Class. Quantum Grav. **16** (1999) 2763–2783. Printed in the UK PII: S0264-9381(99)00509-2

Null strings in Bianchi I models: dynamical anisotropy damping and consequences

A Kuiroukidis, K Kleidis and D B Papadopoulos

Department of Physics, Section of Astrophysics, Astronomy and Mechanics, Aristotle University of Thessaloniki, 54006 Thessaloniki, Greece

Received 31 December 1998, in final form 23 April 1999

Abstract. A generic ansatz is introduced which provides families of exact solutions to the equations of motion and constraints for null strings in Bianchi type I cosmological models. This is achieved irrespective of the form of the metric. Within classes of dilaton cosmologies a backreaction mapping relation is established where the null string leads to more or less anisotropic members of the family. The equations of motion and constraints for the generic model are cast in first-order form and integrated both analytically and numerically.

PACS number: 9880H

1. Introduction

In recent years string theory has emerged as the most promising candidate for the consistent quantization of gravity and a unified description of all the fundamental interactions. A consistent quantum theory of gravity is a necessary part of a unified theory of all interactions, because pure gravity (a model containing only gravitons) cannot be a physical and realistic theory. This is the strongest motivation for the study of strings in curved spacetimes [1–3].

In this context strings moving in curved spacetimes have gained considerable attention, since they could provide clues to a proper generalization of the theory [2, 3]. Among other notable features, string theory has become a theory that gives interesting answers in other fields, such as the physics of black holes, cosmology, galaxy formation, etc [2–4].

In the cosmological context inflationary models have become natural outcomes of the theory. Yet a treatment of anisotropy which is a basic feature of cosmological spacetimes has not be considered within the framework of string theory. Anisotropic cosmological spacetimes are candidates for a description of the early Universe, because it is known that inhomogeneous and anisotropic features may have prevailed in the primary stages of the evolution of the Universe.

Since present-day observations suggest that the Universe is highly homogeneous and isotropic, it would be interesting to examine whether string theory could account for a possible altering of anisotropic features that may have prevailed in the primordial stages of the Universe.

Generic Bianchi I type cosmological solutions can occur in the context of more general dynamical theories [5]. As is known dilaton fields appear naturally at the low-energy limit of string theory, coupled with Einstein–Maxwell fields [6–8]. Also, dilaton fields appear as a result of dimensional reduction, of the Kaluza–Klein-type Lagrangian [9, 10]. The presence of homogeneous primordial magnetic fields implies that the cosmological model is necessarily

0264-9381/99/082763+21$30.00