

Appendix C

X-rays routinely found in gamma spectra

The table below is intended to assist gamma spectroscopists in identifying X-rays in their spectra. All those associated with nuclides mentioned in the text, those sometimes visible in background and one or two extra items that have caught the author unawares in the past. The data are taken from an online source provided by the US Lawrence Berkeley Laboratory. All energies have been rounded to two decimal places. You should be aware that other lower intensity X-rays will accompany those listed in the table. In particular, the $K_{\alpha 1}$ and $K_{\alpha 2}$ X-rays are accompanied by $K_{\beta 1}$ and $K_{\beta 2}$, respectively, at almost the same energy.

Table A.1 X-ray energies associated with nuclides discussed within the book

	Z	X-ray designation				Possible origin		
		$L_{\alpha 1}$	$L_{\alpha 2}$	$K_{\alpha 1}$	$K_{\alpha 2}$			
V	23			4.94	4.95	5.43	^{51}Cr	
Cr	24			5.41	5.42	5.95	^{54}Mn	
Mn	25			5.89	5.90	6.49	^{55}Fe	
Fe	26			6.39	6.40	7.06	$^{56,57,58}\text{Co}$	
Ni	28			7.46	7.48	8.27	^{60}Co	
Cu	29			8.03	8.05	8.91	Fluorescence, ^{65}Zn	
As	33			10.51	10.54	11.73	11.86	^{75}Se
Rb	37			13.34	13.40	14.96	15.19	^{85}Sr
Sr	38			14.10	14.17	15.84	16.09	^{88}Y
Nb	41			16.52	16.62	18.62	18.95	^{95}Zr
Ag	47			21.99	22.16	24.94	25.46	^{109}Cd
Cd	48			22.98	23.17	26.10	26.64	Fluorescence
In	49			24.00	24.21	27.28	27.86	Fluorescence, ^{113}Sn
Sn	50			25.04	25.27	28.49	29.11	Fluorescence
Ba	56			31.82	32.19	36.38	37.26	^{137}Cs
La	57			33.03	33.44	37.80	38.73	^{139}Ce
Sm	62			39.52	40.12	45.41	46.58	^{152}Eu
W	74			57.98	59.32	67.24	69.07	Self-fluorescence in slags
Tl	81			70.83	72.87	82.57	84.87	^{203}Hg , $^{211,212}\text{Bi}$
Pb	82			72.80	74.97	84.94	87.30	Fluorescence, ^{208}Tl , ^{214}Po
Bi	83			74.82	77.11	87.35	89.78	$^{211,212,214}\text{Pb}$
Po	84			76.86	79.29	89.81	92.32	$^{212,214}\text{Bi}$, ^{219}Rn
Rn	86			81.07	83.79	94.87	97.53	$^{223,224}\text{Ra}$
Ra	88	12.34	15.24	85.43	88.47	100.13	102.95	^{227}Th
Th	90	12.97	16.20	89.96	93.35	105.60	108.58	^{235}U
Pa	91	13.29	16.71	92.28	95.86	108.42	111.49	$^{231,234}\text{Th}$
U	92	13.62	17.22	94.65	98.43	111.30	114.45	$^{233,234\text{m}}\text{Pa}$, Pu, Np isotopes
Np	93	13.95	17.75	97.07	101.06	114.23	117.46	Am isotopes, ^{237}Pu
Pu	94	14.28	18.30	99.53	103.73	117.23	120.54	Np isotopes
Am	95	14.62	18.86	102.03	106.47	120.28	123.68	^{243}Pu

Source of data: <http://ie.lbl.gov/atomic/x2.pdf>.

Energies are rounded to 2 decimal places. $K_{\alpha 1}$ and $K_{\alpha 2}$ are also associated with smaller $K_{\beta 1}$ and $K_{\beta 2}$ X-rays, respectively, at almost the same energy. 'Fluorescence' in this context, refers to gamma-rays from the source, acting on the materials of the detector shielding.