(intensity 5%) from the Hf^{175} obtained when the natural isotope mixture is irradiated in a reactor.

The contribution of the bremsstrahlung from the β electrons was determined more precisely by measuring the polarization of γ quanta from a source of Lu^{177}, which has a β spectrum with end-point energy 490 keV and relatively soft γ quanta (208 keV), suppressed with filters. The measurements were made with a source of 4000 Ci activity, prepared in the same manner as the Hf^{181} source. Negative polarization was observed, which when recalculated in terms of the activity of the Hf^{181} source provides an estimate of the contribution made to the polarization by the bremsstrahlung ($P_\gamma = -0.5 \times 10^{-5}$).

Thus, our results do not agree with the data of Boehm and Kankeleit [2], who obtained a value $P_\gamma = -(2.0 \pm 0.4) \times 10^{-4}$ for the polarization of the γ quanta of the 482-keV transition in Ta^{181}. It is quite difficult to determine the causes of the discrepancy, and we can only emphasize once more that the measurement of so small a polarization by means of the usual procedure is an extremely difficult task.

According to calculations by Wahlborn [6], the amplification factor for this transition lies in the range $30 \leq R \leq 110$, so that an estimate of the mixing factor F from our data will yield $F < (6 - 2) \times 10^{-7}$, which does not contradict the estimate given in [7] (8×10^{-7}), taking into account the highly approximate nature of such estimates.

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THE MOSSBAUER EFFECT ON Dy^{161} IMPURITY NUCLEI IN MATALLIC GADOLINIUM

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Irradiation of metallic gadolinium in a reactor (97% Gd^{160}) gives rise to the reaction $Gd^{160}(n\,\gamma)Gd^{161} \xrightarrow{3.7\ min} Tb^{161}$, and the decay of the Tb^{161} causes emission of γ rays of

Dy^{161}. We have investigated the Mossbauer spectra of such a source, constituting in fact Dy^{161} impurity nuclei in a gadolinium lattice. We can investigate the magnetic properties of the gadolinium matrix by studying the hyperfine splitting of the γ rays of these Dy^{161} nuclei. The use for this purpose of the Mossbauer isotopes of gadolinium itself, for example Gd^{155}, is difficult if not impossible, since the hyperfine splitting of the levels of Gd (whose electron shell, unlike Dy, has no orbital angular momentum), is small.

The absorber used was polycrystalline Dy_2O_3 (40 mg/cm^2, 90% Dy^{161}). At T = 300°K, the $Dy_2^{161}O_3$ has a "thick" absorption line (~1 cm/sec, Γ_{nat} = 0.02 cm/sec), which is suitable, however, for the study of large magnetic hyperfine splittings of the source (~25 cm/sec). We used a Mossbauer spectrometer with a permanent-magnet vibrator, operating in the constant-velocity mode [1]. The spectra were measured at different source temperatures from 5 to 300°K [1]. Figure 1 shows part of the obtained spectra.

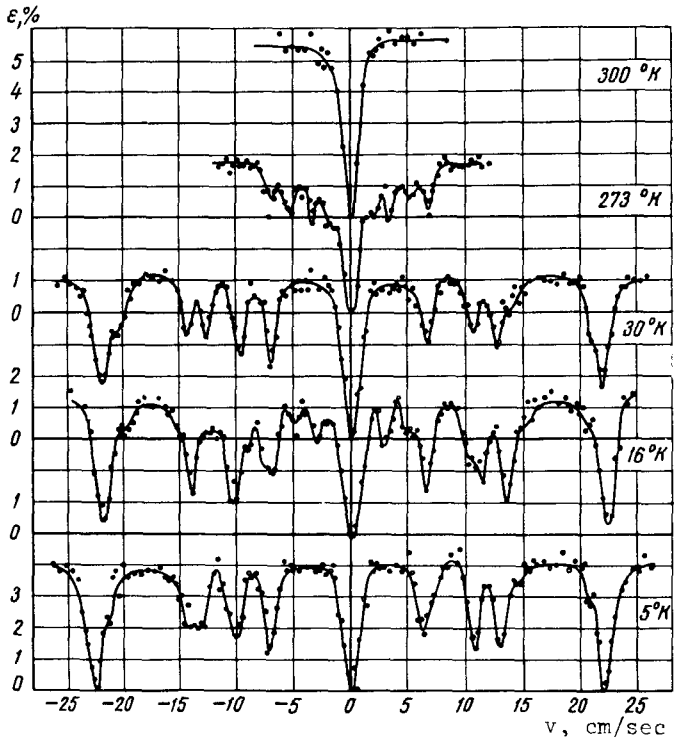

Fig. 1.

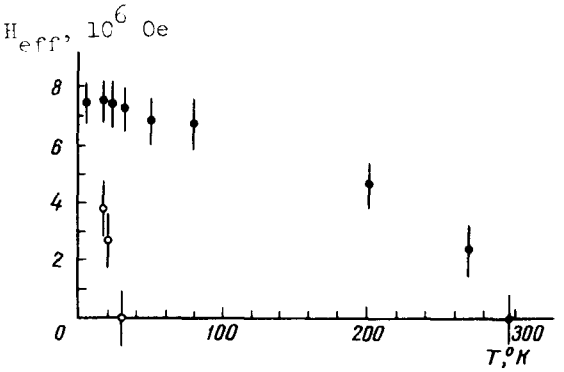

Fig. 2.

At T = 5°K the spectrum is the usual hyperfine splitting spectrum of Dy^{161}, consisting of 14 lines (not all lines are resolved). The magnitude of the magnetic splitting corresponds to a field ~7.3 x 10^6 Oe on the Dy nuclei. At T = 16°K the number of lines increases, and at T = 30°K it assumes the previous value, but the relative intensity of the central peak increases sharply compared with the spectrum at 5°K. With further rise in temperature the magnetic splitting decreases gradually and finally vanishes near the Curie point of gadolinium.

This behavior of the spectra can be explained as follows. At T = 5°K there are two different systems of lines (two different spectra) with approximately identical hyperfine split-

ting. With increasing temperature, the magnetic splitting of one of these spectra decreases rapidly and vanishes at T = 30°K. The lines of the spectra are crowded together and enter the central peak, thus increasing its intensity.

Measurements of individual spectral lines at T = 7.5 and 10°K have made it possible to trace the broadening and then also the splitting of the spectral lines at 5°K. In addition, we measured the individual lines of the spectrum at T = 5°K with an absorber heated to T = 800°K and having a narrower line than at T = 300°K [2]. These measurements have shown that actually the spectral lines at 5°K are doublets, i.e., this spectrum consists of two different spectra with somewhat differing hyperfine splittings. The presence of two hyperfine-splitting spectra was observed by us earlier also in the case of the emission spectrum of Dy^{161} in Gd_2O_3 [2].

In our opinion, two systems of hyperfine splittings correspond to two different states of the electron shell of the Dy ions, produced in the β decay of Tb^{161}. Such a phenomenon is known to exist in the case of Co^{57} [3]. A distinctive feature of our case is that it is observed in a metal, where the relaxation times of the electron shell should seemingly be small.

Figure 2 shows the temperature dependence of the fields on the Dy^{161} nuclei, corresponding to these two systems of hyperfine splitting. For T = 200 and 273°K, H_{nuc} was obtained from the position of the outermost lines of the spectrum. We see that $H_{nuc}(T)$ for the second system vanishes near the Curie point of gadolinium. The variation of $H_{nuc}(T)$ for the first system apparently offers evidence of the fact that the corresponding Dy ions behave like paramagnetic ions in gadolinium.

Reduction of the spectra of Fig. 1 yielded for the ratio of the magnetic and quadrupole moments of the first-excited and ground states values $\mu_*/\mu_0 = -1.2 \pm 0.1$ ($\mu_0 = -0.37 \pm 0.05$), $Q_*/Q_0 = 0.85 \pm 0.1$. These values are in good agreement with the results by others: $\mu_*/\mu_0 = -1.19 \pm 0.05$, $Q_*/Q_0 = 0.95 \pm 0.1$ [4], and $\mu_*/\mu_0 = -1.2 \pm 0.1$, $Q_*/Q_0 = 0.83 \pm 0.08$ [5]. The quadrupole splittings $W = (1/4)eqQ_0$ at temperatures 30 and 80°K turned out to be 660 ± 60 and 530 ± 50 Mcs.

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1) The source temperature was regulated by varying the temperature gradient along a special heat bridge connecting the source with the liquefied-gas bath.