

Sangeet Paul

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PhD candidate working on computational astrophysics. Studying black holes and neutron stars using gravitational waves.

Education

- 2019 – **PhD, Physics**, *University of Oregon*, Eugene, OR, USA.
2013 – 18 **BSc-MSc, Physics**, *National Institute of Science Education and Research, HBNI*, Bhubaneswar, India.

Skills

physics	Gravitational-wave astronomy, General relativity, Quantum mechanics, Quantum field theory.
quantitative	Bayesian inference, Markov chain Monte Carlo (MCMC), Cluster analysis, Machine learning.
python astro	AstroPy , bilby , PyCBC , GWpy .
python ML	TensorFlow , keras , scikit-learn.
python GPU	JAX , CuPy (CUDA).
python misc	emcee , Pandas, SciPy, Numpy, matplotlib.
languages	Python, C, C++, Java, R.
software	Mathematica, MATLAB.

Research Experience

- Jul 2021 – **Research Assistant**, *Institute of Fundamental Sciences*, University of Oregon.

Worked on parameter estimation of gravitational-wave events, and astrophysical population analysis of gravitational-wave catalogs, as part of the [LIGO Scientific Collaboration](#).

- ★ **Hierarchical mergers of binary black holes in dynamical astrophysical environments**
Built population (Bayesian) inference software to find evidence of hierarchical mergers of binary black holes in LIGO-Virgo-KAGRA's gravitational wave catalogs using the coagulation model for black hole mergers in dynamical astrophysical environments, such as globular clusters and active galactic nuclei' accretion disks.
- ★ **Simultaneous inference of astrophysical and noise parameters in gravitational wave data**
Built Bayesian inference software for data from gravitational-wave interferometers to estimate astrophysical signal models and detector noise models simultaneously, without assuming any intrinsic lack of correlation.
- ★ **Clustering algorithms for significantly uncertain data**
Built algorithms to cluster data with high uncertainty, such as data from gravitational-wave interferometers.

- 2018 – 19 **Research Fellow**, *National Institute of Science Education and Research*.

- ★ **Blackfolds in higher-dimensional gravity**
Analyzed the stability of blackfolds – higher-dimensional equivalents of black holes. Verified through simulations that a perturbed black string asymptotically settles down to a black hole due to the Gregory–Laflamme instability.

2013 – 18 **Research Scholar**, *National Institute of Science Education and Research*.

- ★ **Membrane – gravity duality in a large number of dimensions** (Thesis)
Demonstrated that black hole event horizons are analogous to hydrodynamic membranes.
- ★ **Analytical predictions of the mass function of halos**
Analyzed the effects of varying dark matter halos' mass functions on astronomical and cosmological observations.
- ★ **Magneto-optic Kerr effect: experiment design**
Constructed theory for an experiment to use the magneto-optic Kerr effect to analyse magnetized surfaces.

May–Jul 2017 **Research Scholar**, *Institute of Physics, Homi Bhabha National Institute, Department of Atomic Energy*.

- ★ **Superstring theory: Tree-approximation scattering amplitudes**
Studied the foundations of superstring theory, starting with bosonic strings, moving on to supersymmetry and gauge interactions, finishing with the evaluation of tree-level scattering amplitudes.

May–Jul 2016 **Research Scholar**, *Centre for Excellence in Basic Sciences, University of Mumbai – Department of Atomic Energy*.

- ★ **Quantum field theory: Decays of the Higgs boson**
Studied relativistic quantum mechanics, quantum electrodynamics, Feynman diagrams, renormalization, and gauge field theories. Analyzed the radiation of gluon jets, the Coleman-Weinberg potential, and the decays of the Higgs boson.

Teaching Experience

Sep 2019 – **Teaching Assistant**, *Department of Physics, University of Oregon*.

grad-level Scientific computation (machine learning), Design of experiments (Bayesian statistics).

undergrad Quantum mechanics, Astronomy, Fourier analysis, Algebra-based physics, Calculus-based physics.

Achievements

2020 **Weiser Award for Excellence in Teaching**, *Department of Physics, University of Oregon*

2018 – 2019 **Junior Research Fellow**, *Council of Scientific and Industrial Research, Ministry of S&T, Govt. of India*

2013 – 2018 **INSPIRE Scholar**, *Department of Science and Technology, Ministry of S&T, Govt. of India*

2008 – 2018 **NTSE Scholar**, *Department of Science and Technology, Ministry of S&T, Govt. of India*

2013 **3rd prize in NASA Ames Space Settlement Contest** conducted by NASA Ames Research Center, San Jose State University, and National Space Society, USA

Conferences

Jan 2024 **American Astronomical Society Meeting**, *New Orleans, LA*.

Jun 2023 **Gravitational-Wave Astronomy North-West**, *Hanford, WA*.

Jan 2023 **American Astronomical Society Meeting**, *Seattle, WA*.

Jun 2022 **Gravitational-Wave Astronomy North-West**, *Hanford, WA*.

May 2022 **Astronomical Software Development**, *New York, NY*.

Apr 2022 **Intermediate-Mass Black Holes**, *San Juan, PR*.

Service Experience

2023 – 24 Graduate Support Group, Dept of Physics, U Oregon

2022 – 23 PhD Admissions Committee, Dept of Physics, U Oregon

2021 – 22 Vice-President, Graduate Student Council, Dept of Physics, U Oregon

Dec 2016 Organizer, International Olympiad of Astronomy and Astrophysics

2014 – 18 Organizer, NISER's Open Science Day

2013 – 15 Treasurer, Student Council, NISER

Languages

English, Hindi, Odia, Bengali, Gahaḷā.

I maintain a language documentation project for my native language Gahaḷā [here](#).

Publications

- 1 LSC, Virgo, and KAGRA. Observation of Gravitational Waves from the Coalescence of a 2.5-4.5 M_{\odot} Compact Object and a Neutron Star. *Accepted by ApJL*, Apr 2024.
- 2 LSC, Virgo, and KAGRA. Ultralight vector dark matter search using data from the KAGRA O3GK run. *Submitted to PRD*, Mar 2024.
- 3 Fermi-GBM, Swift-BAT, LSC, Virgo, and KAGRA. A Joint Fermi-GBM and Swift-BAT Analysis of Gravitational-Wave Events from the GWTC-3 Catalog. *Astrophys. J.* 964, 149, Aug 2023.
- 4 LSC, Virgo, and KAGRA. Search for Eccentric Black Hole Coalescences During the Third Observing Run of LIGO and Virgo. *Submitted to ApJ*, Aug 2023.
- 5 LSC, Virgo, and KAGRA. Search for gravitational-lensing signatures in the full third observing run of the LIGO-Virgo network. *Accepted by ApJ*, Apr 2023.
- 6 LSC, Virgo, and KAGRA. Open data from the third observing run of LIGO, Virgo, KAGRA and GEO. *Astrophys. J. Supp.* 267, 29, Feb 2023.
- 7 LSC, Virgo, KAGRA, S. Shandera, and D. Jeong. Search for subsolar-mass black hole binaries in the second part of Advanced LIGO and Virgo's third observing run. *Monthly Notices of the Royal Astronomical Society* 524, 5984, Dec 2022.
- 8 LSC, Virgo, and KAGRA. Search for gravitational-wave transients associated with magnetar bursts in Advanced LIGO and Advanced Virgo data from the third observing run. *Astrophys. J.* 966, 137, Oct 2022.
- 9 LSC, Virgo, and KAGRA. Model-based cross-correlation search for gravitational waves from the low-mass X-ray binary Scorpius X-1 in LIGO O3 data. *Astrophys. J. Lett.* 941, L30, Sep 2022.
- 10 LSC, Virgo, and KAGRA. Search for continuous gravitational wave emission from the Milky Way center in O3 LIGO-Virgo data. *Phys. Rev. D* 106, 042003, Apr 2022.
- 11 LSC, Virgo, and KAGRA. Search for gravitational waves associated with Fast Radio Bursts Detected by CHIME/FRB During the LIGO-Virgo Observing Run O3a. *Astrophys. J.* 955, 155, Mar 2022.
- 12 LSC, Virgo, and KAGRA. First joint observation by the underground gravitational-wave detector KAGRA with GEO 600. *Progress of Theor. and Exp. Phys.* 2022, 063F01, Mar 2022.
- 13 LSC, Virgo, and KAGRA. Search for gravitational waves from Scorpius X-1 with a hidden Markov model in O3 LIGO data. *Phys. Rev. D* 106, 062002, Jan 2022.
- 14 LSC, Virgo, and KAGRA. All-sky search for continuous gravitational waves from isolated neutron stars using Advanced LIGO and Advanced Virgo O3 data. *Phys. Rev. D* 106, 102008, Jan 2022.
- 15 LSC, Virgo, KAGRA, 28 radio astronomers, and NICER science team members. Narrowband searches for continuous and long-duration transient gravitational waves from known pulsars in the LIGO-Virgo third observing run. *Astrophys. J.* 932, 133, Dec 2021.
- 16 LSC, Virgo, and KAGRA. Tests of General Relativity with GWTC-3. *Accepted by PRD*, Dec 2021.
- 17 LSC and Virgo. Search of the Early O3 LIGO Data for Continuous Gravitational Waves from the Cassiopeia A and Vela Jr. Supernova Remnants. *Phys. Rev. D* 105, 082005, Nov 2021.

- 18 LSC, Virgo, and KAGRA. All-sky search for gravitational wave emission from scalar boson clouds around spinning black holes in LIGO O3 data. *Phys. Rev. D* 105, 102001, Nov 2021.
- 19 LSC, Virgo, and KAGRA. Searches for Gravitational Waves from Known Pulsars at Two Harmonics in the Second and Third LIGO-Virgo Observing Runs. *Astrophys. J.* 935, 1, Nov 2021.
- 20 LSC, Virgo, and KAGRA. Constraints on the cosmic expansion history from the third LIGO-Virgo-KAGRA Gravitational-Wave Transient Catalog. *Astrophys. J.* 949, 76, Nov 2021.
- 21 LSC, Virgo, and KAGRA. GWTC-3: Compact Binary Coalescences Observed by LIGO and Virgo During the Second Part of the Third Observing Run. *Phys. Rev. X* 13, 041039, Nov 2021.
- 22 LSC, Virgo, and KAGRA. Search for Gravitational Waves Associated with Gamma-Ray Bursts detected by Fermi and Swift during the O3b LIGO-Virgo Run. *Astrophys. J.* 928, 186, Nov 2021.
- 23 LSC, Virgo, and KAGRA. Population of merging compact binaries inferred using gravitational waves through GWTC-3. *Phys. Rev. X* 13, 011048, Nov 2021.
- 24 LSC, Virgo, and KAGRA. All-sky, all-frequency directional search for persistent gravitational waves from Advanced LIGO's and Advanced Virgo's first three observing runs. *Phys. Rev. D* 105, 122002, Oct 2021.
- 25 LSC, Virgo, KAGRA, D. Jeong, and S. Shandera. Search for subsolar-mass binaries in the first half of Advanced LIGO and Virgo's third observing run. *Phys. Rev. Lett.* 129, 061104, Sep 2021.
- 26 LSC, Virgo, KAGRA, A. C. Albayati, D. Altamirano, P. Bult, D. Chakrabarty, M. Ng, P. S. Ray, A. Sanna, and T. E. Strohmayer. Search for continuous gravitational waves from 20 accreting millisecond X-ray pulsars in O3 LIGO data. *Phys. Rev. D* 105, 022002, Sep 2021.
- 27 LSC and Virgo. GWTC-2.1: Deep Extended Catalog of Compact Binary Coalescences Observed by LIGO and Virgo During the First Half of the Third Observing Run. *Phys. Rev. D* 109, 022001, Jul 2021.
- 28 LSC, Virgo, and KAGRA. All-sky search for long-duration gravitational-wave transients in the third Advanced LIGO observing run. *Phys. Rev. D* 104, 102001, Jul 2021.
- 29 LSC, Virgo, and KAGRA. All-sky search for short gravitational-wave bursts in the third Advanced LIGO and Advanced Virgo run. *Phys. Rev. D* 104, 122004, Jul 2021.
- 30 LSC and Virgo. All-sky search for continuous gravitational waves from isolated neutron stars in the Early O3 LIGO Data. *Phys. Rev. D* 104, 082004, Jul 2021.
- 31 LSC, Virgo, and KAGRA. Observation of gravitational waves from two neutron star-black hole coalescences. *Astrophys. J. Lett.* 915, L5, Jun 2021.
- 32 LSC, Virgo, and KAGRA. Search for intermediate mass black hole binaries in the third observing run of Advanced LIGO and Advanced Virgo. *Astronomy & Astrophysics* 659, A84, May 2021.
- 33 LSC, Virgo, and KAGRA. Constraints on dark photon dark matter using data from LIGO's and Virgo's third observing run. *Phys. Rev. D* 105, 063030, May 2021.