was measured to determine the absolute values of the differential cross sections; this scattering is purely Coulomb at these deuteron energies.

Figures 2 and 3 show the angular distributions of four groups of α particles from the reaction $C^{12}(d, \alpha)B^{10}$, corresponding to the ground (α_0) and three excited states (α_1, α_2, α_3 - 0.72, 2.15, and 3.58 MeV) of B^{10}, and two groups of α particles (α_0 and α_2) from the reaction $O^{16}(d, \alpha)N^{14}$, corresponding to the ground and second-excited (3.94 MeV) states of N^{14}. The absolute values of the differential cross sections were determined accurate to ± 15%.

The characteristic peculiarities of the angular distributions, and the relatively weak dependence of the distribution on the deuteron energy, indicate that the direct interaction plays a predominant role. The obtained data are presently the subject of a theoretical analysis from the point of view of various direct-reaction mechanisms.

PHENOMENOLOGICAL WAVE FUNCTION OF A SUPERFLUID LIQUID IN A POROUS MEDIUM

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It was shown in [1] that the density of the superfluid component of stationary helium II in an infinite plane gap is described by a function that has a maximum at the center of the gap and zeros on its walls, and vanishes identically at $d = d_c$, where d_c is the critical width of the gap, $d_c = \pi a_0$ (a_0 is a characteristic dimension that depends on the temperature; $a_0 \approx 4.3 \times 10^{-8} (T_\lambda - T)^{1/2}$ cm). It can be shown that the density of the superfluid component of stationary helium behaves in similar fashion in a cylindrical capillary, the critical radius being $R_c = j_{01} a_0 \approx 2.4 a_0$, where j_{01} is the first root of the Bessel function J_0. It is therefore natural to assume that critical dimensions $\delta_c \equiv D_c/a_0 \sim 3 - 5$ and a gradient of ρ_s across the channel when $\delta \geq \delta_c$ are general properties of narrow channels (pores) of arbitrary shape.

In this connection, in considering the problem of the distribution of the density of a "stationary" superfluid component in a porous medium, it is natural to attempt to get around the difficulties connected with the need for taking into account the complicated boundary conditions by averaging the wave function $\psi = f \exp(i\varphi)$ over a volume containing sufficiently many pores ($\rho_S = mf^2\alpha/\beta$, where m is the mass of the helium atom, $\alpha \approx 4.5 \times 10^{-17}(T_\lambda - T)$ erg, and $\beta \approx 4 \times 10^{-40}$ erg-cm^3; in stationary helium φ = const). It is accordingly necessary to modify the equation for f, representing for this purpose the gradient of the unaveraged function f by a sum of an average gradient ∇f and a "small-scale" gradient $\sim f/\delta$ transverse to the channel (∇ denotes differentiation with respect to the coordinates, which are measured in units of a_0). After averaging, the free energy per unit volume is written in the form (see [1])

$$F = (\nabla f)^2 - a^2 f^2 + (1/2) f^4 + F_0 \quad (1)$$

where F is measured in units of α^2/β, $a \sim (1 - 1/\delta^2)^{1/2}$ or, more accurately, $a = (1 - \delta_c^2/\delta^2)^{1/2}$ (this form of a will be justified below)

$$F_0 \neq F_0(f, \nabla f)$$

Minimization of $\int F dV$ with respect to f then leads to the equation

$$\nabla^2 f + a^2 f - f^3 = 0 \qquad (2)$$

which replaces the corresponding equation of [1] and goes over into the latter when a = 1, i.e., when $\delta = \infty$.

In an infinite porous medium filled with stationary liquid helium, $\nabla^2 f = 0$ and f = a. It is therefore natural to obtain a = 1 when $\delta = \infty$ and a = 0 when $\delta = \delta_c$.

Let us consider some particular solutions of (2). Let the half-space x < 0 be a solid (where $f \equiv 0$), and let the half-space x > 0 be occupied by a porous medium of liquid helium. Then

$$f = a \tanh(ax/\sqrt{2}) \qquad (3)$$

It is interesting to note here that the distance from the wall at which the hyperbolic tangent is practically equal to unity is increased by a factor 1/a (compared with the case when $\delta = \infty$ [1]).

On the other hand, if the medium bordering on the left of the porous half-space x > 0 is not a solid but liquid helium II, then the solution of Eq. (2), continued together with its first derivative at x = 0, takes the form

$$f = \begin{cases} -\tanh\left(\dfrac{x}{\sqrt{2}} - \tanh^{-1}\sqrt{\dfrac{1+a^2}{2}}\right) & x < 0 \\ a \coth\left(\dfrac{ax}{\sqrt{2}} + \coth^{-1}\sqrt{\dfrac{1+a^2}{2a^2}}\right) & x > 0 \end{cases} \qquad (4)$$

It is interesting to note, first, that Eq. (4) yields f > a in the entire volume x > 0 and, second, that we have $f \neq 0$ even when a = 0 ($\delta = \delta_c$!)

$$f = \begin{cases} -\tanh\left(\dfrac{x}{\sqrt{2}} - \tanh^{-1}\dfrac{1}{\sqrt{2}}\right) & x < 0 \\ \dfrac{\sqrt{2}}{x + 2} & x > 0 \end{cases} \qquad (5)$$

The increase in the density of the superfluid component in a porous medium bordering on a free volume of a superfluid liquid is obviously connected with the propagation of the wave field of the condensate to neighboring regions, leading in the case of superconductors to the Josephson effect [2]. Analogous effects can be observed also in a partition with minute pores, separating two volumes of a superfluid liquid.

[1] V. L. Ginzburg and L. P. Pitaevskii, JETP 34, 1240 (1958), Soviet Phys. JETP 7, 858 (1958).

[2] B. D. Josephson, Phys. Lett. 1, 251 (1962).