RESONANCE SCATTERING OF GAMMA RAYS BY Te^{124} *NUCLEI*

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The lifetime of the excited state at 608 kev in Te^{124} was determined from the experimental value of the cross section for resonance scattering of γ quanta. The value obtained is compared with the predictions of the single particle model.

We have studied the resonance scattering by Te^{124} of the 608-kev γ quanta which are emitted in the decay $Sb^{124} \rightarrow Te^{124}$. The resonance condition was guaranteed by the Doppler broadening of the 608-kev line resulting from recoil in the preceding part of the cascades,[1] which are listed in the table.

To eliminate effects of slowing down of recoil nuclei on the shape of the spectrum, the main experiment was done with a gaseous source. A 3.4-mC source of highly volatile $SbCl_3$ was heated to 220° and converted completely to gas. The vapor pressure in the ampoule did not exceed atmospheric. The scatterers were cylinders of TeI_2 and CdO. Measurements were made with solid and gaseous sources. In the latter case, with a tellurium scatterer we observed an increase in counting rate (by 0.43 pulse/sec) over a cadmium scatterer.

The cross section $\bar{\sigma}$ for resonance scattering was computed using the standard formula,[2] and when the angular distribution of the scattered γ quanta and the self absorption in the scatterer were included we found the value $(3.5 \pm 1.1) \times 10^{-25}\,cm^2$. The lifetime τ_γ for the 608-kev level of Te^{124} was found from the formula

$$\tau_\gamma = (\sigma_0 \pi \hbar / 2\bar{\sigma}) N(E_r)/N, \qquad (1)$$

where $N(E_r)/N$ is the fraction of the 608-kev γ quanta which fall in a 1-ev interval around the resonance energy. We computed the partial values of $N(E_r)/N$ by starting from the relative intensities of the cascades,[3,4] disregarding effects of chemical binding. However the latter do not essentially change the total value $N(E_r)/N = 0.058 \pm 0.006$. The error in $N(E_r)/N$ resulting from the inaccuracy in the determination of the relative

$\beta\gamma$-cascades in the $Sb^{124} \rightarrow Te^{124}$ decay

	End point of β spectrum, kev	Intensity of β component, %	Cascades preceding the 608-kev level	Relative intensity of cascade, %	Partial values $N(E_r)/N$, %
1	2312	28	β	28	1.44
2	1596	10	β (γ—723)	10	0.68
3			β (γ—1370)	4	0,24
4	952	4	β (γ—646) (γ—646)	$\leqslant 1$ *	
5			β (γ—724) (γ—646)	$\leqslant 1$ *	
6			β (γ—1692)	47	2.78
7	610	49	β (γ—1047) (γ—646)	} ~ 2 *	
8			β (γ—969) (γ—724)		
9			β (γ—2088)	6,5	0.30
10			β (γ—1450) (γ—646)	~ 1 *	
11			β (γ—1361) (γ—723)	$\leqslant 1$ *	
12	219	9	β (γ—714) (γ—1370)	} $\leqslant 3$ *	
13			β (γ—714) (γ—724) (γ—646)		
14			β (γ—714) (γ—646) (γ—723)		
					$\Sigma = 5,84$

*Inclusion of these cascades adds approximately 0.4% to $N(E_r)/N$.

intensities of the cascades is 8%, which is greater than the errors due to neglect of correlations[1] and the choice of the variant of β decay theory.[5]

According to Eq. (1), the lifetime of the 608-kev level was $(5.8 \pm 1.5) \times 10^{-12}$ sec. A value of $\tau_\gamma < 2 \times 10^{-11}$ sec was found[6] by using $\beta\gamma$ coincidences. By studying Coulomb excitation,[7] the reduced transition probability $B(E2,\ 0^+ \rightarrow 2^+)$ was found to be $0.39\ e^2 \cdot barn^2$, which gives $\tau_\gamma = 12.6 \times 10^{-12}$ sec. Computations using the Weisskopf[8] formula, which is based on the single particle model, give the value $\tau_\gamma = 1.2 \times 10^{-10}$ sec. Thus the E2 quadrupole transition at 608 kev in Te^{124} is enhanced, with an enhancement factor equal to 20, which shows the collective nature of the excitation.

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171