Sachin Venkatesh Thakku Saravana, PhD Candidate

404-706-9018 • tssachin.venkatesh@gmail.com • centarsirius.github.io • LinkedIn • Google Scholar

EDUCATION

Northwestern University — Evanston, IL
Ph.D. Physics (Advisor: Alexander Tchekhovskoy) — Secondary Field: AI for Science — *Expected 2028*

Georgia Institute of Technology — Atlanta, GA
M.S. Computational Science & Eng.; M.S. Physics (Advisor: Matthew Liska, Ph.D. transferred) — *May 2025*

Delhi Technological University — Delhi, India
B.Tech. Engineering Physics (Minor in Space and Atmospheric Sciences) — *May 2022*

TECHNICAL SKILLS & COURSEWORK

Programming & HPC: Python, C/C++, CUDA, MPI, R, SQL, Bash, Linux, Git, Slurm, MATLAB, LaTeX

ML & Data Infrastructure: PyTorch, JAX, TensorFlow, Hugging Face, Unsloth, Snowflake, PySpark, Teradata, Flask

Methods & Domains: Numerical Simulations, Neural Operators, Physics-Informed ML, Autoregressive Time-Series Forecasting, Super-Resolution, LLMs / LoRA, Bayesian Inference (GMM, BIC, MCMC)

Relevant Coursework: High Performance Computing; Modeling & Simulation; Data Structures & Algorithms; Computational Data Science & Analysis; Theory & Algorithms for LLMs; Probability & Statistics

EXPERIENCE

Graduate Researcher, Northwestern University — *Jun 2025 – Present*

- Developing **TRON**, a physics-constrained hybrid U-shaped Neural Operator surrogate replacing $\mathcal{O}(N \log N)$ curved-spacetime 3D GRMHD simulations with $\mathcal{O}(N)$ autoregressive rollouts, forecasting up to 40× faster than GPU solvers.
- Engineered a multi-worker MPI preprocessing and multi-node PyTorch DDP (NCCL) training pipeline with activation checkpointing and rank-synchronized NaN gradient guards over thousands of GRMHD states on GH200 GPU clusters.
- Designed topology-matched cylindrical/spherical boundary padding, 3D FFT spectral bottlenecks (`rfftn`, `irfftn`), Kerr metric injection, closed-form Lorentz clamping, a 9-objective homoscedastic physics loss, and detached unrolled curriculum training—cutting parameters $\sim$10× (170M → 17.9M) across stable multi-step forecasts (paper in prep; live demos on centarsirius.github.io).
- Contributed to analytic binary black-hole spacetime metric development for H-AMR.

Graduate Researcher, Georgia Institute of Technology — *Sep 2023 – May 2025*

- Prototyped physics-informed state reconstruction architectures (`CoordResVAE` and neural-operator baselines) to reduce spatial resolution and compute cost of turbulent 3D GRMHD simulations.
- Built curved-spacetime normalization, bound validation, and physical validity suites adopted in **TRON**.

Data Engineer, Genpact — *Jul 2022 – Jun 2023*

- Built production-scale automated data lakes and ETL pipelines (Snowflake, SQL, PySpark, Teradata) powering high-volume enterprise analytics workflows.
- Architected and shipped a full-stack (frontend + backend) legacy-DB-to-Snowflake automated migrator achieving a 17× query runtime speedup.

Research Intern, National Astronomical Observatory of Japan (NAOJ) — *May 2022 – Aug 2023*

- Modeled Swift-BAT and BATSE gamma-ray burst optical/X-ray plateau catalogs using Gaussian Mixture Models with Bayesian Information Criterion (GMM+BIC in R) across 10+ physical classes.
- Co-authored peer-reviewed classification study (*MNRAS* 525) establishing robust multi-wavelength plateau clusters for time-domain astrophysics.

Undergraduate Researcher, University of Delhi (DU IoE Project) *Nov 2021 – Dec 2022*

- Contributed to an INR 800,000 grant-funded radio astronomy lab (*Peering into the Radio Universe*), designing and fabricating low-frequency antenna hardware and RF receiver signal-conditioning electronics.

Summer Intern, Center for Computational Astrophysics (Flatiron Institute) *May 2021 – Aug 2021*

- Analyzed ∼100 TB-scale IllustrisTNG dark-matter halo merger trees via time-series ML to test self-similarity scaling across parallel cosmological trajectories.

Team Lead — Fluid Mechanics, Delhi Technological University *Feb 2020 – May 2022*

- Led student team benchmarking physics-aware deep super-resolution and ML inference for spatio-temporal upscaling of forced isotropic turbulence; earned ASME IMECE2021 talk & proceedings, ASME Applied-ML Honorable Mention, and DeepAI Special Mention.

PUBLICATIONS

- **In Prep: Venkatesh** et al., "Physics-constrained Hybrid (2+1)D U-NO for autoregressive forecasting of 3D GRMHD accretion on curved spacetime" (Target: *PRL/PRD*, 2026).
- Bhardwaj, Dainotti, **Venkatesh** et al. 2023, "GRB optical and X-ray plateau properties classifier using unsupervised machine learning," *MNRAS* 525(4), 5204–5223.
- **Venkatesh** & Pundir 2022, "PERISTOLE: Package that generates time delay plots caused by gravitational lensing," *Res. Notes AAS* 6, 255 (Zenodo | Website).
- **Venkatesh**, Bhatt et al. 2021, "A comparative study of various deep learning techniques for spatio-temporal super-resolution reconstruction of forced isotropic turbulent flows," *ASME IMECE2021-69923*.

SELECTED TALKS & POSTERS

- **Chicagoland AI+Cosmology Workshop**, Fermilab [Talk] Aug 2026
- **Bridging Scales Workshop, Black Hole Initiative**, Harvard [Talk] Mar 2026
- **UChicago & Caltech AI+Science Conference 2026**, UChicago [Poster] Oct 2026
- **OpenSKAI Conference**, SKAI, Northwestern [Poster] Sep 2025, Sep 2026
- **IAIFI Summer School & Workshop**, Harvard & MIT [Lightning Talk] Aug 2025
- **ASME International Mechanical Engineering Congress & Exposition**, IMECE [Talk] Nov 2021
- **NANOGrav Fall Meeting** [Poster] Oct 2021

LEADERSHIP, TEACHING & SERVICE

- **Mentor**, NASA Space Apps Challenge (Chicago) Nov 2026
- **Reviewer**, PEARC: Systems and Systems Software May 2025
- **Mentor & Teaching Assistant (Parallel Programming)**, Code/Astro, Northwestern Jul 2024
- **Graduate Teaching Assistant**, Northwestern & Georgia Tech 2023–2026
- **Mentor**, Major League Hacking Jan 2021

AWARDS & HONORS

- IAU Symposium 377 Monsoon School Scholarship 2023
- ASME Honorable Mention in "Applied ML" (IMECE) 2022
- Delhi University Institute of Eminence (IoE) Radio Astronomy Lab Grant (INR 800,000) 2022
- PyData Global Impact Scholar 2022
- SciPy Conference Scholar 2021
- DeepAI Special Mention for Novel Work in Super-Resolution 2021