ESF-Short Visit Grant 2844, "Neutrino emissivity of superfluid nuclear matter", Final Report: The purpose of the visit is to continue our collaboration on description of neutrino cooling of neutron stars and more specifically on the particular role of the pair breaking and formation processes in superfluid neutron star matter.

During the visit we continued our study of the problem of the neutrino emissivity of neutron stars began in Ref. [1]. In this paper the neutrino emissivity from the pair breaking and formation processes in superfluid neutron star matter in presence of the $1S_0$ neutron and proton pairing was calculated with inclusion of the zero-th harmonics Γ_0^ω and Γ_0^ξ of the expansion of the nucleon-nucleon interaction in the Legendre polinomials.

In the present study we considered general case for the $1S_0$ neutron pairing. We developed formalism that allows to include the whole series of the Legendre expansion of the nucleon-nucleon interaction, and then we explicitly demonstrated effect of the two first harmonics. Within this formalism both possibilities of the S and P pairing can be treated on equal footing. We found that in order to fulfill the vector current conservation one necessarily should incorporate the Γ_1^ξ harmonics, provided one had included Γ_1^ω amplitude.

We also demonstrated that recent work [2] suffers of number of inconsistencies. The main one is that the author applies the Leggett equations presented in the limit $\omega \ll |\vec{q}|v_F$, whereas the relevant case corresponds to the limit $\omega > 2\Delta$, $\omega \geq |\vec{q}|$, where ω is the energy of the $\nu\bar{\nu}$ pair, $\vec{q}$ is the momentum, Δ is the pairing gap and v_F is the nucleon Fermi velocity. Thereby Ref. [2] comes to incorrect conclusions.

Finally with inclusion of the two first Fermi liquid harmonics in nucleon-nucleon interaction we support main conclusions of Ref. [1]. Now we are preparing the paper for the publication.

We will continue the collaboration considering further in more detail effects of the P-pairing, the tensor interactions, and some other effects.

References

[1] E.E. Kolomeitsev, D.N. Voskresensky, Phys.Rev. **C77**, 065808 (2008).

[2] L.B. Leinson, e-Print arXiv:0904.0320 [astro-ph.HE].