KERR-NUT SEEDS FOR COSMIC STRINGS *

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Abstract

We solve analytically the Einstein-Maxwell equations with a particular choice of the Ernst potential, to derive a new exact solution to the Einstein-Maxwell equations depending on five parameters: the mass (m), the angular-momentum (α), the electromagnetic field strength (k), the parameter p and the Kerr-NUT parameter (l). This (Petrov Type D) solution is cylindrically-symmetric and represents the curved background around an electrified, rotating cosmic string interacting with gravitational and electromagnetic waves.

Key-words: Einstein-Maxwell equations - Exact solutions - Cosmic strings

1. Introduction

Cosmic strings are one-dimensional objects that can be formed as linear defects at a symmetry breaking phase transition (for a detailed analysis see Hindmarsh and Kibble [1] as well as Vilenkin and Shellard [2] . If they exist, they may help us to explain some of the large-scale structures seen in the Universe today, such as gravitational lenses [3, 4] . They may also serve as *seeds* for density perturbations [5], as well as potential sources of relic gravitational radiation [6].

The curved space-time around a straight, isolated cosmic string is constructed by a flat background from which a wedge has been (locally) cut off. The resulting metric tensor acquires a *conical singularity* located on the axis of symmetry and the corresponding *angle-deficit* is given by $\delta\phi = 8\pi\mu$, where μ is the *mass-density per unit length* [1] . The cosmic-string radius is extremely small, of the order 10^{-27} m [7, 8]. Hence, from the macroscopic point of view, the cosmic string is described as a *line-source* and the gravitational field produced by it has *cylindrical symmetry* [3] .

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