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Gravitational Waves in f(R) Gravity for Curved Spacetimes

Following the detection of GW150914 by LIGO, General Relativity (GR) has solidified its status as a definitive theory of gravity. However, in certain regimes—particularly at high energies—modifications to the Einstein-Hilbert action have been proposed. Terms such as the Starobinsky correction (R^2), as well as higher-order contributions like R
$BoxR$, can robustly describe phenomena such as the inflationary phase of the universe's expansion. Typically, gravitational waves (GWs) are analyzed against a flat background. However, on cosmological scales, spacetime curvature can no longer be neglected. To address this, the shortwave approximation formalism is employed, allowing GWs to be studied in curved backgrounds. In this work, we investigate GW propagation in a general background within the framework of modified gravity, incorporating $f\left(R^2\right)$ terms to explore their implications.

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