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General Relativistic Study of the Structure of Highly Magnetized Neutron Stars

Neutron stars are one of the most compact and densest astrophysical objects known in nature, they result from the supernova explosion of a massive star. Many of the neutron stars have very strong magnetic fields, which lead to the emission of radio and X-ray radiation. This work is devoted to study the effects of strong magnetic fields in the structure of neutron stars, within the framework of the general relativity theory. We study the formal aspects of the magnetic field in the stellar structure and gravitational equations using two different approaches, which allow us to introduce new quantities and their possible physical interpretation. By other hand, we study the theoretical formalism describing rotating and highly magnetized neutron stars within the context of Einstein-Maxwell's equations. Specifically, for magnetized neutron stars, we study poloidal magnetic fields and static configurations. We discuss about the relevant physical quantities describing these objects and the contribution of the electromagnetic energy to the total gravitational mass. we found the space-time describing rotating and magnetized neutron stars, the distribution of the different terms that contribute to the total gravitational mass and the mass-radius relation. The results show that for stars with magnetic fields ~ 10^{18} G the electromagnetic effects increase the mass in 10.1% with respect to the configuration without magnetic field. The studies performed in this work are key for the understanding the astrophysical objects known as a Soft-Gamma Ray Repeaters and Anomalous X-Ray Pulsars, which are understood as being one class of neutron stars called as magnetars.

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