Carfora, Mauro; Familiari, Francesca

A comparison theorem for cosmological lightcones.  (English)  Zbl 1466.83143


The authors consider cosmological spacetimes describing the evolution of an isotropic and homogeneous universe at large scale, but can be highly inhomogeneous at small scales. The authors search for a correspondence between a past lightcone in a given isotropic and homogeneous spacetime and a lightcone in an idealized in the family of Friedmann-Lemaitre-Robertson-Walker (FLRW) universe. In a such a framework they introduce a scale-dependent light-cone comparison functional, defined by a harmonic type energy, associated with a natural map between the physical lightcone and FLRW reference lightcone.

This lightcone functional has a series of properties, which are investigated in the actual paper. Particularly, it vanishes if, at the given length scale, the corresponding lightcone surface sections are isometric. The lightcone surface sections are called celestial spheres.

The authors discuss the variational analysis and prove the existence of the minimum that characterizes a natural scale-dependent distance functional between the 2 lightcones. The authors search for possible extensions of the results obtained to the case, when caustics develop on the physical past lightcone.

By exploiting causal diamond theory, the authors show how the distance lightcones functional is related to main orders in the length scale to spacetime scalar curvature in the causal past of the two lightcones. Finally, some illustrations are designed to envisage possible applications.

Reviewer: Alex B. Gaina (Chişinău)

MSC:

83F05 Relativistic cosmology
83C10 Equations of motion in general relativity and gravitational theory
58Z05 Applications of global analysis to the sciences
53Z05 Applications of differential geometry to physics

Keywords:

lightcone cosmography; mathematical cosmology; cosmological backreaction; lightcones; causal diamond theory

Full Text: DOI

References:
