of Fig. 2 and Fig. 4 shows that the cross section for the (γ, α) reaction in Cu^{65} is an order of magnitude greater than that in Rb^{87}.

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The Decay of Co⁶¹*

L. A. Smith, R. N. H. Haslam, and J. G. V. Taylor
*Department of Physics, University of Saskatchewan,
Saskatoon, Saskatchewan, Canada*
(Received September 20, 1951)

DURING the course of experiments to determine the Cu^{65}-$(\gamma, \alpha)Co^{61}$ cross section[1] decay curves of Co^{61} which could be followed over ten half-lives were obtained. A typical curve is shown in Fig. 1. From an analysis of eleven such curves a half-life of 99.0±0.3 minutes was obtained. This is considerably lower than previously reported values [2,3] but should be more accurate because of the high counting rates obtained here.

To analyze the decay of Co^{61}, activities were obtained by two reactions, $Cu^{65}(\gamma, \alpha)Co^{61}$ and $Ni^{62}(\gamma, p)Co^{61}$. Both methods gave the same results from the analyses of the absorption curves in aluminum. An aluminum absorption curve is shown in Fig. 2 and the corresponding analysis by the nth power method[4-6] is given in Fig. 3.

It is obvious that two β's are present. The average of two determinations of the maximum beta-energies by the foregoing method showed (55±10) percent of the disintegrations with a maximum energy of 1.42±0.02 Mev and (45±10) percent with a maximum energy of 1.00±0.02 Mev. To search for a possible gamma-ray the Co^{61} was counted with a scintillation counter. Alternately the sample was counted with no filter and with one of two filters, each thick enough to absorb all the betas, (860 and 1340 mg/cm²). The count through the thick filters decayed with the same half-life as without a filter so a Co^{61} gamma-ray was indicated. A rough lead absorption curve obtained during the same experiment indicated a gamma-energy of about 0.5 Mev. During the chemical separation for absorption experiments, holdback
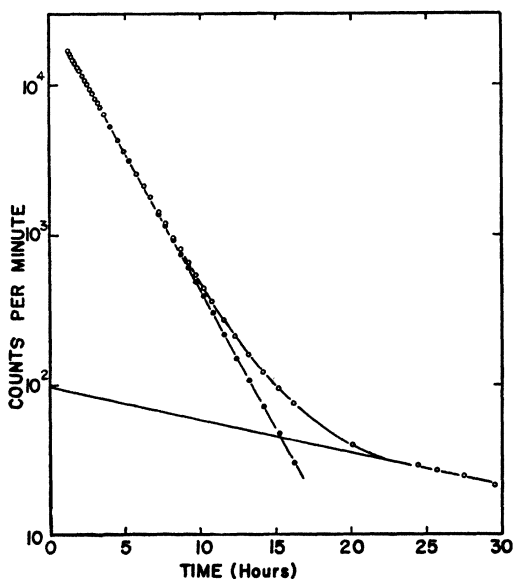

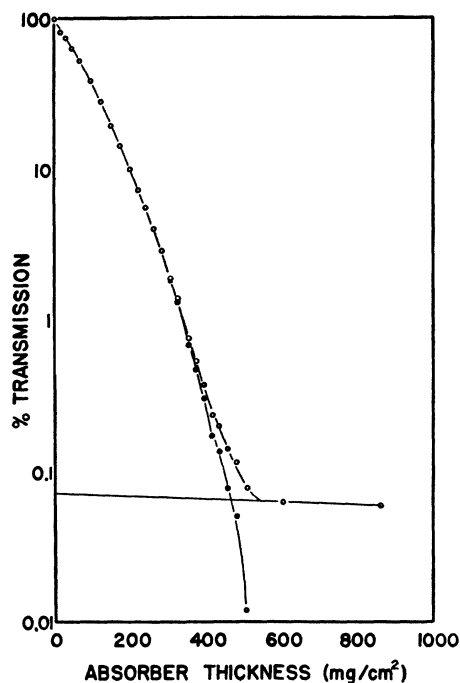FIG. 1. Decay curve of 99.0-minute Co^{61}. The background activity is 12.9-hour Cu^{64}.

FIG. 2. Aluminum absorption curve for Co^{61}.

carriers were used to reduce the amount of copper contamination as much as possible.

The simplest decay scheme on the basis of the above results is that the 1.42-Mev β goes from the ground state of Co^{61} to that of Ni^{61}, and the 1.00-Mev β leads to an excited state of Ni^{61} which decays to ground emitting a 0.42-Mev gamma-ray. The possibility that the complex spectrum is the result of an isomeric state of Co^{61} is ruled out by the nuclear shell model,[7] by the fact that both transitions have ft values corresponding to allowed transitions, and in view of the branching ratio.

Since both Co^{61} and Cu^{61} decay by allowed transitions to Ni^{61}, it is necessary to assign spin orbit values other than those predicted by the nuclear shell model.[7] Nordheim has suggested $f=5/2$ for the spin orbit values of Ni^{61} but this makes the Cu^{61} decay l forbidden.[8] Since the energy level reported here, 0.42 Mev, does not occur in the decay of Cu^{61},[9] and those which do occur in the Cu^{61} decay did not appear in the Co^{61} decay, it might be possible to assign spin values to some of the excited energy levels of Ni^{61}.
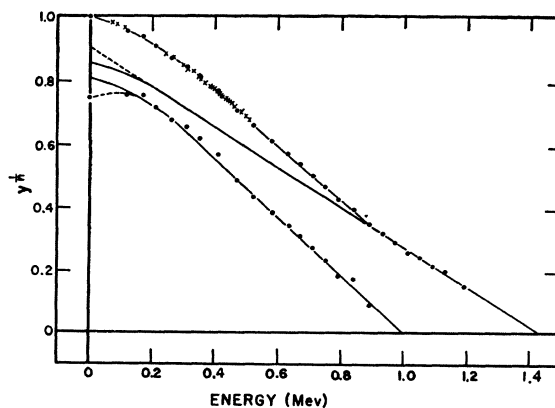

FIG. 3. nth power plot for Co^{61} showing β end point energies of 1.43 Mev ($n = 4.72$) and 1.00 Mev ($n = 3.26$).

However, this must await the clearing up of the values to be assigned the ground states of Co^{61}, Ni^{61}, and Cu^{61}.

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Laboratory Observation of the $A^2\Pi - X^2\Sigma$ Bands of the N_2^+ Molecule

F. W. DALBY* AND A. E. DOUGLAS
Division of Physics, National Research Council, Ottawa, Canada
(Received September 25, 1951)

BOTH the electron configuration[1] of N_2^+ and the observed spectra of isoelectronic molecules lead one to believe that the N_2^+ molecule has a low-lying $^2\Pi$ state. Meinel[2] has observed a system of bands in the infrared spectrum of the aurora which he has attributed to transitions from this $^2\Pi$ state to the ground state. Up until now, however, no such bands have been observed in laboratory spectra. Recently we have succeeded in exciting these bands in a discharge tube.

A mixture of helium and nitrogen was passed through a hollow cathode discharge tube and the spectrum of the discharge photographed on the first order of a twenty-one foot concave grating. When the pressure of the helium in the discharge tube was high and the quantity of nitrogen very small, the first positive bands of nitrogen appeared only weakly while the ultraviolet bands of N_2^+ were strong. Under these conditions the infrared spectrum of the discharge has been photographed on N and M plates with exposure times of several hours.

Besides the well-known first positive bands of nitrogen, the infrared spectrum of the discharge tube shows a system of bands degraded to the red. Each of these bands has two prominent heads and others less prominent. The positions of the strong heads, together with a possible vibrational numbering, are shown in Table I. On our plates the (4,2) (3,1) and (2,0) bands are strong and free from overlapping lines, while the (2,1) and (2,0) bands are very weak and the (3,0) band is overlapped.

The agreement between our wavelengths and those of Meinel as shown in Table I leaves no doubt that the bands observed here are the same as those observed in the aurora. The consistent difference of about 3A between the two sets of measurements is the result of the fact that Meinel has measured intensity maxima whereas we have measured band heads. Also the assignment of these bands to the N_2^+ molecule appears certain for the following reasons. First, the structure of the bands is very similar to that of the $^2\Pi - ^2\Sigma$ bands of the isoelectronic CN molecule. Second, within the fine structure of the bands the lines of the series show the alternation of intensities which is to be expected in bands of the N_2^+ molecule. Finally, the magnitude of the vibrational quanta of the lower state of these bands agrees with that calculated from the well-known ultraviolet N_2^+ bands.

TABLE I. Infrared bands of N_2^+.

Vibrational numbering	Wavelength, A Authors	Meinel	Vibrational numbering	Wavelength, A Authors	Meinel
1,0	9208.00 9147.31(?)		2,0	7874.63 7825.72	7879.6 7828.2
2,1	9502.27 9428.90(?)		3,1	8105.31 8053.63	8107.0 8056.8
3,0	6890.49	6892.2	4,2	8348.25 8293.41	8349.2 8297.6

An analysis of the fine structure of these bands is in progress and the results will be published in the near future.

We are indebted to Dr. G. Herzberg for helpful discussions of this problem.

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On the Magnetic Moment of $Te^{123,125}$ and Si^{29}*

S. S. DHARMATTI AND H. E. WEAVER, JR.
Department of Physics, Stanford University, Stanford, California
(Received October 1, 1951)

NUCLEAR induction signals of $Te^{123,125}$ were detected in a solution of TeO_2 (3.1 molar) in HCl and chemically pure tellurium metal in aqua regia. Signals of Te^{125} with a line width of about 1/10 gauss (probably in part determined by the magnetic field inhomogeneity) were observed in both the above solutions without the addition of paramagnetic ions.

A comparison of the resonant frequency of Te^{125} with that of Na^{23} gives the result

$$\nu(Te^{125})/\nu(Na^{23}) = 1.19457 \pm 0.00004. \qquad (1)$$

With the known magnetic moment of Na^{23} and the fact that the spin of the tellurium isotopes is $\frac{1}{2}$,[1,2] the sign and value of the magnetic moment of Te^{125} were found to be

$$\mu(Te^{125}) = -0.88235 \pm 0.00004. \qquad (2)$$

This value agrees well with the spectroscopic data in the literature.[3]

The abundance of Te^{123} being only 0.85 percent, one would expect the signal amplitude of the isotope to be about $\frac{1}{8}$ that of Te^{125}, whose abundance is 7.0 percent. If was therefore necessary to modify the present spectrometer[4] with the introduction of an amplifier of higher gain and lower noise figure.[5] This apparatus permitted the detection of Te^{123} signals with a signal-to-noise ratio of about seven. Thus a comparison of the resonant frequency with that of Na^{23} yielded the results[1]

$$\nu(Te^{123})/\nu(Na^{23}) = 0.99085 \pm 0.00003 \qquad (3)$$

and

$$\mu(Te^{123}) = -0.73188 \pm 0.00004.[3] \qquad (4)$$

The ratio of the magnetic moments of the two isotopes is therefore calculated to be

$$\mu(Te^{125})/\mu(Te^{123}) = 1.20560 \pm 0.00007, \qquad (5)$$

which is in good agreement with that of Mack and Arroe.[6] The ratio of signal amplitudes of the two isotopes was found to be in agreement with the known ratio of abundances within an experimental error of about 5 percent.

It is known that there exists monatomic tellurium[7] in acid solutions and further, that these atoms are likely to be paramagnetic in analogy with oxygen. It was for this reason that paramagnetic catalysts were not added to the solutions, and the fact that good signals were detected may be ascribed to the action of these paramagnetic atoms.

The first tellurium signals of a natural line width of one gauss were observed in a sample of powdered tellurium metal. The fact that one deals here with nuclear induction in a semiconductor may be of interest in view of the resonance shifts observed by Knight[8] in metals; no observable shift was found between the resonance frequency of Te^{125} in the metal and in solution. In spite of its low conductivity it was necessary to pulverize the metal in order to reduce losses caused by eddy currents.

The use of metallic tellurium was encouraged by previous experiments in which signals of Si^{29} were found in powdered silicon metal. Signals were also found in a solution of 2.5 molar SiO_2 in