Damping of sound waves in superfluid nucleon-hyperon mixture

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We consider the sound waves in superfluid matter of neutron stars composed of electrons and muons, nucleons (neutrons and protons), and hyperons (Λ and Σ^-). We show that three types of sound modes can propagate in such matter, namely the "normal" mode, analogous to sound waves in non-superfluid matter, and two "superfluid" modes. We analyse the speed of sound and its temperature dependence for each of the modes. Also, we study characteristic damping times for these modes, which are due to non-equilibrium processes of mutual transformations of particles. We demonstrate that the correct consideration of these processes leads to substantially faster damping of sound modes, in comparison to estimates presented in the literature. The obtained results can influence the "instability windows" of neutron stars, that is the region of spin frequencies and internal temperatures at which a star becomes unstable with respect to the emission of gravitational waves.

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