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Generalizing the stochastic gravitational wave signal to Horndeski theories

In this work, we generalize to a viable Horndeski theory of gravity, the most general scalar-tensor theory that has second-order field equations in four dimensions, the expression of a statistically homogeneous and unpolarized stochastic gravitational wave background signal measured as the correlation between the individual signals detected by two not coincident and not coaligned GW interferometers. We also discuss an inconsistency between results found in literature regarding cosmological distances in modified theories, namely, the simultaneous validity of a duality-distance relation for gravitational wave signals and of the coincidence between the gravitational wave luminosity distance and amplitude distances. This discussion allows us to conclude that the spectral energy density of an astrophysical stochastic gravitational wave signal has the same functional dependence with the luminosity of each emitting source as in General Relativity. Using the generalized expression of the gravitational wave energy-momentum tensor and the modified propagation law for the tensorial modes, we conclude that, for any wave-packet, the energy density of gravitational waves maintain the same functional relation with the scale factor as in General Relativity.

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