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Perturbation to a magnetic neutron star with shear modulus

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The extent of the magnetic field at the interior of a neutron star is mostly unknown from the observed radiation features as it can probe up to the outer stellar surface. Theoretical models on the interior magnetic field geometry are generally oversimplified to avoid the complexity and mostly based on the axisymmetric barotropic fluid system. But these static magnetic equilibrium configurations are unstable with a short time scale against an infinitesimal perturbation to consider as a realistic model. The stellar material does not behave as a perfect fluid and the matter in the neutron star crust forms an ionic crystal. The electrostatic interactions between the crystallized charged particles can generate shear stress against any applied strain as a form of a perturbation. To incorporate the effect of crystallized crust on the dynamical evolution of the perturbed equilibrium structure, we study the effect of shear on the instability within the axisymmetric magnetic star. We find the limit of the critical shear modulus to prevent magnetic instability and the corresponding astrophysical consequences.

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