

# AN ANALYSIS OF TOTAL GAMMA RAY CROSS SECTIONS IN THE ENERGY REGION FROM 40 TO 80 KEV IN Cu, Sn, W, AND Pb†

By M. RAJA RAO‡ and K. PARTHASARADHI†

In Table 1 the values of the experimental total  $\gamma$ -ray cross sections measured by Wiedenbeck (1962), Bearden (1966), Knerr and Vonach (1967), and McCrary *et al.* (1967) at energies of 40, 50, 60, 70, and 80 keV in the elements Cu, Sn, W, and Pb are given. It will be seen that in Cu at 80 keV, in Sn at 40 keV, in W at 50 keV, and

TABLE 1  
TOTAL  $\gamma$  CROSS SECTIONS IN Cu, Sn, W, AND Pb

Reference	Cross Section (bn atom <sup>-1</sup> )				
	40	50	60	70	80 keV
Cu					
Wiedenbeck (1962)	511.4 ± 10.2	267.1 ± 5.2	169.2 ± 3.4	110.5 ± 2.2	81.0 ± 1.6
Bearden (1966)	517.0 ± 5.2	—	—	—	—
Knerr and Vonach (1967)	510.9 ± 10.2	271.3 ± 5.4	166.8 ± 3.3	114.1 ± 2.3	77.4 ± 1.6
McCrary <i>et al.</i> (1967)	513.7 ± 5.1	273.8 ± 2.7	167.0 ± 1.7	111.4 ± 1.1	81.5 ± 0.8
Sn					
Wiedenbeck (1962)	3851 ± 77	2128 ± 42	1278 ± 27	833.7 ± 16.7	597.3 ± 11.9
Bearden (1966)	3700 ± 37	—	—	—	—
Knerr and Vonach (1967)	4104 ± 82	2148 ± 43	1293 ± 26	870.4 ± 17.0	587.7 ± 11.8
McCrary <i>et al.</i> (1967)	3779 ± 38	2081 ± 21	1287 ± 13	843.1 ± 8.0	593.2 ± 6.0
W					
Wiedenbeck (1962)	3227 ± 65	1829 ± 37	1130 ± 23	—	2394 ± 48
Knerr and Vonach (1967)	3286 ± 65	1742 ± 35	1104 ± 22	—	2391 ± 47
McCrary <i>et al.</i> (1967)	3198 ± 32	1760 ± 18	1109 ± 11	—	2333 ± 25
Pb					
Wiedenbeck (1962)	4661 ± 93	2566 ± 51	—	1118 ± 22	—
Knerr and Vonach (1967)	5146 ± 103	2486 ± 50	—	1161 ± 23	—
McCrary <i>et al.</i> (1967)	5140 ± 51	2743 ± 27	—	1120 ± 11	—

in Pb at 40, 50, and 70 keV these values do not agree well amongst themselves, even after considering the error limits. It is of interest therefore to derive a mean cross section value at each energy for each element from the available data so as to make a comparison with the theoretical estimates.

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‡ Department of Nuclear Physics, Andhra University, Waltair (A.P.), India.

The desired total  $\gamma$  cross sections were derived by taking the mean of each set of values given in Table 1 at each energy in each element, and the standard deviation of the set as the corresponding error of this mean. This method has been described previously (Parthasaradhi 1968). The results obtained are given in Table 2, together with the theoretical total  $\gamma$  cross sections which were computed by adding the recent theoretical photoelectric cross sections of Schmickley and Pratt (1967) and the scattering cross sections of Brown (1966). It will be seen from Table 2 that the mean values are in excellent agreement with the theoretical values, within the range of errors. However, in the case of Pb at 50 keV there is a difference exceeding the error limits and further measurements would be desirable in this instance.

TABLE 2  
MEAN TOTAL  $\gamma$  CROSS SECTIONS COMPARED WITH THEORETICAL PREDICTIONS

Element	Value	Cross Section (bn atom <sup>-1</sup> )				
		40	50	60	70	80 keV
Cu	Exp. mean	513.2 $\pm$ 2.8	270.7 $\pm$ 3.4	167.7 $\pm$ 1.3	112.0 $\pm$ 1.9	80.0 $\pm$ 2.2
	Theoretical*	507.0 $\pm$ 5.1	270.6 $\pm$ 2.7	167.7 $\pm$ 1.7	112.2 $\pm$ 1.1	80.1 $\pm$ 0.8
Sn	Exp. mean	3859 $\pm$ 175	2119 $\pm$ 34	1286 $\pm$ 8	849.3 $\pm$ 19.0	592.1 $\pm$ 6.0
	Theoretical*	3816 $\pm$ 38	2122 $\pm$ 21	1307 $\pm$ 13	853.0 $\pm$ 9.0	594.7 $\pm$ 6.0
W	Exp. mean	3237 $\pm$ 45	1777 $\pm$ 46	1114 $\pm$ 14	—	2373 $\pm$ 34
	Theoretical*	3284 $\pm$ 33	1820 $\pm$ 18	1137 $\pm$ 11	—	2396 $\pm$ 24
Pb	Exp. mean	4982 $\pm$ 278	2598 $\pm$ 132	—	1133 $\pm$ 24	—
	Theoretical*	4972 $\pm$ 50	2770 $\pm$ 28	—	1168 $\pm$ 12	—

\* Computed by adding the photoelectric cross sections of Schmickley and Pratt (1967) and the scattering cross sections of Brown (1966).

### References

- BEARDEN, A. J. (1966).—*J. appl. Phys.* **36**, 1681.  
 BROWN, W. D. (1966).—Boeing Company Reps D2-125316-1 and D2-125317-1.  
 KNERR, R. P., and VONACH, H. (1967).—*Z. angew. Phys.* **6**, 507.  
 MCCRARY, J. H., *et al.* (1967).—*Phys. Rev.* **153**, 307.  
 PARTHASARADHI, K. (1968).—*J. appl. Phys.* **39**, 1407.  
 SCHMICKLEY, R. D., and PRATT, R. H. (1967).—*Phys. Rev.* **163**, 104.  
 WIEDENBECK, M. (1962).—*Phys. Rev.* **126**, 1009.