Ellis, George F. R.
Dynamical properties of cosmological solutions. (English) | Zbl 1088.83022 |
J. Hyperbolic Differ. Equ. 2, No. 2, 381-395 (2005).

The purpose of the paper under review is to look how the cosmological evolution equations can be cast as first–order symmetric hyperbolic differential equation systems, and hence to determine the nature of their characteristics [*K. O. Friedrichs*, Commun. Pure Appl. Math. 7, 345–392 (1954; Zbl 0059.08902)], which affect the nature of causality in relativistic cosmology. More precisely, the present paper considers first–order symmetric hyperbolic system formulations and associated results in relativistic cosmologies expressed in terms of $1 + 3$ tetrads [*H. van Elst, C. Uggla*, Class. Quantum Grav. 14, 2673–2695 (1997; Zbl 0888.53058)]. The evolution first order symmetric hyperbolic differential equation systems are capable to describe the physical transport along bicharacteristic rays of jump discontinuities that exist in the outward first derivatives across a characteristic surface of the field variables. Their tangential first derivatives as well as the field variables themselves are assumed to be continuous across the characteristic surface. The characteristics of scalar and vector perturbations are timelike, hence the real domains of dependence in cosmology are much smaller than implied by the light cone, associated with gravitational wave perturbations [*J. Ehlers, A. R. Prasanna, R. A. Breuer*, "Propagation of gravitational waves through pressureless matter". Classical Quantum Gravity 4, 253–264 (1987)]. In fact, there is no known time in the evolution of the universe when the gravitational wave modes dominated except for anisotropic modes at very early times in certain Bianchi cosmological models. The final conclusion is that the really important characteristics in the physical evolution process of the universe are the timelike characteristics, not the null characteristics.

Reviewer: Walter Schempp (Siegen)

MSC:

83F05	Relativistic cosmology
85A40	Astrophysical cosmology
35Q75	PDEs in connection with relativity and gravitational theory
83C05	Einstein's equations (general structure, canonical formalism, Cauchy problems)

Cited in **1** Review
Cited in **1** Document

Full Text: DOI

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