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Semi-Analytic Calculation of Gravitational Wave Spectrum Induced from Primordial Curvature Perturbations

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Whether or not the primordial gravitational wave (GW) produced during inflation is sufficiently strong to be observable, GWs are necessarily produced from the primordial curvature perturbations in the second order of perturbation. The induced GWs can be enhanced by curvature perturbations enhanced at small scales or by the presence of matter-dominated stages of the cosmological history, both of which are motivated in primordial black hole scenarios to explain dark matter or the LIGO/Virgo event rate. We analytically calculate the integral in the expression of the power spectrum of the induced GWs which is a universal part independent of the primordial spectrum. This makes the subsequent numerical integrals significantly easy. In simple cases, we derive fully analytic formulae for the induced GW spectrum.

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