fashion by measuring the as yet unknown $\Sigma\Lambda\pi$ interaction constant and the probability of the as yet unobserved decay

$$\Sigma^{\pm} \rightarrow \Lambda^0 + e^{\pm} \pm \nu. \tag{4}$$

The axial vector part of the amplitude of the decay (4) has the form (see, for example, reference 2)

$$\langle \Lambda | j_\alpha | \Sigma \rangle = \bar{u}_\Lambda [A\gamma_\alpha + Bk_\alpha + C(\gamma_\alpha \hat{k} - \hat{k}\gamma_\alpha)] O u_\Sigma, \tag{5}$$

where k is the summed four-momentum of the leptons, A, B, and C are functions of k^2, and the operator O is equal to γ_5 if the parities of Σ and Λ are identical ($P_{\Sigma\Lambda} = +1$), and equal to 1 if $P_{\Sigma\Lambda} = -1$. Using condition (1) we easily obtain

$$k_\alpha \langle \Lambda | j_\alpha | \Sigma \rangle = Gfm^2 \langle \Lambda | \pi | \Sigma \rangle = Gfm^2 \Gamma(k^2) D(k^2) \bar{u}_\Lambda O u_\Sigma. \tag{6}$$

Here the vertex part $\Gamma(k^2) = h\gamma(k^2)$, where h is the $\Sigma\Lambda\pi$ interaction constant, and $D(k^2) = (k^2 - m^2)^{-1}$ is the Green's function for the π meson, where $\gamma(m^2) = d(m^2) = 1$. Since the nearest singularities of $A(k^2)$, $\gamma(k^2)$, and $d(k^2)$ lie at $k^2 = 9m^2$, it may be expected that A, γ, and d change slowly in the interval $-m^2 \le k^2 \le m^2$.‡

Multiplying (5) by k_α and using (6), we find

$$Gfm^2 \Gamma(k^2) D(k^2) = A(M_\Sigma \pm M_\Lambda) + Bk^2 \tag{7}$$

(the upper sign corresponds to $P_{\Sigma\Lambda} = +1$, the lower sign to $P_{\Sigma\Lambda} = -1$). Considering equation (7) at the point $k^2 = m^2$, we obtain

$$B(k^2) \approx Gfh / (k^2 - m^2). \tag{8}$$

If we look at (7) at the point $k^2 = 0$, we find

$$f \approx A(M_\Sigma \pm M_\Lambda) / Gh. \tag{9}$$

Relation (8) is not a specific consequence of the hypothesis (1); it should hold in any arbitrary theory if one assumes, as we essentially did, that the one-meson pole graph gives the most important contribution to $B(k^2)$ (the effective pseudoscalar) in the region $-m^2 \lesssim k^2 \lesssim m^2$.

Relation (9), which is the analog of (2), is a specific consequence of hypothesis (1). For its verification one must know the values of h and A.

By virtue of the conservation law for the vector current, the contribution of the vector interaction to the decay (4) is very small.[7,2,8] Therefore it is just the value of A (with an accuracy up to terms proportional to k in the amplitude) which determines the probability of the decay (4):

$$w_{\Sigma\Lambda} \approx 3A^2\Delta^5 / 60\pi^3, \quad \text{if} \quad P_{\Sigma\Lambda} = +1,$$
$$w_{\Sigma\Lambda} \approx A^2\Delta^5 / 60\pi^3 \quad \text{if} \quad P_{\Sigma\Lambda} = -1, \tag{10}$$

where $\Delta = M_\Sigma - M_\Lambda$, and $\hbar = c = 1$ as in all the preceding equations. The value of the $\Sigma\Lambda\pi$ interaction constant h, on the other hand, might, for example, be obtained from an analysis of processes of the type

$$\Lambda(\Sigma) + N \rightarrow \Sigma(\Lambda) + N.$$

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*Relation (2) was first obtained by Goldberger and Treiman[3] with the help of dispersion theory techniques and a number of unjustified assumptions.

†We note that within the framework of the Sakata model relation (1) could serve as a definition of what is called the π meson field in the usual form of the weak interaction.

‡We note that the physical region of values of k^2 in the decay (4) lies within the limits $0 \leqslant k^2 \leqslant (M_\Sigma - M_\Lambda)^2$.

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THE PROBLEM OF THE FORM OF THE SPECTRUM OF ELEMENTARY EXCITATIONS OF LIQUID HELIUM II

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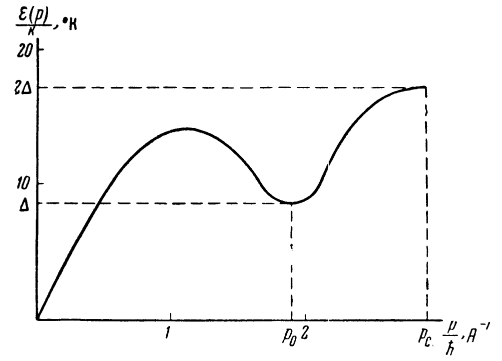
In a recently published preliminary communication by Henshaw, Woods, and Brockhouse,[1] data are given on the behavior of the energy spectrum of liquid helium II in the region of energies $\epsilon \approx 2\Delta$

$= 17.3°K$, obtained by investigation of the inelastic scattering of neutrons. In this case it was shown that the function $\epsilon(p)$ in this region has a negative second derivative, i.e., that the spectrum begins to "bend." In the opinion of the authors of the communication, this suggests the presence of a second maximum in the function $\epsilon(p)$.

The purpose of the present note is to turn attention to the fact that this phenomenon actually has another explanation. That is, we have shown[2] that the curve of the energy spectrum of liquid helium II generally cannot rise above the energy $\epsilon = 2\Delta$. This is connected with the fact that an elementary excitation with energy $\epsilon \geq 2\Delta$ can divide into two excitations with energy $\epsilon = \Delta$. At the energy $\epsilon = 2\Delta$ the curve $\epsilon(p)$ reaches a maximum and breaks off, so that this point is the end point of the spectrum. Close to it the spectrum has the form

$$\varepsilon(p) = 2\Delta - \alpha \exp[-a/(p_c - p)], \qquad (1)$$

where p_c is the momentum for which the energy is equal to 2Δ while α and a are certain constants. Thus the complete curve of the spectrum of elementary excitations of liquid helium II has, qualitatively, the form shown in the drawing. However, it should be noted that, until experimental data become available, theoretical prediction of the behavior of the curve $\epsilon(p)$ was not completely unique, inasmuch as the possibility was not excluded that the velocity of the excitation at some point with $\epsilon < 2\Delta$ would not equal the velocity of sound.* In this case the curve $\epsilon(p)$ would be gradually washed out because of radiation of phonons, not achieving the value 2Δ. The data obtained in reference 1 precisely show that this is not the case, i.e., that the spectrum without damping achieves the energy 2Δ where it must terminate.



We also note that the probability of the creation of a single excitation with energy ϵ by a neutron vanishes as $\epsilon \to 2\Delta$ according to the law

$$w = A^{\frac{(2\Delta - \varepsilon)}{a}} \ln^2 \frac{\alpha}{2\Delta - \varepsilon}. \qquad (2)$$

This is in qualitative agreement with the fact that, for the maximum energy obtained in reference 1, $\epsilon = 17.1°K$, the probability of the creation of an excitation amounts to 6 per cent of the probability of the creation of an excitation with $\epsilon = \Delta$.

*We do not mention another method of termination of the spectrum described in reference 2, inasmuch as it is extremely improbable in helium.

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NEGATIVE ABSORPTION IN METAL VAPORS

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SCHAWLOW and Townes[1] have considered the use of negative absorption for the amplification and generation of radiation in the optical region of the spectrum. As an example they have considered potassium vapor, excited by ultraviolet light from a potassium lamp. However, the intensity of the exciting light proved to be insufficient, and this behavior is typical for metals. The use of a different source cannot be a universal method, since there exist at most 2 or 3 coinciding pairs of lines from different elements suitable for the purpose in view. There is therefore a limited outlook for the direct optical excitation of metal vapors. It seems possible to circumvent this difficulty by working with a mixture of two gases, in which a resonance level of one gas is close to an excited level of the other. Under these conditions we can expect an intense optical excitation of the first gas and an effective population of the neighboring level in the other, thanks to resonance transfer of the excitation energy. It is this effect,