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Primordial power spectrum from a matter-ekpyrotic bounce scenario in loop quantum cosmology

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A union of matter bounce and ekpyrotic scenarios is often studied in an attempt to combine the most promising features of these two models. Since nonperturbative quantum geometric effects in loop quantum cosmology (LQC) result in natural bouncing scenarios without any violation of energy conditions or fine tuning, an investigation of matter-ekpyrotic bounce scenario is interesting to explore in this quantum gravitational setting. In this work, we explore this unified phenomenological model for a spatially flat Friedmann-Lemaître-Robertson-Walker (FLRW) universe in LQC filled with dust and a scalar field in an ekpyrotic scenario like negative potential. Background dynamics and the power spectrum of the comoving curvature perturbations are numerically analyzed with various initial conditions and a suitable choice of the initial states. By varying the initial conditions we consider different cases of dust and ekpyrotic field domination in the contracting phase. We use the dressed metric approach to numerically compute the primordial power spectrum of the comoving curvature perturbations which turns out to be almost scale invariant for the modes which exit the horizon in the matter-dominated phase. But, in contrast with a constant magnitude power spectrum obtained under approximation of a constant ekpyrotic equation of state using deformed algebra approach in an earlier work, we find that the magnitude of power spectrum changes during evolution. Our analysis shows that the bouncing regime only leaves imprints on the modes outside the scale-invariant regime. However, an analysis of the spectral index shows inconsistency with the observational data, thus making further improvements in such a model necessary.

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