Quantitative Ratio between Heat Flows due to Sound and Diffusion in Superfluid Helium

K. E. Nemchenko[a], Yu. V. Rogov[b], and S. Rogova[a]

[a]Energy Physics Department, Karazin Kharkiv National University, Kharkiv, Ukraine
[b]Research associate 'Accelerator', NSC Kharkiv Institute of Physics and Technology, Kharkiv, Ukraine

It is known that in superfluid ^{3}He-^{4}He mixtures temperature and concentration relaxation is defined not only by second sound mode like in pure ^{4}He, but by the dissipative diffusion mode too. So, when considering the problem of the temporal evolution of heat flow in helium mixtures, it is necessary to take in account both modes.
Amplitudes relations of temperature or concentration in competing hydrodynamic modes do not give a complete picture of the problem with the periodic heat sources placed in helium. The fact is that the heat flows are determined by velocity of perturbations propagation in helium rather than by amplitudes relation. The aim of this report is to clarify the question which of the modes gives a greater contribution to propagation of heat.
Starting from the two-fluid hydrodynamic model quantitative contributions of second sound mode and dissipative thermal conductivity mode to total heat flow in superfluid ^{3}He-^{4}He mixtures is studied. The problem is considered in a cell with heat sources of the form $Q_0 \cos^2(\omega t)$ at one side. Analytical expressions for space-time temperature and heat flow dependence were obtained and analyzed.

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