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Non-Existence of Axially Symmetric Massive Scalar Fields

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Abstract. It has been observed that for the axially symmetric Einstein-Rosen metric, the stress-tensor of a scalar meson field associated with meson of rest mass μ cannot be the source term for generating gravitation. The above result also holds even when this meson field is coupled with an electromagnetic field.

1. Introduction

The study of scalar meson fields in general relativity has drawn the attention of many workers. Bergmann and Leipnik [1], Buchdahl [2], Bramhachary [3], Stephenson [4], Janis *et al.* [5], Penney [6, 7], Gautreau [8], Misra and Pandey [9] are some of the authors who have investigated various aspects of the problem.

Rao *et al.* [10] have recently found out exact solutions for nonstatic axially symmetric Einstein-Rosen metric when a Zeromass meson field is coupled with an electromagnetic field. A natural extension of this investigation would be the inclusion of the mass of the meson field. To this end, we have taken up the problem of interacting gravitational and massive (nonzero-rest-mass) scalar meson fields in Section 2, and in Section 3 we have studied the more general case when the massive scalar field is coupled with an electromagnetic field. In both the cases it has been observed that the stress-tensor of the massive scalar meson field cannot be the source term for generating gravitation. This result excludes the possibility of any further extension of our previous work [10].

2. Axially Symmetric Massive Scalar Field

We consider the axially symmetric Einstein-Rosen metric

$$ds^2 = e^{2\alpha - 2\beta}(dt^2 - d\varrho^2) - \varrho^2 e^{-2\beta}\, d\phi^2 - e^{2\beta}\, dz^2\,, \tag{2.1}$$

where α and β are functions of ϱ and t only and ϱ, ϕ, z, t correspond respectively to x^1, x^2, x^3, x^4 coordinates.