Gravitational Waves About Curved Backgrounds: A Consistency Analysis In De Sitter Spacetime

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Abstract: The theory of gravitational waves is considered in the case of metric perturbations about a curved background metric, rather than the flat Minkowski metric. In this case, when the de Donder gauge is imposed, its preservation under infinitesimal spacetime diffeomorphisms is guaranteed if and only if the associated covector is ruled by a second-order hyperbolic operator which is the classical counterpart of the ghost operator in quantum gravity. In such a wave equation, the Ricci term has opposite sign with respect to the wave equation for Maxwell theory in the Lorenz gauge. We are nevertheless able to relate the solutions of the two problems, and the algorithm is applied to the case when the curved background geometry is de Sitter spacetime. We study such vector wave equations in two different ways, i.e. an integral representation or through a factorization of the solution of the hyperbolic equation. This is a step towards finding solutions of wave equations in de Sitter cosmologies.