 2012 - December, 2015]
- Part of the Astronomy and Astrophysics Working Group for the Mega-Science Vision - 2035 exercise initiated by the office of the Principal Scientific Advisor (PSA) to the government of India.

- Chaired several administrative and purchase committees at IUCAA
- Presently member of the following IUCAA committees: Teaching Programme Committee (TPC), Infrastructure committee, Science Popularisation and Outreach Programme (SciPOP) committee
- Organised several introductory and advanced workshops on GW, including GWPAW-2013

Publications

- INSPIRE-HEP: Citations 129,000+, h-index 125
- Scopus (AuthorID 56643292200): Citations 80,000+, h-index 101

Book

[1] Sanjeev Dhurandhar & Sanjit Mitra, "General Relativity and Gravitational Waves: Essentials of Theory and Practice, " Springer, Cham (2022), https://link.springer.com/book/10.1007/978-3-030-92335-8.

Limited Author Publications

[1] D. Agarwal, J. Suresh, S. Mitra, and A. Ain, "Angular power spectra of anisotropic stochastic gravitational wave background: developing statistical methods and analyzing data from ground-based detectors,"*arXiv e-prints* (Feb., 2023) arXiv:2302.12516, arXiv:2302.12516 [gr-qc].

[2] K. Soni, B. U. Gadre, S. Mitra, and S. Dhurandhar, "Hierarchical search for compact binary coalescences in the Advanced LIGO's first two observing runs,"Phys. Rev. D **105** (Mar., 2022) 064005, arXiv:2106.08925 [gr-qc].

[3] D. Agarwal, J. Suresh, S. Mitra, and A. Ain, "Upper limits on persistent gravitational waves using folded data and the full covariance matrix from Advanced LIGO's first two observing runs,"Phys. Rev. D **104** (Dec., 2021) 123018, arXiv:2105.08930 [gr-qc].

[4] S. Mukherjee, S. Mitra, and S. Chatterjee, "Gravitational wave observatories may be able to detect hyperbolic encounters of black holes,"MNRAS **508** (Dec., 2021) 5064–5073, arXiv:2010.00916 [gr-qc].

[5] J. Suresh, D. Agarwal, and S. Mitra, "Jointly setting upper limits on multiple components of an anisotropic stochastic gravitational-wave background,"Phys. Rev. D **104** (Nov., 2021) 102003, arXiv:2106.09593 [gr-qc].

[6] S. Jadhav, N. Mukund, B. Gadre, S. Mitra, and S. Abraham, "Improving significance of binary black hole mergers in Advanced LIGO data using deep learning: Confirmation of GW151216,"Phys. Rev. D **104** (Sept., 2021) 064051, arXiv:2010.08584 [gr-qc].

[7] J. Suresh, A. Ain, and S. Mitra, "Unified mapmaking for an anisotropic stochastic gravitational wave background,"Phys. Rev. D **103** (Apr., 2021) 083024, arXiv:2011.05969 [gr-qc].

[8] S. Panda, S. Bhagwat, J. Suresh, and S. Mitra, "Stochastic gravitational wave background mapmaking using regularized deconvolution,"Phys. Rev. D **100** (Aug, 2019) 043541, arXiv:1905.08276 [gr-qc].

[9] B. Gadre, S. Mitra, and S. Dhurandhar, "Hierarchical search strategy for the efficient detection of gravitational waves from nonprecessing coalescing compact binaries with aligned-spins,"Phys. Rev. D **99** (Jun, 2019) 124035, arXiv:1807.06803 [astro-ph.IM].

[10] N. Mukund, B. O'Reilly, S. Somala, and S. Mitra, "Effect of induced seismicity on advanced gravitational wave interferometers,"*Classical and Quantum Gravity (Letter)* **36** (May, 2019) 10LT01, arXiv:1811.11817 [astro-ph.IM].

[11] A. Parida, J. Suresh, S. Mitra, and S. Jhingan, "Component separation map-making for stochastic gravitational wave background,"*arXiv e-prints* (Apr, 2019) , arXiv:1904.05056 [gr-qc].

[12] C. Afle, A. Gupta, B. Gadre, P. Kumar, N. Demos, G. Lovelace, H. G. Choi, H. M. Lee, S. Mitra, M. Boyle, D. A. Hemberger, L. E. Kidder, H. P. Pfeiffer, M. A. Scheel, and B. Szilagyi, "Detection and characterization of spin-orbit resonances in the advanced gravitational wave detectors era,"Phys. Rev. D **98** (Oct., 2018) 083014, arXiv:1803.07695 [gr-qc].

[13] A. Ain, J. Suresh, and S. Mitra, "Very fast stochastic gravitational wave background map making using folded data,"Phys. Rev. D **98** (July, 2018) 024001, arXiv:1803.08285 [gr-qc].

[14] N. Mukund, S. Thakur, S. Abraham, A. K. Aniyan, S. Mitra, N. Sajeeth Philip, K. Vaghmare, and D. P. Acharjya, "An Information Retrieval and Recommendation System for Astronomical Observatories,"ApJS **235** (Mar., 2018) 22, arXiv:1710.05350 [astro-ph.IM].

[15] N. Mukund, S. Abraham, S. Kandhasamy, S. Mitra, and N. S. Philip, "Transient classification in LIGO data using difference boosting neural network,"Phys. Rev. D **95** (May, 2017) 104059, arXiv:1609.07259 [astro-ph.IM].

[16] S. V. Dhurandhar and S. Mitra, "Einsteins centennial gift: Gravitational waves discovered,"*Physics Education* **32** (June, 2016) . http://www.physedu.in/pub/Apr-Jun-2016/PE16-05-380.

[17] M. Coughlin, N. Mukund, J. Harms, J. Driggers, R. Adhikari, and S. Mitra, "Towards a first design of a Newtonian-noise cancellation system for Advanced LIGO,"*Classical and Quantum Gravity* **33** (Dec., 2016) 244001, arXiv:1606.01716 [gr-qc].

[18] S. Das, S. Mitra, A. Rotti, N. Pant, and T. Souradeep, "Statistical isotropy violation in WMAP CMB maps resulting from non-circular beams,"*Astron. & Astrophys.* **591** (June, 2016) A97, arXiv:1401.7757.

[19] A. Parida, S. Mitra, and S. Jhingan, "Component separation of a isotropic Gravitational Wave Background,"J. Cosmology Astropart. Phys. **4** (Apr., 2016) 024, arXiv:1510.07994.

[20] N. Pant, S. Das, A. Rotti, S. Mitra, and T. Souradeep, "Estimating statistical isotropy violation in CMB due to non-circular beam and complex scan in minutes,"J. Cosmology Astropart. Phys. **3** (Mar., 2016) 035, arXiv:1511.03672.

[21] A. Ain, P. Dalvi, and S. Mitra, "Fast gravitational wave radiometry using data folding,"*Phys. Rev. D* **92** (July, 2015) 022003, arXiv:1504.01714 [gr-qc].

[22] A. Ain, S. Kastha, and S. Mitra, "Stochastic gravitational wave background from exoplanets,"*Phys. Rev. D* **91** (June, 2015) 124023, arXiv:1504.01715 [gr-qc].

[23] E. Thrane, S. Mitra, N. Christensen, V. Mandic, and A. Ain, "All-sky, narrowband, gravitational-wave radiometry with folded data,"*Phys. Rev. D* **91** (June, 2015) 124012, arXiv:1504.02158 [astro-ph.IM].

[24] S. Das, S. Mitra, and S. Tabitha Paulson, "Effect of noncircularity of experimental beam on CMB parameter estimation,"J. Cosmology Astropart. Phys. **3** (Mar., 2015) 48, arXiv:1501.02101.

[25] S. Kumar, A. Rotti, M. Aich, N. Pant, S. Mitra, and T. Souradeep, "Orthogonal bipolar spherical harmonics measures: Scrutinizing sources of isotropy violation,"*Phys. Rev. D* **91** (Feb., 2015) 043501, arXiv:1409.4886.

[26] N. Mazumder, S. Mitra, and S. Dhurandhar, "Astrophysical motivation for directed searches for a stochastic gravitational wave background,"*Phys. Rev. D* **89** (Apr., 2014) 084076, arXiv:1401.5898 [gr-qc].

[27] F. A. Ramamonjisoa, S. Ray, S. Mitra, and T. Souradeep, "Fast algorithm for the computation of the CMB polarization TE power spectrum using non-circular beam,"*New Astronomy* **64** (Oct., 2018) 44.

[28] N. Joshi, S. Das, A. Rotti, S. Mitra, and T. Souradeep, "Revealing Non-circular beam effect in WMAP-7 CMB maps with BipoSH measures of Statistical Isotropy,"*ArXiv e-prints* (Oct., 2012) , arXiv:1210.7318 [astro-ph.CO].

[29] D. Talukder, S. Mitra, and S. Bose, "Multibaseline gravitational wave radiometry,"*Phys. Rev. D* **83** (Mar., 2011) 063002, arXiv:1012.4530 [gr-qc].

[30] S. Mitra, G. Rocha, K. M. Górski, K. M. Huffenberger, H. K. Eriksen, M. A. J. Ashdown, and C. R. Lawrence, "Fast Pixel Space Convolution for Cosmic Microwave Background Surveys with Asymmetric Beams and Complex Scan Strategies: FEBeCoP,"*Astrophys. J. Suppl.* **193** (Mar., 2011) 5, arXiv:1005.1929 [astro-ph.CO].

[31] E. Thrane, S. Ballmer, J. D. Romano, S. Mitra, D. Talukder, S. Bose, and V. Mandic, "Probing the anisotropies of a stochastic gravitational-wave background using a network of ground-based laser interferometers,"*Phys. Rev. D* **80** (Dec., 2009) 122002, arXiv:0910.0858.

[32] S. Mitra, A. S. Sengupta, S. Ray, R. Saha, and T. Souradeep, "Cosmic microwave background power spectrum estimation with non-circular beam and incomplete sky coverage,"*Mon. Not. Roy. Astron. Soc.* **394** (Apr., 2009) 1419–1439, arXiv:astro-ph/0702100.

[33] S. Mitra, S. Dhurandhar, T. Souradeep, A. Lazzarini, V. Mandic, S. Bose, and S. Ballmer, "Gravitational wave radiometry: Mapping a stochastic gravitational wave background,"*Phys. Rev. D* **77** (Feb., 2008) 042002, arXiv:0708.2728.

[34] T. Souradeep, S. Mitra, A. Sengupta, S. Ray, and R. Saha, "Non-circular beam correction to the CMB power spectrum,"*New Astronomy Review* **50** (Dec., 2006) 1030–1035, arXiv:astro-ph/0608505.

[35] S. Mitra, S. V. Dhurandhar, and L. S. Finn, "Improving the efficiency of the detection of gravitational wave signals from inspiraling compact binaries: Chebyshev interpolation,"*Phys. Rev. D* **72** (Nov., 2005) 102001, arXiv:gr-qc/0507011.

[36] S. Mitra, A. S. Sengupta, and T. Souradeep, "CMB power spectrum estimation using noncircular beams,"*Phys. Rev. D* **70** (Nov., 2004) 103002, arXiv:astro-ph/0405406.

[37] T. K. Das, J. K. Pendharkar, and S. Mitra, "Multitransonic Black Hole Accretion Disks with Isothermal Standing Shocks,"*Astrophys. J.* **592** (Aug., 2003) 1078–1088, arXiv:astro-ph/0301189.

LIGO-Virgo Collaboration Publications

[1] Abbott, R., Abe, H., Acernese, F., et al. (2023), MNRAS, "Search for subsolar-mass black hole binaries in the second part of Advanced LIGO's and Advanced Virgo's third observing run, "*Monthly Notices of the Royal Astronomical Society* , .

[2] Abbott, R., Abe, H., Acernese, F., et al. (2022), ApJ, 941, L30 "Model-based Cross-correlation Search for Gravitational Waves from the Low-mass X-Ray Binary Scorpius X-1 in LIGO O3 Data, "*The Astrophysical Journal* **941** L30, arXiv:2209.02863.

[3] Abbott, R., Abe, H., Acernese, F., et al. (2022), Phys. Rev. D, 106, 102008 "All-sky search for continuous gravitational waves from isolated neutron stars using Advanced LIGO and Advanced Virgo O3 data, "*Physical Review D* **106** 102008, arXiv:2201.00697.

[4] Abbott, R., Abe, H., Acernese, F., et al. (2022), Phys. Rev. D, 106, 062002 "Search for gravitational waves from Scorpius X-1 with a hidden Markov model in O3 LIGO data, "*Physical Review D* **106** 062002, arXiv:2201.10104.

[5] Abbott, R., Abbott, T. D., Acernese, F., et al. (2022), Phys. Rev. Lett., 129, 061104 "Search for Subsolar-Mass Binaries in the First Half of Advanced LIGO's and Advanced Virgo's Third Observing Run, "*Physical Review Letters* **129** 061104, arXiv:2109.12197.

[6] Abbott, R., Abe, H., Acernese, F., et al. (2022), Phys. Rev. D, 106, 042003 "Search for continuous gravitational wave emission from the Milky Way center in O3 LIGO-Virgo data, "*Physical Review D* **106** 042003, arXiv:2204.04523.

[7] Abbott, R., Abe, H., Acernese, F., et al. (2022), ApJ, 935, 1 "Searches for Gravitational Waves from Known Pulsars at Two Harmonics in the Second and Third LIGO-Virgo Observing Runs, "*The Astrophysical Journal* **935** 1, arXiv:2111.13106.

[8] Abbott, R., Abbott, T. D., Acernese, F., et al. (2022), Phys. Rev. D, 105, 122001 "All-sky, all-frequency directional search for persistent gravitational waves from Advanced LIGO's and Advanced Virgo's first three observing runs, "*Physical Review D* **105** 122001, arXiv:2110.09834.

[9] Abbott, R., Abe, H., Acernese, F., et al. (2022), Progress of Theoretical and Experimental Physics, 2022, 063F01 "First joint observation by the underground gravitational-wave detector KAGRA with GEO 600, "*Progress of Theoretical and Experimental Physics* **2022** 063F01, arXiv:2203.01270.

[10] Abbott, R., Abbott, T. D., Acernese, F., et al. (2022), ApJ, 932, 133 "Narrowband Searches for Continuous and Long-duration Transient Gravitational Waves from Known Pulsars in the LIGO-Virgo Third Observing Run, "*The Astrophysical Journal* **932** 133, arXiv:2112.10990.

[11] Abbott, R., Abe, H., Acernese, F., et al. (2022), Phys. Rev. D, 105, 102001 "All-sky search for gravitational wave emission from scalar boson clouds around spinning black holes in LIGO O3 data, "*Physical Review D* **105** 102001, arXiv:2111.15507.

[12] Abbott, R., Abbott, T. D., Acernese, F., et al. (2022), Phys. Rev. D, 105, 082005 "Search of the early O3 LIGO data for continuous gravitational waves from the Cassiopeia A and Vela Jr. supernova remnants, "*Physical Review D* **105** 082005, arXiv:2111.15116.

[13] Abbott, R., Abbott, T. D., Acernese, F., et al. (2022), ApJ, 928, 186 "Search for Gravitational Waves Associated with Gamma-Ray Bursts Detected by Fermi and Swift during the LIGO-Virgo Run O3b, "*The Astrophysical Journal* **928** 186, arXiv:2111.03608.

[14] Abbott, R., Abbott, T. D., Acernese, F., et al. (2022), Phys. Rev. D, 105, 063030 "Constraints on dark photon dark matter using data from LIGO's and Virgo's third observing run, "*Physical Review D* **105** 063030, arXiv:2105.13085.

[15] Abbott, R., Abbott, T. D., Acernese, F., et al. (2022), A&A, 659, A84 "Search for intermediate-mass black hole binaries in the third observing run of Advanced LIGO and Advanced Virgo, "*Astronomy and Astrophysics* **659** A84, arXiv:2105.15120.

[16] Abbott, R., Abbott, T. D., Acernese, F., et al. (2022), Phys. Rev. D, 105, 022002 "Search for continuous gravitational waves from 20 accreting millisecond x-ray pulsars in O3 LIGO data, "*Physical Review D* **105** 022002, arXiv:2109.09255.

[17] Abbott, R., Abbott, T. D., Acernese, F., et al. (2021), Phys. Rev. D, 104, 122004 "All-sky search for short gravitational-wave bursts in the third Advanced LIGO and Advanced Virgo run, "*Physical Review D* **104** 122004, arXiv:2107.03701.

[18] Abbott, R., Abbott, T. D., Abraham, S., et al. (2021), ApJ, 923, 14 "Search for Lensing Signatures in the Gravitational-Wave Observations from the First Half of LIGO-Virgo's Third Observing Run, "*The Astrophysical Journal* **923** 14, arXiv:2105.06384.

[19] Abbott, R., Abbott, T. D., Acernese, F., et al. (2021), Phys. Rev. D, 104, 102001 "All-sky search for long-duration gravitational-wave bursts in the third Advanced LIGO and Advanced Virgo run, "*Physical Review D* **104** 102001, arXiv:2107.13796.

[20] Abbott, R., Abbott, T. D., Abraham, S., et al. (2021), ApJ, 922, 71 "Constraints from LIGO O3 Data on Gravitational-wave Emission Due to R-modes in the Glitching Pulsar PSR J0537-6910, "*The Astrophysical Journal* **922** 71, arXiv:2104.14417.

[21] Abbott, R., Abbott, T. D., Abraham, S., et al. (2021), ApJ, 921, 80 "Searches for Continuous Gravitational Waves from Young Supernova Remnants in the Early Third Observing Run of Advanced LIGO and Virgo, "*The Astrophysical Journal* **921** 80, arXiv:2105.11641.

[22] Abbott, R., Abbott, T. D., Abraham, S., et al. (2021), Phys. Rev. D, 104, 082004 "All-sky search for continuous gravitational waves from isolated neutron stars in the early O3 LIGO data, "*Physical Review D* **104** 082004, arXiv:2107.00600.

[23] Abbott, R., Abbott, T. D., Abraham, S., et al. (2021), Phys. Rev. D, 104, 022005 "Search for anisotropic gravitational-wave backgrounds using data from Advanced LIGO and Advanced Virgo's first three observing runs, "*Physical Review D* **104** 022005, arXiv:2103.08520.

[24] Abbott, R., Abbott, T. D., Abraham, S., et al. (2021), Phys. Rev. D, 104, 022004 "Upper limits on the isotropic gravitational-wave background from Advanced LIGO and Advanced Virgo's third observing run, "*Physical Review D* **104** 022004, arXiv:2101.12130.

[25] Abbott, R., Abbott, T. D., Abraham, S., et al. (2021), ApJ, 915, L5 "Observation of Gravitational Waves from Two Neutron Star-Black Hole Coalescences, "*The Astrophysical Journal* **915** L5, arXiv:2106.15163.

[26] Abbott, R., Abbott, T. D., Abraham, S., et al. (2021), ApJ, 915, 86 "Search for Gravitational Waves Associated with Gamma-Ray Bursts Detected by Fermi and Swift during the LIGO-Virgo Run O3a, "*The Astrophysical Journal* **915** 86, arXiv:2010.14550.

[27] Abbott, R., Abbott, T. D., Abraham, S., et al. (2021), Phys. Rev. Lett., 126, 241102 "Constraints on Cosmic Strings Using Data from the Third Advanced LIGO-Virgo Observing Run, "*Physical Review Letters* **126** 241102, arXiv:2101.12248.

[28] Abbott, R., Abbott, T. D., Abraham, S., et al. (2021), Phys. Rev. D, 103, 122002 "Tests of general relativity with binary black holes from the second LIGO-Virgo gravitational-wave transient catalog, "*Physical Review D* **103** 122002, arXiv:2010.14529.

[29] Abbott, R., Abbott, T. D., Abraham, S., et al. (2021), ApJ, 913, L27 "Diving below the Spin-down Limit: Constraints on Gravitational Waves from the Energetic Young Pulsar PSR J0537-6910, "*The Astrophysical Journal* **913** L27, arXiv:2012.12926.

[30] Abbott, R., Abbott, T. D., Abraham, S., et al. (2021), ApJ, 913, L7 "Population Properties of Compact Objects from the Second LIGO-Virgo Gravitational-Wave Transient Catalog, "*The Astrophysical Journal* **913** L7, arXiv:2010.14533.

[31] Abbott, R., Abbott, T. D., Abraham, S., et al. (2021), Physical Review X, 11, 021053 "GWTC-2: Compact Binary Coalescences Observed by LIGO and Virgo during the First Half of the Third Observing Run, "*Physical Review X* **11** 021053, arXiv:2010.14527.

[32] Abbott, R., Abbott, T. D., Abraham, S., et al. (2021), Phys. Rev. D, 103, 064017 "All-sky search in early O3 LIGO data for continuous gravitational-wave signals from unknown neutron stars in binary systems, "*Physical Review D* **103** 064017, arXiv:2012.12128.

[33] Abbott, B. P., Abbott, R., Abbott, T. D., et al. (2021), ApJ, 909, 218 "A Gravitational-wave Measurement of the Hubble Constant Following the Second Observing Run of Advanced LIGO and Virgo, "*The Astrophysical Journal* **909** 218, arXiv:1908.06060.

[34] Abbott, R., Abbott, T. D., Abraham, S., et al. (2021), SoftwareX, 13, 100658 "Open data from the first and second observing runs of Advanced LIGO and Advanced Virgo, "*SoftwareX* **13** 100658, arXiv:1912.11716.

[35] Abbott, R., Abbott, T. D., Abraham, S., et al. (2020), ApJ, 902, L21 "Gravitational-wave Constraints on the Equatorial Ellipticity of Millisecond Pulsars, "*The Astrophysical Journal* **902** L21, arXiv:2007.14251.

[36] Abbott, R., Abbott, T. D., Abraham, S., et al. (2020), Phys. Rev. Lett., 125, 101102 "GW190521: A Binary Black Hole Merger with a Total Mass of 150 $M_\odot$, "*Physical Review Letters* **125** 101102, arXiv:2009.01075.

[37] Abbott, B. P., Abbott, R., Abbott, T. D., et al. (2020), Living Reviews in Relativity, 23, 3 "Prospects for observing and localizing gravitational-wave transients with Advanced LIGO, Advanced Virgo and KAGRA, "*Living Reviews in Relativity* **23** 3, .

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