ELASTICITY OF THE INNER CRUST OF A NEUTRON STAR: THE ROLE OF NUCLEAR DEFORMATION AND THE TYPE OF CRYSTALLINE LATTICE

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Observational data on neutron stars are extensive, and the interpretation of some of it is based on the elasticity of the outer layers of neutron stars - the crust. A quantitative description of elastic properties requires the use of theoretical models, typically employing model is the Coulomb crystal. Last year, at the NPP-2022 workshop, we presented a report showing that accurate calculation of elastic properties must take into account the finite size of atomic nuclei and the change in their shape under deformation. These effects are the most important in the deepest layers of the crust. Calculations were performed analytically within the Wigner-Seitz approximation. In 2023, we present the results of new calculations that do not use the Wigner-Seitz approximation, but accurately take into account the crystalline lattice. Specifically, for face-centred and body-centred lattices, we calculated two elastic coefficients describing shear deformations and, in particular, showed that taking into account the change in shape of atomic nuclei leads to their reduction. We also used this result to calculate the effective shear modulus, which was found to be in good agreement with the calculation in the Wigner-Seitz approximation, although there are small quantitative differences.

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