ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 14, Issue, 09, pp.22350-22351, September, 2022
DOI: https://doi.org/10.24941/ijcr.44084.09.2022

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

REVIEW ARTICLE

A CYLINDRICALLY SYMMETRIC MODEL IN PRESENCE OF ELECTROMAGNETIC AND SCALAR FIELD IN GENERAL RELATIVITY

***Dudheshwar Mahto**

Maharashi Paramhansh College of Education Ramgarh, India

ARTICLE INFO

Article History:
Received 20th June, 2022
Received in revised form
27th July, 2022
Accepted 09th August, 2022
Published online 30th September, 2022

Key words:

Coupled, Gravitational, Zero-Restmasmeson, Spherically, Symmetric, Zero- Rest-Mass, Scalar, Field, Singularities.

**Corresponding Author:*
Dudheshwar Mahto

ABSTRACT

The idea has been initiated by Brahmchary who considered theproblem of the coupled gravitational and zero-restmasmeson (zerospin) in the case of static spherically symmetric field. He has shown that no exact solution of the scalar meson field can be found in strictly empty space. however, an approximately solution has been obtained by him, which is valid with in a certain region. The spherically symmetric zero- rest-mass scalar field have been also investigated by Bergmann leipnik, Buchdahl has constructed reciprocal static solution for axial and spherical fields Janis, Newman and Winicokr have analysed the problem further from the point of view of singularities. There analysis shows that ,with the addition of zero-rest-mass scalar field, the structure of the event horizon corresponding to g^{44}=0 and t constant charge from a non singular hyper surface to a singular point. Gautreu has extendedthe study to the case of non spherical Weyl field's whereas Singh has considered plan symmetric field's. the investigation mentioned above deal with interaction of the scalar meson field (with zero-rest-mass) and the gravitational field.

Citation: *Dudheshwar Mahto.* 2022. "A cylindrically symmetric model in presence of electromagnetic and scalar field in general relativity". *International Journal of Current Research*, 14, (09), 22350-22351.

INTRODUCTION

Various relativists have focused their mind on the study of relativistics filed equations in the presence of a scalar meson field. The idea has been initiated by Brahmchary who considered the problem of the coupled gravitational and zero-restmasmeson (zerospin) in the case of static spherically symmetric field. He has shown that no exact solution of the scalar meson field can be found in strictly empty space. however, an approximately solution has been obtained by him, which is valid with in a certain region. The spherically symmetric zero- rest-mass scalar field have been also investigated by Bergmann leipnikBuchdahlhas constructed reciprocal static solution for axial and spherical fields Janis, Newman and Winicokr have analysed the problem further from the point of view of singularities. There analysis shows that ,with the addition of zero-rest-mass scalar field, the structure of the event horizon corresponding to g^{44}=0 and t constant charge from a non singular hyper surface to a singular point. Gautreu has extendedthe study to the case of non spherical Weyl field's whereas Singh has considered plan symmetric field's. the investigation mrntioned above deal with interaction of the scalar meson field (with zero-rest-mass) and the gravitational field. Stephenson 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 ϵ, a nuclear g.

He has obtained an approximate solution and has shown that the coulomb's field is affected by the presence of nuclear charge on the source. This effect is brought a bout 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 steel open to study the effects of the two field's in the case of exact solutions. Considering the cylindrically symmetric metric of Marder, Roy and prakashhave constructed an isotropic magneto-hydrodynamic cosmological model in General Relativity. Latter on Singh and Yadav have also constructed a non-static cylindrically symmetric cosmological model which is spatially homogeneous non-degenerated prototype I. they have assumed the energy momentum tensor to be that of a perfect fluid with an electromagnetic field. Solutions of Einstein-Maxwell equation's cylindrically symmetric space time has also been extensively studical by Singh et. al. and Roy Tripathi . Singh et. al. have presented a procedure which enables one to construct solutions to the cylindrically symmetric gravitational field coupled to electro-magnatic and mass-less scalar fields Sharma and Yadav have investigated the problem of coupled gravitational, electro-magnetic and scalar fields. It is found the source term for a cylindrically symmetric gravitational field with two degrees of freedom. A similar result in the case of sylindrically that the energy momentum tensor of massive scalar field cannot be symmetric Einstein-Rosen metric with one degree of freedom has been obtained by Roy and Rao Yadav and Kumar have studied a static cylindrically symmetric cosmological model with electro-magnetic and scalar field in general relativity.

THE FIELD EQUATIONS AND THEIR SOLUTIONS

We considered the satchel metric in the form given by

$$ds^2=e^{2n-2\delta}(dt^2-dr^2)-(X^2e^{2\delta}+r^2e^{-2\delta})d\phi^2 \ e^{2\delta}dz^2-2Xe^{2\delta}d\phi dz \quad (1)$$

Where n , X and δ are the function of r only and r,ϕ, z, t correspond respectively x^1,x^2,x^3, x^4 coordinates. When X =0 , this goes to the well known Einstein-Rosenmetric with one degree of freedom. The distribution consist of an electromagnetic field and a scalar zero rest mass meson field V. Thus the field equation are

$$R_{ij} = - K\,[\epsilon_{ij}+v, i\ v, j], \quad (2)$$

$$E_{ij} = -g^{ab}F_{ai}F_{bj} +\tfrac{1}{4}g_{ij}F_{ab}F^{ab}, \quad (3)$$

$$F_{[ijk]}=0, \quad (4)$$

$$F^{ij},j =0 \quad (5)$$

$$g^{ij}v;ij=0 \quad (6)$$

for the metric (1)the components R_{12}, R_{13} ,R_{24},and R_{34} vanish identically . this leads to

$$F_{13}F_{23}\frac{e^{2\delta}}{r^2} =F_{12}F_{23}\frac{Xe^{-2\delta}}{r^2} +F_{14}F_{24}e^{2\delta-2n}, \quad (7)$$

$$F_{12}F_{32}\left[e^{+2\delta}+\frac{X^2e^{+2\delta}}{r^2}\right] =F_{13}F_{32}\frac{Xe^{+2\delta}}{r^2}+ F_{14}F_{34}e^{2\delta-2n}, \quad (8)$$

$$F_{31}F_{41}e^{2\delta-2n}= F_{32}F_{43}\frac{Xe^{+2\delta}}{r^2}- F_{32}F_{42}\left[e^{-2\delta}+\frac{X^2e^{+2\delta}}{r^2}\right] \quad (9)$$

$$F_{21}F_{41}e^{2\delta-2n} = F_{23}F_{42}\frac{Xe^{+2\delta}}{r^2} - F_{23}F_{43}\frac{1e^{+2\delta}}{r^2} \quad (10)$$

In view of (5.2.7)-(5.2.10) two cases may arise

(i) $F_{12} =F_{13}=F_{24}=F_{34} =0,F_{23},F_{14}\neq 0$ (11)

(ii) $F_{14} =F_{23}=0, F_{12},F_{13},F_{24},F_{34}\neq 0$ (12)

Case (i) is done directly in term of F_{ij} components, case(ii) is done in term of two potentials θ_2 and θ_3 which give rise to all the non-vanishing components of F_{ij}.

SECTION-I

Here we will consider case (i).

The field equation (2)-(6) for the metric

(1) are,

$$R_{11} = -K\left[-\frac{1}{2}\left\{e^{2\delta-2n}F_{14}^2+\frac{e^{2n-2\delta}}{r^2}F_{23}^2\right\}+V_1^2\right] \quad (13)$$

$$R_{22}=-K\left[-\frac{1}{2}\left\{e^{4\delta-4n}(X^2e^{2\delta}+r^2e^{-2\delta})F_{14}^2\right\}+(X^2e^{2\delta}+\ r^2e^{-2\delta})\frac{F_{23}^2}{2r^2}\right] \quad (14)$$

$$R_{33} = -K\left[e^{6\delta-4n}F_{14}^2+\frac{e^{+2\delta}}{2r^2}F_{23}^2\right] \quad (15)$$

$$R_{44} = -K\left[\frac{1}{2}\left\{\frac{e^{2\delta-2n}}{2}F_{14}^2+\frac{e^{2n-2\delta}}{r^2}F_{23}^2\right\}\right] \quad (16)$$

$$R_{23} = -K\left[-\frac{X}{2}\left\{e^{6\delta-4n}F_{14}^2+\frac{e^{+2\delta}}{r^2}F_{23}^2\right\}\right] \quad (17)$$

$$F_{23} =H \quad (18)$$

$$F_{14} =K_1 \quad (19)$$

$$V_{11} +\frac{V_1}{r}=0 \quad (20)$$

CONCLUSION

In this chapter we have conclude that some solutions of electro-magnetic and scalar field for cylindrically symmetric metric (Stachel metric) in two different cases in which case (1) is done directly is terms of F_{ij} components

REFERENCES

1. Bergmann, O and Leipnik, R 1957. Phys., Rev. 107, 1157.
2. Bonner, W. B. 1954. Proc. Phys. Soc. (London) A67,225.
3. Brahmchary, R. L. 1960. Prog. Theor. Phys., 23, 749.
4. Buchbahl, H. A. 1959. Phys. Rev., 115, 1325.
5. Einstein, A. and Rosen, N. 1937. J. Franklin Inst.,223, 43.
6. Gautreu, R. 1969. Nuovo cimento B., 62, 360.
7. Janis, A. I., Newman, E. T. and Winicour, J. 1968. Phys. Rev. Letters, 20, 878 .
8. Marder, L. 1958. Proc. R. Soc. A246, 133.
9. Rosen, N. 1954. Bull Res. Counc. Isrel, 3, 328.
10. Roy, S. R. and Prakash, S. 1978. Ind. J. Phys. 52B, 470.
11. Roy, S. R. and Tripathi, V. N. 1972. Ind. Jour. Pure Appl. Math. 3,926.

****