Commun. math. Phys. 25, 233—244 (1972)

Homogeneous Rotating Universe with Flat Space

M. DEMIAŃSKI
Institute of Theoretical Physics, University of Warsaw, Warsaw, Poland

L. P. GRISHCHUK
Sternberg Astronomical Institute, Moscow, USSR

Received October 11, 1971

Abstract. The homogeneous, anisotropic cosmological model is considered. It satisfies three physically reasonable conditions: it is space homogeneous, possesses flat space like sections and is filled with expanding, rotating and shearing matter. The asymptotic solution is presented and general properties are discussed. The question how the rotation influences the behaviour of matter near the singularity is investigated.

I. Introduction

There is currently a continuous interest in studying the space homogeneous world models. This interest was stimulated by the discovery of the 3° K background black body radiation [1] and question of its anisotropy [2, 3]. It is generally believed that those models could quite satisfactory describe the complexity of data related to the large scale structure of our universe [4–6].

We will present here a homogeneous world model with flat 3-dimensional sections filled with rotating, shearing and expanding matter.

The model we are considering is a unique model satisfying the following physically justified conditions: it is space homogeneous (the space like sections are the transitivity hypersurfaces of a three parameter group of motions), the space like sections are flat and the matter is rotating.

The model is interesting also as an example satisfying the group criterion of homogeneity but non-homogeneous according to the physical criterion discussed recently by one of us (L.P.G.) [7, 8].

Since the space like sections are flat it is possible to introduce on each of them a Cartesian coordinate system and easily stress the main differences between those criteria.

The homogeneous world models are usually parametrized by a synchronous coordinate system in which the hypersurfaces of transitivity are given by the $t = \text{const}$ sections [9, 10]. To get the physical charac-