

Relativistic fluid sphere on pseudo-spheroidal space-time

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Abstract. A new exact closed form solution of Einstein's field equations is reported describing the space-time in the interior of a fluid sphere in equilibrium. The physical 3-space, $t = \text{constant}$ of its space-time has the geometry of a 3-pseudo spheroid. The suitability of this solution for describing the model of a relativistic superdense star is discussed and the stability of the model under radial pulsations is examined.

Keywords. General relativity; static fluid sphere; superdense stars.

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1. Introduction

The non-linear nature of the Einstein's field equations is a consequence of the self-interaction of the gravitational field. This makes it difficult to obtain relativistic models of spherical stars based on exact solution of Einstein's field equations describing spherical distributions of matter. The actual properties in the central region of a relativistic compact star are not precisely known and so assumptions of general nature to obtain exact solutions of Einstein's field equations become necessary. It is desired that solutions should be physically plausible and at the same time simple in form. This problem has been considered by several authors [1–6].

Here we have investigated the gravitational significance of space-times whose physical space obtained as $t = \text{constant}$ section has the geometry of 3-pseudo spheroid and it is shown that it can describe spherical compact distributions of matter. The form of the space-time metric and its general features are discussed in § 2. It is shown that the geometry of the space-time is governed by two parameters R and K . The space-time metric corresponding to a new exact closed form solution of Einstein's field equations is written in § 3. The suitability of this solution for describing the model of a superdense star is explored following the approach of [4, 5, 9] in the subsequent sections.

2. Static pseudo spheroidal space-time

A 3-pseudo spheroid immersed in the 4-dimensional Euclidean space with metric