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Cosmological gravitational particle production of massive spin-2 particles

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The phenomenon of cosmological gravitational particle production (CGPP) is expected to occur during the period of inflation and the transition into a hot big bang cosmology. Particles may be produced even if they only couple directly to gravity, and so CGPP provides a natural explanation for the origin of dark matter. In this work we study the gravitational production of massive spin-2 particles assuming two different couplings to matter. We evaluate the full system of mode equations, including the helicity-0 modes, and by solving them numerically we calculate the spectrum and abundance of massive spin-2 particles that results from inflation on a hilltop potential. We conclude that CGPP might provide a viable mechanism for the generation of massive spin-2 particle dark matter during inflation, and we identify the favorable region of parameter space in terms of the spin-2 particle's mass and the reheating temperature. As a secondary product of our work, we identify the conditions under which such theories admit ghost or gradient instabilities, and we thereby derive a generalization of the Higuchi bound to Friedmann-Robertson-Walker (FRW) spacetimes.

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