## Characterizing, Not Just Detecting: Bayesian Neural Networks for Gravitational-Wave Physics

Wednesday 28 May 2025 15:06 (12 minutes)

Gravitational waves provide a powerful means to perform null tests of strong-gravity physics. Statistical methods based on hierarchical inference, adapted from population studies, have been developed to confidently identify potential signatures of new physics. While these methods are well-suited for detection, they provide limited insight into how exotic physics depends on standard degrees of freedom, such as the mass and spin of an observed black hole. In this talk, we present an extension of hierarchical tests that enables the modeling of such dependencies in a flexible and theory-agnostic manner using fully connected neural networks. Additionally, we incorporate Bayesian neural networks and variational inference to model epistemic uncertainty in the network weights, optimizing the hierarchical population likelihood. Finally, we also discuss an alternative optimization strategy based on Gaussian Process Regression.

Author: PACILIO, Costantino

**Co-author:** BUSCICCHIO, Riccardo

Presenter: PACILIO, Costantino

Session Classification: Observational Science (OSB)

Track Classification: Observational Science (OSB): Div9