

Table I. Isotopic Data

| Z  | El | A  | Abundance(%) | $\sigma_{\gamma}(\text{total})$ b          | g(293°K) | N $\gamma$ | E $\gamma(\sigma_{\gamma})$ for most intense capture gamma rays                                  |
|----|----|----|--------------|--|----------|------------|--|
| 1  | H  | 1  | 99.9885(70)  | 0.3326(7)                                  | 0.999    | 1          | 2223.24835(0.3326)   |
|    | H  | 2  | 0.0115(70)   | 0.000519(7)                                | 1.000    | 1          |  |
| 2  | He | 3  | 0.000137(3)  | 0.000031(9)                                | 1.000    | 1          | 20520.46(4.2×10 <sup>-11</sup> )   |
|    |    |    |              | $\sigma_p(^3\text{He})=5333(7)$ b          |          |            |  |
| 3  | He | 4  | 99.999863(3) | 0.0  | 1.000    | 0          |  |
|    | Li | 6  | 7.59(4)      | 0.039(4)                                   | 1.000    | 3          |  |
|    |    |    |              | $\sigma_{\alpha}(^6\text{Li})=940(4)$ b    |          |            |  |
|    | Li | 7  | 92.41(4)     | 0.045(3)                                   | 1.000    | 3          | 2032.30(0.0381), 980.53(0.00415), 1051.90(0.00414)   |
| 4  | Be | 9  | 100          | 0.0088(4)                                  | 1.000    | 13         | 6809.61(0.0058), 3367.448(0.00285), 853.630(0.00208)   |
| 5  | B  | 10 | 19.9(7)      | 0.5(1)                                     | 1.000    | 10         | 477.595(716)   |
|    |    |    |              | $\sigma_{\alpha}(^{10}\text{B})=3837(9)$ b |          |            |  |
|    | B  | 11 | 80.1(7)      | 0.005(3)                                   | 1.000    | 0          |  |
| 6  | C  | 12 | 98.93(8)     | 0.00353(5)                                 | 1.000    | 6          | 4945.301(0.00261), 1261.765(0.00124), 3683.920(0.00122)  |
|    | C  | 13 | 1.07(8)      | 0.00137(4)                                 | 0.998    | 7          |  |
| 7  | N  | 14 | 99.632(7)    | 0.0798(14)                                 | 1.000    | 60         | 5269.159(0.0236), 5297.821(0.01680), 5533.395(0.0155)  |
|    |    |    |              | $\sigma_p(^{14}\text{N})=1.83(3)$ b        |          |            |  |
|    | N  | 15 | 0.368(7)     | 0.000024(8)                                | 1.003    | 12         |  |
| 8  | O  | 16 | 99.757(16)   | 0.000190(19)                               | 1.000    | 4          | 870.68(1.77×10 <sup>-4</sup> ), 2184.42(1.64×10 <sup>-4</sup> ), 1087.75(1.58×10 <sup>-4</sup> ) |
|    | O  | 17 | 0.038(1)     | 0.00054(7)                                 | 0.999    | 20         |  |
|    | O  | 18 | 0.205(14)    | 0.00016(1)                                 | 1.000    | 13         |  |
| 9  | F  | 19 | 100          | 0.0096(5)                                  | 1.000    | 168        | 1633.53(0.0096)d, 583.561(0.00356), 656.006(0.00197)   |
| 10 | Ne | 20 | 90.48(3)     | 0.037(4)                                   | 1.000    | 27         | 2035.67(0.0245), 350.72(0.0198), 4374.13(0.01910)  |
|    | Ne | 21 | 0.27(1)      | 0.67(11)                                   | 1.000    | 11         |  |
|    | Ne | 22 | 9.25(3)      | 0.045(6)                                   | 1.000    | 15         | 1979.89(0.00306), 1017.00(0.0030)  |
| 11 | Na | 23 | 100          | 0.530(5)                                   | 1.000    | 240        | 1368.66(0.530)d, 2754.13(0.530)d, 472.202(0.478)d  |
| 12 | Mg | 24 | 78.99(4)     | 0.0536(15)                                 | 1.001    | 35         | 3916.84(0.0320), 585.00(0.0314), 2828.172(0.0240)  |
|    | Mg | 25 | 10.00(1)     | 0.200(5)                                   | 1.001    | 206        | 1808.668(0.0180), 1129.575(0.00891), 3831.480(0.00418)   |
|    | Mg | 26 | 11.01(3)     | 0.0386(6)                                  | 1.001    | 44         |  |
| 13 | Al | 27 | 100          | 0.231(3)                                   | 1.000    | 216        | 1778.92(0.232)d, 30.6380(0.0798), 7724.027(0.0493)   |
| 14 | Si | 28 | 92.2297(7)   | 0.177(5)                                   | 1.001    | 46         | 3538.966(0.1190), 4933.889(0.1120), 2092.902(0.0331)   |
|    | Si | 29 | 4.6832(5)    | 0.119(3)                                   | 1.003    | 99         |  |
|    | Si | 30 | 3.0872(5)    | 0.107(2)                                   | 1.007    | 39         |  |
| 15 | P  | 31 | 100          | 0.172(6)                                   | 1.001    | 158        | 512.646(0.079), 78.083(0.059), 636.663(0.0311)   |
| 16 | S  | 32 | 94.93(31)    | 0.548(10)                                  | 1.000    | 101        | 840.993(0.347), 5420.574(0.308), 2379.661(0.208)   |
|    | S  | 33 | 0.76(2)      | 0.454(25)                                  | 1.001    | 249        |  |
|    | S  | 34 | 4.29(28)     | 0.235(5)                                   | 1.001    | 55         |  |
|    | S  | 36 | 0.02(1)      | 0.23(2)                                    | 1.014    | 22         |  |
| 17 | Cl | 35 | 75.78(4)     | 43.5(4)                                    | 1.000    | 384        | 1164.8650(8.91), 517.0730(7.58), 6110.842(6.59)  |
|    | Cl | 37 | 24.22(4)     | 0.430(6)                                   | 1.000    | 71         |  |
| 18 | Ar | 36 | 0.3365(30)   | 5.2(5)                                     | 1.016    | 10         |  |
|    | Ar | 38 | 0.0632(5)    | 0.8(2)                                     | 1.040    | 0          |  |
|    | Ar | 40 | 99.6003(30)  | 0.66(1)                                    | 1.002    | 40         | 167.30(0.53), 4745.3(0.36), 1186.8(0.34)   |
| 19 | K  | 39 | 93.2581(44)  | 2.1(2)                                     | 1.001    | 308        | 29.8300(1.380), 770.3050(0.903), 1158.887(0.1600)  |
|    | K  | 40 | 0.0117(1)    | 30(4)                                      | 1.000    | 490        |  |
|    | K  | 41 | 6.7302(44)   | 1.45(3)                                    | 1.001    | 638        |  |
| 20 | Ca | 40 | 96.94(16)    | 0.41(2)                                    | 1.001    | 49         | 1942.67(0.352), 6419.59(0.176), 4418.52(0.0708)  |
|    | Ca | 42 | 0.647(23)    | 0.68(7)                                    | 1.001    | 44         |  |
|    | Ca | 43 | 0.135(10)    | 6.2(6)                                     | 1.001    | 129        |  |
|    | Ca | 44 | 2.09(11)     | 0.88(5)                                    | 1.001    | 41         |  |
|    | Ca | 46 | 0.004(3)     | 0.72(3)                                    | 1.000    | 10         |  |
|    | Ca | 48 | 0.187(21)    | 1.09(14)                                   | 1.001    | 15         |  |
| 21 | Sc | 45 | 100          | 27.2(2)                                    | 1.002    | 440        | 227.773(7.13), 147.011(6.08), 142.528(4.88)d   |
| 22 | Ti | 46 | 8.25(3)      | 0.59(18)                                   | 1.001    | 23         |  |
|    | Ti | 47 | 7.44(2)      | 1.52(11)                                   | 1.001    | 175        |  |
|    | Ti | 48 | 73.72(3)     | 7.88(25)                                   | 1.002    | 92         | 1381.745(5.18), 6760.084(2.97), 6418.426(1.96)   |
|    | Ti | 49 | 5.41(2)      | 1.79(12)                                   | 1.001    | 88         |  |
|    | Ti | 50 | 5.18(2)      | 0.179(3)                                   | 1.001    | 19         |  |
| 23 | V  | 50 | 0.250(4)     | 21(4)                                      | 0.999    | 328        |  |
|    | V  | 51 | 99.750(4)    | 4.92(4)                                    | 1.001    | 309        | 1434.10(4.81)d, 125.082(1.61), 6517.282(0.78)  |
| 24 | Cr | 50 | 4.345(13)    | 15.9(2)                                    | 1.000    | 64         | 749.09(0.569), 8510.77(0.233), 8482.80(0.169)  |
|    | Cr | 52 | 83.789(18)   | 0.76(6)                                    | 1.000    | 16         | 7938.46(0.424)   |
|    | Cr | 53 | 9.501(17)    | 18.2(15)                                   | 1.000    | 90         | 834.849(1.38), 8884.36(0.78), 9719.06(0.260)   |
|    | Cr | 54 | 2.365(7)     | 0.36(4)                                    | 1.000    | 38         |  |
| 25 | Mn | 55 | 100          | 13.36(5)                                   | 1.000    | 126        | 846.754(13.10)d, 1810.72(3.62)d, 26.560(3.42)  |
| 26 | Fe | 54 | 5.845(35)    | 2.25(18)                                   | 1.001    | 33         | 9297.68(0.0747)  |
|    | Fe | 56 | 91.754(36)   | 2.59(14)                                   | 1.000    | 193        | 7631.136(0.653), 7645.5450(0.549), 352.347(0.273)  |
|    | Fe | 57 | 2.119(10)    | 2.5(3)                                     | 1.001    | 35         |  |
|    | Fe | 58 | 0.282(4)     | 1.30(3)                                    | 1.002    | 67         |  |
| 27 | Co | 59 | 100          | 37.18(6)                                   | 1.000    | 340        | 229.879(7.18), 277.161(6.77), 555.972(5.76)  |
| 28 | Ni | 58 | 68.0769(89)  | 4.5(2)                                     | 1.000    | 236        | 8998.414(1.49), 464.978(0.843), 8533.509(0.721)  |
|    | Ni | 60 | 26.2231(77)  | 2.9(2)                                     | 1.000    | 137        | 7819.517(0.336), 282.917(0.211), 7536.637(0.190)   |
|    | Ni | 61 | 1.1399(6)    | 2.5(8)                                     | 1.000    | 64         |  |
|    | Ni | 62 | 3.6345(17)   | 14.5(3)                                    | 1.000    | 53         | 6837.50(0.458)   |
|    | Ni | 64 | 0.9256(9)    | 1.63(7)                                    | 1.000    | 35         |  |

\* Decay gamma: <sup>20</sup>F(11.163 s), <sup>24</sup>Na(20.20 ms), <sup>28</sup>Al(2.2414 m), <sup>46</sup>Sc(18.75 s), <sup>52</sup>V(3.75 m), <sup>56</sup>Mn(2.5789 h)

Table I. Isotopic Data, continued

| Z  | El | A   | Abundance(%) | $\sigma\gamma$ (total) | b | g(293°K) | N $\gamma$ | E $\gamma$ ( $\sigma\gamma$ ) for most intense capture gamma rays |
|----|----|-----|--------------|------------------------|---|----------|------------|---|
| 29 | Cu | 63  | 69.17(3)     | 4.52(2)                |   | 1.001    | 305        | 278.250(0.893), 7915.62(0.869), 159.281(0.648)                    |
|    | Cu | 65  | 30.83(3)     | 2.17(3)                |   | 1.002    | 350        | 185.96(0.244), 465.14(0.1350), 385.77(0.1310)                     |
| 30 | Zn | 64  | 48.63(60)    | 1.1(1)                 |   | 1.001    | 78         | 115.225(0.167), 7863.55(0.1410), 855.69(0.066)                    |
|    | Zn | 66  | 27.90(27)    | 0.62(6)                |   | 1.000    | 17         | 6958.8(0.043)   |
|    | Zn | 67  | 4.10(13)     | 9.5(14)                |   | 1.000    | 175        | 1077.335(0.356), 1883.12(0.0718), 1340.14(0.0457)                 |
|    | Zn | 68  | 18.75(51)    | 1.07(10)               |   | 1.000    | 33         | 1007.809(0.056), 5474.02(0.042), 834.77(0.037)                    |
|    | Zn | 70  | 0.62(3)      | 0.091(5)               |   | 1.000    | 79         |   |
| 31 | Ga | 69  | 60.108(9)    | 1.68(7)                |   | 1.000    | 66         | 508.19(0.349), 690.943(0.305), 187.84(0.1080)                     |
|    | Ga | 71  | 39.892(9)    | 4.73(15)               |   | 1.001    | 245        | 834.08(1.65)d, 2201.91(0.52)d, 629.96(0.490)d                     |
| 32 | Ge | 70  | 20.84(87)    | 3.45(16)               |   | 1.000    | 84         | 175.05(0.164), 499.87(0.162)                                      |
|    | Ge | 72  | 27.54(34)    | 0.95(11)               |   | 1.000    | 47         |   |
|    | Ge | 73  | 7.73(5)      | 14.4(4)                |   | 1.000    | 603        | 595.851(1.100), 867.899(0.553), 608.353(0.250)                    |
|    | Ge | 74  | 36.28(73)    | 0.53(5)                |   | 1.000    | 47         |   |
|    | Ge | 76  | 7.61(38)     | 0.14(2)                |   | 1.000    | 196        |   |
| 33 | As | 75  | 100          | 4.23(8)                |   | 1.000    | 348        | 559.10(2.00)d, 165.0490(0.996), 86.7880(0.579)                    |
| 34 | Se | 74  | 0.89(4)      | 51.8(12)               |   | 1.001    | 142        | 286.5710(0.280)   |
|    | Se | 76  | 9.37(29)     | 85(7)                  |   | 1.000    | 456        | 238.9980(2.06), 520.6370(1.260), 161.9220(0.855)d                 |
|    | Se | 77  | 7.63(16)     | 42(4)                  |   | 1.000    | 215        | 613.724(2.14), 694.914(0.443), 1308.632(0.317)                    |
|    | Se | 78  | 23.77(28)    | 0.430(22)              |   | 1.000    | 37         |   |
|    | Se | 80  | 49.61(41)    | 0.61(5)                |   | 1.000    | 71         |   |
|    | Se | 82  | 8.73(22)     | 0.044(3)               |   | 1.000    | 0          |   |
| 35 | Br | 79  | 50.69(7)     | 10.32(13)              |   | 1.000    | 257        | 245.203(0.80), 271.374(0.462), 314.982(0.460)                     |
|    | Br | 81  | 49.31(7)     | 2.36(5)                |   | 1.000    | 181        | 776.517(0.990)d, 554.3480(0.838)d, 619.106(0.515)d                |
| 36 | Kr | 78  | 0.35(1)      | 4.7(7)                 |   | 1.000    | 1          |   |
|    | Kr | 80  | 2.28(6)      | 11.5(5)                |   | 1.000    | 1          |   |
|    | Kr | 82  | 11.58(14)    | 19(4)                  |   | 1.000    | 2          |   |
|    | Kr | 83  | 11.49(6)     | 202(10)                |   | 0.995    | 75         | 881.74(20.8), 1213.42(8.28), 1463.86(7.10)                        |
|    | Kr | 84  | 57.00(4)     | 0.111(15)              |   | 1.000    | 7          |   |
|    | Kr | 86  | 17.30(22)    | 0.003(2)               |   | 1.000    | 38         |   |
| 37 | Rb | 85  | 72.17(2)     | 0.48(9)                |   | 1.000    | 90         | 556.82(0.0913), 487.89(0.0494), 555.61(0.0407)d                   |
|    | Rb | 87  | 27.83(2)     | 0.12(3)                |   | 1.000    | 86         | 196.34(0.00964)   |
| 38 | Sr | 84  | 0.56(1)      | 0.62(6)                |   | 1.000    | 5          |   |
|    | Sr | 86  | 9.86(1)      | 1.04(7)                |   | 1.000    | 375        |   |
|    | Sr | 87  | 7.00(1)      | 17(3)                  |   | 1.006    | 210        | 1836.067(1.030), 898.055(0.702), 850.657(0.275)                   |
|    | Sr | 88  | 82.58(1)     | 0.0058(4)              |   | 1.000    | 57         |   |
| 39 | Y  | 89  | 100          | 1.28(2)                |   | 1.005    | 397        | 6080.171(0.76), 776.613(0.659), 202.53(0.289)                     |
| 40 | Zr | 90  | 51.45(40)    | 0.011(5)               |   | 1.000    | 15         | 1465.7(0.063), 1205.6(0.042), 2042.2(0.032)                       |
|    | Zr | 91  | 11.22(5)     | 1.24(25)               |   | 1.000    | 81         | 934.4640(0.125), 1405.159(0.0301), 560.958(0.0285)                |
|    | Zr | 92  | 17.15(8)     | 0.22(6)                |   | 1.000    | 18         |   |
|    | Zr | 94  | 17.38(28)    | 0.0499(24)             |   | 1.000    | 14         |   |
|    | Zr | 96  | 2.80(9)      | 0.020(1)               |   | 1.000    | 34         | 1102.67(0.0235)   |
| 41 | Nb | 93  | 100          | 1.15(5)                |   | 1.002    | 535        | 99.4070(0.196), 255.9290(0.176), 253.115(0.1320)                  |
| 42 | Mo | 92  | 14.84(35)    | 0.0190                 |   | 1.000    | 5          |   |
|    | Mo | 94  | 9.25(12)     | 0.0150                 |   | 1.001    | 13         |   |
|    | Mo | 95  | 15.92(13)    | 13.4(3)                |   | 0.998    | 139        | 778.221(2.02), 849.85(0.43), 847.603(0.324)                       |
|    | Mo | 96  | 16.68(2)     | 0.5(2)                 |   | 1.001    | 36         |   |
|    | Mo | 97  | 9.55(8)      | 2.5(2)                 |   | 0.998    | 110        |   |
|    | Mo | 98  | 24.13(31)    | 0.137(5)               |   | 1.000    | 56         |   |
|    | Mo | 100 | 9.63(23)     | 0.199(3)               |   | 1.000    | 332        |   |
| 44 | Ru | 96  | 5.54(14)     | 0.22(2)                |   | 1.001    | 2          |   |
|    | Ru | 98  | 1.87(3)      | <8.0                   |   | 1.002    | 1          |   |
|    | Ru | 99  | 12.76(14)    | 7.1(10)                |   | 1.002    | 134        | 539.538(1.53), 686.907(0.52)                                      |
|    | Ru | 100 | 12.60(7)     | 5.0(6)                 |   | 1.000    | 32         |   |
|    | Ru | 101 | 17.06(2)     | 3.4(9)                 |   | 1.001    | 60         | 475.0950(0.98), 631.22(0.30), 627.970(0.176)                      |
|    | Ru | 102 | 31.55(14)    | 1.21(7)                |   | 1.000    | 173        | 1959.30(0.210)  |
|    | Ru | 104 | 18.62(27)    | 0.47(2)                |   | 1.000    | 183        |   |
| 45 | Rh | 103 | 100          | 145(2)                 |   | 1.023    | 264        | 180.87(22.6), 97.14(19.5), 51.50(16.0)                            |
| 46 | Pd | 102 | 1.02(1)      | 3.4(3)                 |   | 0.997    | 4          |   |
|    | Pd | 104 | 11.14(8)     | 0.6(3)                 |   | 1.000    | 11         |   |
|    | Pd | 105 | 22.33(8)     | 21.0(15)               |   | 0.995    | 114        | 511.843(4.00), 717.356(0.777), 616.192(0.629)                     |
|    | Pd | 106 | 27.33(3)     | 0.31(3)                |   | 0.999    | 7          |   |
|    | Pd | 108 | 26.46(9)     | 7.6(4)                 |   | 1.000    | 140        |   |
|    | Pd | 110 | 11.72(9)     | 0.23(3)                |   | 1.000    | 87         |   |
| 47 | Ag | 107 | 51.839(8)    | 37.6(12)               |   | 0.998    | 172        | 78.91(3.90), 206.46(3.58), 192.90(2.20)                           |
|    | Ag | 109 | 48.161(8)    | 91(1)                  |   | 1.005    | 129        | 198.72(7.75), 235.62(4.62), 117.45(3.85)                          |
| 48 | Cd | 106 | 1.25(6)      | ~1.0                   |   | 1.000    | 0          |   |
|    | Cd | 108 | 0.89(3)      | 0.72(13)               |   | 1.001    | 0          |   |
|    | Cd | 110 | 12.49(18)    | 11(1)                  |   | 1.000    | 191        | 245.3(274)  |
|    | Cd | 111 | 12.80(12)    | 24(3)                  |   | 0.995    | 5          |   |
|    | Cd | 112 | 24.13(21)    | 2.2(5)                 |   | 1.000    | 0          |   |
|    | Cd | 113 | 12.22(12)    | 20600(400)             |   | 1.337    | 134        | 558.32(1860), 651.19(358)   |
|    | Cd | 114 | 28.73(42)    | 0.34(2)                |   | 1.000    | 0          |   |
|    | Cd | 116 | 7.49(18)     | 0.075(20)              |   | 1.000    | 0          |   |

\* Decay gamma: <sup>72</sup>Ga(39.68 ms), <sup>76</sup>As(26.24 h), <sup>77</sup>Se(17.36 s), <sup>82</sup>Br(35.30 h), <sup>86</sup>Rb(1.017 m)

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| Z  | El | A   | Abundance(%) | $\sigma_{\gamma}(\text{total})$ | b | g(293°K) | N $_{\gamma}$ | E $_{\gamma}(\sigma_{\gamma})$ for most intense capture gamma rays |
|----|----|-----|--------------|---------------------------------|---|----------|---------------|--|
| 49 | In | 113 | 4.29(5)      | 15.1(13)                        |   | 1.012    | 232           |  |
|    | In | 115 | 95.71(5)     | 283(8)                          |   | 1.019    | 199           | 1293.54(131)d, 1097.30(87.3)d, 416.86(43.0)d                       |
| 50 | Sn | 112 | 0.97(1)      | 0.86(9)                         |   | 1.000    | 0             |  |
|    | Sn | 114 | 0.66(1)      | 0.12(3)                         |   | 1.001    | 0             |  |
|    | Sn | 115 | 0.34(1)      | 30(7)                           |   | 1.000    | 395           | 1293.591(0.1340), 972.619(0.0158), 2112.302(0.0152)                |
|    | Sn | 116 | 14.54(9)     | 0.14(3)                         |   | 1.000    | 9             | 158.65(0.0145)   |
|    | Sn | 117 | 7.68(7)      | 1.32(18)                        |   | 1.000    | 19            | 1229.64(0.0673)  |
|    | Sn | 118 | 24.22(9)     | 0.23(5)                         |   | 1.000    | 9             |  |
|    | Sn | 119 | 8.59(4)      | 2.2(5)                          |   | 1.000    | 9             | 1171.28(0.0879)  |
|    | Sn | 120 | 32.58(9)     | 0.14(3)                         |   | 1.000    | 10            |  |
|    | Sn | 122 | 4.63(3)      | 0.139(15)                       |   | 1.000    | 9             |  |
|    | Sn | 124 | 5.79(5)      | 0.134(5)                        |   | 1.000    | 25            |  |
| 51 | Sb | 121 | 57.21(5)     | 5.9(2)                          |   | 1.003    | 151           | 564.24(2.700)d, 61.4130(0.75), 78.0910(0.48)                       |
|    | Sb | 123 | 42.79(5)     | 4.1(1)                          |   | 1.001    | 175           | 87.6010(0.212), 40.8040(0.10), 155.1780(0.081)                     |
| 52 | Te | 120 | 0.09(1)      | 2.3(3)                          |   | 1.000    | 0             |  |
|    | Te | 122 | 2.55(12)     | 3.9(5)                          |   | 1.000    | 113           |  |
|    | Te | 123 | 0.89(3)      | 418(30)                         |   | 1.011    | 162           | 602.729(2.46), 722.772(0.52), 645.819(0.263)                       |
|    | Te | 124 | 4.74(14)     | 6.8(13)                         |   | 1.000    | 280           |  |
|    | Te | 125 | 7.07(15)     | 1.55(16)                        |   | 1.000    | 8             |  |
|    | Te | 126 | 18.84(25)    | 1.0(15)                         |   | 1.000    | 2             |  |
|    | Te | 128 | 31.74(8)     | 0.215(8)                        |   | 1.000    | 23            |  |
|    | Te | 130 | 34.08(62)    | 0.29(6)                         |   | 1.000    | 258           |  |
| 53 | I  | 127 | 100          | 6.2(2)                          |   | 0.999    | 348           | 133.6110(1.42), 442.901(0.595)d, 27.3620(0.43)                     |
| 54 | Xe | 124 | 0.09(1)      | 165(11)                         |   | 1.004    | 4             |  |
|    | Xe | 126 | 0.09(1)      | 3.8(8)                          |   | 1.000    | 0             |  |
|    | Xe | 128 | 1.92(3)      | 5.2(13)                         |   | 0.998    | 7             |  |
|    | Xe | 129 | 26.44(24)    | 21(7)                           |   | 1.001    | 59            | 536.17(1.71)   |
|    | Xe | 130 | 4.08(2)      | 4.8(12)                         |   | 0.998    | 13            |  |
|    | Xe | 131 | 21.18(3)     | 85(10)                          |   | 1.002    | 72            | 667.79(6.7), 772.72(1.78), 630.29(1.41)                            |
|    | Xe | 132 | 26.89(6)     | 0.41(5)                         |   | 1.000    | 0             |  |
|    | Xe | 134 | 10.44(10)    | 0.265(20)                       |   | 0.999    | 0             |  |
|    | Xe | 136 | 8.87(16)     | 0.26(2)                         |   | 1.000    | 113           |  |
| 55 | Cs | 133 | 100          | 30.3(11)                        |   | 1.002    | 384           | 176.4040(2.47), 205.615(1.560), 510.795(1.54)                      |
| 56 | Ba | 130 | 0.106(1)     | 8.7(9)                          |   | 1.000    | 2             |  |
|    | Ba | 132 | 0.101(1)     | 7.0(8)                          |   | 0.979    | 2             |  |
|    | Ba | 134 | 2.417(18)    | 1.5(3)                          |   | 1.000    | 120           |  |
|    | Ba | 135 | 6.592(12)    | 5.8(9)                          |   | 1.000    | 87            | 818.514(0.212), 1261.52(0.095)                                     |
|    | Ba | 136 | 7.854(24)    | 0.68(17)                        |   | 1.000    | 96            | 283.58(0.0404)   |
|    | Ba | 137 | 11.232(24)   | 3.6(2)                          |   | 1.000    | 210           | 1435.77(0.308), 1444.91(0.0801), 462.78(0.0660)                    |
|    | Ba | 138 | 71.698(42)   | 0.40(4)                         |   | 1.000    | 48            | 627.29(0.294), 4095.84(0.155), 454.73(0.0853)                      |
| 57 | La | 138 | 0.090(1)     | 57(6)                           |   | 1.003    | 6             |  |
|    | La | 139 | 99.910(1)    | 9.04(4)                         |   | 0.999    | 308           | 1596.21(5.84)d, 487.021(2.79)d, 815.772(1.430)d                    |
| 58 | Ce | 136 | 0.185(2)     | 6.5(10)                         |   | 0.999    | 65            |  |
|    | Ce | 138 | 0.251(2)     | 1.02(24)                        |   | 0.991    | 9             |  |
|    | Ce | 140 | 88.450(51)   | 0.58(2)                         |   | 0.999    | 29            | 661.99(0.241), 4766.10(0.113), 475.04(0.082)                       |
|    | Ce | 142 | 11.114(51)   | 0.97(2)                         |   | 0.998    | 48            | 1107.66(0.040), 737.43(0.026), 4336.46(0.0251)                     |
| 59 | Pr | 141 | 100          | 11.5(3)                         |   | 0.999    | 213           | 176.8630(1.06), 140.9050(0.479), 1575.6(0.426)d                    |
| 60 | Nd | 142 | 27.2(5)      | 18.7(7)                         |   | 0.998    | 208           | 742.106(3.8)   |
|    | Nd | 143 | 12.2(2)      | 325(10)                         |   | 0.996    | 119           | 696.499(33.3), 618.062(13.4), 814.12(4.98)                         |
|    | Nd | 144 | 23.8(3)      | 3.6(3)                          |   | 1.000    | 16            |  |
|    | Nd | 145 | 8.3(1)       | 42(2)                           |   | 1.000    | 123           |  |
|    | Nd | 146 | 17.2(3)      | 1.41(5)                         |   | 0.999    | 73            |  |
|    | Nd | 148 | 5.7(1)       | 2.58(14)                        |   | 1.000    | 298           |  |
|    | Nd | 150 | 5.6(2)       | 1.03(8)                         |   | 0.999    | 581           |  |
| 62 | Sm | 144 | 3.07(7)      | 1.64(10)                        |   | 0.999    | 0             |  |
|    | Sm | 147 | 14.99(18)    | 57(3)                           |   | 1.001    | 22            |  |
|    | Sm | 148 | 11.24(10)    | 2.4(6)                          |   | 1.000    | 0             |  |
|    | Sm | 149 | 13.82(7)     | 40100(600)                      |   | 1.718    | 161           | 333.97(4790), 439.40(28601), 737.44(597)                           |
|    | Sm | 150 | 7.38(1)      | 100(4)                          |   | 0.998    | 301           |  |
|    | Sm | 152 | 26.75(16)    | 206(6)                          |   | 1.003    | 160           |  |
|    | Sm | 154 | 22.75(29)    | 8.3(5)                          |   | 1.000    | 136           |  |
| 63 | Eu | 151 | 47.81(3)     | 9200(300)                       |   | 0.900    | 200           | 89.847(1430), 841.570(223)d, 77.23(187)                            |
|    | Eu | 153 | 52.19(3)     | 312(7)                          |   | 0.966    | 64            |  |
| 64 | Gd | 152 | 0.20(1)      | 735(20)                         |   | 0.998    | 503           |  |
|    | Gd | 154 | 2.18(3)      | 85(12)                          |   | 1.000    | 329           |  |
|    | Gd | 155 | 14.80(12)    | 60900(500)                      |   | 0.843    | 324           | 199.2130(2020), 88.9670(1380)                                      |
|    | Gd | 156 | 20.47(9)     | 1.8(7)                          |   | 1.001    | 0             |  |
|    | Gd | 157 | 15.65(2)     | 254000(800)                     |   | 0.852    | 390           | 181.931(72003), 79.5100(40101), 944.174(3090)                      |
|    | Gd | 158 | 24.84(7)     | 2.2(2)                          |   | 1.000    | 20            |  |
|    | Gd | 160 | 21.86(19)    | 1.4(3)                          |   | 1.000    | 98            |  |
| 65 | Tb | 159 | 100          | 23.3(4)                         |   | 1.000    | 224           | 75.0500(1.78), 63.6860(1.46), 64.1100(1.2)                         |

\* Decay gamma:  $^{116}\text{In}$ (54.41 m),  $^{122}\text{Sb}$ (2.7238 d),  $^{128}\text{I}$ (24.99 m),  $^{140}\text{La}$ (1.6781 d),  $^{142}\text{Pr}$ (19.12 h),  $^{152}\text{Eu}$ (9.3116 h)

Table I. Isotopic Data, continued

| Z  | El | A   | Abundance(%) | $\sigma_{\gamma}(\text{total})$ | b | g(293°K) | $N_{\gamma}$ | $E_{\gamma}(\sigma_{\gamma})$ for most intense capture gamma rays |
|----|----|-----|--------------|---------------------------------|---|----------|--------------|---|
| 66 | Dy | 156 | 0.06(1)      | 33(3)                           |   | 1.009    | 25           |   |
|    | Dy | 158 | 0.10(1)      | 43(6)                           |   | 0.989    | 0            |   |
|    | Dy | 160 | 2.34(8)      | 55(3)                           |   | 1.009    | 100          |   |
|    | Dy | 161 | 18.91(24)    | 600(25)                         |   | 0.991    | 78           | 185.19(39.1), 882.27(18.3), 80.64(16.5)                           |
|    | Dy | 162 | 25.51(26)    | 194(10)                         |   | 1.005    | 328          |   |
|    | Dy | 163 | 24.90(16)    | 134(7)                          |   | 1.003    | 45           |   |
|    | Dy | 164 | 28.18(37)    | 2650(70)                        |   | 0.988    | 271          | 184.257(146), 538.609(69.2), 496.931(44.9)                        |
| 67 | Ho | 165 | 100          | 64.7(12)                        |   | 1.002    | 550          | 136.6650(14.5), 116.8360(8.1), 80.574(3.87)d                      |
| 68 | Er | 162 | 0.14(1)      | 19(2)                           |   | 1.001    | 1            |   |
|    | Er | 164 | 1.61(3)      | 13(2)                           |   | 1.000    | 0            |   |
|    | Er | 166 | 33.61(35)    | 16.9(16)                        |   | 1.000    | 87           |   |
|    | Er | 167 | 22.93(17)    | 649(8)                          |   | 1.069    | 805          | 184.2850(56), 815.9890(42.5), 198.2440(29.9)                      |
|    | Er | 168 | 26.78(26)    | 2.74(8)                         |   | 1.000    | 102          |   |
|    | Er | 170 | 14.93(27)    | 8.9(3)                          |   | 1.000    | 97           |   |
| 69 | Tm | 169 | 100          | 105(2)                          |   | 1.005    | 302          | 204.4480(8.72), 149.7180(7.11), 144.4800(5.96)                    |
| 70 | Yb | 168 | 0.13(1)      | 2300(170)                       |   | 1.057    | 233          | 191.2140(0.22)  |
|    | Yb | 170 | 3.04(15)     | 9.9(18)                         |   | 1.001    | 23           |   |
|    | Yb | 171 | 14.28(57)    | 58(4)                           |   | 0.999    | 266          | 78.7430(0.67), 181.529(0.53), 1076.246(0.52)                      |
|    | Yb | 172 | 21.83(67)    | 1.3(8)                          |   | 1.000    | 25           |   |
|    | Yb | 173 | 16.13(27)    | 15.5(15)                        |   | 1.001    | 44           | 175.30(0.58), 102.60(0.44), 76.99(0.40)                           |
|    | Yb | 174 | 31.83(92)    | 63.2(15)                        |   | 0.999    | 176          | 514.868(9.0)d, 639.261(1.43), 396.329(1.42)d                      |
|    | Yb | 176 | 12.76(41)    | 2.85(5)                         |   | 1.000    | 129          |   |
| 71 | Lu | 175 | 97.41(2)     | 23.1(14)                        |   | 0.976    | 304          | 71.5170(3.96), 225.4030(1.73), 310.1870(1.49)                     |
|    | Lu | 176 | 2.59(2)      | 2090(70)                        |   | 1.752    | 184          | 150.392(13.8), 457.944(8.3), 138.607(6.79)                        |
| 72 | Hf | 174 | 0.16(1)      | 549(7)                          |   | 0.986    | 23           |   |
|    | Hf | 176 | 5.26(7)      | 24(3)                           |   | 1.002    | 5            |   |
|    | Hf | 177 | 18.60(9)     | 373(10)                         |   | 1.020    | 308          | 213.439(29.3), 93.182(13.3), 325.559(6.69)                        |
|    | Hf | 178 | 27.28(7)     | 137(7)                          |   | 1.003    | 347          | 214.3410(16.3)d, 214.3410(5.7), 303.9880(3.38)                    |
|    | Hf | 179 | 13.629(6)    | 41(3)                           |   | 0.997    | 339          |   |
|    | Hf | 180 | 35.08(16)    | 13.04(7)                        |   | 0.997    | 105          |   |
| 73 | Ta | 180 | 0.012(2)     | 563(60)                         |   | 1.358    | 0            |   |
|    | Ta | 181 | 99.988(2)    | 20.5(5)                         |   | 1.004    | 262          | 270.4030(2.60), 173.2050(1.210), 402.623(1.180)                   |
| 74 | W  | 180 | 0.12(1)      | <150                            |   | 0.997    | 3            |   |
|    | W  | 182 | 26.50(16)    | 19.9(2)                         |   | 1.003    | 131          | 6190.78(0.45), 46.4840(0.192), 5164.43(0.19)                      |
|    | W  | 183 | 14.31(4)     | 10.3(2)                         |   | 0.999    | 211          | 111.216(0.195), 792.059(0.119), 903.274(0.115)                    |
|    | W  | 184 | 30.64(2)     | 1.7(1)                          |   | 0.999    | 75           | 4573.7(0.104)   |
|    | W  | 186 | 28.42(19)    | 38.5(5)                         |   | 1.001    | 225          | 685.73(3.24)d, 479.550(2.59)d, 72.002(1.32)d                      |
| 75 | Re | 185 | 37.40(2)     | 112(2)                          |   | 1.004    | 188          | 59.0100(5.5), 137.157(5.29)d, 214.647(2.53)                       |
|    | Re | 187 | 62.60(2)     | 79.2(10)                        |   | 0.982    | 218          | 63.5820(8.0), 155.041(7.16)d, 207.853(4.44)                       |
| 76 | Os | 184 | 0.02(1)      | 3000(150)                       |   | 1.000    | 72           |   |
|    | Os | 186 | 1.59(3)      | 80(13)                          |   | 0.998    | 38           |   |
|    | Os | 187 | 1.96(2)      | 245(40)                         |   | 0.983    | 174          | 155.10(1.19), 633.14(0.585), 478.04(0.523)                        |
|    | Os | 188 | 13.24(8)     | 4.7(5)                          |   | 1.002    | 163          | 272.82(0.242)   |
|    | Os | 189 | 16.15(5)     | 25(4)                           |   | 1.004    | 147          | 186.7180(2.08), 557.978(0.84), 569.344(0.694)                     |
|    | Os | 190 | 26.26(2)     | 13.1(9)                         |   | 0.997    | 76           | 5146.63(0.409), 527.60(0.300)                                     |
|    | Os | 192 | 40.78(19)    | 3.12(16)                        |   | 1.000    | 95           |   |
| 77 | Ir | 191 | 37.3(2)      | 954(10)                         |   | 0.996    | 286          | 351.689(10.9), 84.2740(7.7), 136.1250(6.5)                        |
|    | Ir | 193 | 62.7(2)      | 111(5)                          |   | 1.017    | 303          | 328.448(9.1)d, 371.5020(2.11), 278.5040(1.8)                      |
| 78 | Pt | 190 | 0.014(1)     | 142(4)                          |   | 0.998    | 0            |   |
|    | Pt | 192 | 0.782(7)     | 10.0(25)                        |   | 1.001    | 0            |   |
|    | Pt | 194 | 32.967(99)   | 0.58(19)                        |   | 1.000    | 64           |   |
|    | Pt | 195 | 33.832(10)   | 28.5(12)                        |   | 1.000    | 235          | 355.6840(6.17), 332.985(2.580)                                    |
|    | Pt | 196 | 25.242(41)   | 0.45(4)                         |   | 1.000    | 36           |   |
|    | Pt | 198 | 7.163(55)    | 3.66(19)                        |   | 1.000    | 44           |   |
| 79 | Au | 197 | 100          | 98.65(9)                        |   | 1.005    | 737          | 411.8020(94.30)d, 214.9710(9.0), 247.5730(5.56)                   |
| 80 | Hg | 196 | 0.15(1)      | 3190(180)                       |   | 0.988    | 10           |   |
|    | Hg | 198 | 9.97(20)     | 2.0(3)                          |   | 1.001    | 3            |   |
|    | Hg | 199 | 16.87(22)    | 2150(50)                        |   | 0.989    | 425          | 367.947(251), 5967.02(62.5), 1693.296(56.2)                       |
|    | Hg | 200 | 23.10(19)    | <60                             |   | 1.000    | 0            |   |
|    | Hg | 201 | 13.18(9)     | 5.7(12)                         |   | 1.000    | 97           |   |
|    | Hg | 202 | 29.86(26)    | 4.42(7)                         |   | 1.000    | 0            |   |
|    | Hg | 204 | 6.87(15)     | 0.43(10)                        |   | 1.000    | 13           |   |
| 81 | Tl | 203 | 29.524(14)   | 11.4(2)                         |   | 1.000    | 113          | 139.94(0.400), 347.96(0.361), 318.88(0.325)                       |
|    | Tl | 205 | 70.476(14)   | 0.104(17)                       |   | 1.000    | 13           |   |
| 82 | Pb | 204 | 1.4(1)       | 0.66(7)                         |   | 1.001    | 35           |   |
|    | Pb | 206 | 24.1(1)      | 0.0266(12)                      |   | 1.001    | 6            |   |
|    | Pb | 207 | 22.1(1)      | 0.63(3)                         |   | 1.001    | 23           | 7367.78(0.137)  |
|    | Pb | 208 | 52.4(1)      | 0.00023(3)                      |   | 1.003    | 0            |   |
| 83 | Bi | 209 | 100          | 0.0338(7)                       |   | 0.999    | 230          | 4171.05(0.0171), 4054.57(0.0137), 319.78(0.0115)                  |
| 90 | Th | 232 | 100          | 7.35(3)                         |   | 0.995    | 196          | 583.27(0.279), 566.63(0.19), 472.30(0.165)                        |
| 92 | U  | 234 | 0.0055(5)    | 99.8(13)                        |   | 0.990    | 49           |   |
|    | U  | 235 | 0.7200(51)   | 98.3(8)                         |   | 0.985    | 8            | 297.00(0.220), 1279.01(0.200), 943.14(0.082)                      |
|    | U  | 238 | 99.274(11)   | 2.680(19)                       |   | 1.002    | 267          | 74.6640(1.30000)d, 106.1230(0.723)d, 277.5990(0.382)d             |

\* Decay gamma:  $^{166}\text{Ho}$ (26.80 h),  $^{175}\text{Yb}$ (4.185 d),  $^{179}\text{Hf}$ (18.67 s),  $^{187}\text{W}$ (23.72 h),  $^{186}\text{Re}$ (3.7183 d),  $^{188}\text{Re}$ (17.005 h),  $^{194}\text{Ir}$ (19.28 h),  $^{198}\text{Au}$ (2.69517 d),  $^{239}\text{U}$ (23.45 m)