A study of static relativistic electrically charged spherical distributions with old and new boundary conditions

Nakandala Arachchige Sashinka Nilani Wimaladharma

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Department of Mathematics,

University of Kelaniya,

Sri Lanka.

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Abstract

The work on Einstein-Maxwell equations for a sphere composed of a special kind of matter distribution called electrically counterpoised dust (ECD) with constant density has been discussed giving the proofs of certain results when necessary. The better understanding of the electrically counterpoised dust model in detail will helps scientists to understand the universe in better way. Along this line, the understanding of static solutions for the electrically counterpoised dust will be a crucial factor.

To understand the static solutions for the electrically counterpoised dust, static solutions for the Einstein-Maxwell equations have been found. In particular, for a sphere composed of electrically counterpoised dust matter using standard boundary conditions and a new set of boundary conditions tested.

With new boundary conditions we found some interesting results. We show that for any given density of the distribution there are maxima for the values of the radial coordinate of the surface of the spherical distribution of matter as seen by an external observer, the value of the radial coordinate of the surface as seen by an internal observer and the mass of the ECD computed adding up the masses of small elements as in literature. It was found that this particular mass also appears in the external metric of the system.

In addition to that the expressions for the redshift, proper velocity and relative velocity of a particle moving along a radial geodesic have been obtained. Our results have been justified in different coordinates in different regions and our new boundary conditions work well with the invariants. It possible to extend this study in general theory of invariants with respect to different systems of coordinates in different regions.

Keywords: electrically counterpoised dust, Einstein-Maxwell equations, radial geodesic, general theory of invariants