2. Alpha-particle Energy and Intensity Standards

Table 2 lists some α-particle energy and intensity standards for calibration of α-particle measurements. The recommended energies were determined by Rytz[1] from an adjustment of experimental values to several absolute energy standards. The recommended α branching values[1] are weighted averages of values reported in the literature. The alpha sources selected for this table have half-lives longer than 1 d, and are presented, for each parent isotope, in order of decreasing α-particle energy. Columns 1 and 2 show the source names and half-lives, respectively. Column 3 lists the recommended α-particle energies, and column 4 shows the α-decay branching intensity per 100 parent α-decays, with the corresponding uncertainty (in italics) in the least significant digit(s).

[1]A. Rytz, *At. Data and Nucl. Data Tables* **47**, 205 (1991).

Table 2. Alpha-particle Energies and Intensities for Some Standard Sources

Source	Half-life	E_α(keV)	I_α(% Branch)
^{146}Sm	1.03×10^{8} y	2455 *4*	100
^{147}Sm	1.06×10^{11} y	2235 *3*	100
^{147}Eu	24.1 d	2906 *4*	100
^{148}Gd	74.6 y	3182.680 *24*	100
^{149}Gd	9.4 d	3016 *4*	100
^{154}Dy	3×10^{6} y	2870 *5*	100
^{210}Bi	5.013 d	4687 *4*	
		4650 *4*	
^{210m}Bi	3.04×10^{6} y	4946 *9*	56.7 *13*
		4908 *9*	37.7 *17*
		4574 *7*	5.8 *4*
^{206}Po	8.8 d	5223.7 *15*	100
^{208}Po	2.898 y	5114.9 *14*	100
^{209}Po	102 y	4880.8 *20*	99.43 *1*
^{210}Po	138.376 d	5304.33 *7*	100
^{222}Rn	3.8235 d	5489.48 *30*	99.92 *1*
^{223}Ra	11.435 d	5871.3 *10*	1.0 *2*
		5747.0 *4*	9.2 *2*
		5716.23 *29*	52.6 *11*
		5606.73 *30*	25.7 *5*
		5539.80 *90*	9.2 *2*
^{224}Ra	3.66 d	5685.37 *15*	94.91 *7*
		5448.6 *9*	5.07 *7*
^{226}Ra	1600 y	4784.34 *25*	94.45 *5*
		4601 *1*	5.55 *5*
^{225}Ac	10.0 d	5829.6 *14*	50.7 *2*
		5793.1 *21*	18.3 *9*
		5731.9 *17*	8.2 *7*
^{227}Ac	21.773 y	4953.26 *14*	47.7 *10*
		4940.7 *8*	39.6 *12*
		4872.7 *2*	6.3 *5*
^{227}Th	18.72 d	6038.01 *15*	24.2 *9*
		5977.72 *10*	23.5 *9*
		5756.87 *15*	20.4 *9*
		5708.8 *16*	8.3 *3*
^{228}Th	1.9131 y	5423.15 *22*	73.4 *10*
		5340.36 *15*	26.6 *3*
^{229}Th	7340 y	5077.4 *23*	0.05 *1*
		5051.2 *23*	6.6 *4*
		4967.6 *23*	7.0 *3*
		4900.9 *23*	10.6 *2*
		4845.1 *23*	58.2 *10*
		4814.6 *23*	9.6 *2*
^{230}Th	7.538×10^{4} y	4687.0 *15*	76.3
		4620.5 *15*	23.4
^{232}Th	1.405×10^{10} y	4013 *3*	77 *3*
		3950 *8*	23 *2*
^{229}Pa	1.50 d	5735 *10*	
		5670 *3*	
		5630 *3*	
		5615 *3*	
		5580 *3*	
		5536 *3*	
^{230}Pa	17.4 d	5344.7 *7*	
		5339.7 *10*	
		5326.2 *7*	
		5312.0 *7*	
		5300.5 *7*	
^{231}Pa	3.2760×10^{4} y	5058.6 *15*	11.0
		5028.4 *10*	20.0
		5013.8 *14*	25.4
		4951.3 *14*	22.8
		4736.0 *8*	8.4
^{230}U	20.8 d	5888.4 *7*	67.4 *4*
		5817.5 *7*	32.0 *2*
^{232}U	68.9 y	5320.12 *14*	68.6 *4*
		5262.36 *9*	31.4 *4*
^{233}U	1.592×10^{5} y	4824.0 *12*	83.3 *3*
		4782.3 *15*	14.1 *4*
^{234}U	2.455×10^{5} y	4774.6 *14*	72.5 *30*
		4722.4 *14*	27.5 *15*
^{235}U	7.038×10^{8} y	4596.4 *13*	5.6
		4397.8 *13*	57
		4366.1 *20*	17
		4214.7 *19*	6.4
^{236}U	2.342×10^{7} y	4493.5 *21*	74
		4445 *4*	26
^{238}U	4.468×10^{9} y	4198 *3*	77 *4*
		4151 *5*	23 *4*
^{235}Np	396.1 d	5108 *3*	
		5025 *2*	
		5007 *4*	
		4997 *4*	
		4925 *2*	

Table 2. Alpha-particle Energies and Intensities (continued)

Source	Half-life	E_α(keV)	I_α(% Branch)
^{237}Np	2.14×10^6 y	4877.1 *17*	0.7 *2*
		4789.8 *12*	47.6 *19*
		4774.2 *14*	18.1 *13*
		4769.2 *14*	14.3 *13*
		4644 *3*	5.9 *8*
^{236}Pu	2.858 y	5767.53 *8*	69.14 *33*
		5730.87 *10*	30.76 *33*
^{238}Pu	87.7 y	5499.03 *20*	71.4 *5*
		5456.3 *3*	28.6 *4*
^{239}Pu	2.4110×10^4 y	5156.59 *14*	73.3 *8*
		5144.3 *8*	15.1 *8*
		5105.8 *8*	11.5 *8*
^{240}Pu	6563 y	5168.13 *15*	73.51 *36*
		5123.45 *23*	26.39 *21*
^{241}Pu	14.35 y	5055 *5*	
		4896.3 *11*	
		4853.0 *11*	
^{242}Pu	3.733×10^5 y	4902.3 *14*	79 *2*
		4858.1 *15*	21 *2*
^{244}Pu	8.08×10^7 y	4589 *1*	80.6 *8*
		4546 *1*	19.4 *8*
^{240}Am	50.8 h	5377.6 *10*	
		5337.1 *20*	
^{241}Am	432.2 y	5544.5 *16*	0.36 *3*
		5485.56 *12*	85.1 *3*
		5442.80 *13*	13.3 *7*
^{242m}Am	141 y	5409.0 *5*	
		5206.5 *5*	
		5141.3 *5*	
^{243}Am	7370 y	5349.4 *23*	0.16
		5275.3 *10*	87.4 *3*
		5233.3 *10*	11.0
^{241}Cm	32.8 d	6080.9 *17*	
		5939.0 *6*	
		5927.2 *15*	
		5884.7 *6*	
^{242}Cm	162.8 d	6112.72 *8*	74.1 *17*
		6069.43 *12*	25.9 *17*
^{243}Cm	29.1 y	6066.2 *17*	1.5 *2*
		5991.8 *15*	5.7 *2*
		5785.2 *9*	73.2 *23*
		5742.1 *9*	11.5 *5*
^{244}Cm	18.10 y	5804.77 *5*	76.4 *12*
		5762.16 *3*	23.6 *12*
^{245}Cm	8500 y	5529.0 *5*	0.7 *2*
		5361.1 *11*	92.7 *9*
		5304.3 *12*	5.1 *4*
^{247}Cm	1.56×10^7 y	5267 *4*	13.8 *7*
		5212 *4*	5.7 *5*
		4870 *4*	71.0 *10*
^{248}Cm	3.40×10^5 y	5078.38 *25*	81.9 *4*
		5034.89 *25*	18.1 *2*
^{245}Bk	4.94 d	6354 *5*	
		6314 *5*	
		6150 *4*	
		6122 *4*	
		6085 *3*	
		5888 *3*	

Source	Half-life	E_α(keV)	I_α(% Branch)
^{247}Bk	1380 y	5794 *5*	5.5 *5*
		5710 *5*	17 *1*
		5688 *5*	13 *1*
		5654 *5*	5.5 *6*
		5531 *5*	45 *2*
		5501 *5*	7 *1*
^{249}Bk	320 d	5436.0 *21*	
		5419 *3*	
		5391 *3*	
^{246}Cf	35.7 h	6754 *4*	78.9 *9*
		6715 *5*	20.9 *9*
^{248}Cf	333.5 d	6258 *5*	80.0 *10*
		6217 *5*	19.6 *10*
^{249}Cf	351 y	6193.6 *11*	2.60 *9*
		5812.8 *16*	82.8 *4*
^{250}Cf	13.08 y	6030.22 *20*	84.7 *6*
		5988.9 *6*	15.0 *2*
^{251}Cf	898 y	6072 *3*	2.7 *2*
		6012 *3*	12.0 *4*
		5849 *3*	27.4 *7*
		5679.3 *16*	34.9 *7*
^{252}Cf	2.645 y	6118.10 *4*	84.3 *3*
		6075.64 *11*	15.5 *3*
^{253}Cf	17.81 d	5980 *4*	94.7 *9*
		5920 *5*	5.3 *19*
^{254}Cf	60.5 d	5833 *5*	
		5791 *5*	
^{251}Es	33 h	6492 *3*	
		6462 *2*	
^{252}Es	471.7 d	6631 *3*	80.7 *8*
		6562 *3*	13.3 *4*
^{253}Es	20.47 d	6632.51 *5*	89.9 *16*
		6590.5 *14*	6.6 *1*
^{254}Es	275.7 d	6512 *5*	0.005
		6429.3 *23*	93.1 *1*
^{254m}Es	39.3 h	6593 *4*	
		6559 *2*	
		6384 *2*	
		6359 *2*	
^{255}Es	39.8 d	6301.0 *17*	
		6266.5 *30*	
^{252}Fm	25.39 h	7039 *2*	84.0 *5*
		6998 *2*	15.0 *2*
^{253}Fm	3.00 d	7083 *4*	
		7023 *4*	
		6943 *3*	
		6901 *4*	
		6846 *3*	
		6673 *3*	
^{257}Fm	100.5 d	6752 *3*	0.58 *6*
		6519.5 *14*	93.8 *7*