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EXACT SOLUTIONS FOR ANISOTROPIC CHARGED PERFECT FLUID SPHERES IN GENERAL RELATIVITY

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Abstract

In this work we study spherically symmetric space times which are static with the perfect fluid source and an electromagnetic field with pressure anisotropy. Our intention is to generate exact solutions to the Einstein-Maxwell system that model the interior of relativistic stars. The field equations are obtained in detail for neutral and charged perfect fluids with anisotropic pressure. A class of exact solutions to the field equations is generated as an infinite series by solving the relevant difference equations. This is achieved by specifying particular forms for one of the gravitational potentials in terms of spheroidal parameter, electric field and the anisotropic factor. We obtain two distinct types of linearly independent solutions, namely polynomial and algebraic forms, by restricting the spheroidal parameter and the two constants related to the electric field and anisotropic factor. We then present the general solutions in terms of elementary functions, from which we regain two particular solutions reported previously for the uncharged isotropic star. In addition, a new closed form solution is obtained and we briefly discuss the physical viability of our solution. These new classes of solutions provide deeper insight into how charge and pressure anisotropy influence stellar structure and stability, offering physically meaningful models for realistic compact stars. We emphasise that our simple approach of utilising the series method of Frobenius yields a rich family of Einstein-Maxwell solutions in terms of elementary functions.

Keywords: *Einstein-Maxwell System, Anisotropic, Method of Frobenius, Exact Solutions, Relativistic Stars, Charged Fluid Spheres*