Energy Levels Associated with Se^{75}*

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THE nucleus Se^{75} was first produced and identified[1] by the bombardment of arsenic with deuterons. Since Se^{74} has a normal abundance of only 0.87 percent, neutron capture in the pile yields only a relatively weak long-lived radioactivity. A selenium specimen enriched in mass 74 to 12.1 percent was made available to us by the AEC and irradiated in the Oak Ridge pile. Spectrometric studies of this sample yield a great number of electron lines as shown in Fig. 1, whose $K-L-M$ differences are characteristic of arsenic, as expected, following positron emission or K-capture in selenium. Successive spectrograms in the figure show the energy resolution with different fixed magnetic fields.

Unpublished results by Deutsch and Osborne had evaluated five gamma-rays at 97, 122, 136, 267, and 403 kev. A subsequent study gave[2] the corresponding energies at 97, 122, 137, 265, and 400 kev. The energies of the many electron lines observed in the present investigation are shown collectively in Table I, together with their interpretations. A summary of the resultant eleven gamma-rays with arbitrarily assigned numbers in the order of increasing energy is presented in Table II.

TABLE I. Electron energies from radioactive selenium.

Electron energy	Interpretation	Energy sum	Electron energy	Interpretation	Energy sum
23.2 kev	L^1	24.7 kev	136.0 kev	M^6	136.2 kev
24.4	M^1	24.6	186.9	K^7	198.8
54.3	K^2	66.2	197.2	L^7	198.7
64.6	L^2	66.1	253.3	K^8	265.2
68.9	K^3	80.8	263.6	L^8	265.1
85.0	K^4	96.9	268.2	K^9	280.1
95.3	L^4	96.8	278.5	L^9	280.0
96.4	M^4	96.6	293.4	K^{10}	305.3
109.4	K^5	121.3	303.4	L^{10}	304.8
119.6	L^5	121.1	390.0	K^{11}	401.9
124.3	K^6	136.2	400.5	L^{11}	402.0
134.7	L^6	136.2			

TABLE II. Gamma-energies in As^{75}.

Arbitrary number	Gamma-energy	Arbitrary number	Gamma-energy
1	24.7 kev	7	198.8 kev
2	66.2	8	265.2
3	80.8	9	280.1
4	96.8	10	305.0
5	121.2	11	401.9
6	136.2		

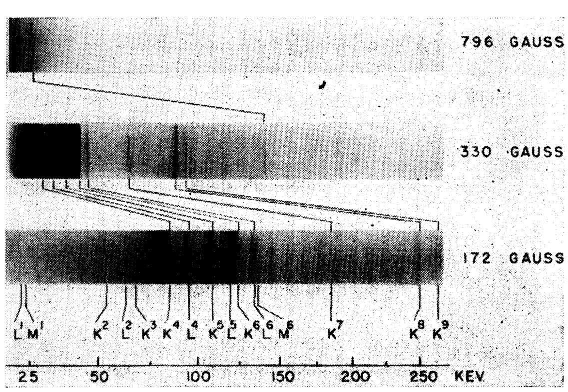

FIG. 1. Spectrograms showing the electron lines from Se^{75} with different magnetic fields.

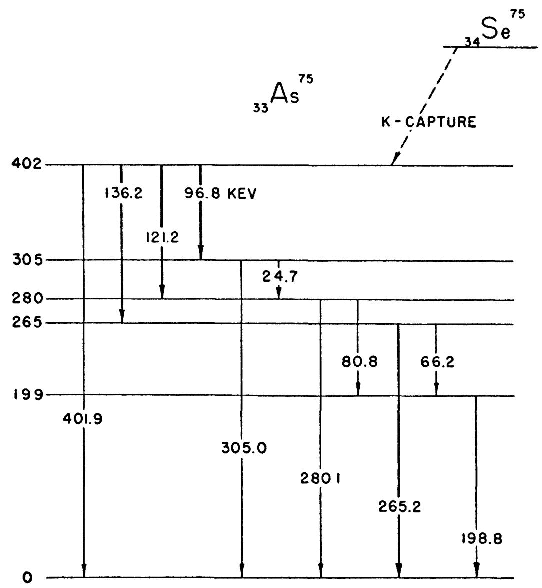

FIG. 2. Level scheme in As^{75}, following K-capture in Se^{75}.

It is now possible to construct a plan of six energy levels as shown in Fig. 2 so that all observed eleven gamma-rays arise in transitions with a remarkably satisfactory agreement.

The half-life of the present specimen appears to be 128 days. A careful search for the presence of positrons by a magnetic field and counter arrangement showed no evidence for their existence. The x-rays to be expected following K-capture in selenium were observed by noting their absorption in aluminum.

* This investigation was made possible by the joint support of the AEC and ONR.
1 C. V. Kent and J. M. Cork, Phys. Rev. 61, 389 (1942).
2 Jensen, Laslett, and Pratt, AECD 1836, April (1948), unpublished; see also Friedlander, Seren, and Turkel, Phys. Rev. 72, 23 (1947); and Cowart, Pool, McCown, and Woodward, Phys. Rev. 73, 1454 (1948).

Thermal Equilibrium in Neutron-Irradiated Semiconductors

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THE conductivity *vs.* irradiation curves of Ge semiconductors exposed to fast and thermal neutron flux in the Oak Ridge pile were recently analyzed. The results indicate that the decrease in electron concentration in N-type Ge is of the order of 3 per incident fast neutron, but that the increase in hole concentration in P-type Ge is much smaller. Additional experiments show that, depending on temperature, 0.6 to 0.8 carrier is released initially per incident neutron. These results are tabulated in Table I.

Bombardment effects on N-type and P-type Ge differ, since, in the case of P-type Ge, only those bombardment-introduced acceptors which are thermally ionized can contribute to conductivity. This explanation holds whether these acceptors have identical or a wide distribution of activation energies.

In all experiments on N-type Ge carried out in the reactor and, therefore, subject to γ- and β-radiation, the maximum resistivity reached during bombardment is smaller than the predicted value, which should be even greater than that of intrinsic Ge due to the additional introduced scattering centers.

Using the mobility and equilibrium values previously reported,[1] it was concluded[2] from the expression for the minimum con-

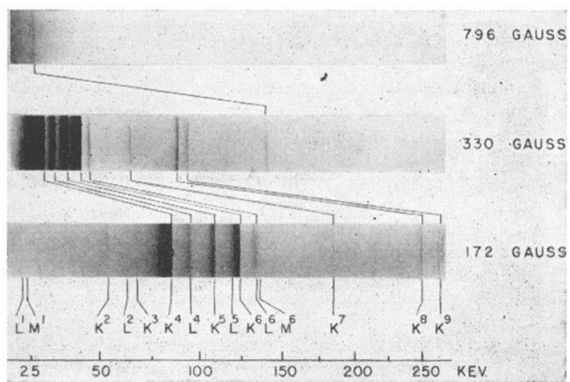

FIG. 1. Spectrograms showing the electron lines from Se^{75} with different magnetic fields.