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ORIGINAL ARTICLE

Bianchi type VI_1 cosmological model with wet dark fluid in scale invariant theory of gravitation

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Abstract In this paper, we have investigated Bianchi type VI_h, II and III cosmological model with wet dark fluid in scale invariant theory of gravity, where the matter field is in the form of perfect fluid and with a time dependent gauge function (Dirac gauge). A non-singular model for the universe filled with disorder radiation is constructed and some physical behaviors of the model are studied for the feasible VI_h $(h = 1)$ space-time.

Keywords Space-time · Scale invariant · Dirac gauge · Wet dark fluid

1 Introduction

Einstein's general theory of gravitation has been successful in describing gravitational phenomena. His theory has been served as a basis for different models of the universe. The homogeneous isotropic expanding model based on general relativity appears to provide a grand approximation to the observed large scale properties of the universe. However, since Einstein first published his theory of gravitation, several modifications have been proposed from time to time which seek to incorporate certain desirable features lacking in the original theory. One of the modifications he himself pointed out that Mach's principle is not substantiated by general relativity. So, there have been considerable attempts made to generalize the general theory of relativity by incorporating Mach's principle and other desired features which are lacking in the original theory.

There has been considerable interest in scale invariant theory owing to the scaling behavior exhibited in high-energy particle scattering experiments (Callan et al. 1970). However, such theories are considered to be valid only in the limit of high energies or vanishing rest masses. This is because in elementary particle theories, rest masses are considered constants, and the scale invariance is generally valid only when the constant rest mass condition is relaxed. It is found from the literature that there are two prominent generalizations of Einstein theory. Firstly, in an attempt to unify electromagnetism with gravitation, Weyl (1922) generalized Riemannian geometry by allowing lengths to change under parallel displacement. The theory being unphysical was soon rejected, wherein a mathematical technique known as gauge transformation was introduced. Eddington (1924) pointed out that, the gauge transformation represents a change of units of measurement and hence gives a general scaling of the physical system. Secondly, Dirac (1973, 1974) rebuilt the Weyl's unified theory by introducing the notion of two metrics and an additional gauge function $\beta(x^i)$. A scale invariant variation principle was proposed from which gravitational and electromagnetic field equations can be derived. It is concluded that an arbitrary gauge function is necessary in all scale invariant theories. It is found that the scale invariant theory of gravitation agrees with general relativity up to the accuracy of observations made of up to now. Dirac (1973, 1974), Hoyle and Narlikar (1974) and Canuto et al. (1977) have studied several aspects of the scale invariant theories of gravitation. But Wesson's (1981a, 1981b) formulation is so far best to describe all the interactions between matter and gravitation in scale free manner.

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