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Editorial Article

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Einstein Field Equations and the Study of Stellar Structure

Manuel Malaver de la Fuente

[1]Maritime University of the Caribbean, Department of Basic Sciences, Catia la Mar, Venezuela

[2]Institute of Scholars, Muddhinapalya Bengaluru-560091, Karnataka, India

***Corresponding author**
Manuel Malaver de la Fuente, Maritime University of the Caribbean, Department of Basic Sciences, Catia la Mar, Venezuela.

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The search for and finding exact solutions to Einstein's field equations is an important area of research in the study of stellar structure, due to significant progress being made in modelling the interior of compact objects. These equations can be expressed as follows:

$$R_{ab} - \frac{1}{2} R g_{ab} = kT_{ab} \quad (1)$$

with a,b,c = 1,2,.., 4 and where and are the Ricci tensor, Ricci scalar, metric tensor, coupling constant and stress - energy tensor respectively [1].

An ordinary star retains its normal size thanks to the balance between an extremely high internal temperature, which tends to expand the stellar structure, and the enormous gravitational pull, which tends to contract it. If at any point the core temperature drops, the star's gravity begins to contract and its atomic structure starts to disintegrate. When this happens, the stellar interior can take any of the following forms [2]:

- **White Dwarf:** This class of star consists basically of degenerate matter, made up of carbon and oxygen nuclei in a sea of degenerated electrons. When its radius reaches a few thousand kilometers, the mass approaches the limit of Chandrasekhar (~ $1.44M_\odot$ where $M_\odot$ is the sun's mass) which is the theoretical limit of the white dwarf's mass.
- **Neutron Stars:** If the white dwarf exceeds the Chandrasekhar limit, then the star contracts again, forcing electrons and protons to combine to form neutrons and forcing the latter to be in close contact and the star collapses into a neutron star which usually reaches a radius of between 10 and 20 kilometers
- **Black Holes:** Under certain conditions, gravitational attraction can overcome the neutron star's stability, so that the star can contract to zero volume and gravity increase infinitely. The gravitational field is so intense that any amount of matter approaching the event horizon would be trapped and cannot escape. The escape velocity quickly reaches the speed of light and as even light cannot escape, the compressed object becomes a black hole.
- **Quark Stars or Strange Stars:** It can happen that neutrons are compressed at a very high temperature and if so, they have to decompose in their quarks components, forming the so-called quark matter. This will shrink the star much further and make it much denser but the star can stabilize and survive in state indefinitely. A star in hypothetical state is known as quark star or strange star.

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