rotates in a stationary fashion on the ion side. With increasing field, the rotation ceases to be stationary, but one can still separate in the oscillation spectrum the frequency corresponding to the rotation, against the background of a broad noise spectrum. Further increase in H leads to a strong randomization of the oscillations (Fig. 3). The analysis of the instability has shown that it can be identified with the developed drift-dissipative instability described in [6]. The limit of this instability corresponds to the condition $\omega_i \tau_i > 1$, as is well confirmed experimentally (Fig. 2).

It must be noted that when this instability sets in the ion-sound oscillations do not disappear, and the number of produced torches always coincides with the number of the mode m for the ion sound near the instability limit.

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DEPENDENCE OF THE DENSITY OF ROTATING LIQUID HELIUM ON THE ANGULAR VELOCITY

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The question of the change in the density of rotating helium II, compared with its motionless state, is of considerable interest in view of the presence in it of quantized Onsager-Feynman vortices [1]. In particular, we frequently encounter the assumption, both spoken and published, that the presence of vortex filaments so to speak "loosens up" the rotating helium II.

To ascertain the velocity dependence of the density of helium II we undertook an experiment, in which a sensitive pycnometer was set in rotation. This pycnometer (Fig. 1) is a 52.57-cc copper bulb connected to a glass capillary (length 60 mm, i.d. 1.75 mm). The top of the capillary expands into a small sphere, and the bottom is glued into the sleeve of the valve used to regulate the amount of liquid helium in the pycnometer. During the measurements the valve was closed, and the pycnometer is illuminated with a daylight lamp and viewed in a cathetometer. The accuracy of each individual reading was in this case ± 0.005 mm, and the scatter of the experimental data did not esceed ± 0.2 mm, making it possible to measure the relative change of the density with accuracy $\Delta\rho/\rho = \pm 0.0009\%$. The entire pycnometer was placed in a vessel made of organic glass and in a liquid-helium bath. This vessel was set in rotation in the usual fashion, with the drive shaft passing through a collar coaxial with the pycnometer.

Our instrument was sensitive enough to register changes in the sixth significant figure of the density. This sensitivity was so high, that it was impossible to measure the temperature dependence of the density directly with the pycnometer, since the liquid level went beyond the limits of the capillary at the least change in temperature.

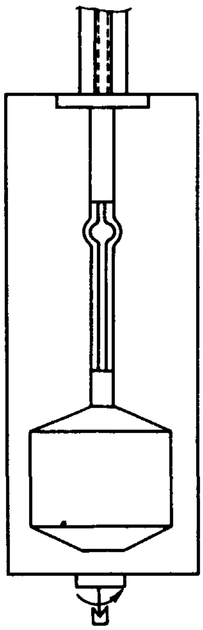

Fig. 1

The measured dependence of the density of helium II on the rotary speed at constant temperature is shown in Fig. 2. On going from one temperature to the other, the liquid level in the capillary was readjusted each time with the aid of the valve.

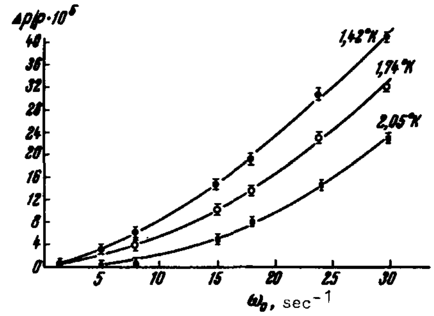

Fig. 2

A striking fact resulting from an examination of Fig. 2 is that when the helium II is twisted it becomes much denser, and the increase in density rises with the temperature and with the angular velocity.

To attribute the observed phenomenon to an increase in the centrifugal pressure, which is equal to $0.5\rho\omega_0^2 r^2$ (ω_0 - angular velocity, r - distance of the rotation axis), would call for a coefficient of compressibility $1/\rho(\partial\rho/\partial P)_T$ which is tens of times larger than the value obtained by extrapolating the existing data to lower pressures (the centrifugal pressure under the conditions of our experiment was small and did not exceed 2×10^{-6} atm.

In addition, it must be noted that if the liquid helium condensation observed by us were due to centrifugal pressure, then the well known properties of the compressibility coefficient should cause the effects to become stronger with increasing temperature, and the derivative $\partial\rho/\partial\omega_0$ should decrease with increasing angular velocity. Actually, however, an increase in the temperature decreases the observed condensation, and $\partial\rho/\partial\omega_0$ increases with increasing ω_0.

If helium-I is set in rotation at the same angular velocity, no change in pressure can be observed.

We must therefore assume that some specific mechanism condensing the helium-II exists. It is not connected with the presence of centrifugal pressure, but apparently with the existence of quantized vortices of the Onsager-Feynman type.

By way of a preliminary result we can report that a jump was observed in the density of the liquid helium as it goes through the phase transition point, thus offering evidence that during rotation the HeII-HeI phase transition is of first and not of second order.

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ON THE SHAPE OF ODD NUCLEI OF THE TRANSITION REGION

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In the transition region of nuclei with $N < 90$ neutrons, the energy of the deformation and the pairing energy have comparable values [1]. Therefore when nucleons are added or when the nucleus becomes excited, the shape of the latter may change.

The large values of log ft of β transitions, systematically observed in the transition region, speak in favor of the assumption that the odd-neutron and odd-proton nuclei of this region have different forms [2].

Direct measurements of the quadrupole moments of the odd-neutron nuclei ${}_{60}Nd^{145}_{85}$, ${}_{62}Sm^{147}_{85}$, ${}_{62}Sm^{149}_{87}$ (+0.02, -0.208, and +0.06 barns, respectively) show that they are spherical in shape; the quadrupole moments of the odd-proton nuclei ${}_{61}Pm^{147}_{86}$ and ${}_{63}Eu^{151}_{88}$, which are respectively equal to 0.7 and 1.16 barns, are much larger than the single-particle value (~0.16 b). We have calculated the equilibrium deformations of odd-proton nuclei by the method of Mottelson and Nilsson [3]. We did not include in the calculations the pairing forces, allowance for which leads to a sharp discrepancy with experiment near the limits of the large-deformation regions [4]. The agreement between the values calculated by us and the experimental ones for nuclei with $N = 90$ (Eu^{153}, Pm^{151}) and $N = 88$ (Eu^{151}) allows us to conclude that the role of pairing in the establishment of the equilibrium form becomes appreciable only when $n < 88$. Comparison of the experimental value of the deformation for Pm^{147} ($\delta = 0.075$) with the calculated value ($\delta = 0.13$) allows us to assess the influence of the pairing forces in other nuclei of the transition region. The approximate values assumed accordingly for the equilibrium deformations of the nuclei are listed in column 3 of the Table (the numbers without the parentheses are the experimental values).

The presence of small deformations should lead to large collectivization of the single-particle states. In terms of the Nilsson scheme, this denotes the existence in the of rotational admixtures. The collective properties of the levels are manifest most strongly in the rates of the electromagnetic transitions between them.

The Table lists the calculated delay factors for M1-transitions ($F_{M1} = B(M1)_{Nils}/B(M1)_{exp}$) and the acceleration factors for E2 transitions ($F_{E2} = B(E2)_{exp}/B(E2)_{Nils}$) between the first-excited and the ground levels of odd-proton nuclei of the transition region. The values for strongly deformed nuclei are included for comparison. The values of the matrix elements of the M1-transitions in the europium isotopes cannot be explained by the method of mixing of configurations with higher values of seniority [5] (the method of Arima et al. [6]).