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Reduction of shear modulus by nuclei finite size in the neutron star inner crust

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The elastic properties of neutron star crust can play important role for interpretation of observations (e.g., quasi-periodic oscillations in the tails of magnetar flares). To calculate the elastic properties one should rely on theoretical models. The most popular model is Coulomb crystal (system of point-like charges on neutralizing uniform background). However, in the innermost layers of crust nuclei size becomes comparable with the internuclear spacing and validity of Coulomb crystal approximation becomes unclear. Indeed, we argue that crust deformation induces nonspherically symmetric potential in a vicinity of the lattice sites and this potential affects nuclei shape. We analyze this problem analytically within compressible liquid drop model. In particular, we have demonstrated that nuclei deformation indeed takes place and reduces the effective shear modulus. Within applied approach, the result is universal, i.e. it does not depend on the applied nucleon interaction model. For the deepest layers of inner crust reduction of the shear modulus reaches ~ 25 percent. The results are published [MNRAS 518, 3813 (2023)].

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