Application

HSF-India: Gravitational Wave Physics Project at the University of Minnesota

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Host University and Advisor

I have the opportunity to work with Prof. Michael Coughlin's group at the Department of Physics and Astronomy, University of Minnesota, United States, as a visiting student for my Master's thesis. This collaboration will allow me to work closely with the group on gravitational-wave astronomy, with access to their research environment, computational resources, and collaborative infrastructure.

I plan to work with the group for approximately 4 months, between September 1, 2026 and January 8, 2027. I will be working under the direct supervision of Dr. Argyro Sasli, a postdoctoral researcher in the group, with overall guidance from Prof. Michael Coughlin.

The research group works broadly in gravitational-wave data analysis, including statistical inference, detector characterization, and the development of advanced analysis frameworks.

Being part of this research environment will allow me to engage directly with ongoing developments in gravitational-wave analysis, gain hands-on experience with collaborative software projects, and contribute meaningfully to the group's efforts while further strengthening my research and technical skills.

Project Overview

Many traditional algorithms in gravitational-wave (GW) astronomy assume that the detector noise is Gaussian and well known. However, this assumption is often violated due to the presence of instrumental glitches, sub-threshold overlapping signals, and uncertainties in the estimated power spectral density (PSD) of the noise. In Sasli et al. (2025,2026) (3) (2) , a new statistical framework was developed to address these limitations through the introduction of a hyperbolic likelihood, which relaxes the strict Gaussian assumption and provides a more flexible description of the noise properties in GW detectors. This approach naturally accommodates non-Gaussian features in the data and allows for corrections related to PSD uncertainties and unresolved signals. The results demonstrate that the hyperbolic likelihood more accurately captures the true statistical behavior of the detector noise, offering a physically motivated alternative for GW data analysis in current and next-generation detectors.

My work will focus on accelerating the computational performance of the HyperWave framework by integrating utilities from the `ML4GW` library (1), which provides GPU-accelerated tools for gravitational-wave data analysis, including waveform generation. The goal is to develop efficient and scalable workflows to significantly reduce the computational cost of parameter estimation, potentially improving performance by up to an order of magnitude.

Financial Support

The major expense categories include airfare, accommodation, food, groceries, daily commute, household items, health insurance, and miscellaneous costs.

Category	**Cost**
Accommodation + Utilities	4 x \$1200
Food & groceries	4 x \$500
Daily needs, local transportation, communication plans	4 x \$400
Insurance (tentative)	4 x \$320
Monthly Total	**4 x \$2,420**
Additional One-Time Costs	
Airfare (KOL $\leftrightarrow$ MSP)	-
J1 Visa (SEVIS + Application Fee)	\$405

Conclusion

I remain highly interested in contributing to the development of efficient and scalable gravitational-wave inference pipelines, particularly through the integration of GPU-accelerated tools within the HyperWave framework. This work will help me better understand how advanced statistical approaches and modern computational techniques come together to enhance data analysis in realistic, non-Gaussian detector environments.

I am strongly motivated to make meaningful contributions to the gravitational wave physics which will further help advance the data analysis of gravitational waves, detected by present and future gravitational wave detectors.

References

[1] Benoit et al. https://doi.org/10.21105/joss.08836.

[2] Sasli et al. https://arxiv.org/abs/2305.04709.

[3] Sasli et al. https://arxiv.org/abs/2602.22074.

[4] ml4gw: Machine learning for gravitational waves. `https://github.com/ML4GW/ml4gw`.