RELATIVISTIC CHARGED STELLAR MODELS IN THE PRESENCE OF ELECTROMAGNETIC FIELD FOR ASTROPHYSICAL COMPACT STARS

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Abstract

To obtain an understanding of the gravitational dynamics of a general relativistic star it is necessary to solve the Einstein-Maxwell equations. The matter distribution may be isotropic in the presence of an electromagnetic field. The intention of this paper is to provide a general framework that admits the possibility of a non-vanishing electric field intensity. We believe that this approach will allow for a richer family of solutions to the Einstein-Maxwell field equations and possibly provide a deeper insight into the behaviour of the gravitational field. We present a class of closed-form solutions to the Einstein–Maxwell system of equations for a static spherically symmetric isotropic star in the presence of an electric field by generalizing earlier approaches. This is achieved by specifying a particular form for one of the gravitational potentials and the electric field intensity. The solution of the system of equations is reduced to a recurrence relation with variable, rational coefficients which can be solved in general. It is possible to expressed exact solutions in terms of integrals form from the series solutions, and the integral can be completed exactly for particular parameter values. The physical features such as the gravitational potentials, electric field intensity, charge distribution and matter distribution are well behaved. These exact solutions describe a charged relativistic sphere with isotropic pressures. Earlier models can be contained in our general class of solutions. We can also obtain new exact solutions from our general treatment which can be used to model a charged isotropic relativistic sphere.

Keywords: exact solutions; Einstein field equations; isotropic stars.