lation is much smaller than the line width. Starting from the Duhamel formula it can be shown that distortions due to rapid passage through the resonance region and the time constant of the phase detector are given by the following when frequency or Zeeman modulation are used:

$$S^* = S_0 + 2(v\tau)^2, \qquad (2)$$

where v is the rate of passage through the resonance region and τ is the time constant of the detector. The final measurements were made with Zeeman modulation. The use of a superregenerative system makes it possible to use a convenient frequency scale since the signals follow the quenching frequency. The quadrupole resonance signals of Cl^{35} and Cl^{37} were observed in $Ba(ClO_3)_2$, $NaClO_3$, and $KClO_3$ powders. At the present time we have also observed the quadrupole resonance in calcium chlorate. The observed signal amplitudes are in good agreement with the natural abundances of the chlorine isotopes. The amplitude of the rf field was rather small in order to avoid the additional broadening, which exceeds the nuclear magnetic resonance broadening by a factor of 4. In spite of the low level of the rf field the signal-to-noise ratio in potassium chlorate was of the order of 60 for Cl^{35}. The total width of the lines were measured at half heights.

The results of the experiment are shown in the table; it is apparent that in these chlorates the line width is determined basically by nuclear dipole-dipole interactions since the ratio of magnetic moments of the chlorine isotopes is 1.2. An estimate of relaxation-time broadening shows that this quantity is less than 0.03 kcs.[4] Because $NaClO_3$ is a cubic crystal, a simple expression can be used for the second moment[5]

$$h^2\langle\Delta\nu^2\rangle_{av} = 60q^4\beta^4d^{-6}, \qquad (3)$$

where h is Planck's constant, g is the gyromagnetic ratio, β is the nuclear magneton and d is the size of an elementary cell.

It should be noted that Eq. (2) applies in the case in which the center of the line is not shifted. When making corrections, however, one must take account of the displacement of the center. With the introductions of corrections for broadening due to the magnetic field of the earth, the rate of passage through the resonance region, and effects due to sodium atoms, the second moment for Cl^{35} in $NaClO_3$ is found to be

$$\langle\Delta\nu^2\rangle_{av} = 0.42\cdot10^5 \text{ cs}^2.$$

Whence we find that d = 6.9 A. This result is in good agreement with the x-ray data,[6] according to

Material	Isotope	Frequency, Mcs.	$\Delta\nu$, kcs	$\frac{\Delta\nu(Cl^{35})}{\Delta\nu(Cl^{37})}$
$Ba(ClO_3)_2$	Cl^{35}	29.6	2.8	1.07
	Cl^{37}	23.2	2.6	
$KClO_3$	Cl^{35}	28.1	1.1	1.2
	Cl^{37}	22.2	0.9	
$NaClO_3$	Cl^{35}	29.9	1.3	1.13
	Cl^{37}	23.6	1.15	

which d = 6.5 A in $NaClO_3$. The calculation which has been carried out on the basis of well-known crystal structures shows that the line shapes in chlorates are amenable to straight-forward interpretation.

In conclusion we wish to thank F. I. Skripov for discussions and his interest in this work.

[1] T. C. Wang, Phys. Rev. **99**, 566 (1955).
[2] G. B. Benedek and T. Kushida, Rev. Sci. Instr. **28**, 92 (1957).
[3] H. C. Allen, J. Phys. Chem. **57**, 501 (1953).
[4] V. S. Grechishkin, J. Exptl. Theoret. Phys. (U.S.S.R.) **35**, 364 (1958), Soviet Phys. JETP **8**, 253 (1959).
[5] A. Abragam and K. Kambe, Phys. Rev. **91**, 894 (1953).
[6] G. Kartha, Proc. Ind. Acad. Sci. **A36**, 501 (1952).

Translated by H. Lashinsky
112

CROSS SECTION OF Te^{125m} PRODUCTION VIA THE (n, γ) REACTION

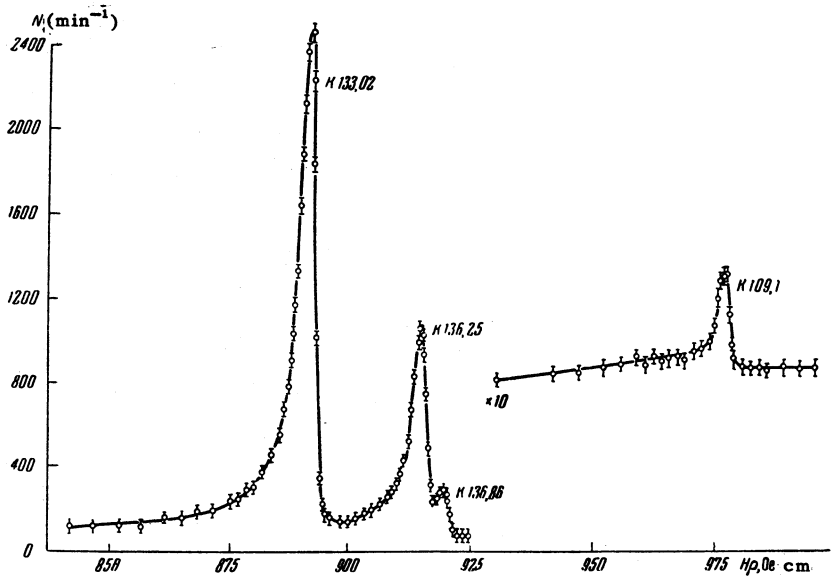
V. S. GVOZDEV and Yu. L. KHAZOV

Leningrad Physico-technical Institute, Academy of Sciences, U.S.S.R.

Submitted to JETP editor November 6, 1958

J. Exptl. Theoret. Phys. (U.S.S.R.) **36**, 632-633 (February, 1959)

WHEN an isomer pair is produced via the (n, γ) reaction, the more probable of the two isomers is the one whose spin is closest to that of the initial nucleus.[1] It has been established that for isotopes of tin, tellurium, and zenon the production cross section of an isomer state with spin $^{11}/_2$ amounts to several dozens of millibarns. Exceptions are the isotopes of tellurium 122 and 124, for which



Hughes and Harvey[2] lists cross sections of 1.0 ± 0.3 and 5 ± 3 barns.

In the present investigation we measured the cross section for the production of the isomer state of Te^{125} with spin $^{11}/_{2}$ via the (n, γ) reaction. The cross section was determined by comparison with the cross section of the Hf^{180}(n, γ) Hf^{181} reaction, which were taken to be 10 ± 3 barns, as in reference 2. Separated Te^{124} and Hf^{180} sources were prepared for the measurements and irradiated simultaneously in the neutron beam.

The internal-conversion electron spectrum of Te^{125m} and Ta^{181}, produced in the β^- decay of Hf^{181}, was investigated with a beta spectrometer. The figure shows the internal-conversion electron K lines of the gamma transitions of energies 133.02, 136.25, and 136.85 kev (Ta^{181}) and 109.1 kev (Te^{125m}, for which the ordinate scale is magnified ten times). By determining the intensity ratio of the 109.1 and 133.02 kev K lines, it is possible to calculate the cross section for the production of Te^{125m} via the (n, γ) reaction; it was found to be 40 ± 25 millibarns.

According to reference 1, the cross section for the production of the ground state of Te^{125} via the (n, γ) reaction is 6.5 ± 1.2 barns. The ratio of the Te^{125m} (spin $^{11}/_{2}$) and Te^{125} (spin $^{1}/_{2}$) cross sections is 0.006.

[1] E. Segrè and A. Helmholz, Rev. Modern Phys. 21, 274 (1949).

[2] D. J. Hughes and J. A. Harvey, Neutron Cross Sections, N. Y., 1955.

Translated by J. G. Adashko
113

THE REACTION T(p, n) He^3 AT 7—12 Mev PROTON ENERGY

G. F. BOGDANOV, N. A. VLASOV, C. P. KALININ, B. V. RYBAKOV, L. N. SAMOĬLOV, and V. A. SIDOROV

Submitted to JETP editor November 17, 1958

J. Exptl. Theoret. Phys. (U.S.S.R.) 36, 633-636 (February, 1959)

THE reaction T(p, n) He^3 is a convenient source of monochromatic neutrons and is widely used in many laboratories. From the results of the study of the reaction in the proton energy range from the reaction threshold (1.019 Mev) to 7 Mev,[1,2] it was possible to deduce the existence of excited levels of the α particle at 22 Mev and 24 — 25 Mev.[1,3] Several experimental works have been published recently[4] confirming the existence of excited states of the α particle.

The cross section and the angular distribution of neutrons in the reaction T(p, n) He^3 in the proton energy range 7 — 12 Mev were measured in the course of the present experiment. It was also attempted to measure the polarization of the neutrons.

A solid tritium-zirconium target of 20 μ thickness was bombarded by 12 Mev protons from a cyclotron. The neutron flux was measured by a telescope consiting of four proportional counters,[5]