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Evolution of axial gravitational waves in rainbow universe. (English) Zbl 07500104

Summary: In view of the Regge-Wheeler formalism (RWF) causing axial and polar gravitational waves (GWs), axial modes of the GWs are investigated by considering the spatially flat conformal Friedmann-Lemaître-Robertson-Walker (FLRW) metric in the rainbow gravity (RBG) that is one of the important nominees for the theory of quantum gravity. We use the zeroth-order and first-order field equations for the rainbow FLRW background with respect to the Regge-Wheeler gauge to obtain unknown perturbation functions that elicit how perturbation influences the metric, material content and the four-velocity vector. In this context, we show that (i) not only the background metric but also the first and third components of four-velocity vector are affected from axial modes and (ii) the background matter distribution is not affected by the perturbation. Furthermore, impacts of the rainbow functions, which are of great importance in describing the physical system, on axial modes are clearly revealed by graphical analysis. We also discuss whether the axial GWs satisfy the Huygens principle.

MSC:
83C35 Gravitational waves
83D05 Relativistic gravitational theories other than Einstein’s, including asymmetric field theories
35B20 Perturbations in context of PDEs
83C20 Classes of solutions; algebraically special solutions, metrics with symmetries for problems in general relativity and gravitational theory
83C45 Quantization of the gravitational field
70S15 Yang-Mills and other gauge theories in mechanics of particles and systems
83C40 Gravitational energy and conservation laws; groups of motions

Keywords:
gravitational waves; rainbow gravity; cosmology; perturbation

Full Text: DOI

References: