A Cylindrically Symmetric Universe In Presence of Electromagnetic and Scalar Field

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INTRODUCTION:-Many workers have focussed their attention on the study of relativistic Leld equations in the presence of a scalar meson field. The idea has been initiated lay Brahmachary [3] who considered the problem of the coupled gravitational and zero-restmassmeson (zero spin) in the case of static spherically symmetric fields. He has shown that no exact solution of the scalar meson field can be found in strictly empty space. However, an approximate solution has been obtained by him which is valid within a certain region. The spherically symmetric zero-rest-mass scalar field have been also investigated by Bergmann and Leipnik [1], Buchdahl [4] has constructed reciprocal static solutions for axial and spherical fields. Janis,

Newmsn and Winicour [7] have analysed the problem further from the point of view of singularities. Their analysis shows that with the addition of zero - rest - mass "scalar field, the structure of the event horizon corresponding to g44 = 0 and t = constant charges from a non - singular hypersurface to a singular point. Gautreu [6] has extended the study to the case of non spherical weyl fields whereas Singh [14] has considered plane symmetric fields. The investigations mentioned above deal with interaction of the scalar meson field (with zer - rest - mass) and the gravitational field. Stephenson [19] has considered the problem of the scalar meson field of non-zero-rest mass coupled with electromagnetic fields for static spherically symmetric gravitational fields, physically this situation may correspond to a point source possessing besides mass m and an electric charge E, a nuclear charge. He has obtained an approximate solution and has shorn that the Coulomb field is affected by the presence of nuclear charge on the source. 03iis effect is brought about by the gravitational interaction of the scalar meson and electromagnetic fields. However, since the approximate solutions may not always give the correct picture of the physical phenomenon involved, the problem remains still open to study the effects of the two fields in the case of exact solutions.

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Considering the cylindrically symmetric metric of Marder [8], Roy and Prakash [10] have constructed an isotropic magnetohydrodynamic cosmological model in General Relativity, Latter on Singh and Yadav [16] have also constructed a non-static cylindrically symmetric cosmological model which is spatially homogeneous non-degenerate petrov type I. They have assumed the energy momentum tensor to be that of a perfect fluid with an electromagnetic field. Solutions of Einstein-Maxwell equations for cylindrically symmetric space time has also been extensively studied by Singh et. al. [15] and Roy and Tripathi [11]. Singh et.al [17] have presented a procedure which enables one-to construct solutions to the cylindrically symmetric gravitational field coupled to electromagnetic and massless scalar fields. Sharma and Yadav [13] have investigated the problem of coupled gravitational, electromagnetic and scalar fields. It is found that the energy momentum tensor of massive scalar field can not be the source term for a cylindrically symmetric gravitational field with two degress of freedom. A similar result in the case of cylindrically symmetric Einstein - Rosen metric with one degree of freedom has been obtained by Roy and Rao [12].

In this chapter we have obtained some solutions of electromagnetic and scalar field for cylindrically symmetric metric (Stachel metric [18]) in two different cases in which case (i) is done directly in terms of Fij components and case (ii) is done in terms of two potentials 2 and 3. Further we have also shown, that starting form any solution to the electrovacuum field equations it is possible to generate a whole class of solutions to the Einstein - Maxwell - massless scalar field equations by a suitable redefinition of one of metric coefficients.

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