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Detection prospects of parity-violating gravitational waves in third-generation ground detectors

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We investigate the prospects for detecting a parity-violating gravitational-wave background with third-generation ground-based detector networks through an adapted theoretical approach combined with a data-based approach. We focus on a variety of networks consisting of an Einstein Telescope and two Cosmic Explorer detectors, varying the Einstein Telescope design, detector locations, orientations, and arm lengths to assess the impact of geometry and scale on detection capabilities. We show that the modified theoretical approach is an excellent proxy for parity violation detection and matches more robust data analysis strategies. We demonstrate that networks with an L-shaped Einstein Telescope design have stronger parity violation constraining power than networks with a triangular Einstein Telescope design, particularly seen when studying Einstein Telescope designs on their own. Our results underscore the critical role of detector configuration in probing parity violation in a gravitational-wave background.

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