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Phase Transitions under Strong Magnetic Fields in Neutron Stars

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A comprehensive study is carried on the impact of strong magnetic fields on the deconfinement phase transition that is anticipated to occur inside massive neutron stars. The basic but effective Vector-Enhanced Bag model (vBag) is used to analyse quark matter, while the very general density-dependent relativistic mean-field (DD-RMF) model is utilised to study hadronic matter. The matter equation of state and the general relativity solutions, which also fulfill Maxwell's equations, are modified when taking magnetic-field effects into account. We observe that the maximum mass, canonical-mass radius, and dimensionless tidal deformability of stars computed using spherically-symmetric TOV equations and axisymmetric solutions obtained through the LORENE library differ significantly for large values of magnetic dipole moment. The discrepancies depend on the stellar mass being studied, as well as the stiffness of the equation of state. This clearly indicates that, contrary to what was previously believed in the literature, the matter composition and interactions determine the magnetic field thresholds for the correct assumption of isotropic stars and the appropriate application of TOV equations.

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