

Al for New Messengers Postdoctoral Fellow · Gravitational Wave Astronomy & Data Analysis · Machine Learning

Department of Physics and Astronomy, Data Science Institute, Vanderbilt University

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Educational Qualification

AI for New Messengers Postdoctoral Fellow

Tennessee, USA

VANDERBILT UNIVERSITY

Dec. 2023 - now

· Joint fellowship by the Department of Physics and Astronomy and Data Science Institute at Vanderbilt University

PhD in Physics Perth, Australia

THE UNIVERSITY OF WESTERN AUSTRALIA

Feb 2020 - Nov 2023

Thesis title: Enabling rapid discovery of gravitational waves using machine learning.
 Supervisors: Prof. Linqing Wen, Prof. Amitava Datta.

M.Sc. in Physics | List of courses

Kolkata, India

PRESIDENCY UNIVERSITY

2016 - 2018

• Thesis title: Dark matter self interaction and its impact on large scale structures. **Supervisors:** Prof. Debashish Majumdar, Prof. Suchetana Chatterjee.

B.Sc. (with Hons.) in Physics | List of courses

Kolkata, India

PRESIDENCY UNIVERSITY

• Thesis title: The Hertzsprung-Russell diagram of stars in the SDSS Stripe-82 Catalog.

Supervisor: Prof. Saumyadip Samui

2013 - 2016

Research Interests

My research focuses on developing foundational AI models to improve the sensitivity of gravitational-wave searches, parameter estimation, and detector characterization, thereby enabling the discovery of new types of signals and providing robust insights into the physics of compact objects and the early universe. Some of the projects I have developed are:

Detection

We have developed **GW-Whisper** the first cross-domain application of OpenAl's Whisper model to gravitational waves, demonstrating that with minimal fine-tuning, pre-trained large audio transformers can be adapted for gravitational wave searches and glitch classification.

Waveform Reconstruction

We have developed **AWaRe** or Attention-boosted Waveform Reconstruction network, a neural network for reconstructing gravitational wave signals from LIGO data, enhancing signal fidelity even in noisy or glitchy environments, and generalizing to unseen waveform features like eccentricity.

Sky Localization

During my PhD, I developed **GW-SkyLocator**, the first deep-learning model for estimating the sky-position distributions of all types of compact binary mergers, including pre-merger localization of binary neutron star systems, enabling rapid electromagnetic follow-up.

Notable Publications

Total: 12 | First author: 9 | Non-First Author: 3. For a full list of my publications, please visit this link.

"Reconstruction of Binary Black Hole Harmonics in LIGO Using Deep Learning"

The Astrophysical Journal

CHAYAN CHATTERJEE AND KARAN JANI

ApJ 969 25 (2024)

- We demonstrate a deep-learning model (AWaRe) that reconstructs binary black hole signals including precession and higher-order harmonics from real LIGO data with high fidelity, achieving overlaps of 0.85–0.98 on real events relative to both modeled and unmodeled benchmarks.
- We follow this work with an enhanced version of AWaRe that not only reconstructs binary black hole signals from real LIGO data including unseen features like eccentricity, high masses, and extra harmonics, but also estimates uncertainty in its reconstructions which align with benchmark methods like BayesWave and coherent WaveBurst. The paper can be found here.

"No Glitch in the Matrix: Robust Reconstruction of Gravitational Wave Signals under Noise Artifacts"

The Astrophysical Journal

ApJ 982 102 (2025)

Chayan Chatterjee and Karan Jani

• We show that using the AWaRe network, gravitational wave signals can be accurately reconstructed even when the data contains noise transients or glitches— even without explicitly training the network on glitches. We validated on real LIGO O3 events (like GW191109 & GW200129), and demonstrating that the residuals align with background noise.

"Rapid Localization of Gravitational Wave Sources from Compact Binary Coalescences Using Deep Learning"

The Astrophysical Journal

CHAYAN CHATTERJEE, MANOJ KOVALAM, LINQING WEN, DAMON BEVERIDGE, FOIVOS DIAKOGIANNIS, AND KEVIN VINSEN

ApJ 959 42 (2023)

- We propose GW-SkyLocator, a normalizing flow-based deep learning method that produces accurate sky localization posteriors for all types of compact binary coalescences orders of magnitude faster than traditional Bayesian techniques.
- In a follow-up work, we show that GW-SkyLocator performs sky-localization of binary neutron star mergers 0-60 seconds before merger, achieving comparable localization areas to BAYESTAR at vastly reduced computational latency. The paper can be found here.

Scholarships, Awards & Grants_

2023	Winner , AI for New Messengers Postdoctoral Fellowship	Vanderbilt U.
2022	Winner, Best Student Talk, Australian Mathematical Sciences Institute Summer School	AMSI
2022	2nd Place , J-P Macquart Best Student Talk Award, Australian National Institute for Theoretical Astrophysics	ANITA
2022	Winner, UWA Postgraduate Student Association Travel Award	UWA
2022	Winner, OzGrav Travel Award	OzGrav
2022	2nd Place, UWA Postgraduate Student Association Research Week Best Talk Award	UWA
2021	Winner, J-P Macquart Best Student Talk Award, Australian National Institute for Theoretical Astrophysics	ANITA
2021	Winner, OzGrav Outreach Superstar Award (Western Australia)	OzGrav
2021	Finalist, FameLab, International Science Communication Competition	FameLab, WA
2020	Winner, Scholarship for International Research Fees and Living Allowance	UWA
2020	Winner, University of Western Australia Three Minute Thesis (3MT) Competition	UWA
2020	People's Choice Award, University of Western Australia Three Minute Thesis (3MT) Competition	UWA
2020	Finalist, Matariki Network of Universities (MNU) Three Minute Thesis Competition	International
2017	Winner, IISER Thiruvananthapuram Visiting Research Student Fellowship	IISER-TVM

Selected Presentations

For a full list of presentations, please see this link.

Invited Talk: Department of Astronomy Seminar
Multimessenger Astronomy in the Era of Foundational Al

Presidency U., Kolkata

Oct. 2025

Invited Talk: Department of Physics Weekly Seminar

TOWARDS A FOUNDATIONAL AI MODEL FOR GRAVITATIONAL WAVES

U. of Western Australia, Perth Mar. 2025

Invited Talk: Institute for Gravitational Research Seminar

U. of Glasgow, Glasgow

RECONSTRUCTION & PARAMETER ESTIMATION OF GRAVITATIONAL WAVES USING DEEP LEARNING

May 2024

Invited Talk: Gravitational Wave Astronomy Group Seminar

Monash U., Melbourne

RAPID SKY LOCALIZATION & WAVEFORM EXTRACTION OF GRAVITATIONAL WAVES USING DEEP LEARNING

Mar. 2023

Invited Talk: Center for Gravitation, Cosmology and Astrophysics Seminar

U. of Wisconsin, Milwaukee

RAPID SKY LOCALIZATION & WAVEFORM EXTRACTION OF GRAVITATIONAL WAVES USING DEEP LEARNING

Invited Talk: Department of Physics seminar talk

Western Sydney University, Sydney

DENOISING AND PARAMETER ESTIMATION OF GRAVITATIONAL WAVES USING DEEP LEARNING

Aug. 2021

Feb. 2023

Major Positions of Responsibility_

ACADEMIC SERVICES

Present	Journal Referee, Nature Scientific Reports, Nature Communications Physics, International Journal of	2020 - now
	Modern Physics D, Astrophysics and Space Science, Science China Physics, Mechanics and Astronomy.	
Present	Review Chair, LIGO Data Quality Report	2024 - now
2025	Organizing Committee , Multimessenger Astronomy in the Era of Foundational Al Workshop, Vanderbilt U.	2025
2024	Chair , OzGrav Gravitational Wave Inference Research Program	2023-2024
2022	Core Committee Member, Australian National Institute for Theoretical Astrophysics	2021-2022
2021	Organizing Committee, UWA Research Week	2020-2021
TEACHIN	ig & Mentoring	
Present	Research Mentor , Mentored/Supervised 12 undergraduate & graduate students at UWA and Vanderbilt U.	2020 - now
Present	Guest Lecturer, Black Holes in Our Universe (ASTR-2190), Vanderbilt University	2024 - now
2023	Lecturer , Gravitational Wave Astronomy (PHYS4420), University of Western Australia.	2022 - 2023
2023	Teaching Facilitator , Our Universe (SCIE1121), University of Western Australia.	2020 - 2023
SCIENCE	OUTREACH	
2024	Presenter, Astronomy on Tap - Nashville	Nashville
2024	Judge , Visualize Your Thesis Competition, The University of Western Australia	Perth
2021-24	Mentor, UWA Three Minute Thesis Competition	Perth
2022	Presenter, Pint for Science, Australia	Perth
2021	Invited Guest, Podcast, "Curiosity Killed the Rat"	Online
2021	Invited Guest, Podcast, "Astrophiz: An Astronomy Podcast"	Online
2021	Invited Guest, Perth Fringe Festival Talk Show, "The Uncertainty Principle Presents: Science After Dark"	Perth
ORGANI	zational & Advocacy	
Present	Fisk-Vanderbilt Bridge Program, Mentoring underrepresented minorities in astronomy	2024 - now
2022	Early Career Researcher Representative, OzGrav, Nominated member from UWA node	2021 - 2022

Technical Skills__

2022

2021

Machine Learning Proficient in PyTorch, TensorFlow and Keras

Mentor & Organizer, NASA Space Apps Challenge, Perth

Programming Proficient in Python. Working knowledge of R, IDL, FORTRAN and HTML.

Postgraduate Student Association, UWA Student Guild, Elected Research Representative

HPC Computing Have used multiple large HPC facilities. Proficient in SLURM, HTCondor schedulers.

Software Development Proficient in Git, GitHub, GitLab.

Scientific Collaborations

LIGO-Virgo-KAGRA CollaborationMember since 2019.American Astronomical SocietyMember since 2023.American Physical SocietyMember since 2020.

OzGrav Member from 2019-2023.

Astronomical Society of Australia Member from 2020-2023. **Australian Institute of Physics** Member from 2020-2023. 2021-2022

2020 - 2021