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World Lines of Dust in *C*-Field Cosmology*

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Abstract. Geodesic and non-geodesic world lines of dust are investigated in Pryce's *C*-field cosmology. A Raychaudhuri type equation is derived for the non-geodesic, rotational dust flow.

I. Introduction

In their investigation of the steady state theory, Raychaudhuri and Banerji [1] obtained a generalization of Raychaudhuri's equation [2]. A similar investigation of the *C*-field equations of Pryce [3] yielded inconclusive results; however, their conclusions were based on the assumption that dust always follows geodesics and also, that rotational motion must be excluded by these *C*-field equations. Nariai [4] pointed out that rotational motion is not excluded by the assumption of a geodesic dust flow and further, that non-geodesic world lines are permissible. Nariai's investigation of the non-geodesic flow led him to postulate an irrotational velocity field.

Here we investigate all possible world lines for dust in Pryce's theory, paying particular attention to the non-geodesic flow. In section III of this paper we show that Nariai's postulate is unnecessary and in section IV we derive a general version of Raychaudhuri's equation for non-geodesic, rotational motion of dust.

II. The Field Equations of Pryce

We are concerned with the following *C*-field equations which Pryce derived from an action principle:

$$R^{\alpha}_{\beta} - \tfrac{1}{2} g^{\alpha}_{\beta} R = -8\pi [T^{\alpha}_{\beta} - f(C^{\alpha} C_{\beta} - \tfrac{1}{2} g^{\alpha}_{\beta} C^{\gamma} C_{\gamma})] , \tag{2.1}$$

$$f C^{\alpha}_{;\alpha} = J^{\alpha}_{;\alpha} \tag{2.2}$$

where C_{α} is the gradient of a scalar ($C_{\alpha} = C_{,\alpha}$) and f is a coupling constant. We adopt the usual notation and denote ordinary differentiation by a

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