extended matter bounce scenario in ghost free $f(R,G)$ gravity compatible with GW170817. (English) Zbl 07396758

Summary: In the context of a ghost free $f(R,G)$ model, an extended matter bounce scenario is studied where the form of the scale factor is given by $a(t) = (a_0 t^2 + 1)^n$. The ghost free character of the model is ensured by the presence of a Lagrange multiplier, as developed in [S. Nojiri, S. D. Odintsov and V. K. Oikonomou, “Ghost-free Gauss-Bonnet theories of gravity”, Phys. Rev. D (3) 99, No. 4, 15 p. (2019; doi:10.1103/PhysRevD.99.044050)]. The conditions under which, in this model, the speed of gravitational waves becomes equal to the speed of light (equal to one, in natural units), thus becoming compatible with the striking event GW170817, is investigated. It is shown that this happens for a class of Gauss-Bonnet (GB) coupling functions ($h(t)$) which satisfies a constraint equation of the form $\ddot{h} = \dot{h} H$, with $H$ the Hubble parameter. This constraint is then imposed on the ghost free $f(R,G)$ gravity theory to be consistent with the GW170817 event, subsequently, the corresponding non-singular bouncing cosmology with the aforementioned scale factor is extensively studied. The forms of the coupling function and Lagrange multiplier in the “low curvature limit” of the theory are reconstructed, yielding a viable approximation for $n < 1/2$. Correspondingly, by solving the cosmological perturbation equation, the main observable quantities, namely the spectral index, tensor to scalar ratio, and the running index are determined and confronted with the latest Planck 2018 data. Consistency with the data is proven for those parametric regimes that which correspond to $n < 1/2$. This makes the low curvature approximation a viable one for calculating the scalar and tensor power spectra.

MSC:
83C45 Quantization of the gravitational field
83C35 Gravitational waves
83F05 Relativistic cosmology
83C25 Approximation procedures, weak fields in general relativity and gravitational theory

Full Text: DOI

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