Entrainment matrix and superfluid properties of neutron stars

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We have derived the entrainment (Andreev-Bashkin) matrix for a neutron-proton mixture at a finite temperature in a neutron star core. The calculation is performed in the frame of the Landau Fermi-liquid theory generalized to account for superfluidity of nucleons. It is shown, that the temperature dependence of the entrainment matrix is described by a universal function independent of a model of nucleon-nucleon interaction employed.

The results are applied for analyzing sound modes in the matter, composed of superfluid neutrons, superconducting protons, and electrons. Pulsations of superfluid neutron stars are also discussed. The emphasis is made on the effects of temperature dependent chirping of pulsation frequencies, which can (in principle) serve as a probe for studying very subtle properties of superdense matter in neutron stars.

This research was supported partly by the Russian Leading Scientific Schools (grant 1115.2003.2), the RFBR (grant 05-02-16247), the Russian Science Support Foundation, and by the INTAS (grant YSF 03-55-2397).