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Chern-Simons gravitational term coupled to a scalar field during inflation

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Chern-Simons gravity is a modified gravity theory where a term like $f(\phi)C\tilde{C}$ is added to the Einstein-Hilbert Lagrangian. Here C symbolically labels the Weyl tensor, the trace-less part of the Riemann tensor. In this context ϕ can be both a scalar or a pseudo-scalar field and $f(\phi)$ is a generic scalar coupling function. Phenomenologically, it is interesting to study the effect of Chern-Simons gravity during inflation where we can identify the scalar field ϕ as the inflaton field. The result is that we have the production of primordial chiral gravitational waves, whose chirality is extremely small in the regime in which we avoid ghost field formation. Analysing also the implications to the bispectrum statistics of primordial perturbations, it is possible to point out that only the mixed $\langle\phi\gamma\gamma\rangle$ bispectrum takes a non negligible contribution. In particular, it is possible to show that, admitting a particular fine-tuning to the second order derivative of the coupling function $f(\phi)$, we could get a signature of this kind of modified gravity model through measurements of CMB primordial non-Gaussianities. However, a new interesting scenario can be identifying ϕ with an external scalar field χ different from the inflaton field. In this case we get a squeezed modulation of primordial gravitational waves chirality. This may enhance the 2-point function chirality, making it interesting for a possible detection through both CMB experiments and interferometers sensitive to the circular polarization of gravitational waves. In the talk I discuss Chern-Simons gravity and give the basic idea of this amplification mechanism.

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