Incoherent scattering of gamma rays by K-shell electrons

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Incoherent scattering is one of the major processes by which gamma rays interact with matter in large energy range. In a discription of this process it is usual to assume that the scattering electrons are free and stationary. This assumption is valid for outer electrons in an atom for which the momentum transfer in the collision greatly exceeds the momentum of the electron in its motion. However, the effects of atomic binding have to be considered in dealing with the interior electrons. To account for this the so called incoherent scattering function is introduced as a correction factor for the Klein-Nishina cross-section. Theoretical approaches for the calculation of this function are already available (Grodstein 1957 ; Jauch *et al* 1955). Shimuju *et al* (1965) evolved a new expression for the calculation of incoherent scattering function.

TABLE 1. Incoherent scattering function of gamma rays

Angle of scattering		Pb	Ta	Sm
Energy 320 KeV				
45°	Experimental	0-50±0.08	0.53+0.08	0.65±0.10
	Theoretical	0.18	0.23	0.30
60°	Experimental	0 60±0.10	0 66±0.10	0.75±0.11
	Theoretical	0.25	0.31	0.42
90°	Experimental	0.70±0.11	0.75±0.11	0.83±0.13
	Theoretical	0.36	0.45	0.63
110°	Experimental	0.84±0.13	0.85±0.13	0.91±0 14
	Theoretical	0.41	0.52	0.73
Energy 662 KeV			—	
30°	Experimental	0.52±0.06	0.49±0.05	0.63±0.09
	Theoretical	0.30	0.38	0.52
45°	Experimental	0.72±0.08	0.73±0.08 ·	0.76±0.12
	Theoretical	0.49	0.64	0.89
60°	Experimental	0.86±0.09	0.92±0.10	0.92±0.14
	Theoretical	0.68	0.88	0.99
90°	Experimental	1.29±0.14	1.13±0.12	
	Theoretical	0.94	1.22	
130°	Experimental	1.54±0.17	1.36±0.14	
	Theoretical	1.12	1.46	

(all the values are corrected to the second decimal place)

In the present investigations, calculations are made using this expression of Shimuju *et al* for 662 and 320 KeV gamma energies in elements Pb, Ta and Sm at various scattering angles and these are compared with the experimental results reported from these laboratories by Reddy (1965). All these results are given in table 1.

It can be seen from the table that at both energies in all elements the calculated values are following the same trend as that of the experimental values. However, for both the energies the theoretical values are smaller than those of the experimental values except at 662 KeV and above 30° in Sm and at 130° in Ta. But the agreement is better as the energy, angle and the atomic number increases.

REFERENCES

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