JAM SADIQ

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EDUCATION AND EMPLOYMENT

Research Software Enginerr   *November 2025 -*
IFAE & PIC, Universitat Autonoma de Barcelona, Spain

Data Engineer   *May 2025 - October 2025*
VitalizeDx, Trieste, Italy

Postdoctoral Researcher   *February 2023 - February 2025*
SISSA (International School for Advanced Studies)
Trieste, Italy

Postdoctoral Researcher   *October 2020 - September 2022*
University of Santiago de Compostela, Spain
Instituto Galego de Fisica de Altas Enerxias - IGFAE, USC

Assistant Professor in Mathematics   *September 2019 - August 2020*
Sukkur IBA University, Sukkur, Sindh, Pakistan
Department of Mathematics and Social Sciences
Courses: General Relativity, Quantum Mechanics, Computational Physics, Introductory Machine Learning

PhD in Astrophysics: Fulbright PhD Fellow   *August 2014 - August 2019*
Rochester Institute of Technology, Rochester, NY, 14623
Center for Computational Relativity and Gravitation

Masters of Philosophy (M.Phil) in Mathematics   *August 2010 - September 2012*
Quaid-i-Azam University, Islamabad, Pakistan
Department of Mathematics

TECHNICAL STRENGTHS

Software	PyCBC, GWpy, LALSuite, GstLAL, Einstein Toolkit, Scikit-learn, PyTorch, VisIt, Mathematica, SageMath Git, Bitbucket, GitLab CI/CD, Dagger
Programing Languages	Python, C/C++, R
Operating System	Fedora/CentosOS/Ubuntu Linux, Mac OS, Windows 10

GRANTS AND FELLOWSHIPS

Postdoctoral Fellowship   *October 2020 - September 2022*
Postdoctoral Research Fellowship at IGFAE under the grant by Xunta de Galicia, at USC, Spain

Fulbright PhD Fellowship   *August 2014 - August 2019*
Fulbright PhD Fellowship by US state department for five years

PROJECTS

Seeking Spinning Subpopulations of Black Hole Binaries via Iterative Density Estimation
Binary black hole (BBH) mergers detected via gravitational waves (GWs) provide insight into formation channels, but spin measurements remain uncertain due to low magnitudes and measurement challenges. Using an iterative KDE-based method on GWTC-3 data, we confirm a low, positive effective spin for low-mass mergers and identify a potential high-spin subpopulation ($\chi_{\text{eff}} \sim 0.45$) for primary masses above $35\ M_\odot$, suggesting a distinct origin. (Submitted to Physical Rev D)

Looking To The Horizon: Hints On An Evolving Black Hole Spectrum With GWTC-3
The current population of black holes observed via gravitational waves spans up to a redshift of $z \leq 1$ for massive binaries and $z \leq 0.25$ for low-mass binaries. Using a model-free reconstruction via adaptive kernel density estimation, we find no significant evidence for evolution in BBH masses with redshift within the current data range. However, more sensitive gravitational wave detectors are essential to uncover potential correlations between BBH mass distributions and redshift. (Submitted to physical Rev D)

Reconstructing the Massive Black hole Binary Population with LISA via Iterative KDE
We investigate massive black hole binaries (MBHBs) detectable by LISA, focusing on those originating from Population III star remnants. To reconstruct the astrophysical distribution of MBHBs from limited observations, we propose an iterative, non-parametric kernel density estimation (KDE) method that accounts for selection effects and addresses statistical challenges across mass and redshift. (Published in Physical Rev D)

K-dynamics: Well-posed 1+1 Evolutions in K-essence using Implicit Solver
K-essence theories modify general relativity by introducing non-canonical kinetic terms for scalar fields, potentially explaining phenomena like inflation and dark energy. A key focus is ensuring the well-posedness of their field equations. I am currently developing an implicit finite difference scheme to study scalar field evolution in spherically symmetric spacetimes, aiming to demonstrate the well-posedness of specific K-essence models.. (Arriving soon)

Binary Vision: Merging Black Hole Binary Mass Distribution through Iterative KDE
Extending our KDE work, we develop a self consistent iterative reweighted KDE based on expectation maximization algorithm and use it to study two-dimensional mass distribution of binary black holes using observed GWs. We studied the correlation between the masses of binary compact objects and the astrophysical implications from these results. (Published 2023)

Estimate for Binary Black hole merger Population Distributions using Adaptive KDE
Utilizing a rapid and flexible adaptive bandwidth KDE, we reconstruct the mass distribution of LIGO-Virgo binary mergers based on parameter estimation outputs. Our findings exhibit comparability with established Bayesian hierarchical models, which assume a specific distribution form and are computationally more demanding. Additionally, we introduce a method for detecting and testing the significance of peaks in a distribution. (Published 2022)

Hybrid Waveforms for Precessing Binary Black Holes for Gravitational-Wave Data Analysis
Construct hybrid waveforms for precessing binary black holes, by combining post-Newtonian waveforms for the early inspiral phase with numerical relativity waveforms for the late inspiral to merger and post-merger phases. Our objective is to create extended hybrid waveforms of high accuracy, enabling precise parameter estimation for signals detected in current and upcoming gravitational wave (GW) observations. (Published 2020)

Assessing Analytical Spacetime Models: Comparing Evolution with Numerical Relativity in Binary Black Hole Systems
We introduced a novel technique for comparing the evolution of analytical spacetime models with their numerical relativity counterparts. The approach utilizes gauge-independent quantities associated with geodesic deviation to access the accuracy and limitation of analytical approximate models that have been used to study the dynamics of accretion disks around supermassive black hole binaries. (Published 2018)

LIGO Collaboration & LISA Research In addition, I also worked in the automation and enhancement of the PyGRB search pipeline as LIGO Scientific Collaboration member. Currently, I am engaged in a project utilizing the Simulation Based Inference (SBI) technique to develop a sophisticated detection pipeline tailored for LISA observations.

CONFERENCES & PRESENTATION

Invited Talk at Strong Gravity Group Seminar: Niels Bohr Institute Copenhagen, Denmark, January 31st, 2025
Talk: Looking To The Horizon: Hints of an Evolving Black Hole Spectrum with GWTC-3?

LISA Spain Meeting, October 15-16, 2024
Contributed Talk: Population Analysis of PopIII Massive Black hole Binaries with LISA using Iterative weighted KDE

The first TEONGRAV international workshop on the theory of gravitational waves, Sapienza Roma, September 16-20, 2024
Contributed Talk:Population Properties of Massive Binary Black hole with LISA observations Using Iterative Reweighted Kernel Density Estimation Technique

(Online) Amaldi15 conference on gravitational waves., July 17-21, 2023
Contributed Talk:Binary vision: The merging black hole binary mass distribution via iterative density estimation

LVK meeting Cardiff September 2022
Poster: Flexible and Fast Estimation of Binary Merger Population Distributions with Adaptive KDE

GWPAW 2021 December 14-17, 2021; Hannover, Germany
Poster: Flexible and Fast Estimation of Binary Merger Population Distributions with Adaptive KDE

(Online) Amaldi14 conference on gravitational waves., July 19-23, 2021
Poster: Flexible and Fast Estimation of Binary Merger Population Distributions with Adaptive KDE

(Online) 11th Iberian Gravitational Waves Meeting, June 9-11, 2021
Talk: Hybrid Waveforms for Precessing Binary Black holes for LIGO Data Analysis

APS April Meeting April 13-16, 2019; Denver, Colorado, USA
Talk: Hybrid Wave-forms for Precessing binary black holes for LIGO data analysis

APS April Meeting April 14-17, 2018; Columbus, Ohio, USA
Talk: A new tool to check the accuracy of Analytic Spacetimes for binary black holes

27th Midwest Relativity Meeting, October 12-14, 2017, Ann Arbor, MI, USA
Talk: Comparing Spacetimes using Geometric Scalars

21st International Conference on General Relativity and Gravitation, Columbia University July 10-15, 2016, New York, USA
Talk: Comparing Space-time using Geometric Scalars

WORKSHOPS

First AI-INFN Advanced Hackathon
 Nov 26-28, 2024, University of Padua, Complesso Paolotti, Italy

Emerging methods in GW population inference, June 24-27, 2024
 Institute for Fundamental Physics of the Universe, Via Beirut, 2, 34151 Trieste TS - Italy

10th Workshop on Collaborative Scientific Software Development and Management of Open Source Scientific Packages, November 6-17, 2023
ICTP, Trieste, Italy

European Einstein Toolkit School 2022, 29 August - 2 September, 2022
University College Dublin, Dublin, Ireland

(Online) Summer School in Statistics for Astronomers XVI, June 1–5, 2021
The Pennsylvania State University, USA

(Online) Current challenges in gravitational physics workshop, April 21-28, 2021
SISSA, Italy

(Online) Statistical Methods for the Detection, Classification, and Inference of Relativistic Objects November 16-20, 2020
Brown University in Providence, Rhode Island, USA

Computational Challenges in Gravitational Wave Astronomy, Jan 28 - Feb 1, 2019
University of California, Los Angeles (UCLA), CA, USA

North American Einstein Toolkit School and Workshop NCSA, July 31 - August 4, 2017
University of Illinois at Urbana Champaign, IL, USA

The Astrophysical Black Hole Merger Workshop VI, June 21-22, 2016
Organizing committee member
Center for Computational Relativity and Gravitation, RIT, Rochester, NY, USA

Caltech Gravitational Wave Astrophysics School 2015, July 6-10, 2015
California Institute of Technology, CA, USA

MENTORING AND TEACHING EXPERIENCE

Zainab Mangi (Sukkur IBA University), **supervised masters thesis** titled **Improved hybrid waveforms for generic precessing binary black holes**, 2023

Ifra Hassan, Nilo Cher, **co-advised, undergraduate students in summer program** at RIT on visualising two and three body Newtonian dynamics, 2018

Taught courses on **general relativity, quantum mechanics and computational physics** to advanced undergraduate students at Sukkur IBA University, 2019-2020.

PUBLIC OUTREACH

SISSA for Schools (S4S) volunteer at Trieste, Italy, 2023-2024

Public lecture on Astronomy and Stephen Hawking contributions to cosmology at Sukkur IBA University, Sukkur, Pakistan, 2019

Volunteer **World Science Festival** and served as **Science Ambassador for City of Science** event, New York, USA, 2017-2018.

Tutor **for Solar Eclipse** event RIT, Rochester, NY, 2018

Member of Astronomy Section Rochester Academy of Science (ASRAS) and took part in public outreach events 2016-2018

REFERENCES

Yosef Zlochower, Ph.D. advisor
Rochester Institute of Technology
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Thomas Dent, Postdoc mentor
University of Santiago de Compostela
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University of Santiago de Compostela
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Quaid-i-Azam University, Islamabad, Pakistan
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Lavinia Alberi Auber
VitalizeDx startup Trieste, Italy
Founder & CEO
laviniaa@vitalizedx.ch

A. SELECTED SENIOR-AUTHOR PUBLICATIONS

1. Seeking Spinning Subpopulations of Black Hole Binaries via Iterative Density Estimation
   Jam Sadiq, Thomas Dent, Ana Lorenzo **arXiv: 2506.02250 (2025)**
   DOI: Submitted to Physical Review D

2. Looking To The Horizon: Probing Evolution in the Black Hole Spectrum With GW Catalogs
   Jam Sadiq, Thomas Dent, Ana Lorenzo **arXiv: 2502.06451 (2025)**
   DOI: Published in Physical Review D

3. Reconstructing the LISA massive black hole binary population via iterative kernel density estimation
   Jam Sadiq, Kallol Dey, Thomas Dent, Ennrico Barausse **Phys.Rev.D 111 (2025) 6, 063051**
   DOI: Published in Physical Review D

4. Binary vision: The merging black hole binary mass distribution via iterative density estimation
   Jam Sadiq, Thomas Dent, Mark Gieles, **ApJ 960 65 (2023)**
   DOI: Published in Astrophysical Journal

5. General-relativistic precession in a black-hole binary
   Hannam, M., Hoy, C., Thompson, J.E. et al. , **Nature 610, 652–655 (2022)**
   DOI: https://doi.org/10.1038/s41586-022-05212-z

6. Flexible and Fast Estimation of Binary Merger Population Distributions with Adaptive KDE
   Jam Sadiq, Thomas Dent, Daniel Wysocki, **Phys.Rev.D105 (2022) 12, 123014**, arXiv e-Print 2112.12659
   DOI: https://journals.aps.org/prd/abstract/10.1103/PhysRevD.105.123014

7. Hybrid waveforms for generic precessing binaries for gravitational-wave data analysis
   Jam Sadiq, Yosef Zlochower, Richard O'Shaughnessy, Jacob Lange, **Phys.Rev.D102 (2020) 2, 024012**, arXiv e-Print 2001.07109
   DOI: https://doi.org/10.1103/PhysRevD.102.024012

8. Comparing an analytical spacetime metric for a merging binary to a fully nonlinear numerical evolution using curvature scalars
   Jam Sadiq, Yosef Zlochower, Hiroyuki Nakano, **Phys.Rev.D97 (2018), 084007**, arXiv e-Print 1802.02990 [gr-qc]
   DOI: https://doi.org/10.1103/PhysRevD.97.084007

B. COLLABORATION PUBLICATIONS

These are some of my LIGO and Virgo scientific collaboration publication that I contributed.

1. GWTC-4.0: Population Properties of Merging Compact Binaries
   LIGO Scientific and Virgo, and KAGRA Collaborations, arXiv e-Print 2508.18083,
   https://arxiv.org/abs/2508.18083

2. Observation of Gravitational Waves from the Coalescence of a 2.5-4.5 $M_\odot$ Compact Object and a Neutron Star
   LIGO Scientific and Virgo, and KAGRA Collaborations, **Astrophys. J. Lett 970, L34** (2024), arXiv e-Print 2404.04248,
   DOI: https://iopscience.iop.org/article/10.3847/2041-8213/ad5beb

3. A Joint Fermi-GBM and Swift-BAT Analysis of Gravitational-wave Candidates from the Third Gravitational-wave Observing Run
   LIGO Scientific and Virgo and KAGRA Collaborations and Fermi Gamma-Ray Burst Monitor Team, **Astrophys. J. 964, 149** (2024), arXiv e-Print 2308.13666,
   DOI: https://iopscience.iop.org/article/10.3847/1538-4357/ad1eed

4. Search for Gravitational Waves Associated with Gamma-Ray Bursts Detected by Fermi and Swift During the LIGO-Virgo Run O3b
LIGO Scientific and Virgo Collaborations, R. Abbott(LIGO Lab., Caltech) et al., **Astrophys. J. 928 , 186** (2022), arXiv e-Print 2111.03608,
DOI: https://iopscience.iop.org/article/10.3847/1538-4357/ac532b

5. Population of merging compact binaries inferred using gravitational waves through GWTC-3
LIGO Scientific and Virgo Collaborations, R. Abbott(LIGO Lab., Caltech) et al., **Phys.Rev.X 13** (2023) 1, 011048
DOI: https://journals.aps.org/prx/abstract/10.1103/PhysRevX.13.011048

6. GWTC-2: Compact Binary Coalescences Observed by LIGO and Virgo During the First Half of the Third Observing Run
LIGO Scientific and Virgo Collaborations, R. Abbott(LIGO Lab., Caltech) et al. **Phys.Rev.X.11 (2021) 021053**, arXiv e-Print 2010.14527 [gr-qc]
DOI: https://doi.org/10.1103/PhysRevX.11.021053

7. Gravitational-wave Constraints on the Equatorial Ellipticity of Millisecond Pulsars
LIGO Scientific and Virgo Collaborations, R. Abbott(LIGO Lab., Caltech) et al., **Astrophys.J.Lett. 902 (2020) 1, L21**, arXiv e-Print 2007.14251 [astro-ph.HE]
DOI: 10.3847/2041-8213/abb655

8. All-sky search in early O3 LIGO data for continuous gravitational-wave signals from unknown neutron stars in binary systems
LIGO Scientific and Virgo Collaborations, R. Abbott(LIGO Lab., Caltech) et al., **Phys.Rev.D 103 (2021) 6, 064017**, arXiv e-Print 2012.12128 [gr-qc]
DOI: 10.1103/PhysRevD.103.064017

9. Search for intermediate mass black hole binaries in the third observing run of Advanced LIGO and Advanced Virgo
LIGO Scientific and Virgo Collaborations, R. Abbott(LIGO Lab., Caltech) et al., **Astron.Astrophys**. 659 (2022) A84
https://doi.org/10.1051/0004-6361/202141452

10. Search for Gravitational Waves Associated with Gamma-Ray Bursts Detected by Fermi and Swift During the LIGO-Virgo Run O3a
LIGO Scientific and Virgo Collaborations, R. Abbott(LIGO Lab., Caltech) et al., arXiv e-Print 2010.14550 [astro-ph.HE] **submitted in ApJ**
https://arxiv.org/abs/2010.14550