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Dust models in Einstein-Gauss-Bonnet gravity

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Abstract: Dust is considered to be the simplest form of matter composed of pressureless, radiation and is abundant in galaxies, clusters and superclusters in a cosmological context. It has also been shown that stars are encompassed by these radiating pressureless particles which make up the atmosphere of the star. The gravitational behaviour of these pressureless fluid distributions are investigated in Einstein-Gauss-Bonnet (EGB) gravity in the presence of an electromagnetic field. The EGB field equations are generated for this system in arbitrary dimensions. It was found that the governing equation for this static charged dust configuration is classified as an Abel differential equation of the second kind; a complicated nonlinear differential equation. These are difficult to solve in general however we demonstrate a method that reduces the nonlinear differential equation to a simpler form enabling exact solutions to be found. This process of finding exact solutions to the governing equations in any gravitational field theory represents a foundation for analysing the gravitational dynamics of astrophysical objects. Furthermore, we demonstrate that the charged dust model obtained is physically well behaved in a region at the centre, and dust spheres can be generated. It can be observed that the higher order curvature terms influence the dynamics of charged dust and the gravitational behaviour which is distinct from general relativity.

Primary author: NAICKER, Shavani (University of KwaZulu-Natal (South Africa))

Co-authors: Dr BRASSEL, Byron (Durban University of Technology); Prof. MAHARAJ, Sunil (University of KwaZulu-Natal (South Africa))

Presenter: NAICKER, Shavani (University of KwaZulu-Natal (South Africa))

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