

SAMSUZZAMAN AFROZ

Quantitative Researcher | PhD Researcher in Physics | Statistical Modeling

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PROFILE SUMMARY

Quantitative researcher and Ph.D. candidate at TIFR with expertise in statistical inference, Bayesian modeling, and large-scale analysis of high-dimensional, noisy datasets. Strong background in Python-based numerical computation, probabilistic modeling, and algorithmic problem-solving, with experience building scalable inference and data analysis pipelines for complex datasets.

EDUCATION

Ph.D. in Physics

Tata Institute of Fundamental Research (TIFR), Mumbai

2022 – 2027 (Expected)

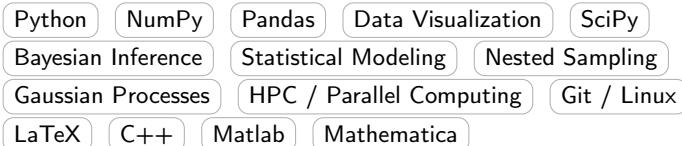
Research focus: Statistical, parametric and non-parametric modeling of large-scale, high-dimensional, noisy datasets using Bayesian inference.

M.Sc. & B.Sc. (Hons.) in Physics

Presidency University, Kolkata & Jamia Millia Islamia, New Delhi

2017 – 2022

TECHNICAL SKILLS



SELECTED TECHNICAL PROJECTS

- Non-parametric Reconstruction Framework:** Built a grid-based pipeline for reconstructing astrophysical and cosmological parameters from noisy data; optimized performance using vectorization and scientific Python stack.
- Bayesian Inference for GW Catalogs:** Developed hierarchical inference code integrating gravitational-wave and large-scale structure data.
- Phase Space Classification Framework:** Designed a fast, high-dimensional trajectory analysis pipeline to extract physical parameters directly from observational data, enabling efficient classification of black hole formation scenarios without relying on traditional models.
- High-Performance Computing Pipelines:** Performed large-scale simulations using MPI-based parallel sampling and cluster resources.
- Cross-Correlation Signal Extraction:** Implemented time-series cross-correlation techniques to recover weak signals embedded in extremely noisy data, enabling reliable extraction of physical information from low signal to noise observations.
- Cross-Modal Signal Integration:** Developed a statistical framework to cross-correlate EM survey data with gravitational-wave event catalogs, enabling joint inference of cosmological parameters through multi-dataset integration and noise-robust correlation analysis.

PROFESSIONAL ACTIVITIES

- Active member of the Nobel Prize-winning LIGO–Virgo–KAGRA (LVK) Collaboration, contributing to large-scale statistical modeling, Bayesian inference, and data-analysis pipelines.
- Delivered invited and contributed talks at multiple national and international conferences and institutes.
- Served on the Local Organizing Committee for two national-level conferences at TIFR, Mumbai.
- Participated in advanced workshops and summer/winter schools focused on Bayesian inference, time-series analysis, numerical simulations, and large-scale statistical modeling.

SELECTED PUBLICATIONS

- Afroz, S., Navdha, & Mukherjee, S. (2025). Are all Binary Black Holes Detected by LIGO–Virgo–KAGRA Following the Universal Time-Delay Distributions? Probably Not. arXiv:2510.06352 [astro-ph.HE].
- Afroz, S. & Mukherjee, S. (2025). The Non Parametric Reconstruction of Binary Black Hole Mass Evolution from GWTC-4.0 Gravitational Wave Catalog. arXiv:2509.25356 [astro-ph.HE].
- Afroz, S. & Mukherjee, S. (2025). Binary Black Hole Phase Space Discovers the Signature of Pair Instability Supernovae Mass Gap. arXiv:2509.09123 [astro-ph.HE].
- Afroz, S. & Mukherjee, S. (2025). Gravitational Wave Burst from Bremsstrahlung in Milky Way Can Discover Sub-Solar Dark Matter in Near Future. arXiv:2507.22126 [astro-ph.CO].
- Afroz, S., Mukherjee, S., & Tasinato, G. (2025). Illuminating Dark Energy with Bright Standard Sirens from Future Detectors. arXiv:2507.06340 [astro-ph.CO].
- Afroz, S. & Mukherjee, S. (2025). The Phase Space of Low-Mass Binary Compact Objects from LVK Catalog: Hints on the Chances of Different Formation Scenarios. arXiv:2505.22739 [astro-ph.HE].
- Afroz, S. & Mukherjee, S. (2025). Hint towards Inconsistency between BAO and Supernovae Dataset: The Evidence of Redshift Evolving Dark Energy from DESI DR2 is Absent. arXiv:2504.16868 [astro-ph.CO].
- Afroz, S. & Mukherjee, S. (2024). Multi-messenger Cosmology: A Route to Accurate Inference of Dark Energy beyond CPL Parametrization from XG Detectors. JCAP 03 (2025) 070, arXiv:2412.12285 [astro-ph.CO].
- Afroz, S. & Mukherjee, S. (2024). Phase Space of Binary Black Holes from Gravitational Wave Observations to Unveil its Formation History. Phys. Rev. D 112 (2025) 2, 023531, arXiv:2411.07304 [astro-ph.HE].
- Afroz, S. & Mukherjee, S. (2024). Prospect of Precision Cosmology and Testing General Relativity using Binary Black Holes–Galaxies Cross-correlation. Mon. Not. R. Astron. Soc. 534 (2024) 2, 1283–1298, arXiv:2407.09262 [astro-ph.CO].
- Afroz, S. & Mukherjee, S. (2024). A Model-independent Precision Test of General Relativity using LISA Bright Standard Sirens. JCAP 10 (2024) 100, arXiv:2406.08791 [astro-ph.CO].
- Afroz, S. & Mukherjee, S. (2023). A Model-independent Precision Test of General Relativity using Bright Standard Sirens from Ongoing and Upcoming Detectors. Mon. Not. R. Astron. Soc. 530 (2024) 4, 3812–3826, arXiv:2312.16292 [astro-ph.CO].
- Full list available at: inspirehep.net/authors/2741174