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COMPUTER PROCESSING OF THE EXPERIMENTAL DATA OF DEPENDENCE OF DAMPING OF OSCILLATING DISK IN THE ROTATING He I ON VELOCITY

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ABSTRACT. **On the basis of the known experimental data we have studied the dependence of damping of small oscillation of disk on velocity in rotating classical liquid (helium I). The experiment was carried out for the different angular ω_0 velocity at temperature T = (2.215÷2.340)^{0}K.**

The small oscillations of a disk, suspended in rotating classical liquids were theoretically investigated by Yu. Mamaladze and S. Matinyan [1]. The experimental proof of this theory in classical liquid (distilled water) of room temperature was realized by K.Mesoed and J. Tsakadze [2].

The dependence of oscillations damping of the disk on velocity in low temperature classical liquid (rotating helium I) was studied at the Laboratory of Low Temperatures Physics of the Tbilisi State University by G.Gujabidze and J.Tsakadze under the leadership of academician E.Andronikashvili. The results of their experiment are presented here for the first time.

The oscillating system represented a disk of small size suspended on the elastic fiber. It fulfilled rotation simultaneously with surrounding liquid and small rotary oscillations round the fiber. Logarithmic decrement of oscillations damping was measured using chronometrical method developed by Andronikashvili, Mamaladze and Tsakadze [3].

This method is based on the dependence of amplitude on the time needed for the light spot which is reflected from a small mirror fastened on the pendant of oscillating disk to move between two fixed points: special electronic scheme measures the time interval,

during which the light spot passes the distance between two photomultipliers.

According to the theory of this method this time interval increases the damping oscillation of the disk by the law :

$$\ln \tau_n = \ln \tau_1 + \frac{\delta}{2} n \qquad (1)$$

if $\tau_n << \frac{\theta}{\pi}$; here n is the number of oscillations; τ_1 and τ_2 are the first and n-th time of the movement of light spot between photomultipliers, δ logarithmic decrement of damping; θ denotes period of the oscillation.

Thus, according to this theory, at graphical treatment of experimental data (immediately measured values of τ_n) logarithmic decrement of the damping is determined as double angular coefficient of straight $\ln\tau_n = f(n)$ line.

The experiment was realized by the rough heavy disk, had period of oscillation θ_1 = 17.36 sec in rotary velocity (0÷120) sec^{-1} and temperature (2,215 ÷ 2,235)^{0}K intervals.

One part of these data, relating to the rotating He I at temperature T=2,215^{0}K, G.Gujabidze and M.Todua processed by computer using program Origin Pro 6.1 in 2002 and the obtained results were published in 2003 [4].

Computer processing of the second part of named data was continued and results are shown in Fig.1, where continuous line represents the theoretical curve, constructed on the ground of the formula Yu.Mamaladze and S.Matinian [1]:

$$\delta - \delta_0 \frac{\Omega_0}{\Omega} = \frac{\pi^2 \eta R^4}{2I\Omega} \left(\frac{1}{\lambda_+} + \frac{1}{\lambda_-} \right) \left(1 + \frac{2d}{R} + \frac{4}{R} \frac{\lambda_+ \lambda_-}{\lambda_+ + \lambda_-} \right) \qquad (2)$$

Here R and d are radius and thickness of the disk; Ω, δ, and Ω_o, δ_o denote frequency and logarithmic decrement of damping, correspondingly in liquid and vacuum; ν is viscousity coefficient of liquid.

The experimental points are labelled by the different symbols corresponding to the various temperatures of the He I in the above - mentioned interval. The error of the computer processing is $\pm 0.01 \cdot 10^{-2}$.

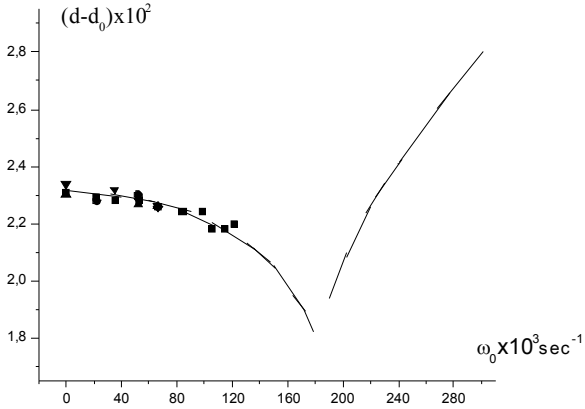

Fig.1. Dependence of logarithmic decrement of damping on rotation velocity for He I at $\theta = 17{,}36\ \text{wm}^{-1}$ (R = 1,5cm ; d = 0,1cm). ■ – T=2,215°K, ● – T=2,245°K, ▲ – T=2,280°K, ▼ – T=2,315°K, ♦ – T=2,335°K.

As can be seen the experimental data of the dependence of oscillation damping on velocity in the rotating He I at the different temperature are in good agreement with the results of theoretical study of analogical question in rotating classical liquid [1].

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მბრუნავ He I-ში რხევადი დისკოს მილევადობის სიჩქარეზე დამოკიდებულების ექსპერიმენტული კვლევის მონაცემთა კომპიუტერული დამუშავება

დასკვნა

წარმოდგენილია მბრუნავ He-1-ში რხევადი დისკოს მილევადობის სიჩქარეზე დამოკიდებულების ექსპერიმენტული მონაცემების კომპიუტერული დამუშავების შედეგები ტემპერატურათა (2.215-2.335) ^{0}K შუალედში. ისინი ეთანხმება ი. მამალაძისა და ს. მატინიანის მიერ კლასიკურ სითხეში დისკოს აქსიალურ-გრეხითი რხევების თეორიული კვლევის დასკვნებს.