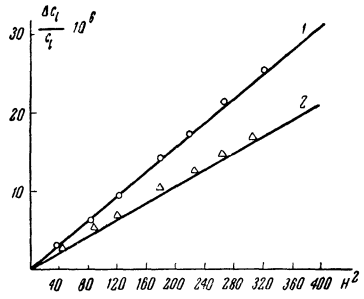

FIG. 2. The velocity of sound as a function of magnetic field.

the wave vector and the magnetic field, H is the magnetic field and μ is the magnetic permeability. These formulas apply when $\sigma \gg c^2\omega/4\pi\mu c_l^2$, where σ is the conductivity, ω is the vibration frequency and c is the velocity of light.

In Fig. 2 are shown the results of experiments carried out at room temperature in a magnetic field perpendicular to the axis of the sample ($\sin\vartheta = 1$). The relative change in velocity c_l is plotted along the ordinate axis while the square of the magnetic field is plotted along the absicca axis. The solid lines are obtained by calculation: (1) for tin (c_{l_0} = 2630 meters/sec), (2) for aluminum (c_{l_0} = 6,000 meters/sec). The absolute values of the velocity were measured by a pulse method. As is apparent from the curves, the experimental points are in good agreement with the theoretical values.

Thus it has been established that the acoustic velocity is proportional to H^2 in a magnetic field and the magnitude of the effect is that predicted by the theory.

It is interesting to note that in bismuth, in which the condition $\sigma \gg c^2\omega/4\pi\mu c_l^2$ is not satisfied, no dispersion in the acoustic velocity at room temperature was found.

In conclusion we wish to express our gratitude to Prof. A. I. Akhiezer and S. V. Peletminskii for calling our attention to this effect.

*These expressions were obtained independently from Alpher and Rubin by A. I. Akhiezer and S. V. Peletminskii.

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THE NEGATIVE ION H_2^-

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ACCORDING to theoretical calculations,[1,2] the molecule H_2 in the lowest electronic state has no affinity for electrons. Nevertheless, the possibility of a stable negative ion H_2^- is not excluded. This unusual situation is due to the fact that, although the fundamental vibrational level of the system H, H^- (which is the H_2^- ion) is higher than the fundamental vibrational level of the H_2 molecule, it has a much larger internuclear separation. The removal of an electron from the H_2^- ion corresponds to an electron transition at an internuclear separation of the order of 3 A, where the potential curve for the H_2 molecule rises higher than the curve for the H_2^- ion. According to Dalgarno and McDowell[2] the "vertical energy of electron removal" from the H_2^- ion is 0.9 ev.

As far as we are aware, the H_2^- ion has never been observed. We have attempted to obtain some evidence for this ion, using the "recharging" method[3] to produce it. Water vapor and antimony vapor were introduced simultaneously into an ion source and bombarded by a beam of electrons (0.3 ma; 80 ev). The resulting negative ions were analyzed in a mass spectrometer connected to an electron multiplier.[4]

When water vapor alone was present in the ion source, the ions H^-, O^- and OH^- were formed. When antimony vapor was subsequently introduced into the source, the additional ions Sb^-, Sb_2^-, and Sb_3^- appeared, together with a negative ion of mass 2. There were also maxima corresponding to mass values of 0.5, $\approx$ 3, and $\approx$ 6. These maxima must be assigned to fragmentary ions, arising from the dissociation of primary ions. To suppress the ion fragments, a retarding potential of 1500 volts was applied to the first diode of the multiplier, while maintaining the primary ion energy at 800 ev. When this was done, the peaks corresponding to the masses 0.5, 3, and 6 completely disappeared; the amplitudes of the peaks at mass 1 (H^-) and mass 2 were practically unchanged. This shows that both these maxima were due to primary ions formed in the source. The height of the peak at mass 2 depended on the vapor pressure of the antimony; even under the most favor-

able conditions the ion current at this mass was only 5×10^{-15} amp.

The question may arise whether or not this peak is due to the formation of the negative deuterium ion D^-, which has a mass of two. However, the height of the peak at mass 2 was only 20 — 30 times less than that of the H^- peak, while the ratio H/D in natural water is 6000. Furthermore, the mass 2 ions appeared only when antimony vapor was present in the ion source.

All of the above leads us to the conclusion that the negative ions with mass 2 which we observed were in fact H_2^- ions. The occurrence of fragmentary ions with mass 0.5 can serve as an additional indication of the presence of H_2^- ions within the apparatus. An apparent mass of 0.5 would be carried by an ion formed by the dissociation of an H_2^- ion outside the source.

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ON THE DETERMINATION OF THE RELATIVE PARITIES OF ELEMENTARY PARTICLES

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SINCE parity is not conserved in the weak interactions, it is of great interest to determine the parities of elementary particles by means of the strong interactions. We consider below several reactions which can be used for the determination of the relative parities of strange particles. We have in mind the following type of reaction:

$$p\,(n) + \mathrm{He}^4 \rightarrow {}_\Lambda\mathrm{He}^5 + K^+\,(K^0) \qquad (1)$$

with the assumption that the spins of ${}_\Lambda\mathrm{He}^5$ and K are $\frac{1}{2}$ and 0, respectively.

This process is completely described by a spin-space matrix $M(\mathbf{n}, \mathbf{n}')$ which gives the amplitude of the diverging wave.[1] The most general form of the matrix $M(\mathbf{n}, \mathbf{n}')$ is

$$M(\mathbf{n}, \mathbf{n}') = a + b\sigma\,[\mathbf{n} \times \mathbf{n}'], \qquad (2)$$

when the product I of the parities of all four particles is equal to +1, and

$$M(\mathbf{n}, \mathbf{n}') = a\sigma\mathbf{n} + b\sigma\mathbf{n}', \qquad (3)$$

when $I = -1$. Here $\mathbf{n}$ and $\mathbf{n}'$ are unit vectors parallel to the momenta of the incident and emerging particles, respectively; a and b are certain functions of the energy and of the angle between $\mathbf{n}$ and $\mathbf{n}'$. The density matrix ρ_i of the initial state has the form

$$\rho_i = A(1 + \sigma\mathbf{P}), \qquad (4)$$

where $\mathbf{P}$ is the polarization vector of the incident particles. If the reaction takes place at threshold, or if we select only the ${}_\Lambda\mathrm{He}^5$ particles emitted forward (i.e., $\mathbf{n} \parallel \mathbf{n}'$), then we can neglect the second term in Eq. (2). At the threshold, Eq. (3) takes the form $M = a\sigma\mathbf{n}$, and for $\mathbf{n} \parallel \mathbf{n}'$ we have $M = (a + b)\sigma\mathbf{n}$. The polarization vector $\mathbf{P}'$ of the ${}_\Lambda\mathrm{He}^5$ particle in the final state is calculated by the formula[1]

$$\mathbf{P}' = \mathrm{Sp}\,(M\rho_i M^+\sigma) / \mathrm{Sp}\,(M\rho_i M^+). \qquad (5)$$

Substituting Eqs. (2), (3), and (4) into (5), we get

$$\mathbf{P}' = \mathbf{P}, \qquad \text{when } I = +1, \qquad (6)$$

$$\mathbf{P}' = (2(\mathbf{P}\mathbf{n})\,\mathbf{n} - \mathbf{P}), \qquad \text{when } I = -1. \qquad (7)$$

If the parity is not conserved in the decay of the ${}_\Lambda\mathrm{He}^5$, then from the angular asymmetry of the decay one can measure the direction of polarization of the ${}_\Lambda\mathrm{He}^5$ and distinguish between the possibilities (6) and (7). We emphasize that the incident beam must be polarized, and in such a way that the polarization vector is neither parallel nor perpendicular to the direction $\mathbf{n}$. The other reactions of this general type are as follows:

$\Sigma^\pm + \mathrm{He}^4 \rightarrow {}_\Lambda\mathrm{He}^5 + \pi^\pm$ at threshold, or when the ${}_\Lambda\mathrm{He}^5$ emerges forward; (8)

$\Sigma^\pm + \mathrm{He}^4 \rightarrow \Lambda + \mathrm{He}^4 + \pi^\pm$ at threshold; (8′)

$p\,(n) + \mathrm{He}^4 \rightarrow \Lambda + \mathrm{He}^4 + K^+\,(K^0)$ at threshold. (1′)

In the last two reactions He^4 can be replaced by any other nucleus with spin 0 (for example, C^{12}).