Letters to the Editor

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The Decay of Ta^{183}†

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IN a previous paper[1] the presence of a γ line decaying with a half-life of the order of 10 days was reported in connection with the decay of 112-day Ta^{112}. Using the curved crystal spectrometer, a photographic γ-ray spectrometer, and the β-ray spectrometer, we have investigated a strong source produced by irradiation of Ta in the Arco (Idaho) reactor.[2] Our results show a number of γ lines associated with a 5.2 ± 0.1 day half-life. This half-life can be ascribed to the decay of Ta^{183}, formed by two successive neutron captures in stable Ta^{181}. Mihelich[3] recently gave a value for the thermal neutron cross section of Ta^{182}, using the intensity ratio of two lines, one in Ta^{182}, the other in Ta^{183}. Our preliminary estimation is based on the ratio of β-spectra intensities of Ta^{182} and Ta^{183}, and gives a value

$$\sigma_c \gtrsim 10\,000 \text{ barns}$$

for this cross section. Table I lists the energy, wavelength, and relative intensity obtained for 21 lines. The associated β^- spectrum has an end point at 558 ± 10 kev, but we have no evidence that it is simple. In spite of the fact that several energy combinations are possible among the γ-lines ($A+B=D$, $O+I=U$, $R+E=U$, $Q+F=U$, $N+E=T$, $D+M=S$, $F+B=L$, $B+E=J\cdots$) we do not believe that a coherent decay scheme can be constructed using these data only. Further investigations are planned.

TABLE I. γ rays emitted by a Ta^{183} source.

Line	Wavelength (in A)	Energy (kev)	γ-ray relative intensity (internal conversion *not* taken into account)
A	266.726 ± 0.025	46.481 ± 0.005	···
B	235.729 ± 0.022	52.593 ± 0.005	···
C	···	$83\ \pm1$	Weak
D	125.141 ± 0.013	99.070 ± 0.010	1.4
E	114.865 ± 0.013	107.933 ± 0.012	2.4
F	112.985 ± 0.013	109.729 ± 0.013	0.4
G	112.303 ± 0.150	110.395 ± 0.150	0.1
H	87.134 ± 0.025	143.773 ± 0.050	0.4
I	86.005 ± 0.025	144.151 ± 0.050	2.7
J	77.229 ± 0.015	160.532 ± 0.030	1.1
K	76.834 ± 0.015	161.458 ± 0.025	3.3
L	76.371 ± 0.015	162.335 ± 0.030	1.8
M	64.339 ± 0.022	192.692 ± 0.065	0.6
N	60.458 ± 0.015	205.062 ± 0.050	1.8
O	59.086 ± 0.100	209.823 ± 0.035	1.9
P	···	$236\ \pm1$	Weak
Q	50.757 ± 0.010	244.259 ± 0.040	3.0
R	50.386 ± 0.006	246.051 ± 0.030	10
S	42.501 ± 0.010	291.708 ± 0.060	2.5
T	39.599 ± 0.010	313.078 ± 0.065	2.6
U	35.018 ± 0.010	354.038 ± 0.090	3.9

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[1] Muller, Hoyt, Klein, and DuMond, Phys. Rev. **88**, 775 (1952).
[2] We gratefully acknowledge the efforts of Dr. W. B. Lewis in arranging the irradiation in the material-testing reactor.
[3] J. W. Mihelich, Phys. Rev. **91**, 427 (1953).

Magnetic Inelastic Scattering of Slow Neutrons*

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IN studies of crystal structure by neutron and by x-ray diffraction, the intensities of the Bragg maxima are reduced by thermal diffuse scattering. This reduction is given, both for neutrons and x-rays, by the well-known Debye-Waller factor. The thermal diffuse scattering differs somewhat for neutrons as compared with x-rays, however, because the large mass of the former implies a substantial energy change of the diffusely scattered neutrons. The energy changes of the neutrons, which need not be considered in diffraction work, are of great importance when extremely slow neutrons are scattered. For incident neutrons in the wavelength range 5–20A, the thermal or inelastic scattering consists almost entirely of energy gain by the neutrons. Under these conditions, the inelastic scattering cross section is proportional to λ; hence it is easily separated experimentally from elastic scattering, which is independent of λ. In addition, the coherent part of the elastic scattering disappears for wavelengths longer than the crystal cut off (twice the longest spacing of lattice planes).

Although measurement of the actual energy gain of the scattered neutrons would give the most direct information on the lattice vibrations in the scattering crystal, results so far in the long-wavelength region have consisted mainly of total cross sections. The total cross sections can be calculated from the Debye spectrum of lattice vibrations but the calculation is exceedingly complicated for any but the simplest crystals. If it is assumed, however, that the inelastically scattered waves from different atoms do not interfere (the incoherent approximation), the calculations can readily be carried out.[1,2] The calculated inelastic scattering using the incoherent approximation is in reasonable agreement with experiments[3,4] for beryllium, aluminum, and copper, for example. Although quantitative discrepancies occur for lead and bismuth, the qualitative variation of the cross section with temperature and wavelength is correct.

The scattering of iron exhibits a behavior that is not in agreement with the theoretical calculations, however. Early experiments[5,6] at room temperature indicated that the inelastic scattering of long-wavelength neutrons is slightly in excess of the theoretical value, but the excess was extremely difficult to determine because of the large capture cross section, which is also proportional to λ. Measurements of the iron cross section at long wavelengths have now been extended to sample temperatures well above the Curie point, using the Brookhaven slow chopper. At high temperature the observed inelastic scattering, identified by proportionality to λ, rises rapidly above the theoretical lattice-vibration value. The results are shown in Figs. 1 and 2 as functions of wavelength and sample temperature, compared with theory.[1,2] The inelastic scattering is obtained from the measured total cross section by subtracting the $1/v$ capture as well as a slight nuclear incoherent contribution (0.4 b).

The excess scattering in iron is certainly inelastic because of

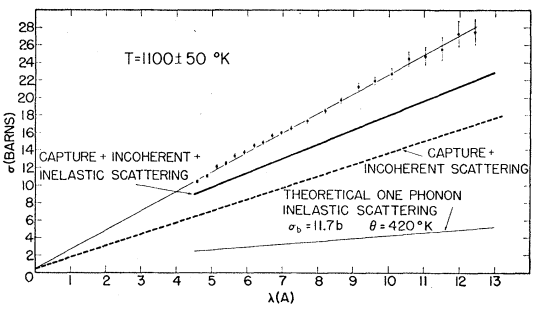

FIG. 1. The measured total cross section of iron at 1100°K as a function of wavelength.