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Crustal torsional oscillations inside the deeper pasta structures

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The quasi periodic oscillations (QPOs) observed in the soft-gamma repeaters are generally considered as a results of the global oscillations of the neutron stars. In this study, we first take into account the torsional oscillations excited in the tube and bubble phases, which can be excited independently of the oscillations in the phases of spherical and cylindrical nuclei, and successfully identify the observed QPO frequencies with such torsional oscillations. The resultant neutron star models are consistent with the mass formula for low-mass neutron stars and the constraint by the gravitational waves from the merger of the neutron star binary, GW170817.

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