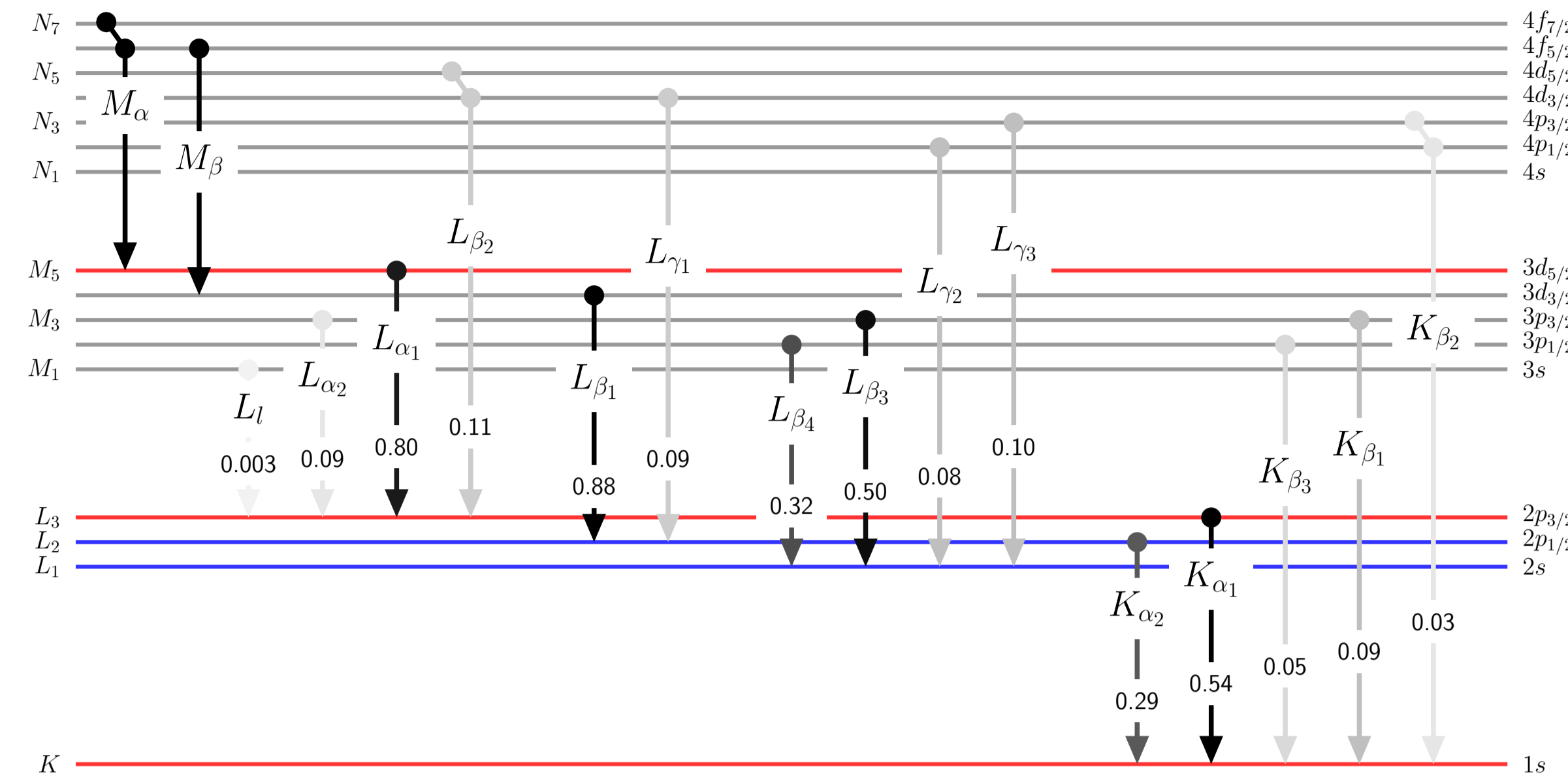


X-ray Absorption and Emission Energies of the Elements



Atomic Data and Energies from
W. T. Elam, B. D. Ravel and J. R. Sieber,
Radiation Physics and Chemistry 63, pp 121-128 (2002)

Common oxidation states from wikipedia.org, after
N. N. Greenwood and A. Earnshaw,
Chemistry of the Elements, 2nd ed. (1997).

All energies in eV.
Emission line strengths are approximate, and vary with element.

Symbol	name	Z
K edge	K_{α_1}	K_{β_1}
L ₁ edge	L_{β_3}	L_{γ_1}
L ₂ edge	L_{β_2}	L_{γ_2}
L ₃ edge	L_{α_1}	L_{β_2}
M ₅ edge	M_{α}	M_{β}
Mass		oxidation states

B	C	N	O	F	Ne												
boron	carbon	nitrogen	oxygen	fluorine	neon												
188 13 5 5	284 277 18 7 7	410 392	543 525	697 677	870 849												
10.81	12.011	14.0067	15.9994	18.9984	20.179												
+3	-4, -3, ..., +2, +3, +4	-3, +3, +5	-2	-1	-1												
Al	Si	P	S	Cl	Ar												
aluminum	silicon	phosphorus	sulfur	chlorine	argon												
1559 1486 1557 118 116 116 73 72	1839 1740 1837 150 148 148 100 99	2146 2010 2140 189 183 182 136 135	2472 2310 2465 231 224 223 164 162	2822 2622 2812 270 260 260 202 200	3206 2958 3190 326 311 310 251 248												
26.9815	28.0855	30.9738	32.06	35.453	39.948												
+3	-4, +4	-3, +3, +5	-2, +2, +4, +6	-1, +1, +3, +5, +7	-1												
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
potassium	calcium	scandium	titanium	vanadium	chromium	manganese	iron	cobalt	nickel	copper	zinc	gallium	germanium	arsenic	selenium	bromine	krypton
3608 3314 3590 379 360 360 297 295	4038 3692 4013 438 413 413 350 346	4492 4093 4464 498 470 470 404 399	4966 4512 4933 561 528 528 460 458 458 454 452 2	5465 4953 5428 627 590 590 520 518 518 512 510 2	5989 5415 5947 696 654 654 584 582 574 572 2	6539 5900 6492 769 722 722 650 648 648 639 637 2	7112 6405 7059 845 792 792 720 718 718 707 705 2	7709 6931 7649 925 865 866 793 790 790 778 775 3	8333 7480 8267 1009 942 941 870 866 866 853 849 4	8979 8046 8904 1097 1022 1019 952 947 947 933 928 5	9659 8637 9570 1196 1108 1105 1045 1035 1035 1022 1012 10	10367 9251 10267 1299 1199 1196 1143 1124 1124 1116 1098 19	11103 9886 10982 1415 1294 1290 1248 1218 1188 1217 1188 29	11867 10543 11726 1527 1386 1381 1359 1317 1188 1324 1282 42	12658 11224 12497 1652 1491 1486 1474 1419 1486 1434 1379 55	13474 11924 13292 1782 1600 1593 1596 1526 260 1550 1481 69	14326 12648 14112 1921 1707 1699 1731 1636 311 1678 1585 94
39.0983	40.08	50.9415	47.88	50.9415	51.996	54.938	55.847	58.9332	58.69	63.546	65.38	69.72	72.59	74.9216	78.96	79.904	83.8
+1	+2	+3	+3, +4	+2, +3, +4, +5	+2, +3, +6	+2, +3, +4, +7	+2, +3	+2, +3	+2	+1, +2	+2	+3	+3	+3, +3, +5	-2, +2, +4, +6	-1, +1, +3, +5	+3
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
rubidium	strontium	yttrium	zirconium	niobium	molybdenum	technetium	ruthenium	rhodium	palladium	silver	cadmium	indium	tin	antimony	tellurium	iodine	xenon
15200 13396 14961 2065 1826 1816 1864 1751 1804 1692 112	16105 14165 15835 2216 1946 1936 2007 1871 1940 1806 134	17038 14958 16739 2373 2074 2062 2156 1998 2080 1924 156	17998 15775 17668 2532 2202 2188 2307 2126 2223 2044 179	18986 16615 18625 2698 2337 2322 2465 2260 2520 2292 202	20000 17480 19606 2866 2472 2454 2625 2394 2677 2423 254	21044 18367 20626 3043 2625 2595 2793 2535 2677 2423 254	22117 19279 21656 3224 2762 2741 2967 2683 2838 2558 280	23220 20216 22724 3412 2916 2891 3146 2834 3144 3004 2697 3002 307	24350 21177 23818 3604 3072 3044 3330 2990 3328 3173 2838 3171 335	25514 22163 24941 3806 3233 3202 3524 3150 3520 3351 2983 3347 368	26711 23173 26093 4018 3400 3365 3727 3315 3715 3538 3133 3526 405	27940 24210 27275 4238 3573 3535 3938 3487 3920 3730 3286 3712 444	29200 25271 28485 4465 3750 3708 4156 3663 4131 3929 3604 4099 485	30491 26359 29725 4698 3932 3885 4939 4118 4068 4612 4029 4570 4341 3768 4299 528	31814 27473 30993 4939 4118 4068 4612 4029 4570 4341 3768 4299 528	33169 28612 32294 5188 4313 4257 4852 4221 4801 4557 3938 4506 619	34561 29775 33620 5453 4512 4451 5107 4418 5038 4786 4110 4716 676
85.4678	87.62	88.9059	91.22	92.9064	95.94	97.907	101.07	102.906	106.42	107.868	112.41	114.82	118.69	121.75	127.6	126.905	131.29
+1	+2	+3	+4	+4, +5	+3, +4, +6	+4, +7	+3, +4, +6	+2, +3, +4	+2, +4	+1	+2	+3	+3	-3, +3, +5	-2, +2, +4, +6	-1, +1, +3, +5, +7	+3
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
cesium	barium	lanthanum	hafnium	tantalum	tungsten	rhenium	osmium	iridium	platinum	gold	mercury	thallium	lead	bismuth	polonium	astatine	radon
35985 30973 34982 5714 4711 4643 5359 4618 5279 5012 4285 4932 727	37441 32194 36378 5989 4926 4852 5624 4828 5531 5247 4466 5154 780	38925 33442 37797 6266 5138 5057 5891 5038 5786 5483 4647 5378 836	65351 55790 63244 11271 9164 8906 10739 9023 10519 9561 7899 9341 1662	67416 57535 65222 11682 9488 9213 11136 9343 10898 9881 8146 9643 1735	69525 59318 67244 12527 9819 9525 11544 9672 11288 10207 8398 9951 1809	71676 61141 69309 12676 10160 9845 11959 10010 11685 10535 8652 10261 1883	73871 63000 71414 12968 10511 10176 12385 10354 12512 10871 8911 10578 1960	76111 64896 73560 13419 10868 10510 13273 11071 12941 11215 9175 10903 2040	78395 66831 75750 13880 11235 10853 13273 11071 12941 11564 9442 11232 2122	80725 68806 77982 14353 11610 11205 13734 11443 13381 11919 9713 11566 2206	83102 70818 80255 14839 11992 11560 14209 11824 13831 12268 10269 12252 2295	85530 72872 82573 15347 12390 11931 14698 12213 14292 12658 10269 12252 2389	88005 74970 84939 15861 12795 12307 16388 13023 15247 13814 11131 13314 2484	90526 77107 87349 16388 13211 12692 16244 13446 15744 13814 11131 13314 2580	93105 79291 89803 16939 13637 13085 16244 13446 15744 13814 11131 13314 2683	95730 81516 92304 17493 14067 13485 16785 13876 16252 14214 11427 13681 2787	98404 83785 94866 18049 14511 13890 17337 14315 16770 14619 11727 14052 2892
132.905	137.33	138.906	178.49	180.948	183.85	186.207	190.2	192.22	195.08	196.967	200.59	204.383	207.2	208.98	208.982	209.987	222.018
+1	+2	+3	+4	+5	+4, +6	+4	+4	+3, +4	+2, +4	+1, +3	+1, +2	+1, +3	+2, +4	+3, +5	-2, +2, +4	-1, +1	+3
Fr	Ra	Ac	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	
francium	radium	actinium	cerium	praseodymium	neodymium	promethium	samarium	europium	gadolinium	terbium	dysprosium	holmium	erbium	thulium	ytterbium	lutetium	
101137 86106 97474 18639 14976 14312 17907 14771 17304 15031 12031 14428 3000	103922 88478 100130 19237 15445 14747 18484 15236 17848 15444 12339 14808 3105	106755 90884 102846 19237 15445 14747 18484 15236 17848 15444 12339 14808 3105	40443 34720 39256 6548 5361 5274 6164 5262 6055 5723 4839 5614 884	41991 36027 40749 6835 5593 5498 6440 5492 6325 5964 5035 5849 929	43569 37361 42272 7126 5829 5723 6722 5719 6602 6208 5228 6088 980	45184 38725 43827 7428 6071 5957 7013 5961 6893 6459 5432 6339 1027	46834 40118 45414 7737 6317 6196 7312 6201 7183 6716 5633 6587 1083	48519 41542 47038 8052 6571 6438 7617 6458 7484 6977 5850 6844 1128	50239 42996 48695 8376 6832 6688 7930 6708 7787 7243 6053 7100 1190	51996 44482 50385 8708 7097 6940 8252 6975 8102 7514 6273 7364 1241	53789 45999 52113 9046 7370 7204 8581 7248 8427 7790 6498 7636 1292	55618 47547 53877 9394 7653 7471 8918 7526 8758 8071 6720 7911 1351	57486 49128 55674 9751 7939 7745 9264 7811 9096 8358 6949 8190 1409	59390 50742 57505 10116 8231 8026 9617 8102 9442 8648 7180 8472 1468	61332 52388 59382 10486 8536 8313 9978 8402 9787 8944 7416 8753 1528	63314 54070 61290 10870 8846 8606 10349 8710 10143 1589	
223.02	226.025	227.028	140.12	140.908	144.24	144.913	150.36	151.96	157.25	158.925	162.5	164.93	167.26	168.934	173.04	174.967	
+1	+2	+3	+3, +4	+3, +4	+3	+3	+3	+2, +3	+3	+3, +4	+3	+3	+3	+3	+3	+3	
Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr				
thorium	protactinium	uranium	neptunium	plutonium	americium	curium	berkelium	californium	einsteinium	fermium	mendelevium	nobelium	lawrencium				
109651 93351 105605 20472 16426 15642 19693 16202 18981 16300 12968 15588 3332	112601 95868 108427 21105 16931 16104 20314 16703 19571 16733 13291 15990 3442	115606 98440 111303 21757 17454 16575 20948 17220 20170 17166 13614 16388 3552	118669 101059 114234 22427 17992 17061 21600 17751 20784 17610 13946 16794 3664	121791 103734 117228 23104 18541 17557 22266 18296 21420 18057 14282 17211 3775	124982 106472 120284 23808 19110 18069 22952 18856 22072 18510 14620 17630 3890	128241 109271 123403 24526 19688 18589 23651 19427 22735 18970 14961 18054 4009	131556 112121 126580 25156 20280 19118 24371 20018 23416 19435 15308 18480 4127	134939 115032 129823 26010 20894 19665 25108 20624 24117 19907 15660 18916 4247	138000 118000 133000 26900 21700 20500 26000 21500 24900 20800 16500 19900 4370	141000 121000 136000 27800 22600 21400 26900 22400 25800 21700 17400 20800 4500	144000 124000 139000 28700 23500 22300 27800 23300 26700 22600 18300 21700 4630	147000 127000 142000 29600 24400 23200 28700 24200 27600 23500 19200 22600 4760					
232.038	231.036	238.051	237.048	239.052	243.061	247.07	247.07	251.08	252.083	253.08	258.10	259.10	260.10				
+4	+5	+4, +6	+3, +4, +5	+3, +4, +5	+3, +4, +5	+3	+3, +4	+3	+3	+3	+3	+3	+3				



Henry Moseley

<https://xrayabsorption.org/xraytable>
Version 4, 2020-April-19

