

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 Rytz¹ from an adjustment of experimental values to several absolute energy standards. The recommended α branching values¹ 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).

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

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

Source	Half-life	E_{α} (keV)	I_{α} (% Branch)	Source	Half-life	E_{α} (keV)	I_{α} (% Branch)
^{237}Np	2.14×10^6 y	4877.1 ¹⁷	0.7 ²	^{247}Bk	1380 y	5794 ⁵	5.5 ⁵
		4789.8 ¹²	47.6 ¹⁹			5710 ⁵	17 ¹
		4774.2 ¹⁴	18.1 ¹³			5688 ⁵	13 ¹
		4769.2 ¹⁴	14.3 ¹³			5654 ⁵	5.5 ⁶
^{236}Pu	2.858 y	4644 ³	5.9 ⁸	^{249}Bk	320 d	5531 ⁵	45 ²
		5767.53 ⁸	69.14 ³³			5501 ⁵	7 ¹
		5730.87 ¹⁰	30.76 ³³			5436.0 ²¹	
^{238}Pu	87.7 y	5499.03 ²⁰	71.4 ⁵			5419 ³	
^{239}Pu	2.4110×10^4 y	5456.3 ³	28.6 ⁴	^{246}Cf	35.7 h	5391 ³	
		5156.59 ¹⁴	73.3 ⁸			6754 ⁴	78.9 ⁹
^{240}Pu	6563 y	5144.3 ⁸	15.1 ⁸	^{248}Cf	333.5 d	6715 ⁵	20.9 ⁹
		5105.8 ⁸	11.5 ⁸			6258 ⁵	80.0 ¹⁰
		5168.13 ¹⁵	73.51 ³⁶			6217 ⁵	19.6 ¹⁰
^{241}Pu	14.35 y	5123.45 ²³	26.39 ²¹	^{249}Cf	351 y	6193.6 ¹¹	2.60 ⁹
		5055 ⁵				5812.8 ¹⁶	82.8 ⁴
		4896.3 ¹¹				6030.22 ²⁰	84.7 ⁶
^{242}Pu	3.733×10^5 y	4853.0 ¹¹		^{250}Cf	13.08 y	5988.9 ⁶	15.0 ²
		4902.3 ¹⁴	79 ²			6072 ³	2.7 ²
		4858.1 ¹⁵	21 ²			6012 ³	12.0 ⁴
^{244}Pu	8.08×10^7 y	4589 ¹	80.6 ⁸	^{251}Cf	898 y	5849 ³	27.4 ⁷
		4546 ¹	19.4 ⁸			5679.3 ¹⁶	34.9 ⁷
^{240}Am	50.8 h	5377.6 ¹⁰		^{252}Cf	2.645 y	6118.10 ⁴	84.3 ³
^{241}Am	432.2 y	5337.1 ²⁰				6075.64 ¹¹	15.5 ³
		5544.5 ¹⁶	0.36 ³	5980 ⁴	94.7 ⁹		
		5485.56 ¹²	85.1 ³	5920 ⁵	5.3 ¹⁹		
$^{242\text{m}}\text{Am}$	141 y	5442.80 ¹³	13.3 ⁷	^{254}Cf	60.5 d	5833 ⁵	
		5409.0 ⁵				5791 ⁵	
		5206.5 ⁵				6492 ³	
^{243}Am	7370 y	5141.3 ⁵		^{251}Es	33 h	6462 ²	
		5349.4 ²³	0.16			6631 ³	80.7 ⁸
		5275.3 ¹⁰	87.4 ³			6562 ³	13.3 ⁴
^{241}Cm	32.8 d	5233.3 ¹⁰	11.0	^{253}Es	20.47 d	6632.51 ⁵	89.9 ¹⁶
		6080.9 ¹⁷				6590.5 ¹⁴	6.6 ¹
		5939.0 ⁶				6512 ⁵	0.005
^{242}Cm	162.8 d	5927.2 ¹⁵		$^{254\text{m}}\text{Es}$	39.3 h	6429.3 ²³	93.1 ¹
		5884.7 ⁶				6593 ⁴	
		6112.72 ⁸	74.1 ¹⁷			6559 ²	
^{243}Cm	29.1 y	6069.43 ¹²	25.9 ¹⁷	^{255}Es	39.8 d	6384 ²	
		6066.2 ¹⁷	1.5 ²			6359 ²	
		5991.8 ¹⁵	5.7 ²			6301.0 ¹⁷	
^{244}Cm	18.10 y	5785.2 ⁹	73.2 ²³	^{252}Fm	25.39 h	6266.5 ³⁰	
		5742.1 ⁹	11.5 ⁵			7039 ²	84.0 ⁵
		5804.77 ⁵	76.4 ¹²			6998 ²	15.0 ²
^{245}Cm	8500 y	5762.16 ³	23.6 ¹²	^{253}Fm	3.00 d	7083 ⁴	
		5529.0 ⁵	0.7 ²			7023 ⁴	
		5361.1 ¹¹	92.7 ⁹			6943 ³	
^{247}Cm	1.56×10^7 y	5304.3 ¹²	5.1 ⁴	^{257}Fm	100.5 d	6901 ⁴	
		5267 ⁴	13.8 ⁷			6846 ³	
		5212 ⁴	5.7 ⁵			6673 ³	
^{248}Cm	3.40×10^5 y	4870 ⁴	71.0 ¹⁰			6752 ³	0.58 ⁶
		5078.38 ²⁵	81.9 ⁴			6519.5 ¹⁴	93.8 ⁷
		5034.89 ²⁵	18.1 ²				
^{245}Bk	4.94 d	6354 ⁵					
		6314 ⁵					
		6150 ⁴					
		6122 ⁴					
		6085 ³					
		5888 ³					