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Modelling magnetically formed neutron star mountains

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With the onset of the era of gravitational-wave astronomy, the search for continuous gravitational waves, which remain undetected to date, has intensified in more ways than one. Rapidly rotating neutron stars with non-axisymmetrical deformations of their crusts are the main targets for CGW searches. The extent of this quadrupolar deformation (commonly referred to as mountains of the neutron star) is measured by the maximum ellipticity that can be sustained by the crust of a neutron star and it places an upper limit on the CGW amplitudes emitted by such systems. In this paper, following the example set by [1] and [2], we calculate the maximum ellipticity of a neutron star crust generated by the Lorentz force exerted on it by the star's internal magnetic fields. We focus on three different scenarios for different configurations of the star's magnetic fields to calculate the size of the neutron star mountain formed using the scheme devised by [1]. We show that the fiducial ellipticity of the star is enhanced in the presence of strong magnetic fields and it is further enhanced when components of the magnetic field are trapped in the crust. This promising result allows us to estimate the increased size of the neutron star mountains which will be vital when the imminent first detection of continuous gravitational waves happens.

References

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