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Exact Solutions of Einstein's Vacuum Field Equations

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Abstract: Some new solution of Einstein's vacuum field equations is investigated which is as a simple generalisation of Ozsvath-Schucking solution and explains its source of curvature in terms of some dimensional parameters.
Keywords and phrases: Vacuum solutions, General Relativity.

1. Introduction

The first solution of Einstein field equation was obtained by Schwarzschild and other important solution was investigated by Kerr. These two solutions have played important role for the study of black holes. Friedman solutions are very crucial for cosmology. Thus exact solutions of Einstein field equation have played very important roles in discussing the physical problems. The exact solutions of vacuum field equations are of vital importance.

$$R^{\alpha\beta} = 0 \tag{1}$$

We are trying to obtain a new solution of eq. (1) which provides the source of curvature of the O-S solution (1962). It is always possible to obtain the source of curvature in a vacuum solution in terms of dimensional parameters present in the solution or in its variant. These parameters come in the Riemann tensor indicating source. The presence of a singularity in a solution may be asserted by the divergence of the Kretschmann scalar K

$$K = R_{\alpha\beta\gamma\delta}R^{\alpha\beta\gamma\delta} \tag{2}$$

but the flatness of a solution maynot be asserted by the vanishing of K. For this one has to depend on the vanishing of the Riemann tensor. However this prescription of source in singularity does not work properly as there are solutions of equation (1), such as O-S solution (1962), Taub-NUT (1963) which are curved but singularity free. Therefore, we have to define the presence of source which may be applied properly to all the solutions of equation (1).