Chayan Chatterjee, PhD

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

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

chayan.chatterjee@vanderbilt.edu | chayanchatterjee.com | 0000-0001-8700-3455 | chayanchatterjee

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

2013 - 2016

- **Thesis title:** The Hertzsprung-Russell diagram of stars in the SDSS Stripe-82 Catalog.
  Supervisor: Prof. Saumyadip Samui

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 OpenAI'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.

Recent Publications

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

"Pre-trained Audio Transformer as a Foundational AI Tool for Gravitational Waves"

Under review in Nature Communications Physics.

ArXiv: 2412.20789 (2024)

Chayan Chatterjee, Abigail Petulante, Yang Hu, Roy Lau, Suyash Deshmukh, Haowei Fu, Trang Hoang, Stephen Chong Zhao, Jesse Spencer-Smith, Karan Jani

- Introduced GW-Whisper, which fine-tunes the encoder of OpenAI's Whisper (pre-trained on generic audio) for detecting gravitational-wave signals and classifying transient noise artifacts ("glitches"). This work demonstrates that adapting audio foundational transformer models via parameter-efficient fine-tuning and transfer learning yields reliable, scalable tools that generalize well as detection rates rise.

"Machine Learning Confirms GW231123 is a 'Lite' Intermediate-Mass Black Hole Merger" *Under review in The Astrophysical Journal Letters.*

Chayan Chatterjee, Kaylah McGowan, Suyash Deshmukh and Karan Jani *ArXiv: 2509.09161 (2025)*

- Confirmed GW231123 as a "lite" intermediate-mass black hole merger (≈ 190–265 $M_\odot$) using combined machine learning methods (GW-Whisper, ArchGEM, AWaRe). This work characterizes the scattered-light glitch close to the event, performs model-agnostic waveform reconstruction that shows signs of unmodeled physics, and demonstrates high-fidelity reconstructions in simulated 100–1000 $M_\odot$ mergers.

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

Chayan Chatterjee and Karan Jani *ApJ 982 102 (2025)*

- 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.

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 *Presidency U., Kolkata*

Multimessenger Astronomy in the Era of Foundational AI *Oct. 2025*

Invited Talk: Department of Physics Weekly Seminar *U. of Western Australia, Perth*

Towards a Foundational AI Model for Gravitational Waves *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 *Feb. 2023*

Invited Talk: Department of Physics seminar talk *Western Sydney University, Sydney*

Denoising and Parameter Estimation of Gravitational Waves Using Deep Learning *Aug. 2021*

Major Positions of Responsibility

Academic Services

Present	**Journal Referee**, Nature Scientific Reports, Nature Communications Physics, International Journal of Modern Physics D, Astrophysics and Space Science, Science China Physics, Mechanics and Astronomy.	*2020 - now*
Present	**Review Chair**, LIGO Data Quality Report	*2024 - now*
2025	**Organizing Committee**, Multimessenger Astronomy in the Era of Foundational AI 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*

Teaching & 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*

Organizational & 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*
2022	**Mentor & Organizer**, NASA Space Apps Challenge, Perth	*2021-2022*
2021	**Postgraduate Student Association, UWA Student Guild**, Elected Research Representative	*2020 - 2021*

Technical Skills

Machine Learning	Proficient in PyTorch, TensorFlow and Keras
Programming	Proficient in Python. Working knowledge of R, IDL, FORTRAN and HTML.
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 Collaboration	Member since 2019.
American Astronomical Society	Member since 2023.
American Physical Society	Member since 2020.
OzGrav	Member from 2019-2023.
Astronomical Society of Australia	Member from 2020-2023.
Australian Institute of Physics	Member from 2020-2023.