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AN EXACT MODEL FOR RELATIVISTIC SPHERE

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Exact solutions of the Einstein-Maxwell system are important in the description of relativistic astrophysical processes. The models generated are used to describe relativistic spheres with strong gravitational fields as is the case in neutron stars. It is for this reason that many investigators use a variety of techniques to attain exact solutions. In order to integrate the field equations, various restrictions have been placed by investigators on the geometry of space time and the matter content. Mainly two distinct procedures have been adopted to solve these equations for spherically symmetric and static manifolds. Firstly, the coupled differential equations are solved by computation after choosing an equation of state. Secondly, the exact Einstein-Maxwell solution can be obtained by specifying the geometry, the form of the electromagnetic field and measure of anisotropy. In the presence of charge, the gravitational collapse of a spherically symmetric matter configuration to a point singularity may be avoided. Einstein-Maxwell solutions are important in studies involving the cosmic censorship hypothesis and the formation of naked singularities. Our intension in this paper is two-fold. Firstly, we seek to model a charged relativistic sphere which is physically acceptable. Secondly, we seek to regain an uncharged solution of Einstein equations which satisfy the relevant physical criteria when the electric field and the anisotropy factor vanishes. This ensures that a neutral relativistic star is regainable as a stable equilibrium state. We seek to construct a model, with limiting uncharged stars as known exact solutions, that exactly satisfies the Einstein-Maxwell systems. This ideal is not easy to achieve in practice and only a few examples with the required two features have been found thus far. Our objective is to find an exact model for relativistic sphere that satisfy the physical criteria given above, and necessarily contains a neutral stellar solution. We express the Einstein-Maxwell field equations for the static spherically symmetric line element as an equivalent set of differential equations utilizing a known transformation. We choose particular forms for one of the gravitational potentials, anisotropic factor and the electric field intensity. This enables us to obtain the condition of pressure isotropy in the remaining gravitational potential as a second order ordinary differential equation which facilitates the integration process. The solutions fall in to three classes based on the parameters used. One of the cases is considered and is related to the standard Bessel equation. It is possible to obtain solutions in terms of elementary functions, Bessel functions and modified Bessel functions for different model parameters. Our results contain particular models found previously including models of charged relativistic isotropic spheres.

Keywords*: Einstein-Maxwell field equations, exact solutions.*