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Bayesian Calibration of Gravitational-Wave Detectors Using Null Streams Without Waveform Assumptions

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Gravitational-wave (GW) astronomy has revolutionized our understanding of the universe, but the precision of its discoveries hinges on the accurate calibration of GW detectors. In this talk, we present a novel Bayesian null-stream method for self-calibration of closed-geometry GW detector networks, such as the Einstein Telescope (ET) and LISA. Unlike traditional approaches that rely on electromagnetic counterparts or waveform models, our method leverages sky-independent null streams to constrain calibration errors using GW signals alone, independent of general relativity or waveform assumptions. We demonstrate the feasibility of this approach through proof-of-concept studies, showing that calibration constraints improve linearly with increasing signal-to-noise ratio and the presence of multiple overlapping signals. This method has the potential to enable robust parameter estimation, early-warning alerts, and cosmological studies, particularly for next-generation detectors.

Authors: VAN DEN BROECK, Chris; WONG, Chun-Fung (KU Leuven); CIREDDU, Francesco; NAROLA, Harsh; WILS, Milan; LI, Tjonnie

Presenter: WONG, Chun-Fung (KU Leuven)

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