ized hyperons resulting from the absorption of K^- mesons by nucleons from filled shells of the nucleus, however the sign of $\overline{P}_Y$ will persist.

I am grateful to I. S. Shapiro for discussions.

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HEAT OF MIXING OF LIGHT AND HEAVY WATER

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IT seems at first glance that the thermal effect in mixing H_2O and D_2O should be very small, since a mixture of molecules of different isotopes could be considered to a high degree of approximation as an ideal solution. But account must be taken of the chemical interaction between the molecules of the initial substances:

$$H_2O + D_2O \rightleftarrows 2HDO. \quad (1)$$

A value $K = 3.26$ is usually taken[1] for the equilibrium constant of the above reaction in the liquid phase. This means that when one mole of H_2O and 1 mole of D_2O are mixed, 0.95 moles of HDO is formed.

The properties of the H_2O and D_2O molecules have been investigated in sufficient detail, but the same cannot be stated with respect to the molecules of HDO, since they always occur mixed with H_2O and D_2O. If the heat of mixing q of light and heavy water and the equilibrium constant of the reaction (1) are known, the heat of formation q' of HDO, when H_2O and D_2O react in the condensed phase, can be determined directly, and certain conclusions can be drawn from this regarding the difference in the zero-point energies of the different isotopic forms of water molecules.

The heat of mixing of H_2O and D_2O (99.7%) was determined in a hermetically sealed reversing calorimeter provided with a heater and a thermistor. A cooling of the system (by $\approx 0.3°C$) was observed on mixing (up to a molecular concentration of deuterium $n \approx 0.5$). The temperature of the external container was adjusted to the temperature of the calorimeter. The correction for heat exchange did not exceed 2.5% of the magnitude of the effect observed. The thermal capacity of the system was determined in the course of the experiment.

As the result of experiments (at 24°C) the following value for the heat of mixing (heat is absorbed) was obtained for the case $n = 0.50$, taking into account possible errors: $q = 7.92 \pm 0.25$ cal/mole.

If we assume the equilibrium constant for the reaction (1) in the liquid phase to be equal to 3.26, we shall obtain for the heat of formation of 1 mole of HDO (not taking into account the effect due to the heavy isotope of oxygen O^{18}) the value $q' = 16.7 \pm 0.5$ cal/mole. This value can be compared with the results of calculations for the gas phase. To do this, we make use of the theoretically calculated dependence of the equilibrium constant on the temperature,[2] and the well-known thermodynamic relation[3]

$$\partial \ln K / \partial T = \Delta H / RT^2, \ \Delta H = 2q'.$$

From this we obtain $q' = 34$ cal/mole. A decrease in the heat of formation of HDO in the condensed phase, compared with the gaseous phase, may be due to a strong intermolecular interaction in solution and to the associated change in the zero-point energies.

I express my gratitude to V. M. Kostin for his help in carrying out the experiments.

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MEASUREMENT OF β-γ CORRELATION FROM ORIENTED NUCLEI

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IN connection with the problem of nonconservation of parity, it has been shown by Dolginov[1] and others[2,3] that in an allowed transition the investigation

of the angular correlation between the β particle and the subsequent γ quantum emitted by an oriented nucleus can give the answer to the question whether the so-called combined parity is conserved in β decay. When there is interference between the Fermi and Gamow-Teller interactions, the shape of the correlation function depends essentially on the validity of the hypothesis of conservation of combined parity which was enunciated by Landau.

One of the experimental difficulties in such measurements is the short time available for the measurements on nuclei which have been oriented at very low temperatures, because of the rapid heating up of the samples. In the first experiments on parity nonconservation[4] the asymmetry of the β radiation disappeared completely after 5 or 6 minutes, and the actual time for the measurements may have amounted to only 3 or 4 minutes.

In studying the correlation we constructed an apparatus for orienting nuclei in which measures were taken to increase the duration and statistical accuracy of the measurements.

The principal source of heat loss is heat radiation passing through the light pipe which serves to transmit the light pulses occurring in the plastic scintillator for recording the β particles (Fig. 1). To absorb this radiation, the 6-micron thick aluminum reflector over the plastic scintillator was covered by a copper foil of the same thickness. Heat absorbed by the foil was transferred to a helium dewar through the clamps and glass of the container.

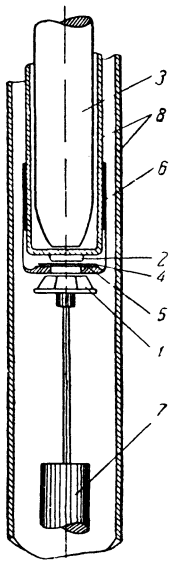

FIG. 1. 1) crystal of $2[Ce(NO_3)_3]\,3[Mg(NO_3)_2]\cdot 24H_2O_2$; 2) plastic scintillator; 3) light pipe; 4) aluminum foil; 5) copper foil; 6) copper clamp; 7) Ballast salt; 8) vessel walls.

Measurements were made of the asymmetry of the β radiation of Co^{60} introduced into a thin surface layer of a crystal of cerium-magnesium nitrate. The polarization of the nuclei alternately in the direction toward the β detector and away from it was accomplished by means of a magnetic field along the axis of the vacuum vessel. The time during which the asymmetry of the radiation was close to its limiting value was about 20 minutes (Fig. 2). The degree of asymmetry of the β radiation in these experiments was approximately half that in the experiments of Wu et al., since the solid angle for counting of the β particles was increased by approximately a factor of 20 and was close to 2π. In measuring the correlation, the decrease of the observed effect by a factor of 2 is more than compensated by the increase in statistical accuracy of the measurements.

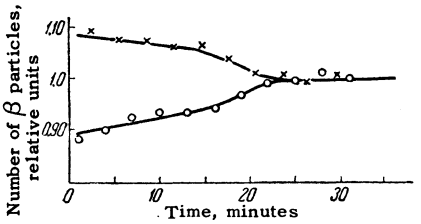

FIG. 2. Asymmetry of β radiation. Direction of polarizing magnetic field: ×) down, o) up.

The Co^{58} isotope was first chosen for the investigation of the β-γ correlation, but before the completion of our experiments it was shown that the interference term in the β decay of Co^{58} should be small[5] and that correlation measurements on this isotope do not allow one to draw any conclusions concerning the conservation of combined parity.[6]

We have made measurements of the β-γ angular correlation for oriented Co^{60} nuclei. The preliminary data do not contradict the theoretical computations made on the assumption of conservation of combined parity. We plan to study the β-γ angular correlation for Mn^{52} and V^{48} in which, according to data in the literature, the interference term should be markedly different from zero.

The authors thank Academician A. I. Alikhanov and Prof. S. Ia. Nikitin for supplying the Co^{58}, A. Z. Dolginov for frequent valuable discussions and for preprints of his papers, and O. V. Larionov for the chemical separation of the Co^{58}.

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μ^+-MESON DEPOLARIZATION IN NUCLEAR EMULSIONS WITH DIFFERENT GELATIN CONTENT

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FRIEDMAN and Telegdi[1,2] and Gurevich et al.[3] have studied the asymmetry in nuclear emulsions in the angular distribution of electrons from the μ^+-e^+ decay to verify the failure of the parity conservation law in weak interactions.[4] Their results for the asymmetry coefficient in the angular distribution had a smaller absolute value than predicted by theory. One of the reasons for this is μ^+-meson depolarization in the emulsion. The results of Chadwick et al.[5] indicate that the depolarization effect is different for the two constituents of the nuclear emulsion (silver halide and gelatin).

The present work was undertaken to clarify the dependence of μ^+-meson depolarization on the relative content of each constituent of the emulsion (by studying the "forword-backward" asymmetry in the electron distribution from μ^+-e^+ decay). To this end a chamber was used consisting of layers of the usual NIKFI type "R" emulsion and of layers of emulsion whose gelatin content by weight was 2, 3, and 4 times that of the usual emulsion. We shall refer to these emulsions as 2-, 3-, and 4-fold diluted emulsions. The chamber was exposed to the π^+-meson beam from the synchrocyclotron of the Joint Institute for Nuclear Research. The emulsion chamber was placed inside a magnetic screen (within which the field intensity did not exceed 0.08 gauss) to prevent precession of the spin of stopped μ^+ mesons due to stray magnetic fields of the synchrocyclotron.

The various emulsions were prepared at the same time and were from the same batch. The thickness of each emulsion layer was measured before and after exposure.

In the scanning process those π^+-μ^+-e^+ decays were registered for which the μ^+-meson track was entirely within one emulsion layer. The direction of electron emission was measured relative to the direction of the μ^+-meson momentum at the point where the π^+ meson decayed. The plane perpendicular to this direction served as the dividing plane for decay electrons emitted forwards and backwards.

The events in which the μ^+ meson decayed within 50 μ from the surface of the unexposed emulsion were excluded in the processing of the results. The resultant data are given in the table.

Emulsion dilution factor	Number of $\pi \to \mu \to e$ decays	Number of undetected electrons	$-A$
×1	2300	11	0.065±0.041
×2	2300	13	0.118±0.041
×3	2300	21	0.14±0.041
×4	1133	53	0.37±0.06

For each emulsion we calculated the ratio $2(N_B - N_F)/(N_B + N_F)$ (N_B, N_F is the number of electrons emitted backwards and forwards respectively), which was taken to be the asymmetry coefficient A. The statistical root-mean-square error was taken to be $2/\sqrt{N}$. It was assumed that the electron angular distribution is of the form $1 + A \cos\theta$, where θ is the angle between the initial directions of the μ-meson and electron momenta. In the first three types of emulsion the number of undetected decay electrons was less than 1%. To exclude the comparatively large number of unseen electrons in 4-fold diluted emulsions it was assumed that all these electrons were emitted forwards. Clearly, this lowers the asymmetry coefficient. Nevertheless, as can be seen from the figure, the angular asymmetry tends to rise with the increase in the gelatin weight content of the nuclear emulsion.