Enhancing Gravitational Wave Data Analysis for the Einstein Telescope

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Abstract

Gravitational waves, spacetime ripples from cataclysmic events like black hole mergers, reveal the universe's secrets. The Einstein Telescope (ET), a third-generation detector, will capture these signals with unmatched precision, but data analysis challenges persist. This talk explores these challenges and our recent studies to address them. Unlike the distant detectors in the LIGO-Virgo-KAGRA network, ET's closely spaced detectors are prone to correlated seismic noise, requiring specialized analysis. We developed a likelihood framework to model this noise correlation, demonstrating biases in parameter estimation, such as black hole masses, if unaccounted for. By comparing detector networks, we found that properly modeled noise correlation does not always degrade parameter estimation. We also leveraged ET's unique null stream, where summed data streams cancel signals, to isolate and subtract transient glitches - noise bursts detrimental to analysis. Finally, I will also discuss applying the null stream to reduce detector calibration errors, ensuring measurement accuracy critical for ET's sensitivity.