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Impact of Correlated Noise on Third-Generation Gravitational-Wave Detectors: Biases in Parameter Estimation and Design Performance

Wednesday 8 May 2024 12:00 (15 minutes)

In-depth understanding of correlated noise effects is critical for optimizing third-generation gravitational-wave detectors such as the Einstein Telescope. This presentation unfolds in two parts. In the first part, we explore the statistical formulation of the likelihood function, integrating correlated noise into parameter estimation for detector networks. Our analysis demonstrates that disregarding noise correlations can significantly compromise parameter estimation, resulting in significant biases in maximally correlated networks. These insights underscore the necessity of precise noise modelling to fully leverage the capabilities of next-generation detectors. The latter part of the talk evaluates colocated versus non-colocated detectors, using hypothetical scenarios with two L-shaped European detectors, and further analyses including a US detector. We present results showing that the colocated configuration, despite challenges in estimating extrinsic parameters, achieves improved accuracy in intrinsic parameter estimation when noise correlation is considered. With the addition of a US detector, the colocated configuration performs better than the non-colocated configuration in estimating extrinsic parameters in the highly correlated scenario, illustrating the non-trivial influence of noise correlations on detector performance and design. These findings emphasize the critical need for integrating noise correlation considerations into both the data analysis and design phases of third-generation gravitational wave detectors to ensure robust and accurate scientific discoveries

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