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Phenomenology: Spectrogram correlated stacking: A time-frequency domain analysis of the Stochastic Gravitational Wave Background

Tuesday, September 5, 2023 5:00 PM (15 minutes)

The stochastic gravitational wave background (SGWB) originates from numerous faint gravitational wave (GW) signals arising from coalescing compact binary objects. Based on the currently estimated merger rate, where the binary merger events are Poisson-distributed at any instance, the SGWB signal is expected to originate from non-overlapping GW signals. Current efforts to detect this signal involve cross-correlating the strain from multiple detectors in a generic way. In this talk, we present a novel technique, Spectrogram Correlated Stacking (or SpeCs), which goes beyond the usual cross-correlation (and to higher frequencies) by exploiting the higher-order statistics in the time-frequency domain. This method would account for the chirping nature of the individual events that comprise SGWB and enable us to extract more information from the signal due to its intrinsic non-gaussianity. We show that SpeCs improve the signal-to-noise for the detection of SGWB by a factor close to 8, compared to standard optimal cross-correlation methods which are tuned to measure only the power spectrum of the signal. SpeCs can probe beyond the power spectrum and its application to the GW data available from the current and next-generation detectors would speed up the SGWB discovery.

Presenter: DEY, Ramit (Western University, perimeter institute)

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