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UNITED STATES DEPARTMENT OF COMMERCE
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X-Ray Wavelengths and

X-Ray Atomic Energy Levels

J. A. Bearden

The Johns Hopkins University
Baltimore, Maryland

[Reprinted from
Reviews of Modern Physics
Vol. 31, No. 1, January 1967]

NSRDS–NBS 14
National Standard Reference Data Series-
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Issued September 25, 1967

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Foreword

The National Standard Reference Data System is a government-wide effort to give to the technical community of the United States optimum access to the quantitative data of physical science, critically evaluated and compiled for convenience. This program was established in 1963 by the President's Office of Science and Technology, acting upon the recommendation of the Federal Council for Science and Technology. The National Bureau of Standards has been assigned responsibility for administering the effort. The general objective of the System is to coordinate and integrate existing data evaluation and compilation activities into a systematic, comprehensive program, supplementing and expanding technical coverage when necessary, establishing and maintaining standards for the output of the participating groups, and providing mechanisms for the dissemination of the output as required.

The NSRDS is conducted as a decentralized operation of nation-wide scope with central coordination by NBS. It comprises a complex of data centers and other activities, carried on in government agencies, academic institutions, and nongovernmental laboratories. The independent operational status of existing critical data projects is maintained and encouraged. Data centers that are components of the NSRDS produce compilations of critically evaluated data, critical reviews of the state of quantitative knowledge in specialized areas, and computations of useful functions derived from standard reference data.

For operational purposes, NSRDS compilation activities are organized into seven categories as listed below. The data publications of the NSRDS, which may consist of monographs, loose-leaf sheets, computer tapes, or any other useful product, will be classified as belonging to one or another of these categories. An additional "General" category of NSRDS publications will include reports on detailed classification schemes, lists of compilations considered to be Standard Reference Data, status reports, and similar material. Thus, NSRDS publications will appear in the following eight categories:

Category	*Title*
1	General
2	Nuclear Properties
3	Atomic and Molecular Properties
4	Solid State Properties
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6	Chemical Kinetics
7	Colloid and Surface Properties
8	Mechanical Properties of Materials

The Present compilation is in category 3 of the above list. It constitutes the 14th publication in the new NBS series known as the National Standard Reference Data Series.

A. V. Astin,
Director.

Preface

The publication philosophy of the National Standard Reference Data System recognizes that data compilations will be most useful if all available channels of publishing and disseminating the information are employed. Selection of a specific channel—Government Printing Office, a scientific journal, or a commercial publishing house—is determined by the circumstances for the individual document concerned. The goal is to reach all of the appropriate audience most readily at minimum expense.

The two compilations which follow were first published in "Reviews of Modern Physics." The authors and the editors felt that journal would reach the intended readers, and the Office of Standard Reference Data agreed. However, all concerned underestimated the demand for reprints, and the supply was exhausted soon after publication.

With the generous permission of the editors of "Reviews of Modern Physics," and the approval of the authors, the Office of Standard Reference Data has undertaken to reprint the articles as a part of the National Standard Reference Data System—National Bureau of Standards series.

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X-Ray Wavelengths

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Inconsistencies in accepted values (in x units) of x-ray reference lines have recently been demonstrated, although all are supposedly based on "good" calcite crystals. Factors supporting the selection of the W $K\alpha_1$ line as *the X-Ray Wavelength Standard* are critically discussed. A review is given of the experimental measurements which are used to establish the wavelength of this line on an absolute angstrom basis. Its value is λ W $K\alpha_1 = (0.2090100 \pm 5$ ppm) Å. This may be used to define a new unit, denoted by Å*, such that the W $K\alpha_1$ wavelength is exactly 0.2090100 Å*; hence 1 Å* = 1 Å ± 5 ppm. The wavelengths of the Ag $K\alpha_1$, Mo $K\alpha_1$, Cu $K\alpha_1$, and the Cr $K\alpha_2$ have been established as secondary standards with probable error of approximately one part per million. Sixty-one additional x-ray lines have been used as reference values in a comprehensive review and reevaluation of more than 2700 emission and absorption wavelengths. The recommended wavelength values are listed in Å* units together with probable errors; corresponding energies are given in keV. A second table lists the wavelengths in numerical order, and likewise includes their energies in keV.

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INTRODUCTION

The higher energy emission and absorption x-ray wavelengths provide energy reference standards for nuclear β- and γ-ray spectroscopy. Crystallographic dimensions are usually measured with the Mo $K\alpha_1$, Cu $K\alpha_1$, and other longer x-ray wavelengths. Accurate relative values of the occupied atomic energy levels have been calculated[1] by the use of all the emission x-ray wavelengths of an element, and the absolute scale can be derived from the wavelength of the absorption edge, or more accurately from x-ray emission wavelengths, and electron energy measurements from photoionization experiments.[2]

Wavelength values for more than twenty-seven hundred x-ray emission lines and absorption edges have been measured and remeasured over the last fifty years. Reviewers have published many critical surveys, listing recommended values for x-ray wavelengths. The best known reviews are those of Siegbahn,[3] Cauchois and Hulubei,[4] and Sandström.[5]

A very serious discrepancy exists in each of these tabulations (and all others): The shorter and longer wavelengths are not on the same relative energy scale. In general wavelengths less than 1.0 Å are consistent with a Mo $K\alpha_1 = 707.831$ xu scale, and those of longer wavelength with a Cu $K\alpha_1 = 1537.400$ xu scale. Recent higher precision measurements[6] of the Mo $K\alpha_1$ and Cu $K\alpha_1$ wavelengths, with carefully selected diffraction crystals of various materials shows that the above values are in disagreement by almost 20 parts per million (ppm) or approximately twenty times the previous estimates[7] of the probable error. If we assume the xu defined by the first-order grating constant of calcite ($d_1 = 3029.04$ xu) the new measurements are consistent with a Cu $K\alpha_1$ value of 1537.400 xu. The cause of the apparent errors in the Mo $K\alpha_1$ and other short wavelengths is still unknown.

In addition to the above discrepancy in the relative values of the wavelengths, the xu,[8] which was intended to be 10^{-3} Å, differs from this absolute scale by more than 200 ppm. Early measurements of x-ray wavelengths were made with NaCl crystals whose grating constant $d = 2.814$ Å was calculated[9] from the crystal geometry, molecular weight, density, and Avogadro's number. The latter was evaluated from the Faraday and the oil-drop value of the electronic charge which was in error by more than 600 ppm. Siegbahn[8] noted the superiority of calcite crystals to NaCl for spectro-

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[1] J. A. Bearden and A. F. Burr, Rev. Mod. Phys. **39**, 125 (1967), following article.

[2] S. Hagström, C. Nordling, and K. Siegbahn, *Alpha-, Beta-, Gamma-ray Spectroscopy*, Kai Siegbahn, Ed. (North-Holland Publishing Co., Amsterdam, 1965), Vol. 1, p. 845.

[3] M. Siegbahn, *Spektroskopie der Röntgenstrahlen* (Julius Springer-Verlag, Berlin, 1931), 2nd ed.

[4] Y. Cauchois and H. Hulubei, *Longueurs d'onde des Emissions X et des Discontinuités d'Absorption X* (Hermann et Cie., Paris, 1947).

[5] A. E. Sandström, *Handbuch der Physik*, S. Flügge, Ed. (Springer-Verlag, Berlin, 1957), Vol. 30, p. 164.

[6] J. A. Bearden, A. Henins, J. G. Marzolf, W. C. Sauder, and J. S. Thomsen, Phys. Rev. **135**, 899 (1964).

[7] See Ref. 5, p. 161.

[8] M. Siegbahn and A. Leide, Phil. Mag. **38**, 647 (1919); M. Siegbahn, Arkiv Mat. Astron. Fys. **14**, Nr. 9 (1920).

[9] H. G. S. Moseley, Phil. Mag. **26**, 1024 (1913).

scopic measurements, and therefore determined the ratio of their grating constants. He assumed $d_1 = 2814.00$ xu for NaCl and obtained for calcite $d_1 = 3029.04$ xu, which has been the accepted definition[10] of the xu. Thus the wavelength values in all previous tables are neither self-consistent nor are on an absolute Å scale.

In practice most x-ray wavelengths have been measured relative to convenient lines whose values had been established on an x-unit scale by other experimenters. Beginning in 1960, work in the x-ray laboratory of The Johns Hopkins University was undertaken on a precise remeasurement of the most used reference lines relative to a selected primary standard[11] wavelength, and also on new measurements to establish the selected primary x-ray wavelength standard on an absolute Angstrom scale. A further part of the work was to make a critical review of all x-ray wavelength papers and recalculate the published values on a single absolute scale with explicitly estimated probable errors for all adopted wavelength values. In the complete report[12] on that work, original published values are listed, changes due to reevaluation of reference lines, and weighting with respect to other values is indicated and recommended wavelength values obtained. Since most of the review and analysis on the shorter wavelengths had been completed on a Mo $K\alpha_1 = 707.831$ xu reference scale before the discrepancy between the Mo $K\alpha_1$ and Cu $K\alpha_1$ wavelengths was realized, the working data in the appendices of the above report[12] was continued on a Mo $K\alpha_1 = 707.83$ or its equivalent W $K\alpha_1 = 208.5770$ xu scale. The final recommended wavelength values of that report were readjusted to a W $K\alpha_1 = 0.2090100$ Å* scale. These are the values (except for minor corrected errors and a few new wavelengths) listed in the present review.

A PRIMARY X-RAY WAVELENGTH STANDARD

Inadequacy of the Calcite xu Standard

The x unit of length introduced by Siegbahn[8] contains one serious flaw: it assumes that every good calcite crystal has the same grating constant. This was recognized as a possible limitation by Siegbahn[8] in 1919 and has been under intermittent criticism ever since. Double-crystal[13] spectrometer measurements in 1930 indicated a variation of 6 ppm between different samples of the best crystals then available. A more recent investigation[14] on a wider selection of clear so-called "perfect" calcites gave a variation of approximately 20 ppm. A good calcite used by Merrill and DuMond[15] gave a value of the Mo $K\alpha_1$ 25 ppm greater than the accepted value of 707.831 xu reported by Sandström.[7]

This flaw has been particularly criticized by DuMond,[16] who suggested that an emission line or lines would form a much better basis for defining a unit of length than a species of crystal. He suggested the use of the Mo $K\alpha_1$ line or, alternatively, an average of five x-ray wavelengths. Bergvall[17] also voiced a similar opinion and stated that the Mo $K\alpha_1$ line had indeed become the working standard at Upsala. However, recent measurements[6] have shown that their adopted value for the Mo $K\alpha_1 = 707.831$ xu is in serious disagreement with the calcite $d_1 = 3029.04$ xu definition and also as noted above with the xu value of Cu $K\alpha_1 = 1537.400$. Thus we have two xu standards and a third, the Angstrom used in crystallography. Any attempt to redefine the xu for use as a primary standard would certainly lead to further confusion in the x-ray wavelength and crystallographic literature.

CONSIDERATIONS IN THE SELECTION OF A WAVELENGTH STANDARD

In principle any x-ray line could be chosen and assigned an arbitrary value; for example, Cu $K\alpha_1 = 1.000000$ Cu unit. Then in every calculation of the properties of matter involving knowledge of atomic dimensions, a conversion factor would be required. Since the vast majority of such calculations do not attain an accuracy better than 10 ppm, this procedure appears to be unnecessary, provided, however, an absolute wavelength standard can be defined whose wavelength in centimeters or Angstroms is known within a few ppm. Of course, for the most precise calculations, e.g., atomic constants, a conversion factor differing from unity by a few ppm will be required, and this factor will change slightly as the accuracy of absolute x-ray wavelength measurements is increased.

Wavelength Defined by Peak Intensity of Line

X-ray spectra are recorded by photographic, counter, and ionization techniques. It would appear that the asymmetry of a line would influence the measurement of its wavelengths by these different techniques. However, this was not observed in the measurements[18] made on the K-series elements from titanium to germanium. Increased precision in the measuring techniques may make such effects observable, and hence only highly symmetrical lines have been considered for a wavelength standard.

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[10] M. Siegbahn, Nature **151**, 502 (1943), and Ref. 3, pp. 42–47.
[11] J. A. Bearden, Phys. Rev. **137**, 455 (1965).
[12] J. A. Bearden, *X-Ray Wavelengths*, NYO-10586 (Fed. Sci. and Tech. Inf., U.S. Dept. of Commerce, Springfield, Va., 1964).
[13] J. A. Bearden, Phys. Rev. **38**, 2089 (1931).
[14] J. A. Bearden, Phys. Rev. **137**, 181 (1964).
[15] J. J. Merrill and J. W. M. DuMond, Phys. Rev. **110**, 84 (1958).
[16] J. W. M. DuMond, Proc. Natl. Acad. Sci. (U.S.) **45**, 1052 (1959).
[17] P. Bergvall, O. Hörnfeldt, and C. Nordling, Arkiv Fysik **17**, 113 (1960).
[18] J. A. Bearden and C. H. Shaw, Phys. Rev. **48**, 18 (1935).

For a symmetrical line, it is immaterial whether the wavelength is defined by the peak (obtained by division of chords[19]) or the mean, i.e., centroid. In general the peak position has been accepted as the wavelength criterion for both symmetrical and asymmetrical lines, *and has been so employed in all measurements in the Johns Hopkins x-ray laboratory.* In the designation of a wavelength standard the peak of the line has been recommended as the most precise indicator of its wavelength. It should be noted that the use of a symmetrical line as a standard does not eliminate all problems involving different methods of measurement; a great many lines are themselves asymmetric or have been measured in terms of asymmetric lines.

Selection of a Wavelength Region

In selecting the wavelength to be used as a standard, primary consideration should be given to the researches which require the highest precision and are most affected by errors arising in making the relative measurements. The energy scale for the highly important β- and γ-ray spectrum is very dependent[20] on the use of short x-ray wavelengths. The most precise γ-ray measurements have been those of Knowles,[21] who has measured the ratio of the third-order positron annihilation radiation to the first order of a γ ray of Ta^{182}, and then compared the third order of this radiation relative to the W $K\alpha_1$ line. In this work the angles were measured to the order of 0.01 sec, indicating the precision that can be attained in the measurement of narrow, symmetrical lines where the diffraction angle is only of the order of a few degrees. Another recent problem[22] which required high accuracy in the short-wavelength region was the location of the lead absorption edge for use in the μ-meson mass determination. In x-ray spectroscopy, shorter wavelengths have frequently been used as reference wavelengths[23] for the measurement of weak spectral lines.

It should be emphasized that the designation of a particular wavelength as *the x-ray standard* does not imply that all crystals and spectrometers must be calibrated by direct comparison to this wavelength. Convenient *secondary standards*[6] with probable errors of the order of 1 ppm are available which are adequate for general use. The designated primary wavelength will be of most value in the highly precise researches whose objective is the establishment of new or better secondary standards.

[19] J. A. Bearden, Phys. Rev. **43**, 94 (1933).
[20] J. W. M. DuMond, Ann. Phys. (N.Y.) **2**, 283 (1957); E. L. Chupp, A. F. Clark, J. W. M. DuMond, F. J. Gordon, and H. Mark, Phys. Rev. **107**, 745 (1957).
[21] J. W. Knowles, Can. J. Phys. **40**, 237 (1962). International Conference on Nuclear Physics with Reactor Neutrons (AEC) ANL-6797, F. E. Throw, Ed., p. 165.
[22] A. J. Bearden, Phys. Rev. Letters **4**, 240 (1960).
[23] E. Ingelstam, Nova Acta Reg. Soc. Sci., Upsala **10**, Nr. 5 (1937).

Width and Symmetry Effects

The width of a line ($E/\Delta E$) is of prime importance in the precision with which its wavelength can be measured. Gamma-ray sources, with narrow symmetrical lines (10^{-6}–10^{-10} eV), would make ideal standards if they could be produced at an intrinsic intensity comparable to that available from x-ray tubes. The width of an x-ray line (in wavelength units) is approximately proportional to its wavelength. In recent γ-ray[21] and x-ray[6] measurements, the centers of the observed symmetrical line profiles were located to within 0.001 of the observed width (not, of course the natural width of the γ-ray line). Thus in principle the peak of a narrow [e.g., W $K\alpha_1$ in (2, +5) is 30 sec] short-wavelength line can be located with a higher precision than its angular position can be read on the divided circle. The error in the reading of the divided circle (approximately 0.1 sec) is constant and hence its error in ppm decreases with increased Bragg angle (the precision of the interferometer angle measuring method[24] is 1 ppm for angles from 3° to 30°). Disregarding other considerations, this would suggest that the long-wavelength symmetrical lines (e.g., Cr $K\alpha_2$) would be measured more accurately with a divided circle than the short wavelengths. However, this advantage is offset by errors in large corrections due to index of refraction and anomalous dispersion,[25] the effect of surface treatment on the index of refraction correction,[26] single-crystal diffraction pattern asymmetry,[27] geometrical imperfection of crystals,[28] and the very important shift in wavelength due to the chemical state of the x-ray tube anode. These conclusions are completely substantiated[6] in the precision evaluation of the wavelength ratio of five x-ray lines, W $K\alpha_1$, Ag $K\alpha_1$, Mo $K\alpha_1$, Cu $K\alpha_1$, and Cr $K\alpha_2$, with five selected crystals. A least-squares analysis of the measurements showed that each of the wavelengths had been measured with a probable error of approximately 1 ppm.

Source Requirements

The x-ray wavelength should be independent of chemical and isotope effects in the source. The $K\alpha_1$ lines of the elements of high atomic number are much less affected by chemical combination than those of low Z. Rogosa and Schwarz[29] were unable to observe any shift in the wavelength peak of the Mo $K\alpha_1$ for separated isotopes of Mo^{92}, Mo^{95}, and Mo^{100} greater than 10 ppm. Shortly afterwards Wertheim and Igo[30]

[24] J. G. Marzolf, Rev. Sci. Instr. **35**, 1212 (1964).
[25] See Ref. 5, p. 143.
[26] J. A. Bearden, Bull. Am. Phys. Soc. **7**, 339 (1962).
[27] M. Renninger, Acta Cryst. **13**, 1067 (1960); J. G. Marzolf, S. J., Bull. Am. Phys. Soc. **8**, 313 (1963); also thesis, Dept. of Physics, The Johns Hopkins University, 1963.
[28] J. A. Bearden and A. Henins, Rev. Sci. Instr. **36**, 334 (1965).
[29] G. L. Rogosa and G. Schwarz, Phys. Rev. **92**, 1434 (1953).
[30] M. S. Wertheim and G. Igo, Phys. Rev. **98**, 1 (1955).

Table I. Fe^{57} Mössbauer wavelength in Å* and keV units measured with calcite and quartz crystals.

Date	Crystals	Order	d (Å* 25°C)	Wavelength Å*	keV
12/26/63	Calcite A, B	(1, ±1)	3.035528	0.860239	14.41239
2/24/64	Calcite A, B	(2, ±2)	3.035835	0.860241	14.41235
2/26/64	Calcite A, B	(2, ±2)	3.035835	0.860238	14.41240
8/7/64	Quartz V_a, V_{14}	(1, ±1)	3.336009	0.860223	14.41254
8/11/64	Quartz V_a, V_{14}	(2, ±2)	3.336412	0.860227	14.41259
			Average	0.860234	14.41247

tsudied the problem and showed from theory that the expected shift for Mo $K\alpha_1$ was of the order of 5 ppm, about half the minimum value detectible by Rogosa and Schwarz. The shift for W $K\alpha_1$ should be substantially greater. However, as long as "natural abundances" of the W or Mo isotopes remain constant within 1%, either line should furnish a satisfactory standard.

A high-activity concentrated γ-ray source of dimensions comparable to an x-ray focal spot yields intensities of the order of 10^4 smaller than that emitted by an x-ray tube. The use of a 200-mCi Fe^{57} Mössbauer source as a wavelength standard has been evaluated[31] by measurement of the wavelength of the 14.4-keV Fe^{57} γ ray with calcite and quartz crystals in the (1, ±1) and (2, ±2) orders. The area of the source was approximately 10 mm × 10 mm, positioned such that its projected area was approximately 2 mm × 10 mm. The adjustment of the spectrometer on the low-intensity γ-ray line was much more difficult than in the case of an intense x-ray line. The recorded intensities at peaks ranged from approximately 0.1 counts sec^{-1} to approximately 0.6 counts sec^{-1}, requiring the utmost precaution to reduce the background to less than 0.01 counts sec^{-1}. Two independent alignments of the spectrometer crystals and γ-ray source were made. The results in the (1, ±1) and (2, ±2) with each crystal were in excellent agreement, but the results with the two crystals differed by approximately 20 ppm. Between the two sets of measurements, which were several months apart, the spectrometer, crystals, and source were completely realigned. The results are listed in Table I. Because of the large difference in the two sets of measurements, no probable errors are calculated.

From the experience with these measurements, it could be seen that the source strength would have to be increased by at least a factor of ten or one hundred to make a γ-ray standard experimentally feasible. Imperfections present in most crystals would also require that the source dimensions be even smaller than those used. These experimental considerations eliminate, at least for the present, the use of a γ-ray wavelength standard.

Crystal Considerations

The index of refraction correction for all crystals used in the first diffraction order (most used in previous wavelength measurements) is of the order of 160 ppm. Very few refraction measurements have been made which are of sufficient accuracy to be the basis for precise correction of wavelengths in low orders. Theories[32] are available for calculating the index of refraction, but each leads to a significantly different value. Anomalous dispersion effects[25] may introduce errors of the order of 20 to 30 ppm in the regions of crystal absorption edges. In establishing a primary standard or relating secondary standards to it, refraction effects seriously limit the use of crystals of high atomic number and also wavelengths greater than one or two angstroms.

The index of refraction correction is reduced by the square of the order of diffraction.[33] W $K\alpha_1$ can be easily recorded in the 5th to 7th orders with calcite or silicon crystals; the refraction correction is thus reduced to 3 to 6 ppm. An error of 10% in the measured value of the index then introduces an error in the wavelength of less than one ppm. The short wavelength of the W $K\alpha_1$ permits its use in transmission, and by proper cutting of the crystal with respect to the atomic plane such that the incident and diffracted beams make equal angles with the crystal surfaces, the index of refraction effect is zero.

Asymmetry in the Darwin–Prins[27] single-crystal rocking curve affects the measured x-ray wavelength to a much smaller degree than the index of refraction. Its effect is wavelength-dependent and can be neglected for low atomic weight crystals used at the shorter (e.g., W $K\alpha_1$) wavelengths.

A more serious limitation to the accuracy of x-ray wavelength measurements is due to the large scale

[31] J. A. Bearden, Bull. Am. Phys. Soc. 9, 387 (1964).

[32] H. Kallmann and H. Mark, Ann. Physik **82**, 585 (1927); J. A. Prins, Z. Physik **47**, 479 (1928); H. Honl, Z. Physik **84**, 1 (1933); J. A. Wheeler and J. A. Bearden, Phys. Rev. **46**, 755 (1934).

[33] Reference 5, p. 138.

imperfection[28] of all natural and most synthetic crystals. Large single crystals approaching geometrical perfection are exceedingly rare and, even in the best examples, sharply bounded volumes occur whose planes differ from the average orientation by as much as a second of arc. Since all wavelength measurements, except those made in transmission, require a rotation of the crystal by $(180° \pm 2\theta)$, failure of the x-ray beam to be diffracted from exactly the same crystal volume in both positions may introduce an appreciable error in the wavelength measurement. Grinding and etching a crystal surface parallel to the atomic planes, precise alignment of the crystal parallel to and on the rotation axis of the spectrometer, and the use of a narrowly defined x-ray beam minimize this error. The present availability of good synthetic crystals of silicon alleviates many of these difficulties.

THE W $K\alpha_1$ WAVELENGTH STANDARD

A wavelength standard should possess characteristics which permit its ready redetermination in other laboratories by different techniques. Considering all of the factors involved in the selection of a wavelength standard, the W $K\alpha_1$ line is superior to any other x-ray or γ-ray wavelength. Its advantages as the x-ray wavelength standard are:

(1) In diffraction measurements with W $K\alpha_1$ in transmission, the correction for index of refraction μ is negligible (0 for equal incident and emergent angles). The anomalous dispersion correction is negligible (less than 1 ppm) at this wavelength for either reflection or transmission in crystals of low atomic number.

(2) The W $K\alpha_1$ line is highly symmetrical, and any wavelength dependence on chemical effects or variations in the natural isotopic abundance of tungsten is well below present experimental errors.

(3) The measurement of the diffraction angle for the W $K\alpha_1$ line in transmission is affected by crystal imperfections and asymmetries in the single-crystal diffraction patterns considerably less than for lines of longer wavelengths.

(4) The interferometer method[24] of measuring angles is ideally suited to the transmission method; the requirement of a high-precision divided circle is unnecessary.

(5) The short wavelength of the W $K\alpha_1$ can be used directly to calibrate γ-ray lines if the latter are taken in high orders. Hence nuclear energy level systems can be calibrated.

(6) By secondary standards[6] (already determined) x-ray wavelengths and parameters of individual crystal samples can be placed on a precise scale relative to the W $K\alpha_1$ with probable errors of approximately 1 ppm.

The W $K\alpha_1$ Wavelength

In order to complete the discussion of the W $K\alpha_1$ wavelength standard, use will be made of the result obtained in a following section on the ratio of the absolute wavelength of the Cu $K\alpha_1\alpha_2$ (and to some extent the Cr and Al $K\alpha_1\alpha_2$) lines to their xu value or $\Lambda = \lambda_g/\lambda_s = 1.002056 \times 10^{-3}$. In the section on the inadequacy of the calcite xu standard, it was pointed out that a value of Cu $K\alpha_1 = 1537.400$ xu was consistent with the calcite definition $d_1 = 3029.04$ xu. Hence the absolute wavelength of the Cu $K\alpha_1$ is

$$\text{Cu } K\alpha_1 = 1.540562 \text{ Å} \pm 5 \text{ ppm.}$$

The precision (five crystals) measurement[6] of the ratio of the Cu $K\alpha_1$ wavelength to the W $K\alpha_1$ gave 7.370757 ± 1.2 ppm. Dividing the Cu $K\alpha_1$ wavelength by this factor yields the wavelength in angstroms of the W $K\alpha_1$ line or

$$\lambda\text{W } K\alpha_1 = 0.2090100 \text{ Å} \pm 5 \text{ ppm.}$$

This numerical value of the wavelength of the W $K\alpha_1$ line is used to define the *x-ray wavelength standard* by the relation

$$\lambda(\text{W } K\alpha_1) = 0.2090100 \text{ Å*}.$$

This is a new unit of length which may differ from the angstrom by ±5 ppm (probable error), *but as a wavelength standard it has no error*. In order to clearly indicate that this unit is not exactly an angstrom, it has been designated Å*[11] and has been used for all wavelength values appearing in this review. When higher accuracy is attained in the absolute measurement of the W $K\alpha_1$ line, a conversion factor slightly different from unity will then be required for the extremely precise calculations, for example in atomic constants.

SECONDARY STANDARDS

Secondary standards of wavelength are desirable to provide suitable reference lines for various portions of the x-ray spectrum. The recent study by Bearden *et al.*[6] was designed to establish a group of such standards to the highest precision presently attainable. This investigation consisted of a long series of high precision measurements using a spectrometer with a graduated circle calibrated by means of an angular interferometer.[24] The lines studied were: Cr $K\alpha_2$, Cu $K\alpha_1$, Mo $K\alpha_1$, Ag $K\alpha_1$, and W $K\alpha_1$. Five different crystals (one calcite, two quartz, two silicon) were used, some in all wavelength measurements, giving a

TABLE II. Secondary standards.

Primary standard λ W $K\alpha_1$ = 0.2090100 Å*
λ Ag $K\alpha_1$ = (0.5594075±1.1 or 5.2 ppm) Å*
λ Mo $K\alpha_1$ = (0.709300±1.3 or 5.2 ppm) Å*
λ Cu $K\alpha_1$ = (1.540562±1.3 or 5.2 ppm) Å*
λ Cr $K\alpha_2$ = (2.293606±1.3 or 5.2 ppm) Å*

TABLE III. New experimental values of emission lines in Å* units. The probable error is that of the last digit. The α_1 of 47 Ag is a secondary standard.

		44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb
α_2	KL_{II}	0.647404±4	0.617630±4	0.589820±4	0.563799±3	0.539422±3	0.516544±4	0.495052±3	0.474827±3
α_1	KL_{III}	0.643083±4	0.613278±4	0.585449±4	0.5594075	0.535001±3	0.512112±4	0.490599±3	0.470358±3
β_3	KM_{II}	0.573067±4	0.546200±4	0.521123±4	0.497685±4	0.574728±7	0.455185±4	0.435871±5	0.417737±4
β_1	KM_{III}	0.572482±4	0.545605±4	0.520520±4	0.497069±4	0.574106±7	0.454550±4	0.435231±5	0.417086±3
β_5	$KM_{IV,V}$				0.49306±2				
β_2	$KN_{II,III}$		0.53503±2	0.510228±4	0.487032±4	0.465319±7			
β_1	$L_{II}M_{IV}$	4.62058±3	4.37414±4	4.14622±5	3.93473±3	3.73823±4	3.55530±4		3.22567±4
γ_1	$L_{II}N_{IV}$				3.52260±4		3.16213±4		2.85159±3
α_1	$L_{III}M_V$	4.84575±3		4.36767±5	4.15443±3	3.95635±4	3.77192±4	3.59994±3	3.43940±4
$\beta_{2,15}$	$L_{III}N_{IV,V}$			3.90887±4	3.70335±3	3.51408±4	3.33838±3	3.17505±3	3.02335±3

total of twenty different combinations, each one yielding a value of λ/d. There then resulted twenty equations for nine unknown quantities (four wavelengths and five grating constants). This system of overdetermined linear equations was solved by a least-squares adjustment on an IBM 7094 computer.

The resulting wavelength values are given in Table II. Two probable errors in ppm are given; the first is relative to the W $K\alpha_1$ as *the primary standard*, and the second takes into account the probable error of ±5 ppm in the conversion factor Λ and hence is the probable error of the wavelength in absolute angstroms. These probable errors are borne out by the internal consistency of the data in a χ^2 test.

Additional Reference Standards

It was pointed out in the Introduction that most x-ray wavelengths have been measured relative to a few conveniently located lines whose values had been determined directly. About sixty of these lines have been remeasured in order to be able to reevaluate the published values on a consistent wavelength scale. These new values are the basis on which many wavelengths have been recomputed and hence are listed for convenience in Table III.

The instrumentation and method of measurement were basically the same as in the determination of reference wavelengths.[6] Naturally less time and effort were devoted to each individual wavelength. In most cases only one crystal was used for each line and only one or two "runs" were taken. Each run consisted of about six curves taken alternately in the $(m+n)$ and $(m-n)$ positions of the double-crystal spectrometer.

The K-series measurements were carried out with the same calcite crystal used in the previous study[6]; its grating constant was known to about 1 ppm from the least-squares computation. In the L-series work a helium atmosphere was used to minimize absorption; physical limitations of the apparatus then dictated the use of two smaller calcite crystals. These were calibrated against reference wavelengths and grating constants of standard crystals determined in the least-squares evaluation. The resulting grating constants for the small calcite crystals involved probable errors of about 5 ppm.

Probable errors of the measurements in the K series were determined by the statistical fluctuation of the data and by the average systematic error associated with a single series of runs; the latter was estimated as about 4 ppm. In most cases the resulting wavelength errors ranged from 6 to 8 ppm. Errors in the L-series determinations were slightly greater, due to higher statistical fluctuations and less accurately known grating constants. For the most part probable errors ranged from 8 to 10 ppm.

In many instances, these values were considered sufficiently superior to all previous measurements to be adopted without change. However, there were also numerous instances in which these results were averaged with other high-precision data to obtain a "recommended" value.

X-RAY WAVELENGTH CONVERSION FACTOR $\Lambda(\lambda_g/\lambda_s)$

Two methods have been used for determining the x-ray wavelength conversion factor: (a) the absolute wavelengths of x-ray lines have been measured with a ruled grating and divided by their known value in x units; and (b) it has also been determined by computing the absolute grating constant of crystals from their density, molecular weight, and Avogadro's number.

Two ruled-grating measurements have been made with an accuracy sufficient to be used in a precision evaluation of the conversion factor: the early measurements[34] on the α and β lines of Cu and Cr, and the remeasurement of the Al $K\alpha$ plates of Tyren by Edlen and Svensson.[35] The value of the Al $K\alpha$ line in xu was

[34] J. A. Bearden, Phys. Rev. **37**, 1210 (1931).
[35] B. Edlen and L. A. Svensson, Arkiv Fysik **28**, 427 (1965).

taken from the work of Nordfors,[36] who used the L lines of Ag as references. The Ag L series was, in turn measured by Haglund[37] with respect to the Cu $K\alpha_1$. The resulting values of Λ are shown in Table III.

Unless there is a serious error (greater than 50 ppm) in Avogadro's number as listed in a recent analysis of atomic constants,[38] the measurement of crystal properties affords the most accurate method of evaluating the conversion factor. There is some question as to the constancy of isotopic abundances in nature[39] which needs further study. Precision density and x-ray measurements[40] have been made on eighteen high-purity silicon crystals obtained from various sources. The results were highly consistent, and a careful analysis of the errors in atomic weight, isotopic abundance, density, and Avogadro's number gave a final probable error of less than 5 ppm. In another experiment[41] nine selected calcite crystals were used and corrections made for the known chemical impurities in each crystal. The results were in excellent agreement with the silicon values, giving some indication that the isotopic abundance question may not be serious. Smakula *et al.*[42] have measured the density of seven crystals, Al, CaF_2, CsI, Ge, TlCl, TlBr, and Si. Powdered samples of these were then used to measure the diffraction angles for Cu $K\alpha_1$ x rays and hence to determine Λ. Several older and less accurate measurements[43] have been made with Mo $K\alpha_1$ radiation and are included with the other values in Table IV.

The high-frequency limit of the continuous x-ray spectrum $Ve=h\nu$ may be rewritten

$$\Lambda=(h/e)c^2/V\lambda_s \text{ Å-kxu}^{-1},$$

where Λ is the conversion factor, h/e the ratio of Planck's constant to the electronic charge, c the velocity of light, V the x-ray tube voltage, and λ_s the wavelength of the limit in xu. $V\lambda_s$ has been measured[44] using a mercury gas target x-ray tube in order to avoid solid state fine structure at the high-frequency limit. The resulting value of Λ is lower than any of the others in Table IV but there is no reason for rejecting this value or increasing its probable error.

The final recommended value from Table IV (based on Cu $K\alpha_1=1537.400$ xu) is

$$\Lambda=(1.002056\pm0.000005) \text{ Å-kxu}^{-1}.$$

RECOMPUTATION OF X-RAY WAVELENGTHS

Literature Data

In addition to the comparatively few measurements described above, a vast amount of other x-ray wavelength data covering a period of over forty years has been reconsidered. Most of the measurements have employed one of five experimental methods[45]—the single-crystal spectrometer, the tube spectrometer, the double-crystal spectrometer, the curved-crystal spectrometer, and the ruled grating (primarily in the soft x-ray region). In general, the double-crystal and tube-spectrometer results are considered more accurate, along with a few of the curved-crystal measurements.

If one measurement seemed clearly superior to all others by a significant margin, it was adopted without change. When two or more values of comparable accuracy were available, an average was taken. Such an average can be computed on a rigorous basis in comparatively few cases. This really requires a thorough

TABLE IV. Values of Λ based on Cu $K\alpha_1=1.537400$ kxu. The mean value was calculated with statistical weighting and the p.e. 4 is by internal consistency.

Experiment	Λ	p.e. (ppm)
Crystal constants		
Henins[a] (Si)	1.002057	5
Bearden[b] ($CaCO_3$)	1.002055	9
Smakula[c] (Al, Si, Ge, CaF_2, CsI, TlCl, and TlBr)	1.00207	15
Various[a] Mo $K\alpha_1\lambda$		
($CaCO_3$, Qz, C)	1.00205	20
Ruled grating		
Bearden[d]—plain	1.00203	30
Edlen[e]-Tyren—concave	1.002060	20
"h/e exptl."		
Spijkerman[f]	1.00201	26
Mean	1.002056	4

Note: Atomic constants needed in calculation of the above values of Λ are taken from E. R. Cohen and J. W. M. DuMond, Rev. Mod. Phys. **37**, 537 (1965).
[a] I. Henins and J. A. Bearden, Phys. Rev. **135**, 890 (1964).
[b] J. A. Bearden, Phys. Rev. **137**, 181 (1965).
[c] A. Smakula and J. Kalnajs, Nuovo Cimento Suppl. **6**, 214 (1957); Phys. Rev **99**, 1737 (1955); A. Smakula and V. Sils, Phys. Rev. **99**, 1744 (1955); A. Smakula, J. Kalnajs, and V. Sils, Phys. Rev. **99**, 1747 (1955); see also Ref. a.
[d] J. A. Bearden, Phys. Rev. **37**, 1210 (1931).
[e] B. Edlen and L. A. Svensson, Arkiv Fysik **28**, 427 (1965).
[f] J. J. Spijkerman and J. A. Bearden, Phys. Rev. **134**, A871 (1964).

[36] B. Nordfors, Arkiv Fysik **10**, 279 (1956).
[37] Ph. Haglund, Z. Physik **94**, 369 (1935).
[38] E. R. Cohen and J. W. M. DuMond, Rev. Mod. Phys. **37**, 590 (1965).
[39] R. J. Allenby, Geochim. Cosmochim. Acta **5**, 40 (1954); K. Rankama, *Isotope Geology* (McGraw-Hill Book Co., Inc., New York, 1954), p. 272.
[40] I. Henins and J. A. Bearden, Phys. Rev. **135**, 890 (1964); and I. Henins, J. Res. Natl. Bur. Std. (U.S.) **68**, 529 (1964).
[41] J. A. Bearden, Phys. Rev. **137**, 181 (1965).
[42] A. Smakula and J. Kalnajs, Nuovo Cimento Suppl. **6**, 214 (1957). Phys. Rev. **99**, 1737 (1955); A. Smakula and V. Sils, Phys. Rev. **99**, 1744 (1955); A. Smakula, J. Kalnajs, and V. Sils, Phys. Rev. **99**, 1747 (1955).
[43] See Ref. 40, p. 897.
[44] J. J. Spijkerman and J. A. Bearden, Phys. Rev. **134**, 871 (1964).
[45] See Ref. 5, pp. 94 to 129.

discussion of both systematic and statistical errors (the latter preferably supported by detailed data on individual runs) by each of the workers involved. In addition, it is desirable to have several measurements, say four or more, so that the external consistency of the data is subject to a meaningful check; it is particularly helpful if the workers involved have all measured a whole series of lines rather than an isolated one. In such instances, one can form a weighted average with reasonable confidence. In the case of spin doublets, a check of the consistency of the doublet wavelength separation was helpful in estimating the accuracy of the measurements.

However, for the majority of measurements, the available information is less than complete. There are often just two precision measurements, both with inadequate error discussion or with error estimates which are clearly overly optimistic. In such cases one has to combine intelligent guesswork and indirect evidence. The latter may include error estimates obtained from comparison with other lines measured by a given worker in the same report, or simply from those errors normally encountered with the same general design of instrument.

Two other types of indirect evidence have been used in many instances. One is energy-level data, which give a measure of the same energy difference by an indirect series of transitions between the two levels involved. This procedure rests on a rigorous basis, although the indirect values are often less precise than the direct ones. The second method is based on the familiar Moseley diagram. Reasonably adequate data are usually available to use this approach profitably.

In a few instances directly measured values have been rejected entirely, and interpolated values, based on the same line for neighboring elements, have been adopted. Interpolated values are also given for some cases where no direct measurements have been reported.

Conventions

Wavelengths tabulated normally refer to the pure element in its solid form. However, there are many instances in which such data are not available. For example, rare gases are of necessity almost always used in the gaseous form, while the rare-earth elements were customarily used in the form of salts. In many instances the data are sufficiently crude or the particular lines are so insensitive to chemical effects that the distinction becomes of no practical importance.

In high precision work there is some ambiguity as to exactly what feature of a line profile should be taken to be the "true wavelength." In double-crystal work the line peak is usually employed. In crystallography the centroid is widely used; in photographic work with visual observation of the plates, there is involved some subjective criterion of the observer which it is difficult to define precisely. In this survey the peak of the line profile has been adopted as the standard criterion. This is one reason for giving preference to double-crystal values in most cases. Of course for the majority of lines the data are not sufficiently precise and well-defined to make the distinction between the various criteria at all meaningful.

The above criterion has been followed as consistently as possible even in the case of rather broad emission bands. In cases where the peak value could not be established with any degree of certainty, a value near the center of the band has been chosen and assigned a rather large probable error. In such cases the peak is usually not the best-defined feature of the band. The short-wavelength limit is often much sharper and more reproducible. In such cases the original experimental paper should be consulted to obtain a better-detailed picture of the band structure.

Errors

Previously published x-ray wavelength tables have usually not included any error estimates, except as these were implied by the number of significant figures stated. However, in order to give the maximum information on any experimentally determined quantity, it should be accompanied by a statement of estimated error. Hence it has been decided to list a probable error with each emission line in the accompanying tables.

The error criterion used is that of *probable error*. This term must emphatically not be misinterpreted as a limit of error. It is merely a rather crude estimate such that, in the judgment of the author, roughly half the true wavelength values lie within the assigned errors. In most cases there is no implication of a Gaussian error distribution. In particular, the probability of large deviations may be substantially greater than implied by Gaussian distributions; for example, it is likely that the chance of a discrepancy exceeding five probable errors is substantially greater than one in a thousand. As mentioned in the preceding section, there are a few instances in which experimental errors are fully discussed in the papers involved and in which there are a sufficient number of measurements by different workers to obtain a good check by external consistency. In such cases a probable error can be assigned on a reasonably rigorous basis. The greater majority of cases fall short of this ideal. However, it was considered more desirable to estimate probable errors and risk some serious mistakes in judgment than to omit this important information entirely.

WAVELENGTH TABLES V AND VI

In Table V all the emission lines of an element are listed under the element heading. The line and level designation are shown in the first column. The wavelengths in the second column are in Å* units (i.e., relative to the primary x-ray wavelength standard

TABLE V. X-ray wavelengths in Å* units and in keV. The probable error (p.e.) is the error in the last digit of wavelength. Designation indicates both conventional Siegbahn notation (if applicable) and transition, e.g., $\beta_1\ L_{II}M_{IV}$ denotes a transition between the L_{II} and M_{IV} levels, which is the $L\beta_1$ line in Siegbahn notation.

Designation	Å*	p.e.	keV	Å*	p.e.	keV
	3 Lithium			**4 Beryllium**		
$\alpha\ KL$	228.	1	0.0543	114.	1	0.1085
	5 Boron			**6 Carbon**		
$\alpha\ KL$	67.6	3	0.1833	44.7	3	0.277
	7 Nitrogen			**8 Oxygen**		
$\alpha\ KL$	31.6	4	0.3924	23.62	3	0.5249
	9 Fluorine			**10 Neon**		
$\alpha_{1,2}\ KL_{II,III}$	18.32	2	0.6768	14.610	3	0.8486
$\beta\ KM$				14.452	5	0.8579
	11 Sodium			**12 Magnesium**		
$\alpha_{1,2}\ KL_{II,III}$	11.9101	9	1.0410	9.8900	2	1.25360
$\beta\ KM$	11.575	2	1.0711	9.521	2	1.3022
$L_{II,III}M$	407.1	5	0.03045	251.5	5	0.0493
$L_IL_{II,III}$	376	1	0.0330	317	1	0.0392
	13 Aluminum			**14 Silicon**		
$\alpha_2\ KL_{II}$	8.34173	9	1.48627	7.12791	9	1.73938
$\alpha_1\ KL_{III}$	8.33934	9	1.48670	7.12542	9	1.73998
$\beta\ KM$	7.960	2	1.5574	6.753	1	1.8359
$L_{II,III}$	171.4	5	0.0724	135.5	4	0.0915
$L_IL_{II,III}$	290.	1	0.0428			
	15 Phosphorus			**16 Sulfur**		
$\alpha_2\ KL_{II}$	6.160†	1	2.0127	5.37496	8	2.30664
$\alpha_1\ KL_{III}$	6.157†	1	2.0137	5.37216	7	2.30784
$\beta\ KM$	5.796	2	2.1390			
$\beta_1\ KM$				5.0316	2	2.4640
$\beta_z\ KM$				5.0233	3	2.4681
$L_{II,III}M$	103.8	4	0.1194			
$l,\eta\ L_{II,III}M_I$				83.4	3	0.1487
	17 Chlorine			**18 Argon**		
$\alpha_2\ KL_{II}$	4.7307	1	2.62078	4.19474	5	2.95563
$\alpha_1\ KL_{III}$	4.7278	1	2.62239	4.19180	5	2.95770
$\beta\ KM$	4.4034	3	2.8156			
$\beta_{1,3}\ KM_{II,III}$				3.8860	2	3.1905
$\eta\ L_{II}M_I$	67.33	9	0.1841	55.9†	1	0.2217
$l\ L_{III}M_I$	67.90	9	0.1826	56.3†	1	0.2201
	19 Potassium			**20 Calcium**		
$\alpha_2\ KL_{II}$	3.7445	2	3.3111	3.36166	3	3.68809
$\alpha_1\ KL_{III}$	3.7414	2	3.3138	3.35839	3	3.69168
$\beta_{1,3}\ KM_{II,III}$	3.4539	2	3.5896	3.0897	2	4.0127
$\beta_5\ KM_{IV,V}$	3.4413	4	3.6027	3.0746	3	4.0325

Designation	Å*	p.e.	keV	Å*	p.e.	keV
	19 Potassium (*Cont.*)			**20 Calcium** (*Cont.*)		
$\eta\ L_{II}M_I$	47.24	2	0.2625	40.46	2	0.3064
β_1				35.94	2	0.3449
$l\ L_{III}M_I$	47.74	1	0.25971	40.96	2	0.3027
$\alpha_{1,2}\ L_{III}M_{IV,V}$				36.33	2	0.3413
$M_{II,III}N_I$	692	9	0.0179	525.	9	0.0236
	21 Scandium			**22 Titanium**		
$\alpha_2\ KL_{II}$	3.0342	1	4.0861	2.75216	2	4.50486
$\alpha_1\ KL_{III}$	3.0309†	1	4.0906	2.74851	2	4.51084
$\beta_{1,3}\ KM_{II,III}$	2.7796	2	4.4605	2.51391	2	4.93181
$\beta_5\ KM_{IV,V}$	2.7634	3	4.4865	2.4985	2	4.9623
$\eta\ L_{II}M_I$	35.13	2	0.3529	30.89	3	0.4013
$\beta_1\ L_{II}M_{IV}$	31.02	2	0.3996	27.05	2	0.4584
$l\ L_{III}M_I$	35.59	3	0.3483	31.36	2	0.3953
$\alpha_{1,2}\ L_{III}M_{IV,V}$	31.35	3	0.3954	27.42	2	0.4522
	23 Vanadium			**24 Chromium**		
$\alpha_2\ KL_{II}$	2.50738	2	4.94464	2.293606	3	5.40551
$\alpha_1\ KL_{III}$	2.50356	2	4.95220	2.28970	2	5.41472
$\beta_{1,3}\ KM_{II,III}$	2.28440	2	5.42729	2.08487	2	5.94671
$\beta_5\ KM_{IV,V}$	2.26951	6	5.4629	2.07087	6	5.9869
$\beta_{3,4}\ L_IM_{II,III}$	21.19†	9	0.585	18.96	2	0.654
$\eta\ L_{II}M_I$	27.34	3	0.4535	24.30	3	0.5102
$\beta_1\ L_{II}M_{IV}$	23.88	4	0.5192	21.27	1	0.5828
$l\ L_{III}M_I$	27.77	1	0.4465	24.78	1	0.5003
$\alpha_{1,2}\ L_{III}M_{IV,V}$	24.25	3	0.5113	21.64	3	0.5728
$M_{II,III}M_{IV,V}$	337.	9	0.037	309.	9	0.040
	25 Manganese			**26 Iron**		
$\alpha_2\ KL_{II}$	2.10578	2	5.88765	1.939980	9	6.39084
$\alpha_1\ KL_{III}$	2.101820	9	5.89875	1.936042	9	6.40384
$\beta_{1,3}\ KM_{II,III}$	1.91021	2	6.49045	1.75661	2	7.05798
$\beta_5\ KM_{IV,V}$	1.8971	1	6.5352	1.7442	1	7.1081
$\beta_{3,4}\ L_IM_{II,III}$	17.19	2	0.721	15.65	2	0.792
$\eta\ L_{II}M_I$	21.85	2	0.5675	19.75	4	0.628
$\beta_1\ L_{II}M_{IV}$	19.11	2	0.6488	17.26	1	0.7185
$l\ L_{III}M_I$	22.29	1	0.5563	20.15	1	0.6152
$\alpha_{1,2}\ L_{III}M_{IV,V}$	19.45	1	0.6374	17.59	2	0.7050
$M_{II,III}M_{IV,V}$	273.	6	0.045	243.	5	0.051
	27 Cobalt			**28 Nickel**		
$\alpha_2\ KL_{II}$	1.792850	9	6.91530	1.661747	8	7.46089
$\alpha_1\ KL_{III}$	1.788965	9	6.93032	1.657910	8	7.47815
$\beta_{1,3}\ KM_{II,III}$	1.62079	2	7.64943	1.500135	8	8.26466
$\beta_5\ KM_{IV,V}$	1.60891	3	7.7059	1.48862	4	8.3286
$\beta_{3,4}\ L_IM_{II,III}$	14.31	3	0.870	13.18	1	0.941
$\eta\ L_{II}M_I$	17.87	3	0.694	16.27	3	0.762
$\beta_1\ L_{II}M_{IV}$	15.666	8	0.7914	14.271	6	0.8688
$l\ L_{III}M_I$	18.292	8	0.6778	16.693	9	0.7427
$\alpha_{1,2}\ L_{III}M_{IV,V}$	15.972	6	0.7762	14.561	3	0.8515
$M_{II,III}M_{IV,V}$	214.	6	0.058	190.	2	0.0651

Designation	Å*	p.e.	keV	Å*	p.e.	keV
	29 Copper			**30 Zinc**		
$\alpha_2\ KL_{II}$	1.544390	2	8.02783	1.439000	8	8.61578
$\alpha_1\ KL_{III}$	1.540562	2	8.04778	1.435155	7	8.63886
$\beta_3\ KM_{II}$	1.3926	1	8.9029			
$\beta_{1,3}\ KM_{II,III}$	1.392218	9	8.90529	1.29525	2	9.5720
$\beta_2\ KN_{II,III}$				1.28372	2	9.6580
$\beta_5\ KM_{IV,V}$	1.38109	3	8.9770	1.2848	1	9.6501
$\beta_{3,4}\ L_IM_{II,III}$	12.122	8	1.0228	11.200	7	1.1070
$\eta\ L_{II}M_I$	14.90	2	0.832	13.68	2	0.906
$\beta_1\ L_{II}M_{IV}$	13.053	3	0.9498	11.983	3	1.0347
$l\ L_{III}M_I$	15.286	9	0.8111	14.02	2	0.884
$\alpha_{1,2}\ L_{III}M_{IV,V}$	13.336	3	0.9297	12.254	3	1.0117
$M_{II,III}M_{IV,V}$	173.	3	0.072	157.	3	0.079
	31 Gallium			**32 Germanium**		
$\alpha_2\ KL_{II}$	1.34399	1	9.22482	1.258011	9	9.85532
$\alpha_1\ KL_{III}$	1.340083	9	9.25174	1.254054	9	9.88642
$\beta_3\ KM_{II}$	1.20835	5	10.2603	1.12936	9	10.9780
$\beta_1\ KM_{III}$	1.20789	2	10.2642	1.12894	2	10.9821
$\beta_2\ KN_{II,III}$	1.19600	2	10.3663	1.11686	2	11.1008
$\beta_5\ KM_{IV,V}$	1.1981	2	10.348	1.1195	1	11.0745
$\beta_4\ L_IM_{II}$				9.640	2	1.2861
$\beta_3\ L_IM_{III}$				9.581	2	1.2941
$\beta_{3,4}\ L_IM_{II,III}$	10.359†	8	1.197			
$\eta\ L_{II}M_I$	12.597	2	0.9842	11.609	2	1.0680
$\beta_1\ L_{II}M_{IV}$	11.023	2	1.1248	10.175	1	1.2185
$l\ L_{III}M_I$	12.953	2	0.9572	11.965	4	1.0362
$\alpha_{1,2}\ L_{III}M_{IV,V}$	11.292	1	1.09792	10.4361	8	1.18800
	33 Arsenic			**34 Selenium**		
$\alpha_2\ KL_{II}$	1.17987	1	10.50799	1.10882	2	11.1814
$\alpha_1\ KL_{III}$	1.17588	1	10.54372	1.10477	2	11.2224
$\beta_3\ KM_{II}$	1.05783	5	11.7203	0.99268	5	12.4896
$\beta_1\ KM_{III}$	1.05730	2	11.7262	0.99218	3	12.4959
$\beta_2\ KN_{II,III}$	1.04500	3	11.8642	0.97992	5	12.6522
$\beta_5\ KM_{IV,V}$	1.0488	1	11.822	0.9843	1	12.595
$\beta_{3,4}\ L_IM_{II,III}$	8.929	1	1.3884	8.321†	9	1.490
$\eta\ L_{II}M_I$	10.734	1	1.1550	9.962	1	1.2446
$\beta_1\ L_{II}M_{IV}$	9.4141	8	1.3170	8.7358	5	1.41923
$l\ L_{III}M_I$	11.072	1	1.1198	10.294	1	1.2044
$\alpha_{1,2}\ L_{III}M_{IV,V}$	9.6709	8	1.2820	8.9900	5	1.37910
M_VN_{III}				230.	2	0.0538
	35 Bromine			**36 Krypton**		
$\alpha_2\ KL_{II}$	1.04382	2	11.8776	0.9841	1	12.598
$\alpha_1\ KL_{III}$	1.03974	2	11.9242	0.9801	1	12.649
$\beta_3\ KM_{II}$	0.93327	5	13.2845	0.8790	1	14.104
$\beta_1\ KM_{III}$	0.93279	2	13.2914	0.8785	1	14.112
$\beta_2\ KN_{II,III}$	0.92046	2	13.4695	0.8661	1	14.315
$\beta_5\ KM_{IV,V}$	0.9255	1	13.396	0.8708	2	14.238
$\beta_4\ KN_{IV,V}$				0.8653	2	14.328
$\beta_4\ L_IM_{II}$				7.304	5	1.697
$\beta_3\ L_IM_{III}$				7.264	5	1.707

Designation	Å*	p.e.	keV	Å*	p.e.	keV
	35 Bromine (*Cont.*)			**36 Krypton** (*Cont.*)		
$\beta_{3,4}\ L_IM_{II,III}$	7.767†	9	1.596			
$\eta\ L_{II}M_I$	9.255	1	1.3396			
$\beta_1\ L_{II}M_{IV}$	8.1251	5	1.52590	7.576†	3	1.6366
γ_5				7.279	5	1.703
$l\ L_{III}M_I$	9.585	1	1.2935			
$\alpha_{1,2}\ L_{III}M_{IV,V}$	8.3746	5	1.48043	7.817†	3	1.5860
β_6				7.510	4	1.6510
$L_{II}N_{III}$				7.250	5	1.710
M_IM_{II}	184.6	3	0.0672			
M_IM_{III}	164.7	3	0.0753			
$M_{II}M_{IV}$	109.4	3	0.1133			
$M_{II}N_I$	76.9	2	0.1613			
$M_{III}M_{IV,V}$	113.8	3	0.1089			
	79.8	3	0.1554			
$\zeta_2\ M_{IV}N_{II}$	191.1	2	0.06488			
$M_{IV}N_{III}$	189.5	3	0.0654			
$\zeta_1\ M_VN_{III}$	192.6	2	0.06437			
	37 Rubidium			**38 Strontium**		
$\alpha_2\ KL_{II}$	0.92969	1	13.3358	0.87943	1	14.0979
$\alpha_1\ KL_{III}$	0.925553	9	13.3953	0.87526	1	14.1650
$\beta_3\ KM_{II}$	0.82921	3	14.9517	0.78345	3	15.8249
$\beta_1\ KM_{III}$	0.82868	2	14.9613	0.78292	2	15.8357
$\beta_2\ KN_{II,III}$	0.81645	3	15.1854	0.77081	3	16.0846
$\beta_5\ KM_{IV,V}$	0.8219	1	15.085	0.7764	1	15.969
$\beta_4\ KN_{IV,V}$	0.8154	2	15.205	0.76989	5	16.104
$\beta_4\ L_IM_{II}$	6.8207	3	1.81771	6.4026	3	1.93643
$\beta_3\ L_IM_{III}$	6.7876	3	1.82659	6.3672	3	1.94719
$\gamma_{2,3}\ L_IN_{II,III}$	6.0458	3	2.0507	5.6445	3	2.1965
$\eta\ L_{II}M_I$	8.0415	4	1.54177	7.5171	3	1.64933
$\beta_1\ L_{II}M_{IV}$	7.0759	3	1.75217	6.6239	3	1.87172
$\gamma_5\ L_{II}N_{IV}$	6.7553	3	1.83532	6.2961	3	1.96916
$l\ L_{III}M_I$	8.3636	4	1.48238	7.8362	3	1.58215
$\alpha_2\ L_{III}M_{IV}$	7.3251	3	1.69256	6.8697	3	1.80474
$\alpha_1\ L_{III}M_V$	7.3183	2	1.69413	6.8628	2	1.80656
$\beta_6\ L_{III}N_I$	6.9842	3	1.77517	6.5191	3	1.90181
M_IM_{III}	144.4	3	0.0859			
$M_{II}M_{IV}$	91.5	2	0.1355	85.7	2	0.1447
$M_{II}N_I$	57.0	2	0.2174	51.3	1	0.2416
$M_{III}M_{IV,V}$	96.7	2	0.1282	91.4	2	0.1357
$M_{III}N_I$	59.5	2	0.2083	53.6	1	0.2313
$\zeta_2\ M_{IV}N_{II}$	127.8	2	0.0970			
$M_{IV}N_{III}$	126.8	2	0.0978			
$\zeta_2\ M_{IV}N_{II,III}$				108.0	2	0.1148
$\zeta_1\ M_VN_{III}$	128.7	2	0.0964	108.7	1	0.1140
	39 Yttrium			**40 Zirconium**		
$\alpha_2\ KL_{II}$	0.83305	1	14.8829	0.79015	1	15.6909
$\alpha_1\ KL_{III}$	0.82884	1	14.9584	0.78593	1	15.7751
$\beta_3\ KM_{II}$	0.74126	3	16.7258	0.70228	4	17.654
$\beta_1\ KM_{III}$	0.74072	2	16.7378	0.70173	3	17.6678
$\beta_2\ KN_{II,III}$	0.72864	4	17.0154	0.68993	4	17.970
$\beta_5\ KM_{IV,V}$	0.7345	1	16.879	0.6959	1	17.815

Table V (*Continued*)

Designation	Å*	p.e.	keV	Å*	p.e.	keV
	39 Yttrium (*Cont.*)			**40 Zirconium** (*Cont.*)		
β_4 $KN_{IV,V}$	0.72776	5	17.036	0.68901	5	17.994
β_4 L_IM_{II}	6.0186	3	2.0600	5.6681	3	2.1873
β_3 L_IM_{III}	5.9832	3	2.0722	5.6330	3	2.2010
$\gamma_{2,3}$ $L_IN_{II,III}$	5.2830	3	2.3468	4.9536	3	2.5029
η $L_{II}M_I$	7.0406	3	1.76095	6.6069	3	1.87654
β_1 $L_{II}M_{IV}$	6.2120	3	1.99584	5.8360	3	2.1244
γ_5 $L_{II}N_I$	5.8754	3	2.1102	5.4977	3	2.2551
γ_1 $L_{II}N_{IV}$				5.3843	3	2.3027
l $L_{III}M_I$	7.3563	3	1.68536	6.9185	3	1.79201
α_2 $L_{III}M_{IV}$	6.4558	3	1.92047	6.0778	3	2.0399
α_1 $L_{III}M_V$	6.4488	2	1.92256	6.0705	2	2.04236
β_6 $L_{III}N_I$	6.0942	3	2.0344	5.7101	3	2.1712
$\beta_{2,15}$				5.5863	3	2.2194
$M_{II}M_{IV}$	81.5	2	0.1522	76.7	2	0.1617
$M_{II}N_I$	46.48	9	0.267			
$M_{III}M_V$				80.9	3	0.1533
$M_{III}N_I$	48.5	2	0.256			
$M_{III}M_{IV,V}$	86.5	2	0.1434			
ζ $M_{IV,V}N_{II,III}$	93.4	2	0.1328	82.1	2	0.1511
$M_{IV,V}O_{II,III}$				70.0	4	0.177
	41 Niobium			**42 Molybdenum**		
α_2 KL_{II}	0.75044	1	16.5210	0.713590	6	17.3743
α_1 KL_{III}	0.74620	1	16.6151	0.709300	1	17.47934
β_3 KM_{II}	0.66634	3	18.6063	0.632872	9	19.5903
β_1 KM_{III}	0.66576	2	18.6225	0.632288	9	19.6083
β_2^{II}				0.62107	5	19.963
β_2 $KN_{II,III}$	0.65416	4	18.953	0.62099	2	19.9652
β_4 $KN_{IV,V}$	0.65318	5	18.981			
β_5^{II} KM_{IV}				0.62708	5	19.771
β_5^{I} KM_V				0.62692	5	19.776
β_4 $KN_{IV,V}$				0.62001	9	19.996
β_4 L_IM_{II}	5.3455	3	2.3194	5.0488	3	2.4557
β_3 L_IM_{III}	5.3102	3	2.3348	5.0133	3	2.4730
$\gamma_{2,3}$ $L_IN_{II,III}$	4.6542	2	2.6638	4.3800	2	2.8306
η $L_{II}M_I$	6.2109	3	1.99620	5.8475	3	2.1202
β_1 $L_{II}M_{IV}$	5.4923	3	2.2574	5.17708	8	2.39481
γ_5 $L_{II}N_I$	5.1517	3	2.4066	4.8369	2	2.5632
γ_1 $L_{II}N_{IV}$	5.0361	3	2.4618	4.7258	2	2.6235
l $L_{III}M_I$	6.5176	3	1.90225	6.1508	3	2.01568
α_2 $L_{III}M_{IV}$	5.7319	3	2.1630	5.41437	8	2.28985
α_1 $L_{III}M_V$	5.7243	2	2.16589	5.40655	8	2.29316
β_6 $L_{III}N_I$	5.3613	3	2.3125	5.0488	5	2.4557
$\beta_{2,15}$ $L_{III}N_{IV,V}$	5.2379	3	2.3670	4.9232	2	2.5183
$M_{II}M_{IV}$	72.1	3	0.1718	68.9	2	0.1798
$M_{II}N_I$	38.4	3	0.323	35.3	3	0.351
$M_{II}N_{IV}$	33.1	2	0.375			
$M_{III}M_V$	78.4	2	0.1582	74.9	1	0.1656
$M_{III}N_I$	40.7	2	0.305	37.5	2	0.331
γ $M_{III}N_{IV,V}$	34.9	2	0.356			
ζ $M_{IV,V}N_{II,III}$	72.19	9	0.1717	64.38	7	0.1926
$M_{IV,V}O_{II,III}$	61.9	2	0.2002	54.8	2	0.2262

Designation	Å*	p.e.	keV	Å*	p.e.	keV
	43 Technetium			**44 Ruthenium**		
α_2 KL_{II}	0.67932†	3	18.2508	0.647408	5	19.1504
α_1 KL_{III}	0.67502†	3	18.3671	0.643083	4	19.2792
β_3 KM_{II}	0.60188†	4	20.599	0.573067	4	21.6346
β_1 KM_{III}	0.60130†	4	20.619	0.572482	4	21.6568
β_2 $KN_{II,III}$	0.59024†	5	21.005	0.56166	3	22.074
β_5^{II} KM_{IV}				0.5680	2	21.829
β_5^{I} KM_V				0.56785	9	21.834
β_4				0.56089	9	22.104
β_4 $L_{II}M_{IV}$				4.5230	2	2.7411
β_3 L_IM_{III}				4.4866	3	2.7634
$\gamma_{2,3}$ $L_IN_{II,III}$				3.8977	2	3.1809
η $L_{II}M_I$				5.2050	2	2.38197
β_1 $L_{II}M_{IV}$	4.8873†	8	2.5368	4.62058	3	2.68323
γ_5 $L_{II}N_I$				4.2873	2	2.8918
γ_1 $L_{II}N_{IV}$				4.1822	2	2.9645
l $L_{III}M_I$				5.5035	3	2.2528
α_2 $L_{III}M_{IV}$				4.85381	7	2.55431
α_1 $L_{III}M_V$	5.1148†	3	2.4240	4.84575	5	2.55855
β_6 $L_{III}N_I$				4.4866	3	2.7634
$\beta_{2,15}$ $L_{III}N_{IV,V}$				4.3718	2	2.8360
$M_{II}M_{IV}$				62.2	1	0.1992
$M_{II}N_I$				32.3	2	0.384
$M_{II}N_{IV}$				25.50	9	0.486
$M_{III}M_V$				68.3	1	0.1814
γ $M_{III}N_{IV,V}$				26.9	1	0.462
ζ $M_{IV,V}N_{II,III}$				52.34	7	0.2369
$M_{IV,V}O_{II,III}$				44.8	1	0.2768
	45 Rhodium			**46 Palladium**		
α_2 KL_{II}	0.617630	4	20.0737	0.589821	3	21.0201
α_1 KL_{III}	0.613279	4	20.2161	0.585448	3	21.1771
β_3 KM_{II}	0.546200	4	22.6989	0.521123	4	23.7911
β_1 KM_{III}	0.545605	4	22.7236	0.520520	4	23.8187
β_2^{II} KN_{II}	0.53513	5	23.168			
β_2 $KN_{II,III}$	0.53503	2	23.1728	0.510228	4	24.2991
β_5^{II} KM_{IV}	0.54118	9	22.909			
β_5^{I} KM_V	0.54101	9	22.917			
β_4 $KN_{IV,V}$	0.53401	9	23.217	0.5093	2	24.346
β_5 $KM_{IV,V}$				0.51670	9	23.995
β_4 L_IM_{II}	4.2888	2	2.8908	4.0711	2	3.0454
β_3 L_IM_{III}	4.2522	2	2.9157	4.0346	2	3.0730
$\gamma_{2,3}$ $L_IN_{II,III}$	3.6855	2	3.3640	3.4892	2	3.5533
η $L_{II}M_I$	4.9217	2	2.5191	4.6605	2	2.6603
β_1 $L_{II}M_{IV}$	4.37414	4	2.83441	4.14622	5	2.99022
γ_5 $L_{II}N_I$	4.0451	2	3.0650	3.8222	2	3.2437
γ_1 $L_{II}N_{IV}$	3.9437	2	3.1438	3.7246	2	3.3287
l $L_{III}M_I$	5.2169	3	2.3765	4.9525	3	2.5034
α_2 $L_{III}M_{IV}$	4.60545	9	2.69205	4.37588	7	2.83329
α_1 $L_{III}M_V$	4.59743	9	2.69674	4.36767	5	2.83861
β_6 $L_{III}N_I$	4.2417	2	2.9229	4.0162	2	3.0870
$\beta_{2,15}$ $L_{III}N_{IV,V}$	4.1310	2	3.0013	3.90887	4	3.17179
β_{10} L_IM_{IV}				3.7988	2	3.2637

Designation	Å*	p.e.	keV	Å*	p.e.	keV
	45 Rhodium (*Cont.*)			**46 Palladium** (*Cont.*)		
$\beta_9\ L_IM_V$				3.7920	2	3.2696
$M_IN_{II,III}$				20.1	2	0.616
$M_{II}M_{IV}$	59.3	1	0.2090	56.5	1	0.2194
$M_{II}N_I$	28.1	2	0.442	26.2	2	0.474
$M_{II}N_{IV}$				22.1	1	0.560
$M_{II}\ M_V$	65.5	1	0.1892	62.9	1	0.1970
$M_{II}{}^{I}N_I$	29.8	1	0.417	27.9	1	0.445
$\gamma\ M_{III}N_{IV,V}$	25.01	9	0.496	23.3†	1	0.531
$\zeta\ M_{IV,V}N_{II,III}$	47.67	9	0.2601	43.6	1	0.2844
$M_{IV,V}O_{II,III}$	40.9	2	0.303	37.4	2	0.332
	47 Silver			**48 Cadmium**		
$\alpha_2\ KL_{II}$	0.563798	4	21.9903	0.539422	3	22.9841
$\alpha_1\ KL_{III}$	0.5594075	6	22.16292	0.535010	3	23.1736
$\beta_3\ KM_{II}$	0.497685	4	24.9115	0.475730	5	26.0612
$\beta_1\ KM_{III}$	0.497069	4	24.9424	0.475105	6	26.0955
$\beta_2\ KN_{II,III}$	0.487032	4	25.4564	0.465328	7	26.6438
$\beta_5\ KM_{IV,V}$	0.49306	2	25.145			
$\beta_4\ KN_{IV,V}$	0.48598	3	25.512			
$\beta_4\ L_IM_{II}$	3.87023	5	3.20346	3.68203	9	3.36719
$\beta_3\ L_IM_{III}$	3.83313	9	3.23446	3.64495	9	3.40145
$\gamma_2\ L_IN_{II}$	3.31216	9	3.7432	3.1377	2	3.9513
$\gamma_3\ L_IN_{III}$	3.30635	9	3.7498			
$\eta\ L_{II}M_I$	4.4183	2	2.8061	4.19315	9	2.95675
$\beta_1\ L_{II}M_{IV}$	3.93473	3	3.15094	3.73823	4	3.31657
$\gamma_5\ L_{II}N_I$	3.61638	9	3.42832	3.42551	9	3.61935
$\gamma_1\ L_{III}N_{IV}$	3.52260	4	3.51959	3.33564	6	3.71686
$l\ L_{III}M_I$	4.7076	2	2.6337	4.48014	9	2.76735
$\alpha_2\ L_{III}M_{IV}$	4.16294	5	2.97821	3.96496	6	3.12691
$\alpha_1\ L_{III}M_V$	4.15443	3	2.98431	3.95635	4	3.13373
$\beta_6\ L_{III}N_I$	3.80774	9	3.25603	3.61467	9	3.42994
$\beta_{2,15}\ L_{III}N_{IV,V}$	3.70335	3	3.34781	3.51408	4	3.52812
$\beta_{10}\ L_IM_{IV}$	3.61158	9	3.43287	3.4367	2	3.6075
$\beta_9\ L_IM_V$	3.60497	9	3.43917	3.43015	9	3.61445
$M_IN_{II,III}$	18.8	2	0.658			
$M_{II}M_{IV}$	54.0	1	0.2295	52.0	2	0.2384
$M_{II}N_I$				22.9	2	0.540
$M_{II}N_{IV}$	20.66	7	0.600	19.40	7	0.639
$M_{III}M_V$	60.5	1	0.2048	58.7	2	0.2111
$M_{III}N_I$	26.0	1	0.478	24.5	1	0.507
$\gamma\ M_{III}N_{IV,V}$	21.82	7	0.568	20.47	7	0.606
$M_{IV}O_{II,III}$				30.4	1	0.408
$\zeta\ M_{IV,V}N_{II,III}$	39.77	7	0.3117	36.8	1	0.3371
M_VN_I	24.4	2	0.509			
M_VO_{III}				30.8	1	0.403
$M_{IV,V}O_{II,III}$	33.5	3	0.370			
	49 Indium			**50 Tin**		
$\alpha_2\ KL_{II}$	0.516544	3	24.0020	0.495053	3	25.0440
$\alpha_1\ KL_{III}$	0.512113	3	24.2097	0.490599	3	25.2713
$\beta_3\ KM_{II}$	0.455181	4	27.2377	0.435877	5	28.4440

Designation	Å*	p.e.	keV	Å*	p.e.	keV
	49 Indium (*Cont.*)			**50 Tin** (*Cont.*)		
$\beta_1\ KM_{III}$	0.454545	4	27.2759	0.435236	5	28.4860
$\beta_2\ KN_{II,III}$	0.44500	1	27.8608	0.425915	8	29.1093
$KO_{II,III}$	0.44374	3	27.940	0.42467	3	29.195
$\beta_5{}^{II}\ KM_{IV}$	0.45098	2	27.491	0.43184	3	28.710
$\beta_5{}^{I}\ KM_V$	0.45086	2	27.499	0.43175	3	28.716
$\beta_4\ KN_{IV,V}$	0.44393	4	27.928	0.42495	3	29.175
$\beta_4\ L_IM_{II}$	3.50697	9	3.5353	3.34335	9	3.7083
$\beta_3\ L_IM_{III}$	3.46984	9	3.5731	3.30585	3	3.7500
$\gamma_{2,3}\ L_IN_{II,III}$	2.9800	2	4.1605	2.8327	2	4.3768
$\gamma_4\ L_IO_{II,III}$	2.9264	2	4.2367	2.7775	2	4.4638
$\eta\ L_{II}M_I$	3.98327	9	3.11254	3.78876	9	3.27234
$\beta_1\ L_{II}M_{IV}$	3.55531	4	3.48721	3.38487	3	3.66280
$\gamma_5\ L_{II}N_I$	3.24907	9	3.8159	3.08475	9	4.0192
$\gamma_1\ L_{II}N_{IV}$	3.16213	4	3.92081	3.00115	3	4.13112
$l\ L_{III}M_I$	4.26873	9	2.90440	4.07165	9	3.04499
$\alpha_2\ L_{III}M_{IV}$	3.78073	6	3.27929	3.60891	4	3.43542
$\alpha_1\ L_{III}M_V$	3.77192	4	3.28694	3.59994	3	3.44398
$\beta_6\ L_{III}N_I$	3.43606	9	3.60823	3.26901	9	3.7926
$\beta_{2,15}\ L_{III}N_{IV,V}$	3.33838	3	3.71381	3.17505	3	3.90486
$\beta_7\ L_{III}O_I$	3.324	4	3.730	3.1564	3	3.9279
$\beta_{10}\ L_IM_{IV}$	3.27404	9	3.7868	3.12170	9	3.9716
$\beta_9\ L_IM_V$	3.26763	9	3.7942	3.11513	9	3.9800
$M_{II}M_{IV}$				47.3	1	0.2621
$M_{II}N_I$				20.0	1	0.619
$M_{II}N_{IV}$				16.93	5	0.733
$M_{III}M_V$				54.2	1	0.2287
$M_{III}N_I$				21.5	1	0.575
$\gamma\ M_{III}N_{IV,V}$				17.94	5	0.691
$M_{IV}O_{II,III}$				25.3	1	0.491
$\zeta\ M_{IV,V}N_{II,III}$				31.24	9	0.397
M_VO_{III}				25.7	1	0.483
	51 Antimony			**52 Tellurium**		
$\alpha_2\ KL_{II}$	0.474827	3	26.1108	0.455784	3	27.2017
$\alpha_1\ KL_{III}$	0.470354	3	26.3591	0.451295	3	27.4723
$\beta_3\ KM_{II}$	0.417737	4	29.6792	0.400659	4	30.9443
$\beta_1\ KM_{III}$	0.417085	3	29.7256	0.399995	5	30.9957
$\beta_2\ KN_{II,III}$	0.407973	5	30.3895	0.391102	6	31.7004
$KO_{II,III}$	0.40666	1	30.4875	0.38974	1	31.8114
$\beta_5{}^{II}\ KM_{IV}$	0.41388	1	29.9560			
$\beta_5{}^{I}\ KM_V$	0.41378	1	29.9632			
$\beta_4\ KN_{IV,V}$	0.40702	1	30.4604			
$\beta_4\ L_IM_{II}$	3.19014	9	3.8864	3.04661	9	4.0695
$\beta_3\ L_IM_{III}$	3.15258	9	3.9327	3.00893	9	4.1204
$\gamma_{2,3}\ L_IN_{II,III}$	2.6953	2	4.5999	2.5674	2	4.8290
$\gamma_4\ L_IO_{II,III}$	2.6398	2	4.6967	2.5113	2	4.9369
$\eta\ L_{II}M_I$	3.60765	9	3.43661	3.43832	9	3.60586
$\beta_1\ L_{II}M_{IV}$	3.22567	4	3.84357	3.07677	6	4.02958
$\gamma_5\ L_{II}N_I$	2.93187	9	4.2287	2.79007	9	4.4437
$\gamma_1\ L_{II}N_{IV}$	2.85159	3	4.34779	2.71241	6	4.5709
$l\ L_{III}M_I$	3.88826	9	3.18860	3.71696	9	3.33555
$\alpha_2\ L_{III}M_{IV}$	3.44840	6	3.59532	3.29846	9	3.7588

Table V (*Continued*)

Designation	Å*	p.e.	keV	Å*	p.e.	keV
	51 Antimony (*Cont.*)			**52 Tellurium** (*Cont.*)		
$\alpha_1\ L_{III}M_V$	3.43941	4	3.60472	3.28920	6	3.76933
$\beta_6\ L_{III}N_I$	3.11513	9	3.9800	2.97088	9	4.1732
$\beta_{2,15}\ L_{III}N_{IV,V}$	3.02335	3	4.10078	2.88217	8	4.3017
$\beta_7\ L_{III}O_I$	3.0052	3	4.1255	2.8634	3	4.3298
$\beta_{10}\ L_IM_{IV}$	2.97917	9	4.1616	2.84679	9	4.3551
$\beta_9\ L_IM_V$	2.97261	9	4.1708	2.83897	9	4.3671
$M_{II}M_{IV}$	45.2	1	0.2743			
$M_{II}N_I$	18.8	1	0.658	17.6	1	0.703
$M_{II}N_{IV}$	15.98	5	0.776			
$M_{III}M_V$	52.2	1	0.2375	50.3	1	0.2465
$M_{III}N_I$	20.2	1	0.612	19.1	1	0.648
$\gamma\ M_{III}N_{IV,V}$	16.92	4	0.733	15.93	4	0.778
$M_{IV}O_{II,III}$				21.34	5	0.581
$\zeta\ M_{IV,V}N_{II,III}$	28.88	8	0.429	26.72	9	0.464
M_VO_{III}				21.78	5	0.569
	53 Iodine			**54 Xenon**		
$\alpha_2\ KL_{II}$	0.437829	7	28.3172	0.42087†	2	29.458
$\alpha_1\ KL_{III}$	0.433318	5	28.6120	0.41634†	2	29.779
$\beta_3\ KM_{II}$	0.384564	4	32.2394	0.36941†	2	33.562
$\beta_1\ KM_{III}$	0.383905	4	32.2947	0.36872†	2	33.624
$\beta_2\ KN_{II,III}$	0.37523†	2	33.042	0.36026†	3	34.415
$\beta_4\ L_IM_{II}$	2.91207	9	4.2575			
$\beta_3\ L_IM_{III}$	2.87429	9	4.3134			
$\gamma_{2,3}\ L_IN_{II,III}$	2.4475	2	5.0657			
$\gamma_4\ L_IO_{II,III}$	2.3913	2	5.1848			
$\eta\ L_{II}M_I$	3.27979	9	3.7801			
$\beta_1\ L_{II}M_{IV}$	2.93744	6	4.22072			
$\gamma_5\ L_{II}N_I$	2.65710	9	4.6660			
$\gamma_1\ L_{II}N_{IV}$	2.58244	8	4.8009			
$l\ L_{III}M_I$	3.55754	9	3.48502			
$\alpha_2\ L_{III}M_{IV}$	3.15791	6	3.92604			
$\alpha_1\ L_{III}M_V$	3.14860	6	3.93765	3.0166†	2	4.1099
$\beta_6\ L_{III}N_I$	2.83672	9	4.3706			
$\beta_{2,15}\ L_{III}N_{IV,V}$	2.75053	8	4.5075			
$\beta_7\ L_{III}O_I$	2.7288	3	4.5435			
$\beta_{10}\ L_IM_{IV}$	2.72104	9	4.5564			
$\beta_9\ L_IM_V$	2.71352	9	4.5690			
	55 Cesium			**56 Barium**		
$\alpha_2\ KL_{II}$	0.404835	4	30.6251	0.389668	5	31.8171
$\alpha_1\ KL_{III}$	0.400290	4	30.9728	0.385111	4	32.1936
$\beta_3\ KM_{II}$	0.355050	4	34.9194	0.341507	4	36.3040
$\beta_1\ KM_{III}$	0.354364	7	34.9869	0.340811	3	36.3782
$\beta_2\ KN_{II,III}$	0.34611	2	35.822	0.33277	1	37.257
$KO_{II,III}$				0.33127	2	37.426
$\beta_5^{II}\ KM_{IV}$				0.33835	2	36.643
$\beta_5^{I}\ KM_V$				0.33814	2	36.666
$\beta_4\ KN_{IV,V}$				0.33229	2	37.311
$\beta_4\ L_IM_{II}$	2.6666	2	4.6494	2.5553	2	4.8519
$\beta_3\ L_IM_{III}$	2.6285	2	4.7167	2.5164	2	4.9269
$\gamma_2\ L_IN_{II}$	2.2371	2	5.5420	2.1387	2	5.7969
$\gamma_3\ L_IN_{III}$	2.2328	2	5.5527	2.1342	2	5.8092

Designation	Å*	p.e.	keV	Å*	p.e.	keV
	55 Cesium (*Cont.*)			**56 Tellurium** (*Cont.*)		
$\gamma_4\ L_IO_{II,III}$	2.1741	2	5.7026	2.0756	3	5.9733
$\eta\ L_{II}M_I$	2.9932	2	4.1421	2.8627	3	4.3309
$\beta_1\ L_{II}M_{IV}$	2.6837	2	4.6198	2.56821	5	4.82753
$\gamma_5\ L_{II}N_I$	2.4174	2	5.1287	2.3085	3	5.3707
$\gamma_1\ L_{II}N_{IV}$	2.3480	2	5.2804	2.2415	2	5.5311
$l\ L_{III}M_I$	3.2670	2	3.7950	3.1355	2	3.9541
$\alpha_2\ L_{III}M_{IV}$	2.9020	2	4.2722	2.78553	5	4.45090
$\alpha_1\ L_{III}M_V$	2.8924	2	4.2865	2.77595	5	4.46626
$\beta_6\ L_{III}N_I$	2.5932	2	4.7811	2.4826	2	4.9939
$\beta_{2,15}\ L_{III}N_{IV,V}$	2.5118	2	4.9359	2.40435	6	5.1565
$\beta_7\ L_{III}O_I$	2.4849	2	4.9893	2.3806	2	5.2079
$\beta_{10}\ L_IM_{IV}$	2.4920	2	4.9752	2.3869	2	5.1941
$\beta_9\ L_IM_V$	2.4783	2	5.0026	2.3764	2	5.2171
$\gamma\ M_{III}N_{IV,V}$				12.75	3	0.973
$M_{IV}O_{II}$				15.91	5	0.779
$M_{IV}O_{III}$				15.72	9	0.789
$\zeta\ M_VN_{III}$				20.64	4	0.601
M_VO_{III}				16.20	5	0.765
$N_{IV}O_{II}$	188.6	1	0.06574	163.3	2	0.07590
$N_{IV}O_{III}$	183.8	1	0.06746	159.0	2	0.07796
N_VO_{III}	190.3	1	0.06515	164.6	2	0.07530
	57 Lanthanum			**58 Cerium**		
$\alpha_2\ KL_{II}$	0.375313	2	33.0341	0.361683	2	34.2789
$\alpha_1\ KL_{III}$	0.370737	2	33.4418	0.357092	2	34.7197
$\beta_3\ KM_{II}$	0.328686	4	37.7202	0.316520	4	39.1701
$\beta_1\ KM_{III}$	0.327983	3	37.8010	0.315816	2	39.2573
$\beta_2\ KN_{II,III}$	0.320117	7	38.7299	0.30816	1	40.233
$KO_{II,III}$	0.31864	2	38.909	0.30668	2	40.427
$\beta_5^{II}\ KM_{IV}$	0.32563	2	38.074	0.31357	2	39.539
$\beta_5^{I}\ KM_V$	0.32546	2	38.094	0.31342	2	39.558
$\beta_4\ KN_{IV,V}$	0.31931	2	38.828	0.30737	2	40.337
$\beta_4\ L_IM_{II}$	2.4493	3	5.0620	2.3497	4	5.2765
$\beta_3\ L_IM_{III}$	2.4105	3	5.1434	2.3109	3	5.3651
$\gamma_2\ L_IN_{II}$	2.0460	4	6.060	1.9602	3	6.3250
$\gamma_3\ L_IN_{III}$	2.0410	4	6.074	1.9553	3	6.3409
$\gamma_4\ L_IO_{II,III}$	1.9830	4	6.252	1.8991	4	6.528
$\eta\ L_{II}M_I$	2.740	3	4.525	2.6203	4	4.7315
$\beta_1\ L_{II}M_{IV}$	2.45891	5	5.0421	2.3561	3	5.2622
$\gamma_5\ L_{II}N_I$	2.2056	4	5.621	2.1103	3	5.8751
$\gamma_1\ L_{II}N_{IV}$	2.1418	3	5.7885	2.0487	4	6.052
$\gamma_8\ L_{II}O_I$				2.0237	4	6.126
$l\ L_{III}M_I$	3.006	3	4.124	2.8917	4	4.2875
$\alpha_2\ L_{III}M_{IV}$	2.67533	5	4.63423	2.5706	3	4.8230
$\alpha_1\ L_{III}M_V$	2.66570	5	4.65097	2.5615	2	4.8402
$\beta_6\ L_{III}N_I$	2.3790	4	5.2114	2.2818	3	5.4334
$\beta_{2,15}\ L_{III}N_{IV,V}$	2.3030	3	5.3835	2.2087	2	5.6134
$\beta_7\ L_{III}O_I$	2.275	3	5.450	2.1701	2	5.7132
$\beta_{10}\ L_IM_{IV}$	2.290	3	5.415	2.1958	5	5.646
$\beta_9\ L_IM_V$	2.282	3	5.434	2.1885	3	5.6650
$\gamma\ M_{III}N_{IV,V}$	12.08	4	1.027	11.53	1	1.0749
$\beta\ M_{IV}N_{VI}$	14.51	5	0.854	13.75	4	0.902
$\zeta\ M_VN_{III}$	19.44	5	0.638	18.35	4	0.676
$\alpha\ M_VN_{VI,VII}$	14.88	5	0.833	14.04	2	0.883

Designation	Å*	p.e.	keV	Å*	p.e.	keV
	57 Lanthanum (*Cont.*)			**58 Cerium** (*Cont.*)		
$M_{V}O_{II,III}$				14.39	5	0.862
$N_{IV,V}O_{II,III}$	152.6	6	0.0812	144.4	6	0.0859

Designation	Å*	p.e.	keV	Å*	p.e.	keV
	59 Praseodymium			**60 Neodymium**		
$\alpha_2\ KL_{II}$	0.348749	2	35.5502	0.336472	2	36.8474
$\alpha_1\ KL_{III}$	0.344140	2	36.0263	0.331846	2	37.3610
$\beta_3\ KM_{II}$	0.304975	5	40.6529	0.294027	3	42.1665
$\beta_1\ KM_{III}$	0.304261	4	40.7482	0.293299	2	42.2713
$\beta_2\ KN_{II,III}$	0.29679	2	41.773	0.2861†	1	43.33
$\beta_4\ L_{I}M_{II}$	2.2550	4	5.4981	2.1669	3	5.7216
$\beta_3\ L_{I}M_{III}$	2.2172	3	5.5918	2.1268	2	5.8294
$\gamma_2\ L_{I}N_{II}$	1.8791	4	6.598	1.8013	4	6.883
$\gamma_3\ L_{I}N_{III}$	1.8740	4	6.616	1.7964	4	6.902
$\gamma_4\ L_{I}O_{II,III}$	1.8193	4	6.815	1.7445	4	7.107
$\eta\ L_{II}M_{I}$	2.512	3	4.935	2.4094	4	5.1457
$\beta_1\ L_{II}M_{IV}$	2.2588	3	5.4889	2.1669	2	5.7216
$\gamma_5\ L_{II}N_{I}$	2.0205	4	6.136	1.9355	4	6.406
$\gamma_1\ L_{II}N_{IV}$	1.9611	3	6.3221	1.8779	2	6.6021
$\gamma_8\ L_{II}O_{I}$	1.9362	4	6.403	1.8552	5	6.683
$l\ L_{III}M_{I}$	2.7841	4	4.4532	2.6760	4	4.6330
$\alpha_2\ L_{III}M_{IV}$	2.4729	3	5.0135	2.3807	3	5.2077
$\alpha_1\ L_{III}M_{V}$	2.4630	2	5.0337	2.3704	2	5.2304
$\beta_6\ L_{III}N_{I}$	2.1906	4	5.660	2.1039	3	5.8930
$\beta_{2,15}\ L_{III}N_{IV,V}$	2.1194	4	5.850	2.0360	3	6.0894
$\beta_7\ L_{III}O_{I}$	2.0919	4	5.927	2.0092	3	6.1708
$\beta_{10}\ L_{I}M_{IV}$	2.1071	4	5.884	2.0237	3	6.1265
$\beta_9\ L_{I}M_{V}$	2.1004	4	5.903	2.0165	3	6.1484
$\gamma\ M_{III}N_{IV,V}$	10.998	9	1.1273	10.505	9	1.180
$\beta\ M_{IV}N_{VI}$	13.06	2	0.950	12.44	2	0.997
$\zeta\ M_{V}N_{III}$	17.38	4	0.714	16.46	4	0.753
$\alpha\ M_{V}N_{VI,VII}$	13.343	5	0.9292	12.68	2	0.978
$N_{IV,V}N_{VI,VII}$	113.	1	0.1095	107.	1	0.116
$N_{IV,V}O_{II,III}$	136.5	4	0.0908	128.9	7	0.0962

Designation	Å*	p.e.	keV	Å*	p.e.	keV
	61 Promethium			**62 Samarium**		
$\alpha_2\ KL_{II}$	0.324803	4	38.1712	0.313698	2	39.5224
$\alpha_1\ KL_{III}$	0.320160	4	38.7247	0.309040	2	40.1181
$\beta_3\ KM_{II}$	0.28363†	4	43.713	0.27376	2	45.289
$\beta_1\ KM_{III}$	0.28290†	3	43.826	0.27301	2	45.413
$\beta_2\ KN_{II,III}$	0.2759†	1	44.94	0.2662	1	46.58
$KO_{II,III}$				0.26491	3	46.801
$\beta_5\ KM_{IV,V}$				0.27111	3	45.731
$\beta_4\ L_{I}M_{II}$				2.00095	6	6.1963
$\beta_3\ L_{I}M_{III}$	2.0421	4	6.071	1.96241	3	6.3180
$\gamma_2\ L_{I}N_{II}$				1.66044	6	7.4668
$\gamma_3\ L_{I}N_{III}$				1.65601	3	7.4867
$\gamma_4\ L_{I}O_{II,III}$				1.60728	3	7.7137
$\eta\ L_{II}M_{I}$				2.21824	3	5.5892
$\beta_1\ L_{II}M_{IV}$	2.0797	4	5.961	1.99806	3	6.2051
$\gamma_5\ L_{II}N_{I}$				1.77934	3	6.9678
$\gamma_1\ L_{II}N_{IV}$	1.7989	9	6.892	1.72724	3	7.1780
$\gamma_6\ L_{II}O_{IV}$				1.6966	9	7.3076
$l\ L_{III}M_{I}$				2.4823	4	4.9945

Designation	Å*	p.e.	keV	Å*	p.e.	keV
	61 Promethium (*Cont.*)			**62 Samarium** (*Cont.*)		
$\alpha_2\ L_{III}M_{IV}$	2.2926	4	5.4078	2.21062	3	5.6084
$\alpha_1\ L_{III}M_{V}$	2.2822	3	5.4325	2.1998	2	5.6361
$\beta_6\ L_{III}N_{I}$				1.94643	3	6.3697
$\beta_{2,15}\ L_{III}N_{IV,V}$	1.9559	6	6.339	1.88221	3	6.5870
$\beta_7\ L_{III}O_{I}$				1.85626	3	6.6791
$\beta_5\ L_{III}O_{IV,V}$				1.84700	9	6.7126
$\beta_{10}\ L_{I}M_{IV}$				1.86990	3	6.6304
$\beta_9\ L_{I}M_{V}$				1.86166	3	6.6597
$\gamma\ M_{III}N_{IV,V}$				9.600	9	1.291
$\beta\ M_{IV}N_{VI}$				11.27	1	1.0998
$\zeta\ M_{V}N_{III}$				14.91	4	0.831
$\alpha\ M_{V}N_{VI,VII}$				11.47	3	1.081
$N_{IV,V}N_{VI,VII}$				98.	1	0.126
$N_{IV,V}O_{II,III}$				117.4	4	0.1056

Designation	Å*	p.e.	keV	Å*	p.e.	keV
	63 Europium			**64 Gadolinium**		
$\alpha_2\ KL_{II}$	0.303118	2	40.9019	0.293038	2	42.3089
$\alpha_1\ KL_{III}$	0.298446	2	41.5422	0.288353	2	42.9962
$\beta_3\ KM_{II}$	0.264332	5	46.9036	0.25534	2	48.555
$\beta_1\ KM_{III}$	0.263577	5	47.0379	0.25460	2	48.697
$\beta_2\ KN_{II,III}$	0.256923	8	48.256	0.24816	3	49.959
$KO_{II,III}$	0.255645	7	48.497	0.24687	3	50.221
$\beta_5\ KM_{IV,V}$				0.25275	3	49.052
$\beta_4\ L_{I}M_{II}$	1.9255	2	6.4389	1.8540	2	6.6871
$\beta_3\ L_{I}M_{III}$	1.8867	2	6.5713	1.8150	2	6.8311
$\gamma_2\ L_{I}N_{II}$	1.5961	2	7.7677	1.5331	2	8.087
$\gamma_3\ L_{I}N_{III}$	1.5903	2	7.7961	1.5297	2	8.105
$\gamma_4\ L_{I}O_{II,III}$	1.5439	1	8.0304	1.4839	2	8.355
$\eta\ L_{II}M_{I}$	2.1315	2	5.8166	2.0494	1	6.0495
$\beta_1\ L_{II}M_{IV}$	1.9203	2	6.4564	1.8468	2	6.7132
$\gamma_5\ L_{II}N_{I}$	1.7085	2	7.2566	1.6412	2	7.5543
$\gamma_1\ L_{II}N_{IV}$	1.6574	2	7.4803	1.5924	2	7.7858
$\gamma_8\ L_{II}O_{I}$	1.6346	2	7.5849	1.5707	2	7.894
$\gamma_6\ L_{II}O_{IV}$	1.6282	2	7.6147	1.5644	2	7.925
$l\ L_{III}M_{I}$	2.3948	2	5.1772	2.3122	2	5.3621
$\alpha_2\ L_{III}M_{IV}$	2.1315	2	5.8166	2.0578	2	6.0250
$\alpha_1\ L_{III}M_{V}$	2.1209	2	5.8457	2.0468	2	6.0572
$\beta_6\ L_{III}N_{I}$	1.8737	2	6.6170	1.8054	2	6.8671
$\beta_{2,15}\ L_{III}N_{IV,V}$	1.8118	2	6.8432	1.7455	2	7.1028
$\beta_7\ L_{III}O_{I}$	1.7851	2	6.9453	1.7203	2	7.2071
$\beta_5\ L_{III}O_{IV,V}$	1.7772	2	6.9763	1.7130	2	7.2374
$\beta_{10}\ L_{I}M_{IV}$	1.7993	3	6.890	1.7315	3	7.160
$\beta_9\ L_{I}M_{V}$	1.7916	3	6.920	1.7240	3	7.192
$L_{I}O_{IV,V}$				1.4807	3	8.373
$\gamma\ M_{III}N_{IV,V}$	9.211	9	1.346	8.844	9	1.402
$\beta\ M_{IV}N_{VI}$	10.750	7	1.1533	10.254	6	1.2091
$\zeta\ M_{V}N_{III}$	14.22	2	0.872	13.57	2	0.914
$\alpha\ M_{V}N_{VI,VII}$	10.96	3	1.131	10.46	3	1.185
$N_{IV,V}O_{II,III}$	112.0	6	0.1107			

Designation	Å*	p.e.	keV	Å*	p.e.	keV
	65 Terbium			**66 Dysprosium**		
$\alpha_2\ KL_{II}$	0.283423	2	43.7441	0.274247	2	45.2078
$\alpha_1\ KL_{III}$	0.278724	2	44.4816	0.269533	2	45.9984
$\beta\ KM_{II}$	0.24683	2	50.229	0.23862	2	51.957

Designation	Å*	p.e.	keV	Å*	p.e.	keV
	65 Terbium (*Cont.*)			**66 Dysprosium** (*Cont.*)		
$\beta_1\ KM_{III}$	0.24608	2	50.382	0.23788	2	52.119
$\beta_2\ KN_{II,III}$	0.2397†	2	51.72	0.2317†	2	53.51
$KO_{II,III}$	0.23858	3	51.965	0.23056	3	53.774
$\beta_5\ KM_{IV,V}$				0.23618	3	52.494
$\beta_4\ L_IM_{II}$	1.7864	2	6.9403	1.72103	7	7.2039
$\beta_3\ L_IM_{III}$	1.7472	2	7.0959	1.6822	2	7.3702
$\gamma_2\ L_IN_{II}$	1.4764	2	8.398	1.42278	7	8.7140
$\gamma_3\ L_IN_{III}$	1.4718	2	8.423	1.41640	7	8.7532
$\gamma_4\ L_IO_{II,III}$	1.4276	2	8.685	1.37459	7	9.0195
$\eta\ L_{II}M_I$	1.9730	2	6.2839	1.89743	7	6.5342
$\beta_1\ L_{II}M_{IV}$	1.7768	3	6.978	1.71062	7	7.2477
$\gamma_5\ L_{II}N_I$	1.5787	2	7.8535	1.51824	7	8.1661
$\gamma_1\ L_{II}N_{IV}$	1.5303	2	8.102	1.47266	7	8.4188
$\gamma_8\ L_{II}O_I$	1.5097	2	8.212			
$\gamma_6\ L_{II}O_{IV}$	1.5035	2	8.246	1.44579	7	8.5753
$l\ L_{III}M_I$	2.2352	2	5.5467	2.15877	7	5.7431
$\alpha_2\ L_{III}M_{IV}$	1.9875	2	6.2380	1.91991	3	6.4577
$\alpha_1\ L_{III}M_V$	1.9765	2	6.2728	1.90881	3	6.4952
$\beta_6\ L_{III}N_I$	1.7422	2	7.1163	1.68213	7	7.3705
$\beta_{2,15}\ L_{III}N_{IV,V}$	1.6830	2	7.3667	1.62369	7	7.6357
$\beta_7\ L_{III}O_I$	1.6585	2	7.4753	1.60447	7	7.7272
$\beta_5\ L_{III}O_{IV,V}$	1.6510	2	7.5094	1.58837	7	7.8055
$\beta_{10}\ L_IM_{IV}$	1.6673	3	7.436	1.60743	9	7.7130
$\beta_9\ L_IM_V$				1.59973	9	7.7501
$L_IO_{IV,V}$	1.4228	3	8.714			
$\gamma\ M_{III}N_{IV,V}$	8.486	9	1.461	8.144	9	1.522
$\beta\ M_{IV}N_{VI}$	9.792	6	1.2661	9.357	6	1.3250
$\zeta\ M_VN_{III}$	12.98	2	0.955	12.43	2	0.998
$\alpha\ M_VN_{VI,VII}$	10.00	2	1.240	9.59	2	1.293
$N_{IV,V}N_{VI,VII}$	86.	1	0.144	83.	1	0.149
$N_{IV,V}O_{II,III}$	102.2	4	0.1213	97.2	8	0.128
	67 Holmium			**68 Erbium**		
$\alpha_2\ KL_{II}$	0.265486	2	46.6997	0.257110	2	48.2211
$\alpha_1\ KL_{III}$	0.260756	2	47.5467	0.252365	2	49.1277
$\beta_3\ KM_{II}$	0.23083	2	53.711	0.22341	2	55.494
$\beta_1\ KM_{III}$	0.23012	2	53.877	0.22266	2	55.681
$\beta_2\ KN_{II,III}$	0.2241†	2	55.32	0.2167†	2	57.21
$KO_{II,III}$	0.22305	3	55.584	0.21581	3	57.450
$\beta_5\ KM_{IV,V}$	0.22855	3	54.246	0.22124	3	56.040
$\beta_4\ L_IM_{II}$	1.6595	2	7.4708	1.6007	1	7.7453
$\beta_3\ L_IM_{III}$	1.6203	2	7.6519	1.5616	1	7.9392
$\gamma_2\ L_IN_{II}$	1.3698	2	9.051	1.3210	2	9.385
$\gamma_3\ L_IN_{III}$	1.3643	2	9.087	1.3146	1	9.4309
$\gamma_4\ L_IO_{II,III}$	1.3225	2	9.374	1.2752	2	9.722
$\eta\ L_{II}M_I$	1.8264	2	6.7883	1.7566	1	7.0579
$\beta_1\ L_{II}M_{IV}$	1.6475	2	7.5253	1.5873	1	7.8109
$\gamma_5\ L_{II}N_I$	1.4618	2	8.481	1.4067	3	8.814
$\gamma_1\ L_{II}N_{IV}$	1.4174	2	8.747	1.3641	2	9.089
$\gamma_8\ L_{II}O_I$	1.3983	2	8.867			
$\gamma_6\ L_{II}O_{IV}$	1.3923	2	8.905	1.3397	3	9.255
$l\ L_{III}M_I$	2.0860	2	5.9434	2.015	1	6.152
$\alpha_2\ L_{III}M_{IV}$	1.8561	2	6.6795	1.7955	2	6.9050
$\alpha_1\ L_{III}M_V$	1.8450	2	6.7198	1.78425	9	6.9487
$\beta_6\ L_{III}N_I$	1.6237	2	7.6359	1.5675	2	7.909
$\beta_{2,15}\ L_{III}N_{IV,V}$	1.5671	2	7.911	1.51399	9	8.1890
$\beta_7\ L_{III}O_I$				1.4941	3	8.298
$\beta_5\ L_{III}O_{IV,V}$	1.5378	2	8.062	1.4848	3	8.350

Designation	Å*	p.e.	keV	Å*	p.e.	keV
	67 Holmium (*Cont.*)			**68 Erbium** (*Cont.*)		
$\beta_{10}\ L_IM_{IV}$	1.5486	3	8.006	1.4941	3	8.298
$L_IO_{IV,V}$	1.3208	3	9.387			
$\beta_9\ L_IM_V$				1.4855	5	8.346
$M_{II}N_{IV}$				7.60	1	1.632
$\gamma\ M_{III}N_{IV,V}$	7.865	9	1.576			
$\gamma\ M_{III}\ _V$				7.546	8	1.643
$\beta\ M_{IV}N_{VI}$	8.965	4	1.3830	8.592	3	1.4430
$\zeta\ M_VN_{III}$	11.86	1	1.0450	11.37	1	1.0901
$\alpha\ M_VN_{VI,VII}$	9.20	2	1.348	8.82	1	1.406
$N_{IV}N_{VI}$				72.7	9	0.171
$N_VN_{VI,VII}$				76.3	7	0.163
	69 Thulium			**70 Ytterbium**		
$\alpha_2\ KL_{II}$	0.249095	2	49.7726	0.241424	2	51.3540
$\alpha_1\ KL_{III}$	0.244338	2	50.7416	0.236655	2	52.3889
$\beta_3\ KM_{II}$	0.21636	2	57.304	0.2096†	1	59.14
$\beta_1\ KM_{III}$	0.21556	2	57.517	0.20884	8	59.37
$\beta_2\ KN_{II,III}$	0.2098†	2	59.09	0.2033†	2	60.98
$KO_{II,III}$	0.20891	2	59.346	0.20226	2	61.298
$\beta_5\ KM_{IV,V}$	0.21404	2	57.923	0.20739	2	59.782
$\beta_4\ L_IM_{II}$	1.5448	2	8.026	1.49138	3	8.3132
$\beta_3\ L_IM_{III}$	1.5063	2	8.231	1.45233	5	8.5367
$\gamma_2\ L_IN_{II}$	1.2742	2	9.730	1.22879	7	10.0897
$\gamma_3\ L_IN_{III}$	1.2678	2	9.779	1.22232	5	10.1431
$\gamma_4\ L_IO_{II,III}$	1.2294	2	10.084	1.1853	1	10.4603
$\eta\ L_{II}M_I$	1.6963	2	7.3088	1.63560	5	7.5802
$\beta_1\ L_{II}M_{IV}$	1.5304	2	8.101	1.47565	5	8.4018
$\gamma_5\ L_{II}N_I$	1.3558	2	9.144	1.3063	1	9.4910
$\gamma_1\ L_{II}N_{IV}$	1.3153	2	9.426	1.26769	5	9.8701
$\gamma_8\ L_{II}O_I$				1.24923	5	9.9246
$\gamma_6\ L_{II}O_{IV}$	1.2905	2	9.607	1.24271	3	9.9766
$l\ L_{III}M_I$	1.9550	2	6.3419	1.89415	5	6.5455
$\alpha_2\ L_{III}M_{IV}$	1.7381	2	7.1331	1.68285	5	7.3673
$\alpha_1\ L_{III}M_V$	1.7268†	2	7.1799	1.67189	4	7.4156
$\beta_6\ L_{III}N_I$	1.5162	2	8.177	1.4661	1	8.4563
$\beta_{2,15}\ L_{III}N_{IV,V}$	1.4640	2	8.468	1.41550	5	8.7588
$\beta_7\ L_{III}O_I$				1.3948	1	8.8889
$\beta_5\ L_{III}O_{IV,V}$	1.4349	2	8.641	1.38696	7	8.9390
$\beta_{10}\ L_IM_{IV}$	1.4410	3	8.604	1.3915	1	8.9100
$\beta_9\ L_IM_V$	1.4336	3	8.648	1.3838	1	8.9597
L_IO_I				1.1886	1	10.4312
$L_IO_{IV,V}$	1.2263	3	10.110	1.1827	1	10.4833
$L_{II}M_{II}$				1.58844	9	7.8052
$L_{II}O_{II,III}$				1.2453	1	9.9561
$t\ L_{III}M_{II}$				1.83091	9	6.7715
$L_{III}O_{II,III}$				1.3898	1	8.9209
$M_{III}N_I$				8.470	9	1.464
$\gamma\ M_{III}N_V$				7.024	8	1.765
$\beta\ M_{IV}N_{VI}$	8.249	7	1.503	7.909	2	1.5675
$\zeta\ M_VN_{III}$				10.48	1	1.183
$\alpha\ M_VN_{VI,VII}$	8.48	1	1.462	8.149	5	1.5214
$N_{IV}N_{VI}$				65.1	7	0.190
$N_VN_{VI,VII}$				69.3	5	0.179
	71 Lutetium			**72 Hafnium**		
$\alpha_2\ KL_{II}$	0.234081	2	52.9650	0.227024	3	54.6114
$\alpha_1\ KL_{III}$	0.229298	2	54.0698	0.222227	3	55.7902
$\beta_3\ KM_{II}$	0.20309†	4	61.05	0.19686†	4	62.98

Designation	Å*	p.e.	keV	Å*	p.e.	keV
	71 Lutetium (*Cont.*)			**72 Hafnium** (*Cont.*)		
β_1 KM_{III}	0.20231†	3	61.283	0.19607†	3	63.234
β_2 $KN_{II,III}$	0.1969†	2	62.97	0.1908†	2	64.98
$KO_{II,III}$	0.19589	2	63.293			
β_5 $KM_{IV,V}$	0.20084	2	61.732			
β_4 L_IM_{II}	1.44056	5	8.6064	1.39220	5	8.9054
β_3 L_IM_{III}	1.40140	5	8.8469	1.35300	5	9.1634
γ_2 L_IN_{II}	1.1853	2	10.460	1.14442	5	10.8335
γ_3 L_IN_{III}	1.17953	4	10.5110	1.13841	5	10.8907
γ'_4 L_IO_{II}				1.10376	5	11.2326
γ_4 $L_IO_{II,III}$	1.1435	1	10.8425	1.10303	5	11.2401
η $L_{II}M_I$	1.5779	1	7.8575	1.52325	5	8.1393
β_1 $L_{II}M_{IV}$	1.42359	3	8.7090	1.37410	5	9.0227
γ_5 $L_{II}N_I$	1.2596	1	9.8428	1.21537	5	10.2011
γ_1 $L_{II}N_{IV}$	1.22228	4	10.1434	1.17900	5	10.5158
γ_8 $L_{II}O_I$	1.2047	1	10.2915	1.16138	5	10.6754
γ_6 $L_{II}O_{IV}$	1.1987	1	10.3431	1.15519	5	10.7325
l $L_{III}M_I$	1.8360	1	6.7528	1.78145	5	6.9596
α_2 $L_{III}M_{IV}$	1.63029	5	7.6049	1.58046	5	7.8446
α_1 $L_{III}M_{IV}$	1.61951	3	7.6555	1.56958	5	7.8990
β_6 $L_{III}N_I$	1.4189	1	8.7376	1.37410	5	9.0227
β_{15} $L_{III}N_{IV}$	1.3715	1	9.0395	1.32783	5	9.3371
β_2 $L_{III}N_V$	1.37012	3	9.0489	1.32639	5	9.3473
β_7 $L_{III}O_I$	1.34949	5	9.1873	1.30564	5	9.4958
β_5 $L_{III}O_{IV,V}$	1.34183	7	9.2397	1.29761	5	9.5546
L_IM_I				1.43025	9	8.6685
β_{10} L_IM_{IV}	1.3430	2	9.232	1.29819	9	9.5503
β_9 L_IM_V	1.3358	1	9.2816	1.29025	9	9.6090
L_IN_{IV}	1.16227	9	10.6672	1.12250	9	11.0451
γ_{11} L_IN_V	1.16107	9	10.6782	1.12146	9	11.0553
L_IO_I				1.10664	9	11.2034
L_IO_{IV}				1.10086	9	11.2622
$L_{II}M_{II}$	1.53333	9	8.0858	1.48064	9	8.3735
β_{17} $L_{II}M_{III}$				1.43643	9	8.6312
$L_{II}N_V$				1.17788	9	10.5258
v $L_{II}N_{VI}$				1.15830	9	10.7037
$L_{II}O_{II,III}$	1.2014	1	10.3198			
t $L_{III}M_{II}$	1.7760	1	6.9810	1.72305	9	7.1954
s $L_{III}M_{III}$				1.66346	9	7.4532
$L_{III}N_{II}$				1.35887	9	9.1239
$L_{III}N_{III}$				1.35053	9	9.1802
u $L_{III}N_{VI,VII}$				1.30165	9	9.5249
$L_{III}O_{II,III}$	1.34524	9	9.2163			
$M_{III}N_I$				7.887	9	1.572
γ $M_{III}N_V$	6.768	6	1.832	6.544	4	1.895
ζ_2				9.686	7	1.2800
β $M_{IV}N_{VI}$	7.601	2	1.6312	7.303	1	1.6976
ζ_1				9.686	7	1.2800
α $M_VN_{VI,VII}$	7.840	2	1.5813	7.539	1	1.6446
$N_{IV}N_{VI}$	63.0	5	0.197			
$N_VN_{VI,VII}$	65.7	2	0.1886			
	73 Tantalum			**74 Tungsten**		
α_2 KL_{II}	0.220305	8	56.277	0.213828	2	57.9817
α_1 KL_{III}	0.215497	4	57.532	0.2090100	Std	59.31824
β_3 KM_{II}	0.190890	2	64.9488	0.185181	2	66.9514
β_1 KM_{III}	0.190089	4	65.223	0.184374	2	67.2443
β_2^{II} KN_{II}	0.185188	9	66.949	0.17960	1	69.031
β_2^{I} KN_{III}	0.185011	8	67.013	0.179421	7	69.101

Designation	Å*	p.e.	keV	Å*	p.e.	keV
	73 Tantalum (*Cont.*)			**74 Tungsten** (*Cont.*)		
$KO_{II,III}$	0.184031	7	67.370	0.178444	5	69.479
KL_I				0.21592	4	57.42
β_5^{II} KM_{IV}	0.188920	6	65.626	0.183264	5	67.652
β_5^{I} KM_V	0.188757	6	65.683	0.183092	7	67.715
β_4 $KN_{IV,V}$	0.18451	1	67.194	0.17892	2	69.294
β_4 L_IM_{II}	1.34581	3	9.2124	1.30162	5	9.5252
β_3 L_IM_{III}	1.30678	3	9.4875	1.26269	5	9.8188
γ_2 L_IN_{II}	1.1053	1	11.217	1.06806	3	11.6080
γ_3 L_IN_{III}	1.09936	4	11.2776	1.06200	6	11.6743
γ'_4 L_IO_{II}	1.06544	3	11.6366	1.02863	3	12.0530
γ_4 L_IO_{III}	1.06467	3	11.6451	1.02775	3	12.0634
η $L_{II}M_I$	1.47106	5	8.4280	1.42110	3	8.7243
β_1 $L_{II}M_{IV}$	1.32698	3	9.3431	1.281809	9	9.67235
γ_5 $L_{II}N_I$	1.1729	1	10.5702	1.13235	3	10.9490
γ_1 $L_{II}N_{IV}$	1.13794	3	10.8952	1.09855	3	11.2859
γ_8 $L_{II}O_I$	1.1205	1	11.0646	1.08113	4	11.4677
γ_6 $L_{II}O_{IV}$	1.11388	3	11.1306	1.07448	5	11.5387
l $L_{III}M_I$	1.72841	5	7.1731	1.6782	1	7.3878
α_2 $L_{III}M_{IV}$	1.53293	2	8.0879	1.48743	2	8.3352
α_1 $L_{III}M_V$	1.52197	2	8.1461	1.47639	2	8.3976
β_6 $L_{III}N_I$	1.33094	8	9.3153	1.28989	7	9.6117
β_{15} $L_{III}N_{IV}$	1.28619	5	9.6394	1.24631	3	9.9478
β_2 $L_{III}N_V$	1.28454	2	9.6518	1.24460	3	9.9615
β_7 $L_{III}O_I$	1.26385	5	9.8098	1.22400	4	10.1292
β_5 $L_{III}O_{IV,V}$	1.2555	1	9.8750	1.21545	3	10.2004
L_IM_I				1.3365	3	9.277
β_{10} L_IM_{IV}	1.2537	2	9.889	1.21218	3	10.2279
β_9 L_IM_V	1.2466	2	9.946	1.20479	7	10.2907
L_IN_I	1.11521	9	11.1173			
L_IN_{IV}	1.08377	7	11.4398	1.0468	2	11.844
γ_{11} L_IN_V	1.08205	7	11.4580	1.0458	1	11.856
$L_IN_{VI,VII}$	1.06357	9	11.6570			
L_IO_I	1.06771	9	11.6118	1.0317	3	12.017
$L_IO_{IV,V}$	1.06192	9	11.6752	1.0250	2	12.095
$L_{II}M_{II}$	1.43048	9	8.6671			
β_{17} $L_{II}M_{III}$	1.3864	1	8.9428	1.3387	2	9.261
$L_{II}M_V$	1.31897	9	9.3998	1.2728	2	9.741
$L_{II}N_{II}$	1.1600	2	10.688	1.1218	3	11.052
$L_{II}N_{III}$	1.1553	1	10.7316	1.1149	2	11.120
$L_{II}N_V$	1.13687	9	10.9055			
v $L_{II}N_{VI}$	1.1158	1	11.1113	1.0771	1	11.510
$L_{II}O_{II}$	1.11789	9	11.0907			
$L_{II}O_{III}$	1.11693	9	11.1001	1.0792	2	11.488
t $L_{III}M_{II}$	1.67265	9	7.4123	1.6244	3	7.632
s $L_{III}M_{III}$	1.61264	9	7.6881	1.5642	3	7.926
$L_{III}N_{II}$	1.3167	1	9.4158	1.2765	2	9.712
$L_{III}N_{III}$	1.3086	1	9.4742	1.2672	2	9.784
u $L_{III}N_{VI,VII}$	1.25778	4	9.8572	1.21868	5	10.1733
$L_{III}O_{II,III}$	1.2601	3	9.839	1.2211	2	10.153
M_IN_{III}	5.40	2	2.295	5.172	9	2.397
$M_IO_{II,III}$				4.44	2	2.79
$M_{II}N_I$				6.28	2	1.973
$M_{II}N_{IV}$	5.570	4	2.226	5.357	4	2.314
$M_{III}N_I$	7.612	9	1.629	7.360	8	1.684
$M_{III}N_{IV}$	6.353	5	1.951	6.134	4	2.021
γ $M_{III}N_V$	6.312	4	1.964	6.092	3	2.035
$M_{III}O_I$	5.83	2	2.126	5.628	8	2.203
$M_{III}O_{IV,V}$	5.67	3	2.19			

Designation	Å*	p.e.	keV	Å*	p.e.	keV
	73 Tantalum (*Cont.*)			**74 Tungsten** (*Cont.*)		
$\zeta_2\ M_{IV}N_{II}$	9.330	5	1.3288	8.993	5	1.3787
$M_{IV}N_{III}$	8.90	2	1.393	8.573	8	1.446
$\beta\ M_{IV}N_{VI}$	7.023	1	1.7655	6.757	1	1.8349
$M_{IV}O_{II}$	7.09	2	1.748	6.806	9	1.822
$\zeta_1\ M_{V}N_{III}$	9.316	4	1.3308	8.962	4	1.3835
$\alpha\ M_{V}N_{VI,VII}$	7.252	1	1.7096			
$\alpha_2\ M_{V}N_{VI}$				6.992	2	1.7731
$\alpha_1\ M_{V}N_{VII}$				6.983	1	1.7754
$M_{V}O_{III}$	7.30	2	1.700	7.005	9	1.770
$N_{II}N_{IV}$				54.0	2	0.2295
$N_{IV}N_{VI}$	58.2	1	0.2130	55.8	1	0.2221
$N_{V}N_{VI,VII}$	61.1	2	0.2028			
$N_{V}N_{VI}$				59.5	3	0.208
$N_{V}N_{VII}$				58.4	1	0.2122
	75 Rhenium			**76 Osmium**		
$\alpha_2\ KL_{II}$	0.207611	1	59.7179	0.201639	2	61.4867
$\alpha_1\ KL_{III}$	0.202781	2	61.1403	0.196794	2	63.0005
$\beta_3\ KM_{II}$	0.179697	3	68.994	0.174431	3	71.077
$\beta_1\ KM_{III}$	0.178880	3	69.310	0.173611	3	71.413
$\beta_2^{II}\ KN_{II}$	0.17425	1	71.151	0.16910	1	73.318
$\beta_2^{I}\ KN_{III}$	0.174054	6	71.232	0.168906	6	73.402
$KO_{II,III}$	0.17308	1	71.633	0.16798	1	73.808
$\beta_5^{II}\ KM_{IV}$	0.17783	1	69.719	0.17262	1	71.824
$\beta_5^{I}\ KM_{V}$	0.17766	1	69.786	0.17245	1	71.895
$\beta_4\ KN_{IV,V}$	0.17362	2	71.410	0.16842	2	73.615
$\beta_4\ L_{I}M_{II}$	1.25917	5	9.8463	1.21844	5	10.1754
$\beta_3\ L_{I}M_{III}$	1.22031	5	10.1598	1.17955	7	10.5108
$\gamma_2\ L_{I}N_{II}$	1.03233	5	12.0098	0.99805	5	12.4224
$\gamma_3\ L_{I}N_{III}$	1.02613	7	12.0824	0.99186	5	12.4998
$\gamma'_4\ L_{I}O_{II}$	0.99334	5	12.4813	0.96033	8	12.910
$\gamma_4\ L_{I}O_{III}$	0.99249	5	12.4920	0.95938	8	12.923
$\eta\ L_{II}M_{I}$	1.37342	5	9.0272	1.32785	7	9.3370
$\beta_1\ L_{II}M_{IV}$	1.23858	2	10.0100	1.19727	7	10.3553
$\gamma_5\ L_{II}N_{I}$	1.09388	5	11.3341	1.05693	5	11.7303
$\gamma_1\ L_{II}N_{IV}$	1.06099	5	11.6854	1.02503	5	12.0953
$\gamma_8\ L_{II}O_{I}$	1.04398	5	11.8758	1.00788	5	12.3012
$\gamma_6\ L_{II}O_{IV}$	1.03699	9	11.956	1.00107	5	12.3848
$l\ L_{III}M_{I}$	1.63056	5	7.6036	1.58498	7	7.8222
$\alpha_2\ L_{III}M_{IV}$	1.44396	5	8.5862	1.40234	5	8.8410
$\alpha_1\ L_{III}M_{V}$	1.43290	4	8.6525	1.39121	5	8.9117
$\beta_6\ L_{III}N_{I}$	1.25100	5	9.9105	1.21349	5	10.2169
$\beta_{15}\ L_{III}N_{IV}$	1.20819	5	10.2617	1.17167	5	10.5816
$\beta_2\ L_{III}N_{V}$	1.20660	4	10.2752	1.16979	8	10.5985
$\beta_7\ L_{III}O_{I}$	1.18610	5	10.4529	1.14933	8	10.7872
$\beta_5\ L_{III}O_{IV,V}$	1.17721	5	10.5318	1.1405	1	10.8711
$\beta_{10}\ L_{I}M_{IV}$	1.17218	5	10.5770	1.13353	5	10.9376
$\beta_9\ L_{I}M_{V}$	1.16487	4	10.6433	1.12637	6	11.0071
$L_{I}N_{I}$	1.0420	1	11.899			
$L_{I}N_{IV}$	1.0119	1	12.252	0.9772	3	12.687
$\gamma_{11}\ L_{I}N_{V}$	1.0108	1	12.266	0.9765	3	12.696
$L_{I}O_{I}$	0.9965	1	12.442	0.96318	7	12.8721
$L_{I}O_{IV,V}$	0.9900	1	12.524	0.95603	5	12.9683
$L_{II}M_{II}$	1.3366	1	9.2761	1.2934	2	9.586
$\beta_{17}\ L_{II}M_{III}$	1.2927	1	9.5910	1.2480	2	9.934

Designation	Å*	p.e.	keV	Å*	p.e.	keV
	75 Rhenium (*Cont.*)			**76 Osmium** (*Cont.*)		
$L_{II}M_{V}$	1.2305	1	10.0753	1.18977	7	10.4205
$L_{II}N_{II}$	1.0839	1	11.438			
$L_{II}N_{III}$	1.0767	1	11.515	1.03973	5	11.9243
$v\ L_{II}N_{VI}$	1.0404	1	11.917	1.0050	2	12.337
$L_{II}O_{III}$	1.0397	1	11.925	1.0047	2	12.340
$t\ L_{III}M_{II}$	1.5789	1	7.8525	1.5347	2	8.079
$s\ L_{III}M_{III}$	1.5178	1	8.1682	1.4735	2	8.414
$L_{III}N_{I}$				1.20086	7	10.3244
$L_{III}N_{III}$	1.2283	1	10.0933			
$u\ L_{III}N_{VI,VII}$	1.1815	1	10.4931	1.14537	7	10.8245
$M_{I}N_{III}$				4.79	2	2.59
$M_{II}N_{I}$				5.81	2	2.133
$M_{II}N_{IV}$				4.955	4	2.502
$M_{III}N_{I}$				6.89	2	1.798
$M_{III}N_{IV}$	5.931	5	2.090	5.724	5	2.166
$\gamma\ M_{III}N_{V}$	5.885	2	2.1067	5.682	4	2.182
$\zeta_2\ M_{IV}N_{II}$	8.664	5	1.4310	8.359	5	1.4831
$M_{IV}N_{III}$	8.239	8	1.505			
$\beta\ M_{IV}N_{VI}$	6.504	1	1.9061	6.267	1	1.9783
$\zeta_1\ M_{V}N_{III}$	8.629	4	1.4368	8.310	4	1.4919
$\alpha\ M_{V}N_{VI,VII}$	6.729	1	1.8425	6.490	1	1.9102
$N_{IV}N_{VI}$				51.9	1	0.2388
$N_{V}N_{VI,VII}$				54.7	2	0.2266
	77 Iridium			**78 Platinum**		
$\alpha_2\ KL_{II}$	0.195904	2	63.2867	0.190381	4	65.122
$\alpha_1\ KL_{III}$	0.191047	2	64.8956	0.185511	4	66.832
$\beta_3\ KM_{II}$	0.169367	2	73.2027	0.164501	3	75.368
$\beta_1\ KM_{III}$	0.168542	2	73.5608	0.163675	3	75.748
$\beta_2^{II}\ KN_{II}$	0.16415	1	75.529	0.15939	1	77.785
$\beta_2^{I}\ KN_{III}$	0.163956	7	75.619	0.15920	1	77.878
$KO_{II,III}$	0.163019	5	76.053	0.15826	1	78.341
$\beta_5^{II}\ KM_{IV}$	0.16759	2	73.980	0.16271	2	76.199
$\beta_5^{I}\ KM_{V}$	0.167373	9	74.075	0.16255	3	76.27
$\beta_4\ KN_{IV,V}$	0.16352	2	75.821	0.15881	2	78.069
$\beta_4\ L_{I}M_{II}$	1.17958	3	10.5106	1.14223	5	10.8543
$\beta_3\ L_{I}M_{III}$	1.14085	3	10.8674	1.10394	5	11.2308
$\gamma_2\ L_{I}N_{II}$	0.96545	3	12.8418	0.93427	5	13.2704
$\gamma_3\ L_{I}N_{III}$	0.95931	5	12.9240	0.92791	5	13.3613
$\gamma'_4\ L_{I}O_{II}$	0.92831	3	13.3555	0.89747	4	13.8145
$\gamma_4\ L_{I}O_{III}$	0.92744	3	13.3681	0.89659	4	13.8281
$\eta\ L_{II}M_{I}$	1.28448	3	9.6522	1.2429	2	9.975
$\beta_1\ L_{II}M_{IV}$	1.15781	3	10.7083	1.11990	2	11.0707
$\gamma_5\ L_{II}N_{I}$	1.02175	5	12.1342	0.9877	2	12.552
$\gamma_1\ L_{II}N_{IV}$	0.99085	3	12.5126	0.95797	3	12.9420
$\gamma_8\ L_{II}O_{I}$	0.97409	3	12.7279	0.9411	1	13.173
$\gamma_6\ L_{II}O_{IV}$	0.96708	4	12.8201	0.9342	2	13.271
$l\ L_{III}M_{I}$	1.54094	3	8.0458	1.4995	2	8.268
$\alpha_2\ L_{III}M_{IV}$	1.36250	5	9.0995	1.32432	2	9.3618
$\alpha_1\ L_{III}M_{V}$	1.35128	3	9.1751	1.31304	3	9.4423
$\beta_6\ L_{III}N_{I}$	1.17796	3	10.5251	1.14355	5	10.8418
$\beta_{15}\ L_{III}N_{IV}$	1.13707	3	10.9036			
$\beta_2\ L_{III}N_{V}$	1.13532	3	10.9203	1.10200	3	11.2505
$\beta_7\ L_{III}O_{I}$	1.11489	3	11.1205	1.08168	3	11.4619

Designation	Å*	p.e.	keV	Å*	p.e.	keV
	77 Iridium (*Cont.*)			**78 Platinum** (*Cont.*)		
$\beta_5\ L_{III}O_{IV,V}$	1.10585	3	11.2114	1.0724	2	11.561
L_IM_I	1.2102	2	10.245	1.16962	9	10.6001
$\beta_{10}\ L_IM_{IV}$	1.09702	4	11.3016	1.06183	7	11.6762
$\beta_9\ L_IM_V$	1.08975	5	11.3770	1.05446	5	11.7577
L_IN_I	0.9766	2	12.695	0.9455	2	13.113
L_IN_{IV}	0.9459	2	13.108			
$\gamma_{11}\ L_IN_V$	0.9446	2	13.126	0.9143	2	13.560
$L_IO_{IV,V}$	0.9243	3	13.413			
L_IO_I				0.8995	2	13.784
L_IO_{IV}				0.8943	1	13.864
L_IO_V				0.8934	1	13.878
$L_{II}M_{II}$	1.2502	3	9.917	1.213	1	10.225
$\beta_{17}\ L_{II}M_{III}$	1.2069	2	10.273	1.1667	1	10.6265
$L_{II}M_V$	1.1489	2	10.791	1.1129	2	11.140
$L_{II}N_{II}$	1.0120	2	12.251	0.9792	2	12.661
$L_{II}N_{III}$	1.0054	3	12.332	0.97173	4	12.7588
$v\ L_{II}N_{VI}$	0.97161	6	12.7603	0.93931	5	13.1992
$L_{II}O_{III}$	0.96979	5	12.7843			
$t\ L_{III}M_{II}$	1.4930	3	8.304	1.4530	2	8.533
$s\ L_{III}M_{III}$	1.4318	2	8.659	1.3895	2	8.923
$L_{III}N_{II}$	1.16545	5	10.6380	1.1310	2	10.962
$L_{III}N_{III}$	1.1560	3	10.725	1.1226	2	11.044
$u\ L_{III}N_{VI,VII}$	1.11145	4	11.1549	1.07896	5	11.4908
$L_{III}O_{II,III}$	1.10923	6	11.1772	1.0761	3	11.521
M_IN_{III}	4.631†	9	2.677	4.460	9	2.780
$M_{II}N_{IV}$	4.780	4	2.594	4.601	4	2.695
$M_{III}N_I$	6.669	9	1.859	6.455	9	1.921
$M_{III}N_{IV}$	5.540	5	2.238	5.357	5	2.314
$\gamma\ M_{III}N_V$	5.500	4	2.254	5.319	4	2.331
$M_{III}O_I$				4.876	9	2.543
$M_{III}O_{IV,V}$	4.869	9	2.546	4.694	8	2.641
$\zeta_2\ M_{IV}N_{II}$	8.065	5	1.5373	7.790	5	1.592
$M_{IV}N_{III}$	7.645	8	1.622	7.371	8	1.682
$\beta\ M_{IV}N_{VI}$	6.038	1	2.0535	5.828	1	2.1273
$\zeta_1\ M_VN_{III}$	8.021	4	1.5458	7.738	4	1.6022
$\alpha_2\ M_VN_{VI}$	6.275	3	1.9758	6.058	3	2.047
$\alpha_1\ M_VN_{VII}$	6.262	1	1.9799	6.047	1	2.0505
M_VO_{III}				5.987	9	2.071
$N_{IV}N_{VI}$	50.2	1	0.2470	48.1	2	0.258
$N_VN_{VI,VII}$	52.8	1	0.2348	50.9	1	0.2436
	79 Gold			**80 Mercury**		
$\alpha_2\ KL_{II}$	0.185075	2	66.9895	0.179958	3	68.895
$\alpha_1\ KL_{III}$	0.180195	2	68.8037	0.175068	3	70.819
$\beta_3\ KM_{II}$	0.159810	2	77.580	0.155321	3	79.822
$\beta_1\ KM_{III}$	0.158982	3	77.984	0.154487	3	80.253
$\beta_2^{II}\ KN_{II}$	0.15483	2	80.08	0.15040	2	82.43
$\beta_2^{I}\ KN_{III}$	0.154618	9	80.185	0.15020	2	82.54
$KO_{II,III}$	0.153694	7	80.667	0.14931	2	83.04
KL_I	0.18672	4	66.40			
$\beta_5^{II}\ KM_{IV}$	0.158062	7	78.438			
$\beta_5^{I}\ KM_V$	0.157880	5	78.529			
$\beta_5\ KM_{IV,V}$				0.15353	2	80.75
$\beta_4\ KN_{IV,V}$	0.154224	5	80.391	0.14978	2	82.78
$\beta_4\ L_IM_{II}$	1.10651	3	11.2047	1.07222	7	11.5630
$\beta_3\ L_IM_{III}$	1.06785	9	11.6103	1.03358	7	11.9953

Designation	Å*	p.e.	keV	Å*	p.e.	keV
	79 Gold (*Cont.*)			**80 Mercury** (*Cont.*)		
$\gamma_2\ L_IN_{II}$	0.90434	3	13.7095	0.87544	7	14.162
$\gamma_3\ L_IN_{III}$	0.89783	5	13.8090	0.86915	7	14.265
$\gamma'_4\ L_IO_{II}$	0.86816	4	14.2809	0.84013	7	14.757
$\gamma_4\ L_IO_{III}$	0.86703	4	14.2996	0.83894	7	14.778
$\eta\ L_{II}M_I$	1.20273	3	10.3083	1.1640	1	10.6512
$\beta_1\ L_{II}M_{IV}$	1.08353	3	11.4423	1.04868	5	11.8226
$\gamma_5\ L_{II}N_I$	0.95559	3	12.9743	0.92453	7	13.410
$\gamma_1\ L_{II}N_{IV}$	0.92650	3	13.3817	0.89646	5	13.8301
$\gamma_8\ L_{II}O_I$	0.90989	5	13.6260	0.87995	7	14.090
$\gamma_6\ L_{II}O_{IV}$	0.90297	3	13.7304	0.87319	7	14.199
$l\ L_{III}M_I$	1.45964	9	8.4939	1.4216	1	8.7210
$\alpha_2\ L_{III}M_{IV}$	1.28772	3	9.6280	1.25264	7	9.8976
$\alpha_1\ L_{III}M_V$	1.27640	3	9.7133	1.24120	5	9.9888
$\beta_6\ L_{III}N_I$	1.11092	3	11.1602	1.07975	7	11.4824
$\beta_{15}\ L_{III}N_{IV}$	1.07188	5	11.5667	1.04151	7	11.9040
$\beta_2\ L_{III}N_V$	1.07022	3	11.5847	1.03975	7	11.9241
$\beta_7\ L_{III}O_I$	1.04974	8	11.8106	1.01937	7	12.1625
$\beta_5\ L_{III}O_{IV,V}$	1.04044	3	11.9163	1.00987	7	12.2769
L_IM_I	1.13525	5	10.9210	1.0999	2	11.272
$\beta_{10}\ L_IM_{IV}$	1.02789	7	12.0617	0.9962	2	12.446
$\beta_9\ L_IM_V$	1.02063	7	12.1474	0.9871	2	12.560
L_IN_I	0.9131	1	13.578	0.8827	2	14.045
L_IN_{IV}	0.88563	7	13.999			
$\gamma_{11}\ L_IN_V$	0.88433	7	14.020	0.85657	7	14.474
L_IO_I	0.87074	5	14.2385	0.8452	2	14.670
$L_IO_{IV,V}$	0.86400	5	14.3497	0.8350	2	14.847
$L_{II}M_{II}$	1.1708	1	10.5892	1.1387	5	10.888
$\beta_{17}\ L_{II}M_{III}$	1.12798	5	10.9915	1.0916	5	11.358
$L_{II}M_V$	1.0756	2	11.526			
$L_{II}N_{III}$	0.9402	2	13.186	0.90894	7	13.640
$v\ L_{II}N_{VI}$	0.90837	5	13.6487	0.87885	7	14.107
$L_{II}O_{II}$	0.90746	7	13.662	0.8784	1	14.114
$L_{II}O_{III}$	0.90638	7	13.679	0.8758	1	14.156
$t\ L_{III}M_{II}$	1.41366	7	8.7702	1.3746	2	9.019
$s\ L_{III}M_{III}$	1.35131	7	9.1749	1.3112	2	9.455
$L_{III}N_{II}$	1.09968	7	11.2743	1.0649	2	11.642
$L_{III}N_{III}$	1.09026	7	11.3717	1.0585	1	11.713
$u\ L_{III}N_{VI,VII}$	1.04752	5	11.8357			
$u'\ L_{III}N_{VI}$				1.01769	7	12.1826
$u\ L_{III}N_{VII}$				1.01674	7	12.1940
$L_{III}O_{II,III}$	1.0450	2	11.865			
$L_{III}O_{II}$				1.01558	7	12.2079
$L_{III}O_{III}$				1.01404	7	12.2264
$L_{III}P_{II,III}$	1.03876	7	11.9355			
M_IN_{III}	4.300	9	2.883			
$M_{II}N_{IV}$	4.432	4	2.797			
$M_{III}N_I$	6.259	9	1.981	6.09	2	2.036
$M_{III}N_{IV}$	5.186	5	2.391			
$\gamma\ M_{III}N_V$	5.145	4	2.410	4.984†	2	2.4875
$M_{III}O_I$	4.703	9	2.636			
$M_{III}O_{IV,V}$	4.522	6	2.742			
$\zeta_2\ M_{IV}N_{II}$	7.523	5	1.648			
$M_{IV}N_{III}$	7.101	8	1.746	6.87	2	1.805
$\beta\ M_{IV}N_{VI}$	5.624	1	2.2046	5.4318†	9	2.2825
$\zeta_1\ M_VN_{III}$	7.466	4	1.6605			
$\alpha_2\ M_VN_{VI}$	5.854	3	2.118			

Designation	Å*	p.e.	keV	Å*	p.e.	keV
	79 Gold (*Cont.*)			**80 Mercury** (*Cont.*)		
$\alpha_1\ M_VN_{VII}$	5.840	1	2.1229	5.6476†	9	2.1953
M_VO_{III}	5.767	9	2.150			
$N_{IV}N_{VI}$	46.8	2	0.265	45.2†	3	0.274
$N_VN_{VI,VII}$	49.4	1	0.2510	47.9†	3	0.259
	81 Thallium			**82 Lead**		
$\alpha_2\ KL_{II}$	0.175036	2	70.8319	0.170294	2	72.8042
$\alpha_1\ KL_{III}$	0.170136	2	72.8715	0.165376	2	74.9694
$\beta_3\ KM_{II}$	0.150980	6	82.118	0.146810	4	84.450
$\beta_1\ KM_{III}$	0.150142	5	82.576	0.145970	6	84.936
$\beta_2^{II}\ KN_{II}$	0.14614	1	84.836	0.14212	2	87.23
$\beta_2^{I}\ KN_{III}$	0.14595	1	84.946	0.14191	1	87.364
$KO_{II,III}$	0.14509	1	85.451	0.141012	8	87.922
KP				0.1408	1	88.06
$\beta_5\ KM_{IV,V}$	0.14917	1	83.114			
$\beta_5^{II}\ KM_{IV}$				0.14512	2	85.43
$\beta_5^{I}\ KM_V$				0.14495	3	85.53
$\beta_4\ KN_{IV,V}$	0.14553	2	85.19	0.14155	3	87.59
$\beta_4\ L_IM_{II}$	1.03918	3	11.9306	1.0075	1	12.306
$\beta_3\ L_IM_{III}$	1.00062	3	12.3904	0.96911	7	12.7933
$\gamma_2\ L_IN_{II}$	0.84773	5	14.6251	0.8210	2	15.101
$\gamma_3\ L_IN_{III}$	0.84130	4	14.7368	0.8147	1	15.218
$\gamma'_4\ L_IO_{II}$	0.81308	5	15.2482	0.78706	7	15.752
$\gamma_4\ L_IO_{III}$	0.81184	5	15.2716	0.7858	1	15.777
$\eta\ L_{II}M_I$	1.12769	3	10.9943	1.09241	7	11.3493
$\beta_1\ L_{II}M_{IV}$	1.01513	4	12.2133	0.98291	3	12.6137
$\gamma_5\ L_{II}N_I$	0.89500	4	13.8526	0.86655	5	14.3075
$\gamma_1\ L_{II}N_{IV}$	0.86752	3	14.2915	0.83973	3	14.7644
$\gamma_8\ L_{II}O_I$	0.8513	2	14.564	0.82365	5	15.0527
$\gamma_6\ L_{II}O_{IV}$	0.8442	2	14.685	0.81683	5	15.1783
$L_{II}P_I$				0.81583	5	15.1969
$l\ L_{III}M_I$	1.38477	3	8.9532	1.34990	7	9.1845
$\alpha_2\ L_{III}M_{IV}$	1.21875	3	10.1728	1.18648	5	10.4495
$\alpha_1\ L_{III}M_V$	1.20739	4	10.2685	1.17501	2	10.5515
$\beta_6\ L_{III}N_I$	1.04963	5	11.8118	1.0210	1	12.143
$\beta_{15}\ L_{III}N_{IV}$	1.01201	3	12.2510	0.98389	7	12.6011
$\beta_2\ L_{III}N_V$	1.01031	3	12.2715	0.98221	7	12.6226
$\beta_7\ L_{III}O_I$	0.99017	5	12.5212	0.9620	1	12.888
$\beta_5\ L_{III}O_{IV,V}$	0.98058	3	12.6436	0.9526	1	13.015
L_IM_I	1.0644	2	11.648	1.0323	2	12.010
$\beta_{10}\ L_IM_{IV}$	0.96389	7	12.8626	0.9339	2	13.275
$\beta_9\ L_IM_V$	0.95675	7	12.9585	0.9268	1	13.377
L_IN_I	0.8549	1	14.503	0.82859	7	14.963
L_IN_{IV}	0.83001	7	14.937	0.80364	7	15.427
$\gamma_{11}\ L_IN_V$	0.82879	5	14.9593	0.80233	9	15.453
$L_IN_{VI,VII}$				0.7884	1	15.725
L_IO_I	0.8158	1	15.198	0.7897	1	15.699
$L_IO_{IV,V}$	0.80861	5	15.3327	0.78257	7	15.843
$L_{II}M_{II}$	1.0997	1	11.274	1.0644	2	11.648
$\beta_{17}\ L_{II}M_{III}$	1.05609	7	11.7397	1.0223	1	12.127
$L_{II}M_V$	1.00722	5	12.3093	0.9747	1	12.720
$L_{II}N_{II}$	0.882	2	14.057	0.8585	3	14.442

Designation	Å*	p.e.	keV	Å*	p.e.	keV
	81 Thallium (*Cont.*)			**82 Lead** (*Cont.*)		
$L_{II}N_{III}$	0.87996	5	14.0893	0.85192	7	14.553
$L_{II}N_V$				0.8382	2	14.791
$v\ L_{II}N_{VI}$	0.85048	5	14.5777	0.82327	7	15.060
$L_{II}O_{II}$	0.8490	1	14.604			
$L_{II}O_{III}$				0.8200	1	15.120
$t\ L_{III}M_{II}$	1.34154	5	9.2417	1.30767	7	9.4811
$s\ L_{III}M_{III}$	1.27807	5	9.7007	1.24385	7	9.9675
$L_{III}N_{II}$				1.01040	7	12.2705
$L_{III}N_{III}$	1.0286	1	12.053	1.0005	1	12.392
$u\ L_{III}N_{VI,VII}$	0.9888	1	12.538	0.96133	7	12.8968
$L_{III}O_{II}$	0.98738	5	12.5566	0.9586	1	12.934
$L_{III}O_{III}$	0.98538	5	12.5820	0.9578	1	12.945
$L_{III}P_{II,III}$	0.97926	5	12.6607	0.95118	7	13.0344
M_IN_{III}	4.013	9	3.089	3.872	9	3.202
$M_{II}N_I$				4.655	8	2.664
$M_{II}N_{IV}$	4.116	4	3.013	3.968	5	3.124
$M_{III}N_I$	5.884	8	2.107	5.704	8	2.174
$M_{III}N_{IV}$	4.865	5	2.548	4.715	3	2.630
$\gamma\ M_{III}N_V$	4.823	4	2.571	4.674	1	2.6527
$M_{III}O_I$				4.244	9	2.921
$M_{II}O_{IV,V}$	4.216	6	2.941	4.069	6	3.047
$\zeta_2\ M_{IV}N_{II}$	7.032	5	1.763	6.802	5	1.823
$M_{IV}N_{III}$				6.384	7	1.942
$\beta\ M_{IV}N_{VI}$	5.249	1	2.3621	5.076	1	2.4427
$M_{IV}O_{II}$	5.196	9	2.386	5.004	9	2.477
$\zeta_1\ M_VN_{III}$	6.974	4	1.778	6.740	3	1.8395
$\alpha_2\ M_VN_{VI}$	5.472	2	2.2656	5.299	2	2.3397
$\alpha_1\ M_VN_{VII}$	5.460	1	2.2706	5.286	1	2.3455
M_VO_{III}				5.168	9	2.399
$N_{IV}N_{VI}$				42.3	2	0.293
$N_VN_{VI,VII}$	46.5	2	0.267	45.0	1	0.2756
$N_{VI}O_{IV}$	115.3	2	0.1075	102.4	1	0.1211
$N_{VI}O_V$	113.0	1	0.10968	100.2	2	0.1237
$N_{VII}O_V$	117.7	1	0.10530	104.3	1	0.1189
	83 Bismuth			**84 Polonium**		
$\alpha_2\ KL_{II}$	0.165717	2	74.8148	0.16130†	1	76.862
$\alpha_1\ KL_{III}$	0.160789	2	77.1079	0.15636†	1	79.290
$\beta_3\ KM_{II}$	0.142779	7	86.834	0.13892†	2	89.25
$\beta_1\ KM_{III}$	0.141948	3	87.343	0.13807†	2	89.80
$\beta_2^{II}\ KN_{II}$	0.13817	1	89.733	0.13438†	2	92.26
$\beta_2^{I}\ KN_{III}$	0.13797	1	89.864	0.13418†	2	92.40
$KO_{II,III}$	0.13709	1	90.435			
$\beta_5\ KM_{IV,V}$	0.14111	1	87.860			
$\beta_4\ KN_{IV,V}$	0.13759	2	90.11			
$\beta_4\ L_IM_{II}$	0.97690	4	12.6912	0.9475	3	13.086
$\beta_3\ L_IM_{III}$	0.93855	3	13.2098	0.9091	3	13.638
$\gamma_2\ L_IN_{II}$	0.79565	3	15.5824	0.772	1	16.07
$\gamma_3\ L_IN_{III}$	0.78917	5	15.7102			
$\gamma'_4\ L_IO_{II}$	0.76198	3	16.2709			
$\gamma_4\ L_IO_{III}$	0.76087	3	16.2947			
$\gamma_{13}\ L_IP_{II,III}$	0.75690	3	16.3802			
$\eta\ L_{II}M_I$	1.05856	3	11.7122			
$\beta_1\ L_{II}M_{IV}$	0.951978	9	13.0235	0.9220	2	13.447
$\gamma_5\ L_{II}N_I$	0.83923	5	14.7732			

Designation	Å*	p.e.	keV	Å*	p.e.	keV
	83 Bismuth (*Cont.*)			**84 Pononium** (*Cont.*)		
$\gamma_1\ L_{II}N_{IV}$	0.81311	2	15.2477	0.78748	9	15.744
$\gamma_8\ L_{II}O_I$	0.7973	1	15.551			
$\gamma_6\ L_{II}O_{IV}$	0.79043	3	15.6853	0.7645	2	16.218
$l\ L_{III}M_I$	1.31610	7	9.4204	1.2829	5	9.664
$\alpha_2\ L_{III}M_{IV}$	1.15536	1	10.73091	1.12548†	5	11.0158
$\alpha_1\ L_{III}M_V$	1.14386	2	10.8388	1.11386	4	11.1308
$\beta_6\ L_{III}N_I$	0.99331	3	12.4816	0.9672	2	12.819
$\beta_{15}\ L_{III}N_{IV}$	0.95702	5	12.9549	0.9312	2	13.314
$\beta_2\ L_{III}N_V$	0.95518	4	12.9799	0.92937	5	13.3404
$\beta_7\ L_{III}O_I$	0.93505	5	13.2593			
$\beta_5\ L_{III}O_{IV,V}$	0.92556	3	13.3953	0.8996	2	13.782
L_IM_I	1.0005	9	12.39			
$\beta_{10}\ L_IM_{IV}$	0.90495	4	13.7002			
$\beta_9\ L_IM_V$	0.89791	3	13.8077			
L_IN_I	0.8022	1	15.456			
L_IN_{IV}	0.7795	5	15.904			
$\gamma_{11}\ L_IN_V$	0.77728	5	15.951			
$L_IN_{VI,VII}$	0.7641	5	16.23			
$L_IO_{IV,V}$	0.75791	5	16.358			
$L_{II}M_{II}$	1.0346	9	11.98			
$\beta_{17}\ L_{II}M_{III}$	0.98913	5	12.5344			
$L_{II}M_V$	0.94419	5	13.1310			
$L_{II}N_{II}$	0.8344	9	14.86			
$L_{II}N_{III}$	0.8248	1	15.031			
$v\ L_{II}N_{VI}$	0.79721	9	15.552			
$L_{II}O_{III}$	0.79384	5	15.6178			
$t\ L_{III}M_{II}$	1.2748	1	9.7252			
$s\ L_{III}M_{III}$	1.2105	1	10.2421			
$L_{III}N_{II}$	0.98280	5	12.6151			
$L_{III}N_{III}$	0.97321	5	12.7394			
$u\ L_{III}N_{VI,VII}$	0.93505	5	13.2593			
$L_{III}O_{II}$	0.9323	2	13.298			
$L_{III}O_{III}$	0.9302	2	13.328			
$L_{III}P_{II,III}$	0.92413	4	13.4159			
M_IN_{II}	3.892	9	3.185			
M_IN_{III}	3.740	9	3.315			
$M_{II}N_{IV}$	3.834	4	3.234			
$M_{III}N_I$	5.537	8	2.239			
$M_{III}N_{IV}$	4.571	5	2.712			
$\gamma\ M_{III}N_V$	4.532	2	2.735			
$M_{III}O_I$	4.105	9	3.021			
$M_{III}O_{IV,V}$	3.932	6	3.153			
$\zeta_2\ M_{IV}N_{II}$	6.585	5	1.883			
$M_{IV}N_{III}$	6.162	8	2.012			
$\beta\ M_{IV}N_{VI}$	4.909	1	2.5255			
$M_{IV}O_{II}$	4.823	3	2.571			
$M_{IV}P_{II,III}$	4.59	2	2.70			
$\zeta_1\ M_VN_{III}$	6.521	4	1.901			
$\alpha_2\ M_VN_{VI}$	5.130	2	2.4170			
$\alpha_1\ M_VN_{VII}$	5.118	1	2.4226			
$N_IP_{II,III}$	13.30	6	0.932			
$N_{VI}O_{IV}$	91.6	1	0.1354			
$N_{VII}O_V$	93.2	1	0.1330			

Designation	Å*	p.e.	keV	Å*	p.e.	keV
	85 Astatine			**86 Radon**		
$\alpha_2\ KL_{II}$	0.15705†	2	78.95	0.15294†	3	81.07
$\alpha_1\ KL_{III}$	0.15210†	2	81.52	0.14798†	3	83.78
$\beta_3\ KM_{II}$	0.13517†	4	91.72	0.13155†	5	94.24
$\beta_1\ KM_{III}$	0.13432†	4	92.30	0.13069†	5	94.87
$\beta_2^{II}\ KN_{II}$	0.13072†	4	94.84	0.12719†	5	97.47
$\beta_2^{I}\ KN_{III}$	0.13052†	4	94.99	0.12698†	5	97.64
$\beta_3\ L_IM_{III}$	0.88135†	9	14.067	0.85436†	9	14.512
$\beta_1\ L_{II}M_{IV}$	0.89349†	9	13.876	0.86605†	9	14.316
$\gamma_1\ L_{II}N_{IV}$	0.76289†	9	16.251	0.73928†	9	16.770
$\alpha_2\ L_{III}M_{IV}$	1.09671†	5	11.3048	1.06899†	5	11.5979
$\alpha_1\ L_{III}M_V$	1.08500†	5	11.4268	1.05723†	5	11.7270
	87 Francium			**88 Radium**		
$\alpha_2\ KL_{II}$	0.14896†	3	83.23	0.14512†	2	85.43
$\alpha_1\ KL_{III}$	0.14399†	3	86.10	0.14014†	2	88.47
$\beta_3\ KM_{II}$	0.12807†	5	96.81	0.12469†	3	99.43
$\beta_1\ KM_{III}$	0.12719†	5	97.47	0.12382†	3	100.13
$\beta_2^{II}\ KN_{II}$	0.12379†	5	100.16	0.12050†	3	102.89
$\beta_2^{I}\ KN_{III}$	0.12358†	5	100.33	0.12029†	3	103.07
$\beta_4\ L_IM_{II}$				0.84071	5	14.7472
$\beta_3\ L_IM_{III}$	0.82789†	9	14.976	0.80273	5	15.4449
$\gamma_2\ L_IN_{II}$				0.68199	5	18.179
$\gamma_3\ L_IN_{III}$				0.67538	5	18.357
$\gamma'_4\ L_IO_{II}$				0.65131	5	19.036
$\gamma_4\ L_IO_{III}$				0.64965	5	19.084
$\gamma_{13}\ L_IP_{II,III}$				0.64513	5	19.218
$\eta\ L_{II}M_I$				0.90742	5	13.6630
$\beta_1\ L_{II}M_{IV}$	0.83940†	9	14.770	0.81375	5	15.2358
$\gamma_5\ L_{II}N_I$				0.71774	5	17.274
$\gamma_1\ L_{II}N_{IV}$	0.71652†	9	17.303	0.69463	5	17.849
γ_8				0.6801	1	18.230
$\gamma_6\ L_{II}O_{IV}$				0.67328	5	18.414
$L_{II}P_I$				0.6724	1	18.439
$l\ L_{III}M_I$				1.16719	5	10.6222
$\alpha_2\ L_{III}M_{IV}$	1.04230	5	11.8950	1.01656	5	12.1962
$\alpha_1\ L_{III}M_V$	1.03049	5	12.0313	1.00473	5	12.3397
$\beta_6\ L_{III}N_I$				0.87088	5	14.2362
$\beta_{15}\ L_{III}N_{IV}$				0.83722	5	14.8086
$\beta_2\ L_{III}N_V$	0.858	2	14.45	0.83537	5	14.8414
$\beta_7\ L_{III}O_I$				0.8162	1	15.190
$\beta_5\ L_{III}O_{IV,V}$				0.80627	5	15.3771
$L_{III}P_I$				0.8050	1	15.402
$\beta_{10}\ L_IM_{IV}$				0.77546	5	15.988
$\beta_9\ L_IM_V$				0.76857	5	16.131
L_IN_I				0.6874	1	18.036
L_IN_{IV}				0.6666	1	18.600
$\gamma_{11}\ L_IN_V$				0.6654	1	18.633
$L_IO_{IV,V}$				0.6468	1	19.167
$\beta_{17}\ L_{II}M_{III}$				0.8438	1	14.692
$L_{II}N_{III}$				0.7043	1	17.604
$L_{II}N_V$				0.6932	1	17.884
$L_{II}O_{II}$				0.6780	1	18.286

Designation	Å*	p.e.	keV	Å*	p.e.	keV
	87 Francium (*Cont.*)			**88 Radium** (*Cont.*)		
$L_{II}O_{III}$				0.6764	1	18.330
$L_{II}P_{II,III}$				0.6714	1	18.466
$L_{III}N_{II}$				0.8618	1	14.387
$L_{III}N_{III}$				0.8512	1	14.566
$u\ L_{III}N_{VI,VII}$				0.8186	1	15.146
$L_{III}P_{II,III}$				0.8038	1	15.425
	89 Actinium			**90 Thorium**		
$\alpha_2\ KL_{II}$	0.14141†	2	87.67	0.137829	2	89.953
$\alpha_1\ KL_{III}$	0.136417†	8	90.884	0.132813	2	93.350
$\beta_3\ KM_{II}$	0.12143†	2	102.10	0.118268	3	104.831
$\beta_1\ KM_{III}$	0.12055†	2	102.85	0.117396	9	105.609
$\beta_2^{II}\ KN_{II}$	0.11732†	2	105.67	0.11426	1	108.511
$\beta_2^{I}\ KN_{III}$	0.11711†	2	105.86	0.114040	9	108.717
$KO_{II,III}$				0.11322	1	109.500
$\beta_5\ KM_{IV,V}$				0.116667	9	106.269
$\beta_4\ KN_{IV,V}$				0.11366	2	109.08
$\beta_4\ L_IM_{II}$				0.79257	4	15.6429
$\beta_3\ L_IM_{III}$	0.77822†	9	15.931	0.75479	3	16.4258
$\gamma_2\ L_IN_{II}$				0.64221	4	19.305
$\gamma_3\ L_IN_{III}$				0.63559	4	19.507
$\gamma'_4\ L_IO_{II}$				0.61251	4	20.242
$\gamma_4\ L_IO_{III}$				0.61098	4	20.292
$\gamma_{13}\ L_IP_{II,III}$				0.60705	8	20.424
$\eta\ L_{II}M_I$				0.85446	4	14.5099
$\beta_1\ L_{II}M_{IV}$	0.78903†	9	15.713	0.765210	9	16.2022
$\gamma_5\ L_{II}N_I$				0.67491	4	18.370
$\gamma_1\ L_{II}N_{IV}$	0.67351†	9	18.408	0.65313	3	18.9825
$\gamma_8\ L_{II}O_I$				0.63898	5	19.403
$\gamma_6\ L_{II}O_{IV}$				0.63258	4	19.599
$L_{II}P_I$				0.6316	1	19.629
$L_{II}P_{IV}$				0.62991	9	19.682
$l\ L_{III}M_I$				1.11508	4	11.1186
$\alpha_2\ L_{III}M_{IV}$	0.99178†	5	12.5008	0.96788	2	12.8096
$\alpha_1\ L_{III}M_V$	0.97993†	5	12.6520	0.95600	3	12.9687
$\beta_6\ L_{III}N_I$				0.82790	8	14.975
$\beta_{15}\ L_{III}N_{IV}$				0.79539	5	15.5875
$\beta_2\ L_{III}N_V$				0.79354	3	15.6237
$\beta_7\ L_{III}O_I$				0.77437	4	16.0105
$\beta_5\ L_{III}O_{IV,V}$				0.76468	5	16.213
$L_{III}P_I$				0.76338	5	16.241
$L_{III}P_{IV,V}$				0.76087	9	16.295
$\beta_{10}\ L_IM_{IV}$				0.7301	1	16.981
$\beta_9\ L_IM_V$				0.7234	1	17.139
L_IN_I				0.64755	5	19.146
L_IN_{IV}				0.6276	1	19.755
$\gamma_{11}\ L_IN_V$				0.62636	9	19.794
$L_IN_{VI,VII}$				0.6160	1	20.128
L_IO_I				0.6146	1	20.174
$L_IO_{IV,V}$				0.6083	1	20.383
$L_{II}M_{II}$				0.8338	1	14.869
$\beta_{17}\ L_{II}M_{III}$				0.79257	4	15.6429
$L_{II}M_V$				0.7579	1	16.359
$L_{II}N_{III}$				0.6620	1	18.729
$L_{II}N_V$				0.6521	1	19.014

Designation	Å*	p.e.	keV	Å*	p.e.	keV
	89 Actinium (*Cont.*)			**90 Thorium** (*Cont.*)		
$v\ L_{II}N_{VI}$				0.64064	9	19.353
$L_{II}O_{II}$				0.6369	1	19.466
$L_{II}O_{III}$				0.6356	1	19.506
$L_{II}P_{II,III}$				0.6312	1	19.642
$t\ L_{III}M_I$				1.08009	9	11.4788
$s\ L_{III}M_{II}$				1.0112	1	12.261
$L_{III}N_{II}$				0.8190	2	15.138
$L_{III}N_{III}$				0.8082	1	15.341
$u\ L_{III}N_{VI,VII}$				0.77661	5	15.964
$L_{III}O_{II}$				0.7713	1	16.074
$L_{III}O_{III}$				0.7690	1	16.123
$L_{III}P_{II,III}$				0.7625	2	16.260
M_IN_{III}				2.934	8	4.23
M_IO_{III}				2.442	9	5.08
$M_{II}N_I$				3.537	9	3.505
$M_{II}N_{IV}$				3.011	2	4.117
$M_{II}O_{IV}$				2.618	5	4.735
$M_{III}N_I$				4.568	5	2.714
$M_{III}N_{IV}$				3.718	3	3.335
$\gamma\ M_{II}N_V$				3.679	2	3.370
$M_{III}O_I$				3.283	9	3.78
$M_{III}O_{IV,V}$				3.131	3	3.959
$\zeta_2\ M_VN_{II}$				5.340	5	2.322
$M_{IV}N_{III}$				4.911	5	2.524
$\beta\ M_{IV}N_{VI}$				3.941	1	3.1458
$M_{IV}O_{II}$				3.808	4	3.256
$\zeta_1\ M_VN_{III}$				5.245	5	2.364
$\alpha_2\ M_VN_{VI}$				4.151	2	2.987
$\alpha_1\ M_VN_{VII}$				4.1381	9	2.9961
M_VP_{III}				3.760	9	3.298
$N\ P_{II}$				9.44	7	1.313
$N\ P_{III}$				9.40	7	1.1319
$N_{II}O_{IV}$				11.56	5	1.072
N_IP_I				11.07	7	1.120
$N_{III}O_V$				13.8	1	0.897
$N_{IV}N_{VI}$				33.57	9	0.3693
$N_VN_{VI,VII}$				36.32	9	0.3414
$N_{VI}O_{IV}$				49.5	1	0.2505
$N_{VI}O_V$				48.2	1	0.2572
$N_{VII}O_V$				50.0	1	0.2479
$O_{III}P_{IV,V}$				68.2	3	0.1817
$O_{IV,V}Q_{II,III}$				181.	5	0.068
	91 Protactinium			**92 Uranium**		
$\alpha_2\ KL_{II}$	0.134343†	9	92.287	0.130968	4	94.665
$\alpha_1\ KL_{III}$	0.129325†	3	95.868	0.125947	3	98.439
$\beta_3\ KM_{II}$	0.11523†	2	107.60	0.112296	4	110.406
$\beta_1\ KM_{III}$	0.114345†	8	108.427	0.111394	5	111.300
$\beta_2^{II}\ KN_{II}$	0.11129†	2	111.40	0.10837	1	114.40
$\beta_2^{I}\ KN_{III}$	0.11107†	2	111.62	0.10818	1	114.60
$KO_{II,III}$				0.10744	1	115.39
$\beta_5\ KM_{IV,V}$				0.11069	1	112.01
$\beta_4\ KN_{IV,V}$				0.10780	2	115.01
$\beta_4\ L_IM_I$	0.7699	1	16.104	0.747985	9	16.5753
$\beta_3\ L_IM_{III}$	0.73230	5	16.930	0.71029	2	17.4550

Designation	Å*	p.e.	keV	Å*	p.e.	keV
	91 Protactinium (*Cont.*)			**92 Uranium** (*Cont.*)		
$\gamma_2\ L_IN_{II}$	0.6239	1	19.872	0.605237	9	20.4847
$\gamma_3\ L_IN_{III}$	0.6169	1	20.098	0.598574	9	20.7127
$\gamma'_4\ L_IO_{II}$				0.576700	9	21.4984
$\gamma_4\ L_IO_{II,III}$	0.5937	1	20.882	0.57499	9	21.562
γ_{13}				0.5706	1	21.729
$\eta\ L_{II}M_I$	0.8295	1	14.946	0.80509	2	15.3997
$\beta_1\ L_{II}M_{IV}$	0.74232	5	16.702	0.719984	8	17.2200
$\gamma_5\ L_{II}N_I$	0.6550	1	18.930	0.63557	2	19.5072
$\gamma_1\ L_{II}N_{IV}$	0.63358†	9	19.568	0.614770	9	20.1671
$\gamma_8\ L_{II}O_I$				0.60125	5	20.621
$\gamma_6\ L_{II}O_{IV}$	0.6133	1	20.216	0.594845	9	20.8426
$L_{II}P_{IV}$				0.59203	5	20.942
$l\ L_{III}M_I$	1.0908	1	11.366	1.06712	2	11.6183
$\alpha_2\ L_{III}M_{IV}$	0.94482†	5	13.1222	0.922558	9	13.4388
$\alpha_1\ L_{III}M_V$	0.93284	5	13.2907	0.910639	9	13.6147
$\beta_6\ L_{III}N_I$	0.8079	1	15.347	0.78838	2	15.7260
$\beta_{15}\ L_{III}N_{IV}$				0.756642	9	16.3857
$\beta_2\ L_{III}N_V$	0.7737	1	16.024	0.754681	9	16.4283
$\beta_7\ L_{III}O_I$	0.7546	2	16.431	0.73602	6	16.845
$\beta_5\ L_{III}O_{IV,V}$	0.7452	2	16.636	0.726305	9	17.0701
$L_{III}P_I$				0.72521	5	17.096
$L_{III}P_{IV,V}$				0.72240	5	17.162
$\beta_{10}\ L_IM_{IV}$	0.7088	2	17.492	0.68760	5	18.031
$\beta_9\ L_IM_V$	0.7018	1	17.667	0.681014	8	18.2054
L_IN_{IV}				0.59096	5	20.979
$\gamma_{11}\ L_IN_V$				0.58986	5	21.019
$L_IO_{IV,V}$				0.5725	1	21.657
$\beta_{17}\ L_{II}M_{III}$				0.74503	5	16.641
$L_{II}N_{III}$				0.6228	1	19.907
$v\ L_{II}N_{VI}$				0.6031	1	20.556
$L_{II}O_{III}$				0.59728	5	20.758
$L_{II}P_{II,III}$				0.5930	2	20.906
$t\ L_{III}M_{II}$				1.0347	1	11.982
$s\ L_{III}M_{III}$				0.9636	1	12.866
$L_{III}N_{II}$				0.78017	9	15.892
$L_{III}N_{III}$				0.7691	1	16.120
$u\ L_{III}N_{VI,VII}$				0.738603	9	16.7859
$L_{III}O_{II}$				0.7333	1	16.907
$L_{III}O_{III}$				0.7309	1	16.962
$L_{III}P_{II,III}$				0.72426	5	17.118
M_IN_{II}				2.92	2	4.25
M_IN_{III}				2.753	8	4.50
M_IO_{III}				2.304	7	5.38
M_IP_{III}				2.253	6	5.50
$M_{II}N_I$	3.441	5	3.603	3.329	4	3.724
$M_{II}N_{IV}$	2.910	2	4.260	2.817	2	4.401
$M_{II}O_{IV}$	2.527	4	4.906	2.443	4	5.075
$M_{III}N_I$	4.450	4	2.786	4.330	2	2.863
$M_{III}N_{IV}$	3.614	2	3.430	3.521	2	3.521
$\gamma\ M_{III}N_V$	3.577	1	3.4657	3.479	1	3.563
$M_{III}O_I$	3.245	9	3.82	3.115	7	3.980
$M_{III}O_{IV,V}$	3.038	2	4.081	2.948	2	4.205
$\zeta_2\ M_{IV}N_{II}$	5.193	2	2.3876	5.050	2	2.4548
$M_{IV}N_{III}$				4.625	5	2.681
$\beta\ M_{IV}N_{VI}$	3.827	1	3.2397	3.716	1	3.3367

Designation	Å*	p.e.	keV	Å*	p.e.	keV
	91 Protactinium (*Cont.*)			**92 Uranium** (*Cont.*)		
$M_{IV}O_{II}$	3.691	2	3.359	3.576	1	3.4666
$\zeta_1\ M_VN_{III}$	5.092	2	2.4350	4.946	2	2.507
$\alpha_2\ M_VN_{VI}$	4.035	3	3.072	3.924	1	3.1595
$\alpha_1\ M_VN_{VII}$	4.022	1	3.0823	3.910	1	3.1708
N_IO_{III}				10.09	7	1.229
N_IP_{II}				8.81	7	1.41
N_IP_{III}				8.76	7	1.42
$N_{II}P_I$				10.40	7	1.192
$N_{III}O_V$				12.90	9	0.961
$N_{IV}N_{VI}$				31.8	1	0.390
$N_VN_{VI,VII}$				34.8	1	0.357
$N_{IV}O_{IV}$				43.3	2	0.286
$N_{VI}O_V$				42.1	2	0.295
$N_IP_{IV,V}$				8.60	7	1.44
	93 Neptunium			**94 Plutonium**		
$\beta_4\ L_IM_{II}$	0.72671	2	17.0607	0.70620	2	17.5560
$\beta_3\ L_IM_{III}$	0.68920†	9	17.989	0.66871	2	18.5405
$\gamma_2\ L_IN_{II}$	0.5873	5	21.11	0.57068	2	21.7251
$\gamma_3\ L_IN_{III}$	0.5810	5	21.34	0.564001	9	21.9824
$\gamma'_4\ L_IO_{II}$				0.5432	1	22.823
$\gamma_4\ L_IO_{II,III}$	0.5585	5	22.20	0.5416	1	22.891
$\eta\ L_{II}M_I$	0.7809	2	15.876	0.7591	1	16.333
$\beta_1\ L_{II}M_{IV}$	0.698478	9	17.7502	0.67772	2	18.2937
$\gamma_5\ L_{II}N_I$	0.616	1	20.12	0.5988	1	20.704
$\gamma_1\ L_{II}N_{IV}$	0.596498	9	20.7848	0.578882	9	21.4173
γ_8				0.5658	1	21.914
$\gamma_6\ L_{II}O_{IV}$	0.57699	5	21.488	0.55973	2	22.1502
$l\ L_{III}M_I$	1.0428	6	11.890	1.0226	1	12.124
$\alpha_2\ L_{III}M_{IV}$	0.901045	9	13.7597	0.88028	2	14.0842
$\alpha_1\ L_{III}M_V$	0.889128	9	13.9441	0.86830	2	14.2786
$\beta_6\ L_{III}N_I$	0.769	1	16.13	0.75148	2	16.4983
$\beta_{15}\ L_{III}N_{IV}$				0.7205	1	17.208
$\beta_2\ L_{III}N_V$	0.736230	9	16.8400	0.71851	2	17.2553
$\beta_7\ L_{III}O_I$				0.7003	1	17.705
$\beta_5\ L_{III}O_{IV,V}$	0.70814	2	17.5081	0.69068	2	17.9506
$\beta_{10}\ L_IM_{IV}$				0.6482	1	19.126
$\beta_9\ L_IM_V$				0.6416	1	19.323
$u\ L_{III}N_{VI,VII}$				0.7031	1	17.635
	95 Americium					
$\beta_4\ L_IM_{II}$	0.68639	2	18.0627			
$\beta_3\ L_IM_{III}$	0.64891	2	19.1059			
$\gamma_2\ L_IN_{II}$	0.5544	2	22.361			
$\beta_1\ L_{II}M_{IV}$	0.657655	9	18.8520			
$\gamma_1\ L_{II}N_{IV}$	0.561886	9	22.0652			
$\gamma_6\ L_{II}O_{IV}$	0.54311	2	22.8282			
$l\ L_{III}M_I$	1.0012	6	12.384			
$\alpha_2\ L_{III}M_{IV}$	0.860266	9	14.4119			
$\alpha_1\ L_{III}M_V$	0.848187	9	14.6172			
$\beta_6\ L_{III}N_I$	0.73418	2	16.8870			
$\beta_{15}\ L_{III}N_{IV}$	0.70341	2	17.6258			
$\beta_2\ L_{III}N_V$	0.701390	9	17.6765			
$\beta_5\ L_{III}O_{IV,V}$	0.67383	2	18.3996			

Table VI. Wavelengths in numerical order of the emission lines and absorption edges.

Wavelength Å*	p.e.	Element		Designation	keV
0.10723	1	92 U	K	Abs. Edge	115.62
0.10744	1	92 U		$KO_{II,III}$	115.39
0.10780	2	92 U	$K\beta_4$	$KN_{IV,V}$	115.01
0.10818	1	92 U	$K\beta_2^{I}$	KN_{III}	114.60
0.10837	1	92 U	$K\beta_2^{II}$	KN_{II}	114.40
0.11069	1	92 U	$K\beta_5$	$KM_{IV,V}$	112.01
0.11107	2	91 Pa	$K\beta_2^{I}$	KN_{III}	111.62
0.11129	2	91 Pa	$K\beta_2^{II}$	KN_{II}	111.40
0.111394	5	92 U	$K\beta_1$	KM_{III}	111.300
0.112296	4	92 U	$K\beta_3$	KM_{II}	110.406
0.11307	1	90 Th	K	Abs. Edge	109.646
0.11322	1	90 Th		$KO_{II,III}$	109.500
0.11366	2	90 Th	$K\beta_4$	$KN_{IV,V}$	109.08
0.114040	9	90 Th	$K\beta_2^{I}$	KN_{III}	108.717
0.11426	1	90 Th	$K\beta_2^{II}$	KN_{II}	108.511
0.114345	8	91 Pa	$K\beta_1$	KM_{III}	108.427
0.11523	2	91 Pa	$K\beta_3$	KM_{II}	107.60
0.116667	9	90 Th	$K\beta_5$	$KM_{IV,V}$	106.269
0.11711	2	89 Ac	$K\beta_2^{I}$	KN_{III}	105.86
0.11732	2	89 Ac	$K\beta_2^{II}$	KN_{II}	105.67
0.117396	9	90 Th	$K\beta_1$	KM_{III}	105.609
0.118268	3	90 Th	$K\beta_3$	KM_{II}	104.831
0.12029	3	88 Ra	$K\beta_2^{I}$	KN_{III}	103.07
0.12050	3	88 Ra	$K\beta_2^{II}$	KN_{II}	102.89
0.12055	2	89 Ac	$K\beta_1$	KM_{III}	102.85
0.12143	2	89 Ac	$K\beta_3$	KM_{II}	102.10
0.12358	5	87 Fr	$K\beta_2^{I}$	KN_{III}	100.33
0.12379	5	87 Fr	$K\beta_2^{II}$	KN_{II}	100.16
0.12382	3	88 Ra	$K\beta_1$	KM_{III}	100.13
0.12469	3	88 Ra	$K\beta_3$	KM_{II}	99.43
0.125947	3	92 U	$K\alpha_1$	KL_{III}	98.439
0.12698	5	86 Rn	$K\beta_2^{I}$	KN_{III}	97.64
0.12719	5	86 Rn	$K\beta_2^{II}$	KN_{II}	97.47
0.12719	5	87 Fr	$K\beta_1$	KM_{III}	97.47
0.12807	5	87 Fr	$K\beta_3$	KM_{II}	96.81
0.129325	3	91 Pa	$K\alpha_1$	KL_{III}	95.868
0.13052	4	85 At	$K\beta_2^{I}$	KN_{III}	94.99
0.13069	5	86 Rn	$K\beta_1$	KM_{III}	94.87
0.13072	4	85 At	$K\beta_2^{II}$	KN_{II}	94.84
0.130968	4	92 U	$K\alpha_2$	KL_{II}	94.665
0.13155	5	86 Rn	$K\beta_3$	KM_{II}	94.24
0.132813	2	90 Th	$K\alpha_1$	KL_{III}	93.350
0.13418	2	84 Po	$K\beta_2^{I}$	KN_{III}	92.40
0.13432	4	85 At	$K\beta_1$	KM_{III}	92.30
0.134343	9	91 Pa	$K\alpha_2$	KL_{II}	92.287
0.13438	2	84 Po	$K\beta_2^{II}$	KN_{II}	92.26
0.13517	4	85 At	$K\beta_3$	KM_{II}	91.72
0.136417	8	89 Ac	$K\alpha_1$	KL_{III}	90.884
0.13694	1	83 Bi	K	Abs. Edge	90.534
0.13709	1	83 Bi		$KO_{II,III}$	90.435
0.13759	2	83 Bi	$K\beta_4$	$KN_{IV,V}$	90.11
0.137829	2	90 Th	$K\alpha_2$	KL_{II}	89.953
0.13797	1	83 Bi	$K\beta_2^{I}$	KN_{III}	89.864
0.13807	2	84 Po	$K\beta_1$	KM_{III}	89.80
0.13817	1	83 Bi	$K\beta_2^{II}$	KN_{II}	89.733
0.13892	2	84 Po	$K\beta_3$	KM_{II}	89.25
0.14014	2	88 Ra	$K\alpha_1$	KL_{III}	88.47
0.1408	1	82 Pb		KP	88.06
0.140880	5	82 Pb	K	Abs. Edge	88.005
0.141012	8	82 Pb		$KO_{II,III}$	87.922
0.14111	1	83 Bi	$K\beta_5$	$KM_{IV,V}$	87.860
0.14141	2	89 Ac	$K\alpha_2$	KL_{II}	87.67
0.14155	3	82 Pb	$K\beta_4$	$KN_{IV,V}$	87.59
0.14191	1	82 Pb	$K\beta_2^{I}$	KN_{III}	87.364
0.141948	3	83 Bi	$K\beta_1$	KM_{III}	87.343
0.14212	2	82 Pb	$K\beta_2^{II}$	KN_{II}	87.23
0.142779	7	83 Bi	$K\beta_3$	KM_{II}	86.834
0.14399	3	87 Fr	$K\alpha_1$	KL_{III}	86.10
0.14495	1	81 Tl	K	Abs. Edge	85.533
0.14495	3	82 Pb	$K\beta_5^{I}$	KM_{V}	85.53
0.14509	1	81 Tl		$KO_{II,III}$	85.451
0.14512	2	82 Pb	$K\beta_5^{II}$	KM_{IV}	85.43
0.14512	2	88 Ra	$K\alpha_2$	KL_{II}	85.43
0.14553	2	81 Tl	$K\beta_4$	$KN_{IV,V}$	85.19
0.14595	1	81 Tl	$K\beta_2^{I}$	KN_{III}	84.946
0.145970	6	82 Pb	$K\beta_1$	KM_{III}	84.936
0.14614	1	81 Tl	$K\beta_2^{II}$	KN_{II}	84.836
0.146810	4	82 Pb	$K\beta_3$	KM_{II}	84.450
0.14798	3	86 Rn	$K\alpha_1$	KL_{III}	83.78
0.14896	3	87 Fr	$K\alpha_2$	KL_{II}	83.23
0.14917	1	81 Tl	$K\beta_5$	$KM_{IV,V}$	83.114
0.14918	1	80 Hg	K	Abs. Edge	83.109
0.14931	2	80 Hg		$KO_{II,III}$	83.04
0.14978	2	80 Hg	$K\beta_4$	$KN_{IV,V}$	82.78
0.150142	5	81 Tl	$K\beta_1$	KM_{III}	82.576
0.15020	2	80 Hg	$K\beta_2^{I}$	KN_{III}	82.54
0.15040	2	80 Hg	$K\beta_2^{II}$	KN_{II}	82.43
0.150980	6	81 Tl	$K\beta_3$	KM_{II}	82.118
0.15210	2	85 At	$K\alpha_1$	KL_{III}	81.52
0.15294	3	86 Rn	$K\alpha_2$	KL_{II}	81.07
0.15353	2	80 Hg	$K\beta_5$	$KM_{IV,V}$	80.75
0.153593	5	79 Au	K	Abs. Edge	80.720
0.153694	7	79 Au		$KO_{II,III}$	80.667
0.154224	5	79 Au	$K\beta_4$	$KN_{IV,V}$	80.391
0.154487	3	80 Hg	$K\beta_1$	KM_{III}	80.253
0.154618	9	79 Au	$K\beta_2^{I}$	KN_{III}	80.185
0.15483	2	79 Au	$K\beta_2^{II}$	KN_{II}	80.08
0.155321	3	80 Hg	$K\beta_3$	KM_{II}	79.822
0.15636	1	84 Po	$K\alpha_1$	KL_{III}	79.290
0.15705	2	85 At	$K\alpha_2$	KL_{II}	78.95
0.157880	5	79 Au	$K\beta_5^{I}$	KM_{V}	78.529
0.158062	7	79 Au	$K\beta_5^{II}$	KM_{IV}	78.438
0.15818	1	78 Pt	K	Abs. Edge	78.381
0.15826	1	78 Pt		$KO_{II,III}$	78.341
0.15881	2	78 Pt	$K\beta_4$	$KN_{IV,V}$	78.069
0.158982	3	79 Au	$K\beta_1$	KM_{III}	77.984
0.15920	1	78 Pt	$K\beta_2^{I}$	KN_{III}	77.878
0.15939	1	78 Pt	$K\beta_2^{II}$	KN_{II}	77.785
0.159810	2	79 Au	$K\beta_3$	KM_{II}	77.580
0.160789	2	83 Bi	$K\alpha_1$	KL_{III}	77.1079
0.16130	1	84 Po	$K\alpha_2$	KL_{II}	76.862
0.16255	3	78 Pt	$K\beta_5^{I}$	KM_{V}	76.27
0.16271	2	78 Pt	$K\beta_5^{II}$	KM_{IV}	76.199
0.16292	1	77 Ir	K	Abs. Edge	76.101

Wavelength Å*	p.e.	Element	Designation		keV
0.163019	5	77 Ir		$KO_{II,III}$	76.053
0.16352	2	77 Ir	$K\beta_4$	$KN_{IV,V}$	75.821
0.163675	3	78 Pt	$K\beta_1$	KM_{III}	75.748
0.163956	7	77 Ir	$K\beta_2^{I}$	KN_{III}	75.619
0.16415	1	77 Ir	$K\beta_2^{II}$	KN_{II}	75.529
0.164501	3	78 Pt	$K\beta_3$	KM_{II}	75.368
0.165376	2	82 Pb	$K\alpha_1$	KL_{III}	74.9694
0.165717	2	83 Bi	$K\alpha_2$	KL_{II}	74.8148
0.167373	9	77 Ir	$K\beta_5^{I}$	KM_V	74.075
0.16759	2	77 Ir	$K\beta_5^{II}$	KM_{IV}	73.980
0.16787	1	76 Os	K	Abs. Edge	73.856
0.16798	1	76 Os		$KO_{II,III}$	73.808
0.16842	2	76 Os	$K\beta_4$	$KN_{IV,V}$	73.615
0.168542	2	77 Ir	$K\beta_1$	KM_{III}	73.5608
0.168906	6	76 Os	$K\beta_2^{I}$	KN_{III}	73.402
0.16910	1	76 Os	$K\beta_2^{II}$	KN_{II}	73.318
0.169367	2	77 Ir	$K\beta_3$	KM_{II}	73.2027
0.170136	2	81 Tl	$K\alpha_1$	KL_{III}	72.8715
0.170294	2	82 Pb	$K\alpha_2$	KL_{II}	72.8042
0.17245	1	76 Os	$K\beta_5^{I}$	KM_V	71.895
0.17262	1	76 Os	$K\beta_5^{II}$	KM_{IV}	71.824
0.17302	1	75 Re	K	Abs. Edge	71.658
0.17308	1	75 Re		$KO_{II,III}$	71.633
0.173611	3	76 Os	$K\beta_1$	KM_{III}	71.413
0.17362	2	75 Re	$K\beta_4$	$KN_{IV,V}$	71.410
0.174054	6	75 Re	$K\beta_2^{I}$	KN_{III}	71.232
0.17425	1	75 Re	$K\beta_2^{II}$	KN_{II}	71.151
0.174431	3	76 Os	$K\beta_3$	KM_{II}	71.077
0.175036	2	81 Tl	$K\alpha_2$	KL_{II}	70.8319
0.175068	3	80 Hg	$K\alpha_1$	KL_{III}	70.819
0.17766	1	75 Re	$K\beta_5^{I}$	KM_V	69.786
0.17783	1	75 Re	$K\beta_5^{II}$	KM_{IV}	69.719
0.17837	1	74 W	K	Abs. Edge	69.508
0.178444	5	74 W		$KO_{II,III}$	69.479
0.178880	3	75 Re	$K\beta_1$	KM_{III}	69.310
0.17892	2	74 W	$K\beta_4$	$KN_{IV,V}$	69.294
0.179421	7	74 W	$K\beta_2^{I}$	KN_{III}	69.101
0.17960	1	74 W	$K\beta_2^{II}$	KN_{II}	69.031
0.179697	3	75 Re	$K\beta_3$	KM_{II}	68.994
0.179958	3	80 Hg	$K\alpha_2$	KL_{II}	68.895
0.180195	2	79 Au	$K\alpha_1$	KL_{III}	68.8037
0.183092	7	74 W	$K\beta_5^{I}$	KM_V	67.715
0.183264	5	74 W	$K\beta_5^{II}$	KM_{IV}	67.652
0.18394	1	73 Ta	K	Abs. Edge	67.403
0.184031	7	73 Ta		$KO_{II,III}$	67.370
0.184374	2	74 W	$K\beta_1$	KM_{III}	67.2443
0.18451	1	73 Ta	$K\beta_4$	$KN_{IV,V}$	67.194
0.185011	8	73 Ta	$K\beta_2^{I}$	KN_{III}	67.013
0.185075	2	79 Au	$K\alpha_2$	KL_{II}	66.9895
0.185181	2	74 W	$K\beta_3$	KM_{II}	66.9514
0.185188	9	73 Ta	$K\beta_2^{II}$	KN_{II}	66.949
0.185511	4	78 Pt	$K\alpha_1$	KL_{III}	66.832
0.18672	4	79 Au		KL_I	66.40
0.188757	6	73 Ta	$K\beta_5^{I}$	KM_V	65.683
0.188920	6	73 Ta	$K\beta_5^{II}$	KM_{IV}	65.626
0.18982	5	72 Hf	K	Abs. Edge	65.31
0.190089	4	73 Ta	$K\beta_1$	KM_{III}	65.223
0.190381	4	78 Pt	$K\alpha_2$	KL_{II}	65.122
0.1908	2	72 Hf	$K\beta_2$	$KN_{II,III}$	64.98
0.190890	2	73 Ta	$K\beta_3$	KM_{II}	64.9488
0.191047	2	77 Ir	$K\alpha_1$	KL_{III}	64.8956
0.19585	5	71 Lu	K	Abs. Edge	63.31
0.19589	2	71 Lu		$KO_{II,III}$	63.293
0.195904	2	77 Ir	$K\alpha_2$	KL_{II}	63.2867
0.19607	3	72 Hf	$K\beta_1$	KM_{III}	63.234
0.196794	2	76 Os	$K\alpha_1$	KL_{III}	63.0005
0.19686	4	72 Hf	$K\beta_3$	KM_{II}	62.98
0.1969	2	71 Lu	$K\beta_2$	$KN_{II,III}$	62.97
0.20084	2	71 Lu	$K\beta_5$	$KM_{IV,V}$	61.732
0.201639	2	76 Os	$K\alpha_2$	KL_{II}	61.4867
0.20224	5	70 Yb	K	Abs. Edge	61.30
0.20226	2	70 Yb		$KO_{II,III}$	61.298
0.20231	3	71 Lu	$K\beta_1$	KM_{III}	61.283
0.202781	2	75 Re	$K\alpha_1$	KL_{III}	61.1403
0.20309	4	71 Lu	$K\beta_3$	KM_{II}	61.05
0.2033	2	70 Yb	$K\beta_2$	$KN_{II,III}$	60.89
0.20739	2	70 Yb	$K\beta_5$	$KM_{IV,V}$	59.782
0.207611	1	75 Re	$K\alpha_2$	KL_{II}	59.7179
0.20880	5	69 Tm	K	Abs. Edge	59.38
0.20884	8	70 Yb	$K\beta_1$	KM_{III}	59.37
0.20891	2	69 Tm		$KO_{II,III}$	59.346
0.2090100	Std.	74 W	$K\alpha_1$	KL_{III}	59.31824
0.2096	1	70 Yb	$K\beta_3$	KM_{II}	59.14
0.2098	2	69 Tm	$K\beta_2$	$KN_{II,III}$	59.09
0.213828	2	74 W	$K\alpha_2$	KL_{II}	57.9817
0.21404	2	69 Tm	$K\beta_5$	$KM_{IV,V}$	57.923
0.215497	4	73 Ta	$K\alpha_1$	KL_{III}	57.532
0.21556	2	69 Tm	$K\beta_1$	KM_{III}	57.517
0.21567	1	68 Er	K	Abs. Edge	57.487
0.21581	3	68 Er		$KO_{II,III}$	57.450
0.21592	4	74 W		KL_I	57.42
0.21636	2	69 Tm	$K\beta_3$	KM_{II}	57.304
0.2167	2	68 Er	$K\beta_2$	$KN_{II,III}$	57.21
0.220305	8	73 Ta	$K\alpha_2$	KL_{II}	56.277
0.22124	3	68 Er	$K\beta_5$	$KM_{IV,V}$	56.040
0.222227	3	72 Hf	$K\alpha_1$	KL_{III}	55.7902
0.22266	2	68 Er	$K\beta_1$	KM_{III}	55.681
0.22291	1	67 Ho	K	Abs. Edge	55.619
0.22305	3	67 Ho		$KO_{II,III}$	55.584
0.22341	2	68 Er	$K\beta_3$	KM_{II}	55.494
0.2241	2	67 Ho	$K\beta_2$	$KN_{II,III}$	55.32
0.227024	3	72 Hf	$K\alpha_2$	KL_{II}	54.6114
0.22855	3	67 Ho	$K\beta_5$	$KM_{IV,V}$	54.246
0.229298	2	71 Lu	$K\alpha_1$	KL_{III}	54.0698
0.23012	2	67 Ho	$K\beta_1$	KM_{III}	53.877
0.23048	1	66 Dy	K	Abs. Edge	53.793
0.23056	3	66 Dy		$KO_{II,III}$	53.774
0.23083	2	67 Ho	$K\beta_3$	KM_{II}	53.711
0.2317	2	66 Dy	$K\beta_2$	$KN_{II,III}$	53.47
0.234081	2	71 Lu	$K\alpha_2$	KL_{II}	52.9650
0.23618	3	66 Dy	$K\beta_5$	$KM_{IV,V}$	52.494
0.236655	2	70 Yb	$K\alpha_1$	KL_{III}	52.3889
0.23788	2	66 Dy	$K\beta_1$	KM_{III}	52.119
0.23841	1	65 Tb	K	Abs. Edge	52.002

Wavelength Å*	p.e.	Element		Designation	keV
0.23858	3	65 Tb		$KO_{II,III}$	51.965
0.23862	2	66 Dy	$K\beta_3$	KM_{II}	51.957
0.2397	2	65 Tb	$K\beta_2$	$KN_{II,III}$	51.68
0.241424	2	70 Yb	$K\alpha_2$	KL_{II}	51.3540
0.244338	2	69 Tm	$K\alpha_1$	KL_{III}	50.7416
0.24608	2	65 Tb	$K\beta_1$	KM_{III}	50.382
0.24681	1	64 Gd	K	Abs. Edge	50.233
0.24683	2	65 Tb	$K\beta_3$	KM_{II}	50.229
0.24687	3	64 Gd		$KO_{II,III}$	50.221
0.24816	3	64 Gd	$K\beta_2$	$KN_{II,III}$	49.959
0.249095	2	69 Tm	$K\alpha_2$	KL_{II}	49.7726
0.252365	2	68 Er	$K\alpha_1$	KL_{III}	49.1277
0.25275	3	64 Gd	$K\beta_5$	$KM_{IV,V}$	49.052
0.25460	2	64 Gd	$K\beta_1$	KM_{III}	48.697
0.25534	2	64 Gd	$K\beta_3$	KM_{II}	48.555
0.25553	1	63 Eu	K	Abs. Edge	48.519
0.255645	7	63 Eu		$KO_{II,III}$	48.497
0.256923	8	63 Eu	$K\beta_2^I$	$KN_{II,III}$	48.256
0.257110	2	68 Er	$K\alpha_2$	KL_{II}	48.2211
0.260756	2	67 Ho	$K\alpha_1$	KL_{III}	47.5467
0.263577	5	63 Eu	$K\beta_1$	KM_{III}	47.0379
0.264332	5	63 Eu	$K\beta_3$	KM_{II}	46.9036
0.26464	5	62 Sm	K	Abs. Edge	46.849
0.26491	3	62 Sm		$KO_{II,III}$	46.801
0.265486	2	67 Ho	$K\alpha_2$	KL_{II}	46.6997
0.2662	1	62 Sm	$K\beta_2$	$KN_{II,III}$	46.57
0.269533	2	66 Dy	$K\alpha_1$	KL_{III}	45.9984
0.27111	3	62 Sm	$K\beta_5$	$KM_{IV,V}$	45.731
0.27301	2	62 Sm	$K\beta_1$	KM_{III}	45.413
0.27376	2	62 Sm	$K\beta_3$	KM_{II}	45.289
0.274247	2	66 Dy	$K\alpha_2$	KL_{II}	45.2078
0.27431	5	61 Pm	K	Abs. Edge	45.198
0.2759	1	61 Pm	$K\beta_2$	$KN_{II,III}$	44.93
0.278724	2	65 Tb	$K\alpha_1$	KL_{III}	44.4816
0.28290	3	61 Pm	$K\beta_1$	KM_{III}	43.826
0.283423	2	65 Tb	$K\alpha_2$	KL_{II}	43.7441
0.28363	4	61 Pm	$K\beta_3$	KM_{II}	43.713
0.28453	5	60 Nd	K	Abs. Edge	43.574
0.2861	1	60 Nd	$K\beta_2$	$KN_{II,III}$	43.32
0.288353	2	64 Gd	$K\alpha_1$	KL_{III}	42.9962
0.293038	2	64 Gd	$K\alpha_2$	KL_{II}	42.3089
0.293299	2	60 Nd	$K\beta_1$	KM_{III}	42.2713
0.294027	3	60 Nd	$K\beta_3$	KM_{II}	42.1665
0.29518	5	59 Pr	K	Abs. Edge	42.002
0.29679	2	59 Pr	$K\beta_2$	$KN_{II,III}$	41.773
0.298446	2	63 Eu	$K\alpha_1$	KL_{III}	41.5422
0.303118	2	63 Eu	$K\alpha_2$	KL_{II}	40.9019
0.304261	4	59 Pr	$K\beta_1$	KM_{III}	40.7482
0.304975	5	59 Pr	$K\beta_3$	KM_{II}	40.6529
0.30648	5	58 Ce	K	Abs. Edge	40.453
0.30668	2	58 Ce		$KO_{II,III}$	40.427
0.30737	2	58 Ce	$K\beta_4^I$	$KN_{IV,V}$	40.337
0.30816	1	58 Ce	$K\beta_2$	$KN_{II,III}$	40.233
0.309040	2	62 Sm	$K\alpha_1$	KL_{III}	40.1181
0.31342	2	58 Ce	$K\beta_5^I$	KM_V	39.558
0.31357	2	58 Ce	$K\beta_5^{II}$	KM_{IV}	39.539
0.313698	2	62 Sm	$K\alpha_2$	KL_{II}	39.5224
0.315816	2	58 Ce	$K\beta_1$	KM_{III}	39.2573
0.316520	4	58 Ce	$K\beta_3$	KM_{II}	39.1701
0.31844	5	57 La	K	Abs. Edge	38.934
0.31864	2	57 La		$KO_{II,III}$	38.909
0.31931	2	57 La	$K\beta_4^I$	$KN_{IV,V}$	38.828
0.320117	7	57 La	$K\beta_2$	$KN_{II,III}$	38.7299
0.320160	4	61 Pm	$K\alpha_1$	KL_{III}	38.7247
0.324803	4	61 Pm	$K\alpha_2$	KL_{II}	38.1712
0.32546	2	57 La	$K\beta_5^I$	KM_V	38.094
0.32563	2	57 La	$K\beta_5^{II}$	KM_{IV}	38.074
0.327983	3	57 La	$K\beta_1$	KM_{III}	37.8010
0.328686	4	57 La	$K\beta_3$	KM_{II}	37.7202
0.33104	1	56 Ba	K	Abs. Edge	37.452
0.33127	2	56 Ba		$KO_{II,III}$	37.426
0.331846	2	60 Nd	$K\alpha_1$	KL_{III}	37.3610
0.33229	2	56 Ba	$K\beta_4^{II}$	KN_{IV}	37.311
0.33277	1	56 Ba	$K\beta_2$	$KN_{II,III}$	37.257
0.336472	2	60 Nd	$K\alpha_2$	KL_{II}	36.8474
0.33814	2	56 Ba	$K\beta_5^I$	KM_V	36.666
0.33835	2	56 Ba	$K\beta_5^{II}$	KM_{IV}	36.643
0.340811	3	56 Ba	$K\beta_1$	KM_{III}	36.3782
0.341507	4	56 Ba	$K\beta_3$	KM_{II}	36.3040
0.344140	2	59 Pr	$K\alpha_1$	KL_{III}	36.0263
0.34451	1	55 Cs	K	Abs. Edge	35.987
0.34611	2	55 Cs	$K\beta_2$	$KN_{II,III}$	35.822
0.348749	2	59 Pr	$K\alpha_2$	KL_{II}	35.5502
0.354364	7	55 Cs	$K\beta_1$	KM_{III}	34.9869
0.355050	4	55 Cs	$K\beta_3$	KM_{II}	34.9194
0.357092	2	58 Ce	$K\alpha_1$	KL_{III}	34.7197
0.3584	5	54 Xe	K	Abs. Edge	34.59
0.36026	3	54 Xe	$K\beta_2$	$KN_{II,III}$	34.415
0.361683	2	58 Ce	$K\alpha_2$	KL_{II}	34.2789
0.36872	2	54 Xe	$K\beta_1$	KM_{III}	33.624
0.36941	2	54 Xe	$K\beta_3$	KM_{II}	33.562
0.370737	2	57 La	$K\alpha_1$	KL_{III}	33.4418
0.37381	1	53 I	K	Abs. Edge	33.1665
0.37523	2	53 I	$K\beta_2$	$KN_{II,III}$	33.042
0.375313	2	57 La	$K\alpha_2$	KL_{II}	33.0341
0.383905	4	53 I	$K\beta_1$	KM_{III}	32.2947
0.384564	4	53 I	$K\beta_3$	KM_{II}	32.2394
0.385111	4	56 Ba	$K\alpha_1$	KL_{III}	32.1936
0.389668	5	56 Ba	$K\alpha_2$	KL_{II}	31.8171
0.38974	1	52 Te		$KO_{II,III}$	31.8114
0.38974	1	52 Te	K	Abs. Edge	31.8114
0.391102	6	52 Te	$K\beta_2$	$KN_{II,III}$	31.7004
0.399995	5	52 Te	$K\beta_1$	KM_{III}	30.9957
0.400290	4	55 Cs	$K\alpha_1$	KL_{III}	30.9728
0.400659	4	52 Te	$K\beta_3$	KM_{II}	30.9443
0.404835	4	55 Cs	$K\alpha_2$	KL_{II}	30.6251
0.40666	1	51 Sb		$KO_{II,III}$	30.4875
0.40668	1	51 Sb	K	Abs. Edge	30.4860
0.40702	1	51 Sb	$K\beta_4^I$	$KN_{IV,V}$	30.4604
0.407973	5	51 Sb	$K\beta_2$	$KN_{II,III}$	30.3895
0.41378	1	51 Sb	$K\beta_5^I$	KM_V	29.9632
0.41388	1	51 Sb	$K\beta_5^{II}$	KM_{IV}	29.9560
0.41634	2	54 Xe	$K\alpha_1$	KL_{III}	29.779
0.417085	3	51 Sb	$K\beta_1$	KM_{III}	29.7256

Wavelength Å*	p.e.	Element	Designation		keV
0.417737	4	51 Sb	$K\beta_3$	KM_{II}	29.6792
0.42087	2	54 Xe	$K\alpha_2$	KL_{II}	29.458
0.42467	3	50 Sn		$KO_{II,III}$	29.195
0.42467	1	50 Sn	K	Abs. Edge	29.1947
0.42495	3	50 Sn	$K\beta_4^{I}$	$KN_{IV,V}$	29.175
0.425915	8	50 Sn	$K\beta_2$	$KN_{II,III}$	29.1093
0.43175	3	50 Sn	$K\beta_5^{I}$	KM_V	28.716
0.43184	3	50 Sn	$K\beta_5^{II}$	KM_{IV}	28.710
0.433318	5	53 I	$K\alpha_1$	KL_{III}	28.6120
0.435236	5	50 Sn	$K\beta_1$	KM_{III}	28.4860
0.435877	5	50 Sn	$K\beta_3$	KM_{II}	28.4440
0.437829	7	53 I	$K\alpha_2$	KL_{II}	28.3172
0.44371	1	49 In	K	Abs. Edge	27.9420
0.44374	3	49 In		$KO_{II,III}$	27.940
0.44393	4	49 In	$K\beta_4^{I}$	$KN_{IV,V}$	27.928
0.44500	1	49 In	$K\beta_2$	$KN_{II,III}$	27.8608
0.45086	2	49 In	$K\beta_5^{I}$	KM_V	27.499
0.45098	2	49 In	$K\beta_5^{II}$	KM_{IV}	27.491
0.451295	3	52 Te	$K\alpha_1$	KL_{III}	27.4723
0.454545	4	49 In	$K\beta_1$	KM_{III}	27.2759
0.455181	4	49 In	$K\beta_3$	KM_{II}	27.2377
0.455784	3	52 Te	$K\alpha_2$	KL_{II}	27.2017
0.46407	1	48 Cd	K	Abs. Edge	26.7159
0.465328	7	48 Cd	$K\beta_2$	$KN_{II,III}$	26.6438
0.470354	3	51 Sb	$K\alpha_1$	KL_{III}	26.3591
0.474827	3	51 Sb	$K\alpha_2$	KL_{II}	26.1108
0.475105	6	48 Cd	$K\beta_1$	KM_{III}	26.0955
0.475730	5	48 Cd	$K\beta_3$	KM_{II}	26.0612
0.48589	1	47 Ag	K	Abs. Edge	25.5165
0.4859	9	47 Ag	$K\beta_4$	$KN_{IV,V}$	25.512
0.487032	4	47 Ag	$K\beta_2$	$KN_{II,III}$	25.4564
0.490599	3	50 Sn	$K\alpha_1$	KL_{III}	25.2713
0.49306	2	47 Ag	$K\beta_5$	$KM_{IV,V}$	25.145
0.495053	3	50 Sn	$K\alpha_2$	KL_{II}	25.0440
0.497069	4	47 Ag	$K\beta_1$	KM_{III}	24.9424
0.497685	4	47 Ag	$K\beta_3$	KM_{II}	24.9115
0.5092	1	46 Pd	K	Abs. Edge	24.348
0.5093	2	46 Pd	$K\beta_4$	$KN_{IV,V}$	24.346
0.510228	4	46 Pd	$K\beta_2$	$KN_{II,III}$	24.2991
0.512113	3	49 In	$K\alpha_1$	KL_{III}	24.2097
0.516544	3	49 In	$K\alpha_2$	KL_{II}	24.0020
0.51670	9	46 Pd	$K\beta_5$	$KM_{IV,V}$	23.995
0.520520	4	46 Pd	$K\beta_1$	KM_{III}	23.8187
0.521123	4	46 Pd	$K\beta_3$	KM_{II}	23.7911
0.53395	1	45 Rh	K	Abs. Edge	23.2198
0.53401	9	45 Rh	$K\beta_4^{I}$	$KN_{IV,V}$	23.217
0.535010	3	48 Cd	$K\alpha_1$	KL_{III}	23.1736
0.53503	2	45 Rh	$K\beta_2$	$KN_{II,III}$	23.1728
0.53513	5	45 Rh	$K\beta_2^{II}$	KN_{II}	23.168
0.5365	1	94 Pu	L_I	Abs. Edge	23.109
0.539422	3	48 Cd	$K\alpha_2$	KL_{II}	22.9841
0.54101	9	45 Rh	$K\beta_5^{I}$	KM_V	22.917
0.54118	9	45 Rh	$K\beta_5^{II}$	KM_{IV}	22.909
0.5416	1	94 Pu	$L\gamma_4$	L_IO_{III}	22.891
0.54311	2	95 Am	$L\gamma_6$	$L_{II}O_{IV}$	22.8282
0.5432	1	94 Pu	$L\gamma_4'$	L_IO_{II}	22.823
0.545605	4	45 Rh	$K\beta_1$	KM_{III}	22.7236
0.546200	4	45 Rh	$K\beta_3$	KM_{II}	22.6989
0.5544	2	95 Am	$L\gamma_2$	L_IN_{II}	22.361
0.5572	1	94 Pu	L_{II}	Abs. Edge	22.253
0.5585	5	93 Np	$L\gamma_4$	$L_IO_{II,III}$	22.20
0.5594075	6	47 Ag	$K\alpha_1$	KL_{III}	22.16292
0.55973	2	94 Pu	$L\gamma_6$	$L_{II}O_{IV}$	22.1502
0.56051	1	44 Ru	K	Abs. Edge	22.1193
0.56089	9	44 Ru	$K\beta_4$	$KN_{IV,V}$	22.104
0.56166	3	44 Ru	$K\beta_2$	$KN_{II,III}$	22.074
0.561886	9	95 Am	$L\gamma_1$	$L_{II}N_{IV}$	22.0652
0.563798	4	47 Ag	$K\alpha_2$	KL_{II}	21.9903
0.564001	9	94 Pu	$L\gamma_3$	L_IN_{III}	21.9824
0.5658	1	94 Pu	$L\gamma_8$	$L_{II}O_I$	21.914
0.56785	9	44 Ru	$K\beta_5^{I}$	KM_V	21.834
0.5680	2	44 Ru	$K\beta_5^{II}$	KM_{IV}	21.829
0.5695	1	92 U	L_I	Abs. Edge	21.771
0.5706	1	92 U	$L\gamma_{13}$	$L_IP_{II,III}$	21.729
0.57068	2	94 Pu	$L\gamma_2$	L_IN_{II}	21.1251
0.572482	4	44 Ru	$K\beta_1$	KM_{III}	21.6568
0.5725	1	92 U		$L_IO_{IV,V}$	21.657
0.573067	4	44 Ru	$K\beta_3$	KM_{II}	21.6346
0.57499	9	92 U	$L\gamma_4$	L_IO_{III}	21.562
0.576700	9	92 U	$L\gamma_4'$	L_IO_{II}	21.4984
0.57699	5	93 Np	$L\gamma_6$	$L_{II}O_{IV}$	21.488
0.578882	9	94 Pu	$L\gamma_1$	$L_{II}N_{IV}$	21.4173
0.5810	5	93 Np	$L\gamma_3$	L_IN_{III}	21.34
0.585448	3	46 Pd	$K\alpha_1$	KL_{III}	21.1771
0.5873	5	93 Np	$L\gamma_2$	L_IN_{II}	21.11
0.58906	1	43 Tc	K	Abs. Edge	21.0473
0.589821	3	46 Pd	$K\alpha_2$	KL_{II}	21.0201
0.58986	5	92 U	$L\gamma_{11}$	L_IN_V	21.019
0.59024	5	43 Tc	$K\beta_2$	$KN_{II,III}$	21.005
0.59096	5	92 U		L_IN_{IV}	20.979
0.5919	1	92 U	L_{II}	Abs. Edge	20.945
0.59203	5	92 U		$L_{II}P_{IV}$	20.942
0.5930	2	92 U		$L_{II}P_{II,III}$	20.906
0.5937	1	91 Pa	$L\gamma_4$	$L_IO_{II,III}$	20.882
0.594845	9	92 U	$L\gamma_6$	$L_{II}O_{IV}$	20.8426
0.596498	9	93 Np	$L\gamma_1$	$L_{II}N_{IV}$	20.7848
0.59728	5	92 U		$L_{II}O_{III}$	20.758
0.598574	9	92 U	$L\gamma_3$	L_IN_{III}	20.7127
0.5988	1	94 Pu	$L\gamma_5$	$L_{II}N_I$	20.704
0.60125	5	92 U	$L\gamma_8$	$L_{II}O_I$	20.621
0.60130	4	43 Tc	$K\beta_1$	KM_{III}	20.619
0.60188	4	43 Tc	$K\beta_3$	KM_{II}	20.599
0.6031	1	92 U	Lv	$L_{II}N_{VI}$	20.556
0.605237	9	92 U	$L\gamma_2$	L_IN_{II}	20.4847
0.6059	1	90 Th	L_I	Abs. Edge	20.464
0.60705	8	90 Th	$L\gamma_{13}$	$L_IP_{II,III}$	20.424
0.6083	1	90 Th		$L_IO_{IV,V}$	20.383
0.61098	4	90 Th	$L\gamma_4$	L_IO_{III}	20.292
0.61251	4	90 Th	$L\gamma_4'$	L_IO_{II}	20.242
0.6133	1	91 Pa	$L\gamma_6$	$L_{II}O_{IV}$	20.216
0.613279	4	45 Rh	$K\alpha_1$	KL_{III}	20.2161
0.6146	1	90 Th		L_IO_I	20.174
0.614770	9	92 U	$L\gamma_1$	$L_{II}N_{IV}$	20.1671
0.6160	1	90 Th		$L_IN_{VI,VII}$	20.128

Wavelength Å*	p.e.	Element		Designation	keV
0.616	1	93 Np	$L\gamma_5$	$L_{II}N_{I}$	20.12
0.6169	1	91 Pa	$L\gamma_3$	$L_{I}N_{III}$	20.098
0.617630	4	45 Rh	$K\alpha_2$	KL_{II}	20.0737
0.61978	1	42 Mo	K	Abs. Edge	20.0039
0.62001	9	42 Mo	$K\beta_4^{I}$	$KN_{IV,V}$	19.996
0.62099	2	42 Mo	$K\beta_2$	$KN_{II,III}$	19.9652
0.62107	5	42 Mo	$K\beta_2^{II}$	KN_{II}	19.963
0.6228	1	92 U		$L_{II}N_{III}$	19.907
0.6239	1	91 Pa	$L\gamma_2$	$L_{I}N_{II}$	19.872
0.62636	9	90 Th	$L\gamma_{11}$	$L_{I}N_{V}$	19.794
0.62692	5	42 No	$K\beta_5^{I}$	KM_{V}	19.776
0.62708	5	42 Mo	$K\beta_5^{II}$	KM_{IV}	19.771
0.6276	1	90 Th		$L_{I}N_{IV}$	19.755
0.6299	1	90 Th	L_{II}	Abs. Edge	19.683
0.62991	9	90 Th		$L_{II}P_{IV}$	19.682
0.6312	1	90 Th		$L_{II}P_{II,III}$	19.642
0.6316	1	90 Th		$L_{II}P_{I}$	19.629
0.632288	9	42 Mo	$K\beta_1$	KM_{III}	19.6083
0.63258	4	90 Th	$L\gamma_6$	$L_{II}O_{IV}$	19.599
0.632872	2	42 Mo	$K\beta_3$	KM_{II}	19.5903
0.63358	9	91 Pa	$L\gamma_1$	$L_{II}N_{IV}$	19.568
0.63557	2	92 U	$L\gamma_5$	$L_{II}N_{I}$	19.5072
0.63559	4	90 Th	$L\gamma_3$	$L_{I}N_{III}$	19.507
0.6356	1	90 Th		$L_{II}O_{III}$	19.506
0.6369	1	90 Th		$L_{II}O_{II}$	19.466
0.63898	5	90 Th	$L\gamma_8$	$L_{II}O_{I}$	19.403
0.64064	9	90 Th	Lv	$L_{II}N_{VI}$	19.353
0.6416	1	94 Pu	$L\beta_9$	$L_{I}M_{V}$	19.323
0.64221	4	90 Th	$L\gamma_2$	$L_{I}N_{II}$	19.305
0.643083	4	44 Ru	$K\alpha_1$	KL_{III}	19.2792
0.6445	1	88 Ra	L_{I}	Abs. Edge	19.236
0.64513	5	88 Ra	$L\gamma_{13}$	$L_{I}P_{II,III}$	19.218
0.6468	1	88 Ra		$L_{I}O_{IV,V}$	19.167
0.647408	5	44 Ru	$K\alpha_2$	KL_{II}	19.1504
0.64755	5	90 Th		$L_{I}N_{I}$	19.146
0.6482	1	94 Pu	$L\beta_{10}$	$L_{I}M_{IV}$	19.126
0.64891	2	95 Am	$L\beta_3$	$L_{I}M_{III}$	19.1059
0.64965	5	88 Ra	$L\gamma_4$	$L_{I}O_{III}$	19.084
0.65131	5	88 Ra	$L\gamma_4'$	$L_{I}O_{II}$	19.036
0.6521	1	90 Th		$L_{II}N_{V}$	19.014
0.65298	1	41 Nb	K	Abs. Edge	18.9869
0.65313	3	90 Th	$L\gamma_1$	$L_{II}N_{IV}$	18.9825
0.65318	5	41 Nb	$K\beta_4$	$KN_{IV,V}$	18.981
0.65416	4	41 Nb	$K\beta_2$	$KN_{II,III}$	18.953
0.6550	1	91 Pa	$L\gamma_5$	$L_{II}N_{I}$	18.930
0.657655	9	95 Am	$L\beta_1$	$L_{II}M_{IV}$	18.8520
0.6620	1	90 Th		$L_{II}N_{III}$	18.729
0.6654	1	88 Ra	$L\gamma_{11}$	$L_{I}N_{V}$	18.633
0.66576	2	41 Nb	$K\beta_1$	KM_{III}	18.6225
0.66634	3	41 Nb	$K\beta_3$	KM_{II}	18.6063
0.6666	1	88 Ra		$L_{I}N_{IV}$	18.600
0.66871	2	94 Pu	$L\beta_3$	$L_{I}M_{III}$	18.5405
0.6707	1	88 Ra	L_{II}	Abs. Edge	18.486
0.6714	1	88 Ra		$L_{II}P_{II,III}$	18.466
0.6724	1	88 Ra		$L_{II}P_{I}$	18.439
0.67328	5	88 Ra	$L\gamma_6$	$L_{II}O_{IV}$	18.414
0.67351	9	89 Ac	$L\gamma_1$	$L_{II}N_{IV}$	18.408
0.67383	2	95 Am	$L\beta_5$	$L_{III}O_{IV,V}$	18.3996
0.67491	4	90 Th	$L\gamma_5$	$L_{II}N_{I}$	18.370
0.67502	3	43 Tc	$K\alpha_1$	KL_{III}	18.3671
0.67538	5	88 Ra	$L\gamma_3$	$L_{I}N_{III}$	18.357
0.6764	1	88 Ra		$L_{II}O_{III}$	18.330
0.67772	2	94 Pu	$L\beta_1$	$L_{II}M_{IV}$	18.2937
0.6780	1	88 Ra		$L_{II}O_{II}$	18.286
0.67932	3	43 Tc	$K\alpha_2$	KL_{II}	18.2508
0.6801	1	88 Ra	$L\gamma_8$	$L_{II}O_{I}$	18.230
0.681014	8	92 U	$L\beta_9$	$L_{I}M_{V}$	18.2054
0.68199	5	88 Ra	$L\gamma_2$	$L_{I}N_{II}$	18.179
0.68639	2	95 Am	$L\beta_4$	$L_{I}M_{II}$	18.0627
0.6867	1	94 Pu	L_{III}	Abs. Edge	18.054
0.6874	1	88 Ra		$L_{I}N_{I}$	18.036
0.68760	5	92 U	$L\beta_{10}$	$L_{I}M_{IV}$	18.031
0.68883	1	40 Zr	K	Abs. Edge	17.9989
0.68901	5	40 Zr	$K\beta_4$	$KN_{IV,V}$	17.994
0.68920	9	93 Np	$L\beta_3$	$L_{I}M_{III}$	17.989
0.68993	4	40 Zr	$K\beta_2$	$KN_{II,III}$	17.970
0.69068	2	94 Pu	$L\beta_5$	$L_{III}O_{IV,V}$	17.9506
0.6932	1	88 Ra		$L_{II}N_{V}$	17.884
0.69463	5	88 Ra	$L\gamma_1$	$L_{II}N_{IV}$	17.849
0.6959	1	40 Zr	$K\beta_5$	$KM_{IV,V}$	17.815
0.698478	9	93 Np	$L\beta_1$	$L_{II}M_{IV}$	17.7502
0.7003	1	94 Pu	$L\beta_7$	$L_{III}O_{I}$	17.705
0.701390	9	95 Am	$L\beta_2$	$L_{III}N_{V}$	17.6765
0.70173	3	40 Zr	$K\beta_1$	KM_{III}	17.6678
0.7018	1	91 Pa	$L\beta_9$	$L_{I}M_{V}$	17.667
0.70228	4	40 Zr	$K\beta_3$	KM_{II}	17.654
0.7031	1	94 Pu	Lu	$L_{III}N_{VI,VII}$	17.635
0.70341	2	95 Am	$L\beta_{15}$	$L_{III}N_{IV}$	17.6258
0.7043	1	88 Ra		$L_{II}N_{III}$	17.604
0.70620	2	94 Pu	$L\beta_4$	$L_{I}M_{II}$	17.5560
0.70814	2	93 Np	$L\beta_5$	$L_{III}O_{IV,V}$	17.5081
0.7088	2	91 Pa	$L\beta_{10}$	$L_{I}M_{IV}$	17.492
0.709300	1	42 Mo	$K\alpha_1$	KL_{III}	17.47934
0.71029	2	92 U	$L\beta_3$	$L_{I}M_{III}$	17.4550
0.713590	6	42 Mo	$K\alpha_2$	KL_{II}	17.3743
0.71652	9	87 Fr	$L\gamma_1$	$L_{II}N_{IV}$	17.303
0.71774	5	88 Ra	$L\gamma_5$	$L_{II}N_{I}$	17.274
0.71851	2	94 Pu	$L\beta_2$	$L_{III}N_{V}$	17.2553
0.719984	8	92 U	$L\beta_1$	$L_{II}M_{IV}$	17.2200
0.7205	1	94 Pu	$L\beta_{15}$	$L_{III}N_{IV}$	17.208
0.7223	1	92 U	L_{III}	Abs. Edge	17.165
0.72240	5	92 U		$L_{III}P_{IV,V}$	17.162
0.7234	1	90 Th	$L\beta_9$	$L_{I}M_{V}$	17.139
0.72426	5	92 U		$L_{III}P_{II,III}$	17.118
0.72521	5	92 U		$L_{III}P_{I}$	17.096
0.726305	9	92 U	$L\beta_5$	$L_{III}O_{IV,V}$	17.0701
0.72671	2	93 Np	$L\beta_4$	$L_{I}M_{II}$	17.0607
0.72766	5	39 Y	K	Abs. Edge	17.038
0.72776	5	39 Y	$K\beta_4$	$KN_{IV,V}$	17.036
0.72864	4	39 Y	$K\beta_2$	$KN_{II,III}$	17.0154
0.7301	1	90 Th	$L\beta_{10}$	$L_{I}M_{IV}$	16.981
0.7309	1	92 U		$L_{III}O_{III}$	16.962
0.73230	5	91 Pa	$L\beta_3$	$L_{I}M_{III}$	16.930
0.7333	1	92 U		$L_{III}O_{II}$	16.907

Wavelength Å*	p.e.	Element		Designation	keV
0.73418	2	95 Am	$L\beta_6$	$L_{III}N_I$	16.8870
0.7345	1	39 Y	$K\beta_5$	$KM_{IV,V}$	16.879
0.73602	6	92 U	$L\beta_7$	$L_{III}O_I$	16.845
0.736230	9	93 Np	$L\beta_2$	$L_{III}N_V$	16.8400
0.738603	9	92 U	Lu	$L_{III}N_{VI,VII}$	16.7859
0.73928	9	86 Rn	$L\gamma_1$	$L_{II}N_{IV}$	16.770
0.74072	2	39 Y	$K\beta_1$	KM_{III}	16.7378
0.74126	3	39 Y	$K\beta_3$	KM_{II}	16.7258
0.74232	5	91 Pa	$L\beta_1$	$L_{II}M_{IV}$	16.702
0.74503	5	92 U	$L\beta_{17}$	$L_{II}M_{III}$	16.641
0.7452	2	91 Pa	$L\beta_5$	$L_{III}O_{IV,V}$	16.636
0.74620	1	41 Nb	$K\alpha_1$	KL_{III}	16.6151
0.747985	9	92 U	$L\beta_4$	L_IM_{II}	16.5753
0.75044	1	41 Nb	$K\alpha_2$	KL_{II}	16.5210
0.75148	2	94 Pu	$L\beta_6$	$L_{III}N_I$	16.4983
0.7546	2	91 Pa	$L\beta_7$	$L_{III}O_I$	16.431
0.754681	9	92 U	$L\beta_2$	$L_{III}N_V$	16.4283
0.75479	3	90 Th	$L\beta_3$	L_IM_{III}	16.4258
0.756642	9	92 U	$L\beta_{15}$	$L_{III}N_{IV}$	16.3857
0.75690	3	83 Bi	$L\gamma_{13}$	$L_IP_{II,III}$	16.3802
0.7571	1	83 Bi	L_I	Abs. Edge	16.376
0.7579	1	90 Th		$L_{II}M_V$	16.359
0.75791	5	83 Bi		$L_IO_{IV,V}$	16.358
0.7591	1	94 Pu	$L\eta$	$L_{II}M_I$	16.333
0.7607	1	90 Th	L_{III}	Abs. Edge	16.299
0.76087	9	90 Th		$L_{III}P_{IV,V}$	16.295
0.76087	3	83 Bi	$L\gamma_4$	L_IO_{III}	16.2947
0.76198	3	83 Bi	$L\gamma_4'$	L_IO_{II}	16.2709
0.7625	2	90 Th		$L_{III}P_{II,III}$	16.260
0.76289	9	85 At	$L\gamma_1$	$L_{II}N_{IV}$	16.251
0.76338	5	90 Th		$L_{III}P_I$	16.241
0.7641	5	83 Bi		$L_IN_{VI,VII}$	16.23
0.7645	2	84 Po	$L\gamma_6$	$L_{II}O_{IV}$	16.218
0.76468	5	90 Th	$L\beta_5$	$L_{III}O_{IV,V}$	16.213
0.765210	9	90 Th	$L\beta_1$	$L_{II}M_{IV}$	16.2022
0.76857	5	88 Ra	$L\beta_9$	L_IM_V	16.131
0.769	1	93 Np	$L\beta_6$	$L_{III}N_I$	16.13
0.7690	1	90 Th		$L_{III}O_{III}$	16.123
0.7691	1	92 U		$L_{III}N_{III}$	16.120
0.76973	5	38 Sr	K	Abs. Edge	16.107
0.7699	1	91 Pa	$L\beta_4$	L_IM_{II}	16.104
0.76989	5	38 Sr	$K\beta_4$	$KN_{IV,V}$	16.104
0.77081	3	38 Sr	$K\beta_2$	$KN_{II,III}$	16.0846
0.7713	1	90 Th		$L_{III}O_{II}$	16.074
0.772	1	84 Po	$L\gamma_2$	L_IN_{II}	16.07
0.7737	1	91 Pa	$L\beta_2$	$L_{III}N_V$	16.024
0.77437	4	90 Th	$L\beta_7$	$L_{III}O_I$	16.0105
0.77546	5	88 Ra	$L\beta_{10}$	L_IM_{IV}	15.988
0.7764	1	38 Sr	$K\beta_5$	$KM_{IV,V}$	15.969
0.77661	5	90 Th	Lu	$L_{III}N_{VI,VII}$	15.964
0.77728	5	83 Bi	$L\gamma_{11}$	L_IN_V	15.951
0.77822	9	89 Ac	$L\beta_3$	L_IM_{III}	15.931
0.77954	5	83 Bi		L_IN_{IV}	15.904
0.78017	9	92 U		$L_{III}N_{II}$	15.892
0.7809	2	93 Np	$L\eta$	$L_{II}M_I$	15.876
0.78196	5	82 Pb	L_I	Abs. Edge	15.855
0.78257	7	82 Pb		$L_IO_{IV,V}$	15.843
0.78292	2	38 Sr	$K\beta_1$	KM_{III}	15.8357
0.78345	3	38 Sr	$K\beta_3$	KM_{II}	15.8249
0.7858	1	82 Pb	$L\gamma_4$	L_IO_{III}	15.777
0.78593	1	40 Zr	$K\alpha_1$	KL_{III}	15.7751
0.78706	7	82 Pb	$L\gamma_4'$	L_IO_{II}	15.752
0.78748	9	84 Po	$L\gamma_1$	$L_{II}N_{IV}$	15.744
0.78838	2	92 U	$L\beta_6$	$L_{III}N_I$	15.7260
0.7884	1	82 Pb		$L_IN_{VI,VII}$	15.725
0.7887	1	83 Bi	L_{II}	Abs. Edge	15.719
0.78903	9	89 Ac	$L\beta_1$	$L_{II}M_{IV}$	15.713
0.78917	5	83 Bi	$L\gamma_3$	L_IN_{III}	15.7102
0.7897	1	82 Pb		L_IO_I	15.699
0.79015	1	40 Zr	$K\alpha_2$	KL_{II}	15.6909
0.79043	3	83 Bi	$L\gamma_6$	$L_{II}O_{IV}$	15.6853
0.79257	4	90 Th	$L\beta_4$	L_IM_{II}	15.6429
0.79257	4	90 Th	$L\beta_{17}$	$L_{II}M_{III}$	15.6429
0.79354	3	90 Th	$L\beta_2$	$L_{III}M_V$	15.6237
0.79384	5	83 Bi		$L_{II}O_{III}$	15.6178
0.79539	5	90 Th	$L\beta_{15}$	$L_{III}N_{IV}$	15.5875
0.79565	3	83 Bi	$L\gamma_2$	L_IN_{II}	15.5824
0.79721	9	83 Bi	Lv	$L_{II}N_{VI}$	15.552
0.7973	1	83 Bi	$L\gamma_8$	$L_{II}O_I$	15.551
0.8022	1	83 Bi		L_IN_I	15.456
0.80233	9	82 Pb	$L\gamma_{11}$	L_IN_V	15.453
0.80273	5	88 Ra	$L\beta_3$	L_IM_{III}	15.4449
0.8028	1	88 Ra	L_{III}	Abs. Edge	15.444
0.80364	7	82 Pb		L_IN_{IV}	15.427
0.8038	1	88 Ra		$L_{III}P_{II,III}$	15.425
0.8050	1	88 Ra		$L_{III}P_I$	15.402
0.80509	2	92 U	$L\eta$	$L_{II}M_I$	15.3997
0.80627	5	88 Ra	$L\beta_5$	$L_{III}O_{IV,V}$	15.3771
0.8079	1	91 Pa	$L\beta_6$	$L_{III}N_I$	15.347
0.8081	1	81 Tl	L_I	Abs. Edge	15.343
0.8082	1	90 Th		$L_{III}N_{III}$	15.341
0.80861	5	81 Tl		$L_IO_{IV,V}$	15.3327
0.81163	9	90 Th		L_IM_I	15.276
0.81184	5	81 Tl	$L\gamma_4$	L_IO_{III}	15.2716
0.81308	5	81 Tl	$L\gamma_4'$	L_IO_{II}	15.2482
0.81311	2	83 Bi	$L\gamma_1$	$L_{II}N_{IV}$	15.2477
0.81375	5	88 Ra	$L\beta_1$	$L_{II}M_{IV}$	15.2358
0.8147	1	82 Pb	$L\gamma_3$	L_IN_{III}	15.218
0.81538	5	82 Pb	L_{II}	Abs. Edge	15.2053
0.8154	2	37 Rb	$K\beta_4$	$KN_{IV,V}$	15.205
0.81554	5	37 Rb	K	Abs. Edge	15.2023
0.8158	1	81 Tl		L_IO_I	15.198
0.81583	5	82 Pb		$L_{II}P_I$	15.1969
0.8162	1	88 Ra	$L\beta_7$	$L_{III}O_I$	15.190
0.81645	3	37 Rb	$K\beta_2$	$KN_{II,III}$	15.1854
0.81683	5	82 Pb	$L\gamma_6$	$L_{II}O_{IV}$	15.1783
0.8186	1	88 Ra	Lu	$L_{III}N_{VI,VII}$	15.146
0.8190	2	90 Th		$L_{III}N_{II}$	15.138
0.8200	1	82 Pb		$L_{II}O_{III}$	15.120
0.8210	2	82 Pb	$L\gamma_2$	L_IN_{II}	15.101
0.8219	1	37 Rb	$K\beta_5$	$KM_{IV,V}$	15.085
0.82327	7	82 Pb	Lv	$L_{II}N_{VI}$	15.060
0.82365	5	82 Pb	$L\gamma_8$	$L_{II}O_I$	15.0527
0.8248	1	83 Bi		$L_{II}N_{III}$	15.031

Wavelength Å*	p.e.	Element		Designation	keV
0.82789	9	87 Fr	$L\beta_3$	$L_{I}M_{III}$	14.976
0.82790	8	90 Th	$L\beta_6$	$L_{III}N_{I}$	14.975
0.82859	7	82 Pb		$L_{I}N_{I}$	14.963
0.82868	2	37 Rb	$K\beta_1$	KM_{III}	14.9613
0.82879	5	81 Tl	$L\gamma_{11}$	$L_{I}N_{V}$	14.9593
0.82884	1	39 Y	$K\alpha_1$	KL_{III}	14.9584
0.82921	3	37 Rb	$K\beta_3$	KM_{II}	14.9517
0.8295	1	91 Pa	$L\eta$	$L_{II}M_{I}$	14.946
0.83001	7	81 Tl		$L_{I}N_{IV}$	14.937
0.83305	1	39 Y	$K\alpha_2$	KL_{II}	14.8829
0.8338	1	90 Th		$L_{II}M_{II}$	14.869
0.8344	9	83 Bi		$L_{II}N_{II}$	14.86
0.8350	2	80 Hg		$L_{I}O_{IV,V}$	14.847
0.8353	1	80 Hg	L_{I}	Abs. Edge	14.842
0.83537	5	88 Ra	$L\beta_2$	$L_{III}N_{V}$	14.8414
0.83722	5	88 Ra	$L\beta_{15}$	$L_{III}N_{IV}$	14.8086
0.8382	2	82 Pb		$L_{II}N_{V}$	14.791
0.83894	7	80 Hg	$L\gamma_4$	$L_{I}O_{III}$	14.778
0.83923	5	83 Bi	$L\gamma_5$	$L_{II}N_{I}$	14.7732
0.83940	9	87 Fr	$L\beta_1$	$L_{II}M_{IV}$	14.770
0.83973	3	82 Pb	$L\gamma_1$	$L_{II}N_{IV}$	14.7644
0.84013	7	80 Hg	$L\gamma_4'$	$L_{I}O_{II}$	14.757
0.84071	5	88 Ra	$L\beta_4$	$L_{I}M_{II}$	14.7472
0.84130	4	81 Tl	$L\gamma_3$	$L_{I}N_{III}$	14.7368
0.8434	1	81 Tl	L_{II}	Abs. Edge	14.699
0.8438	1	88 Ra	$L\beta_{17}$	$L_{II}M_{III}$	14.692
0.8442	2	81 Tl	$L\gamma_6$	$L_{II}O_{IV}$	14.685
0.8452	2	80 Hg		$L_{I}O_{I}$	14.670
0.84773	5	81 Tl	$L\gamma_2$	$L_{I}N_{II}$	14.6251
0.848187	9	95 Am	$L\alpha_1$	$L_{III}M_{V}$	14.6172
0.8490	1	81 Tl		$L_{II}O_{II}$	14.604
0.85048	5	81 Tl	Lv	$L_{II}N_{VI}$	14.5777
0.8512	1	88 Ra		$L_{III}N_{III}$	14.566
0.8513	2	81 Tl	$L\gamma_8$	$L_{II}O_{I}$	14.564
0.85192	7	82 Pb		$L_{II}N_{III}$	14.553
0.85436	9	86 Rn	$L\beta_3$	$L_{I}M_{III}$	14.512
0.85446	4	90 Th	$L\eta$	$L_{II}M_{I}$	14.5099
0.8549	1	81 Tl		$L_{I}N_{I}$	14.503
0.85657	7	80 Hg	$L\gamma_{11}$	$L_{I}N_{V}$	14.474
0.858	2	87 Fr	$L\beta_2$	$L_{III}N_{V}$	14.45
0.8585	3	82 Pb		$L_{II}N_{II}$	14.442
0.860266	9	95 Am	$L\alpha_2$	$L_{III}M_{IV}$	14.4119
0.8618	1	88 Ra		$L_{III}N_{II}$	14.387
0.86376	5	79 Au	L_{I}	Abs. Edge	14.3537
0.86400	5	79 Au		$L_{I}O_{IV,V}$	14.3497
0.8653	2	36 Kr	$K\beta_4$	$KN_{IV,V}$	14.328
0.86552	1	36 Kr	K	Abs. Edge	14.3244
0.86605	9	86 Rn	$L\beta_1$	$L_{II}M_{IV}$	14.316
0.8661	1	36 Kr	$K\beta_2$	$KN_{II,III}$	14.315
0.86655	5	82 Pb	$L\gamma_5$	$L_{II}N_{I}$	14.3075
0.86703	4	79 Au	$L\gamma_4$	$L_{I}O_{III}$	14.2996
0.86752	3	81 Tl	$L\gamma_1$	$L_{II}N_{IV}$	14.2915
0.86816	4	79 Au	$L\gamma_4'$	$L_{I}O_{II}$	14.2809
0.86830	2	94 Pu	$L\alpha_1$	$L_{III}M_{V}$	14.2786
0.86915	7	80 Hg	$L\gamma_3$	$L_{I}N_{III}$	14.265
0.87074	5	79 Au		$L_{I}O_{I}$	14.2385
0.8708	2	36 Kr	$K\beta_5$	$KM_{IV,V}$	14.238
0.87088	5	88 Ra	$L\beta_6$	$L_{III}N_{I}$	14.2362
0.8722	1	80 Hg	L_{II}	Abs. Edge	14.215
0.87319	7	80 Hg	$L\gamma_6$	$L_{II}O_{IV}$	14.199
0.87526	1	38 Sr	$K\alpha_1$	KL_{III}	14.1650
0.87544	7	80 Hg	$L\gamma_2$	$L_{I}N_{II}$	14.162
0.8758	1	80 Hg		$L_{II}O_{III}$	14.156
0.8784	1	80 Hg		$L_{II}O_{II}$	14.114
0.8785	1	36 Kr	$K\beta_1$	KM_{III}	14.112
0.87885	7	80 Hg	Lv	$L_{II}N_{VI}$	14.107
0.8790	1	36 Kr	$K\beta_3$	KM_{II}	14.104
0.87943	1	38 Sr	$K\alpha_2$	KL_{II}	14.0979
0.87995	7	80 Hg	$L\gamma_8$	$L_{II}O_{I}$	14.090
0.87996	5	81 Tl		$L_{II}N_{III}$	14.0893
0.88028	2	94 Pu	$L\alpha_2$	$L_{III}M_{IV}$	14.0842
0.88135	9	85 At	$L\beta_3$	$L_{I}M_{III}$	14.067
0.8827	2	80 Hg		$L_{I}N_{I}$	14.045
0.88433	7	79 Au	$L\gamma_{11}$	$L_{I}N_{V}$	14.020
0.88563	7	79 Au		$L_{I}N_{IV}$	13.999
0.8882	2	81 Tl		$L_{II}M_{II}$	13.959
0.889128	9	93 Np	$L\alpha_1$	$L_{III}M_{V}$	13.9441
0.8931	1	78 Pt	L_{I}	Abs. Edge	13.883
0.8934	1	78 Pt		$L_{I}O_{V}$	13.878
0.89349	9	85 At	$L\beta_1$	$L_{II}M_{IV}$	13.876
0.8943	1	78 Pt		$L_{I}O_{IV}$	13.864
0.89500	4	81 Tl	$L\gamma_5$	$L_{II}N_{I}$	13.8526
0.89646	5	80 Hg	$L\gamma_1$	$L_{II}N_{IV}$	13.8301
0.89659	4	78 Pt	$L\gamma_4$	$L_{I}O_{III}$	13.8281
0.89747	4	78 Pt	$L\gamma_4'$	$L_{I}O_{II}$	13.8145
0.89783	5	79 Au	$L\gamma_3$	$L_{I}N_{III}$	13.8090
0.89791	3	83 Bi	$L\beta_9$	$L_{I}M_{V}$	13.8077
0.8995	2	78 Pt		$L_{I}O_{I}$	13.784
0.8996	2	84 Po	$L\beta_6$	$L_{III}O_{IV,V}$	13.782
0.901045	9	93 Np	$L\alpha_2$	$L_{III}M_{IV}$	13.7597
0.90259	5	79 Au	L_{II}	Abs. Edge	13.7361
0.90297	3	79 Au	$L\gamma_6$	$L_{II}O_{IV}$	13.7304
0.90434	3	79 Au	$L\gamma_2$	$L_{I}N_{II}$	13.7095
0.90495	4	83 Bi	$L\beta_{10}$	$L_{I}M_{IV}$	13.7002
0.90638	7	79 Au		$L_{II}O_{III}$	13.679
0.90742	5	88 Ra	$L\eta$	$L_{II}M_{I}$	13.6630
0.90746	7	79 Au		$L_{II}O_{II}$	13.662
0.90837	5	79 Au	Lv	$L_{II}N_{VI}$	13.6487
0.90894	7	80 Hg		$L_{II}N_{III}$	13.640
0.9091	3	84 Po	$L\beta_3$	$L_{I}M_{III}$	13.638
0.90989	5	79 Au	$L\gamma_8$	$L_{II}O_{I}$	13.6260
0.910639	9	92 U	$L\alpha_1$	$L_{III}M_{V}$	13.6147
0.9131	1	79 Au		$L_{I}N_{I}$	13.578
0.9143	2	78 Pt	$L\gamma_{11}$	$L_{I}N_{V}$	13.560
0.9204	1	35 Br	K	Abs. Edge	13.470
0.92046	2	35 Br	$K\beta_2$	$KN_{II,III}$	13.4695
0.9220	2	84 Po	$L\beta_1$	$L_{II}M_{IV}$	13.447
0.922558	9	92 U	$L\alpha_2$	$L_{III}M_{IV}$	13.4388
0.9234	1	83 Bi	L_{III}	Abs. Edge	13.426
0.9236	1	77 Ir	L_{I}	Abs. Edge	13.423
0.92413	4	83 Bi		$L_{III}P_{II,III}$	13.4159
0.9243	3	77 Ir		$L_{I}O_{IV,V}$	13.413
0.92453	7	80 Hg	$L\gamma_5$	$L_{II}N_{I}$	13.410
0.9255	1	35 Br	$K\beta_5$	$KM_{IV,V}$	13.396

Wavelength Å*	p.e.	Element		Designation	keV
0.925553	9	37 Rb	$K\alpha_1$	KL_{III}	13.3953
0.92556	3	83 Bi	$L\beta_5$	$L_{III}O_{IV,V}$	13.3953
0.92650	3	79 Au	$L\gamma_1$	$L_{II}N_{IV}$	13.3817
0.9268	1	82 Pb	$L\beta_9$	L_IM_V	13.377
0.92744	3	77 Ir	$L\gamma_4$	L_IO_{III}	13.3681
0.92791	5	78 Pt	$L\gamma_3$	L_IN_{III}	13.3613
0.92831	3	77 Ir	$L\gamma_4'$	L_IO_{II}	13.3555
0.92937	5	84 Po	$L\beta_2$	$L_{III}N_V$	13.3404
0.92969	1	37 Rb	$K\alpha_2$	KL_{II}	13.3358
0.9302	2	83 Bi		$L_{III}O_{III}$	13.328
0.9312	2	84 Po	$L\beta_{15}$	$L_{III}N_{IV}$	13.314
0.9323	2	83 Bi		$L_{III}O_{II}$	13.298
0.93279	2	35 Br	$K\beta_1$	KM_{III}	13.2914
0.93284	5	91 Pa	$L\alpha_1$	$L_{III}M_V$	13.2907
0.93327	5	35 Br	$K\beta_3$	KM_{II}	13.2845
0.9339	2	82 Pb	$L\beta_{10}$	L_IM_{IV}	13.275
0.93414	5	78 Pt	L_{II}	Abs. Edge	13.2723
0.9342	2	78 Pt	$L\gamma_6$	$L_{II}O_{IV}$	13.271
0.93427	5	78 Pt	$L\gamma_2$	L_IN_{II}	13.2704
0.93505	5	83 Bi	$L\beta_7$	$L_{III}O_I$	13.2593
0.93505	5	83 Bi	Lu	$L_{III}N_{VI,VII}$	13.2593
0.93855	3	83 Bi	$L\beta_3$	L_IM_{III}	13.2098
0.93931	5	78 Pt	Lv	$L_{II}N_{VI}$	13.1992
0.9402	2	79 Au		$L_{II}N_{III}$	13.186
0.9411	1	78 Pt	$L\gamma_8$	$L_{II}O_I$	13.173
0.94419	5	83 Bi		$L_{II}M_V$	13.1310
0.9446	2	77 Ir	$L\gamma_{11}$	L_IN_V	13.126
0.94482	5	91 Pa	$L\alpha_2$	$L_{III}M_{IV}$	13.1222
0.9455	2	78 Pt		L_IN_I	13.113
0.9459	2	77 Ir		L_IN_{IV}	13.108
0.9475	3	84 Po	$L\beta_4$	L_IM_{II}	13.086
0.95073	5	82 Pb	L_{III}	Abs. Edge	13.0406
0.95118	7	82 Pb		$L_{III}P_{II,III}$	13.0344
0.951978	9	83 Bi	$L\beta_1$	$L_{II}M_{IV}$	13.0235
0.9526	1	82 Pb	$L\beta_5$	$L_{III}O_{IV,V}$	13.015
0.95518	4	83 Bi	$L\beta_2$	$L_{III}N_V$	12.9799
0.95559	3	79 Au	$L\gamma_5$	$L_{II}N_I$	12.9743
0.9558	1	76 Os	L_I	Abs. Edge	12.972
0.95600	3	90 Th	$L\alpha_1$	$L_{III}M_V$	12.9687
0.95603	5	76 Os		$L_IO_{IV,V}$	12.9683
0.95675	7	81 Tl	$L\beta_9$	L_IM_V	12.9585
0.95702	5	83 Bi	$L\beta_{15}$	$L_{III}N_{IV}$	12.9549
0.9578	1	82 Pb		$L_{III}O_{III}$	12.945
0.95797	3	78 Pt	$L\gamma_1$	$L_{II}N_{IV}$	12.9420
0.9586	1	82 Pb		$L_{III}O_{II}$	12.934
0.95931	5	77 Ir	$L\gamma_3$	L_IN_{III}	12.9240
0.95938	8	76 Os	$L\gamma_4$	L_IO_{III}	12.923
0.96033	8	76 Os	$L\gamma_4'$	L_IO_{II}	12.910
0.96133	7	82 Pb	Lu	$L_{III}N_{VI,VII}$	12.8968
0.9620	1	82 Pb	$L\beta_7$	$L_{III}O_I$	12.888
0.96318	7	76 Os		L_IO_I	12.8721
0.9636	1	92 U	Ls	$L_{III}M_{III}$	12.866
0.96389	7	81 Tl	$L\beta_{10}$	L_IM_{IV}	12.8626
0.96545	3	77 Ir	$L\gamma_2$	L_IN_{II}	12.8418
0.96708	4	77 Ir	$L\gamma_6$	$L_{II}O_{IV}$	12.8201
0.9671	1	77 Ir	L_{II}	Abs. Edge	12.820
0.9672	2	84 Po	$L\beta_6$	$L_{III}N_I$	12.819
0.96788	2	90 Th	$L\alpha_2$	$L_{III}M_{IV}$	12.8096
0.96911	7	82 Pb	$L\beta_3$	L_IM_{III}	12.7933
0.96979	5	77 Ir		$L_{II}O_{III}$	12.7843
0.97161	6	77 Ir	Lv	$L_{II}N_{VI}$	12.7603
0.97173	4	78 Pt		$L_{II}N_{III}$	12.7588
0.97321	5	83 Bi		$L_{III}N_{III}$	12.7394
0.97409	3	77 Ir	$L\gamma_8$	$L_{II}O_I$	12.7279
0.9747	1	82 Pb		$L_{II}M_V$	12.720
0.9765	3	76 Os	$L\gamma_{11}$	L_IN_V	12.696
0.9766	2	77 Ir		L_IN_I	12.695
0.97690	4	83 Bi	$L\beta_4$	L_IM_{II}	12.6912
0.9772	3	76 Os		L_IN_{IV}	12.687
0.9792	2	78 Pt		$L_{II}N_{II}$	12.661
0.97926	5	81 Tl		$L_{III}P_{II,III}$	12.6607
0.9793	1	81 Tl	L_{III}	Abs. Edge	12.660
0.97974	1	34 Se	K	Abs. Edge	12.6545
0.97992	5	34 Se	$K\beta_2$	$KN_{II,III}$	12.6522
0.97993	5	89 Ac	$L\alpha_1$	$L_{III}M_V$	12.6520
0.9801	1	36 Kr	$K\alpha_1$	KL_{III}	12.649
0.98058	3	81 Tl	$L\beta_5$	$L_{III}O_{IV,V}$	12.6436
0.98221	7	82 Pb	$L\beta_2$	$L_{III}N_V$	12.6226
0.98280	5	83 Bi		$L_{III}N_{II}$	12.6151
0.98291	3	82 Pb	$L\beta_1$	$L_{II}M_{IV}$	12.6137
0.98389	7	82 Pb	$L\beta_{15}$	$L_{III}N_{IV}$	12.6011
0.9841	1	36 Kr	$K\alpha_2$	KL_{II}	12.598
0.9843	1	34 Se	$K\beta_5$	$KM_{IV,V}$	12.595
0.98538	5	81 Tl		$L_{III}O_{III}$	12.5820
0.9871	2	80 Hg	$L\beta_9$	L_IM_V	12.560
0.98738	5	81 Tl		$L_{III}O_{II}$	12.5566
0.9877	2	78 Pt	$L\gamma_5$	$L_{II}N_I$	12.552
0.9888	1	81 Tl	Lu	$L_{III}N_{VI,VII}$	12.538
0.98913	5	83 Bi	$L\beta_{17}$	$L_{II}M_{III}$	12.5344
0.9894	1	75 Re	L_I	Abs. Edge	12.530
0.9900	1	75 Re		$L_IO_{IV,V}$	12.524
0.99017	5	81 Tl	$L\beta_7$	$L_{III}O_I$	12.5212
0.99085	3	77 Ir	$L\gamma_1$	$L_{II}N_{IV}$	12.5126
0.99178	5	89 Ac	$L\alpha_2$	$L_{III}M_{IV}$	12.5008
0.99186	5	76 Os	$L\gamma_3$	L_IN_{III}	12.4998
0.99218	3	34 Se	$K\beta_1$	KM_{III}	12.4959
0.99249	5	75 Re	$L\gamma_4$	L_IO_{III}	12.4920
0.99268	5	34 Se	$K\beta_3$	KM_{II}	12.4896
0.99331	3	83 Bi	$L\beta_6$	$L_{III}N_I$	12.4816
0.99334	5	75 Re	$L\gamma_4'$	L_IO_{II}	12.4813
0.9962	2	80 Hg	$L\beta_{10}$	L_IM_{IV}	12.446
0.9965	1	75 Re		L_IO_I	12.442
0.99805	5	76 Os	$L\gamma_2$	L_IN_{II}	12.4224
1.0005	1	82 Pb		$L_{III}N_{III}$	12.392
1.0005	9	83 Bi		L_IM_I	12.39
1.00062	3	81 Tl	$L\beta_3$	L_IM_{III}	12.3904
1.00107	5	76 Os	$L\gamma_6$	$L_{II}O_{IV}$	12.3848
1.0012	6	95 Am	Ll	$L_{III}M_I$	12.384
1.0014	1	76 Os	L_{II}	Abs. Edge	12.381
1.0047	2	76 Os		$L_{II}O_{III}$	12.340
1.00473	5	88 Ra	$L\alpha_1$	$L_{III}M_V$	12.3397
1.0050	2	76 Os	Lv	$L_{II}N_{VI}$	12.337
1.0054	3	77 Ir		$L_{II}N_{III}$	12.332
1.00722	5	81 Tl		$L_{II}M_V$	12.3093

TABLE VI (*Continued*)

Wavelength Å*	p.e.	Element		Designation	keV
1.0075	1	82 Pb	$L\beta_4$	$L_{I}M_{II}$	12.306
1.00788	5	76 Os	$L\gamma_8$	$L_{II}O_{I}$	12.3012
1.0091	1	80 Hg	L_{III}	Abs. Edge	12.286
1.00987	7	80 Hg	$L\beta_5$	$L_{III}O_{IV,V}$	12.2769
1.01031	3	81 Tl	$L\beta_2$	$L_{III}N_{V}$	12.2715
1.01040	7	82 Pb		$L_{III}N_{II}$	12.2705
1.0108	1	75 Re	$L\gamma_{11}$	$L_{I}N_{V}$	12.266
1.0112	1	90 Th	Ls	$L_{III}M_{III}$	12.261
1.0119	1	75 Re		$L_{I}N_{IV}$	12.252
1.0120	2	77 Ir		$L_{II}N_{II}$	12.251
1.01201	3	81 Tl	$L\beta_{15}$	$L_{III}N_{IV}$	12.2510
1.01404	7	80 Hg		$L_{III}O_{III}$	12.2264
1.01513	4	81 Tl	$L\beta_1$	$L_{II}M_{IV}$	12.2133
1.01558	7	80 Hg		$L_{III}O_{II}$	12.2079
1.01656	5	88 Ra	$L\alpha_2$	$L_{III}M_{IV}$	12.1962
1.01674	7	80 Hg	Lu	$L_{III}N_{VII}$	12.1940
1.01769	7	80 Hg	Lu'	$L_{III}N_{VI}$	12.1826
1.01937	7	80 Hg	$L\beta_7$	$L_{III}O_{I}$	12.1625
1.02063	7	79 Au	$L\beta_9$	$L_{I}M_{V}$	12.1474
1.0210	1	82 Pb	$L\beta_6$	$L_{III}N_{I}$	12.143
1.02175	5	77 Ir	$L\gamma_5$	$L_{II}N_{I}$	12.1342
1.0223	1	82 Pb	$L\beta_{17}$	$L_{II}M_{III}$	12.127
1.0226	1	94 Pu	Ll	$L_{III}M_{I}$	12.124
1.02467	5	74 W	L_{I}	Abs. Edge	12.0996
1.0250	2	74 W		$L_{I}O_{IV,V}$	12.095
1.02503	5	76 Os	$L\gamma_1$	$L_{II}N_{IV}$	12.0953
1.02613	7	75 Re	$L\gamma_3$	$L_{I}N_{III}$	12.0824
1.02775	3	74 W	$L\gamma_4$	$L_{I}O_{III}$	12.0634
1.02789	7	79 Au	$L\beta_{10}$	$L_{I}M_{IV}$	12.0617
1.0286	1	81 Tl		$L_{III}N_{III}$	12.053
1.02863	3	74 W	$L\gamma_4'$	$L_{I}O_{II}$	12.0530
1.03049	5	87 Fr	$L\alpha_1$	$L_{III}M_{V}$	12.0313
1.0317	3	74 W		$L_{I}O_{I}$	12.017
1.03233	5	75 Re	$L\gamma_2$	$L_{I}N_{II}$	12.0098
1.0323	2	82 Pb		$L_{I}M_{I}$	12.010
1.03358	7	80 Hg	$L\beta_3$	$L_{I}M_{III}$	11.9953
1.0346	9	83 Bi		$L_{I}M_{II}$	11.98
1.0347	1	92 U	Lt	$L_{III}M_{II}$	11.982
1.03699	9	75 Re	$L\gamma_6$	$L_{II}O_{IV}$	11.956
1.0371	1	75 Re	L_{II}	Abs. Edge	11.954
1.03876	7	79 Au		$L_{III}P_{II,III}$	11.9355
1.03918	3	81 Tl	$L\beta_4$	$L_{II}M_{II}$	11.9306
1.0397	1	75 Re		$L_{II}O_{III}$	11.925
1.03973	5	76 Os		$L_{II}N_{III}$	11.9243
1.03974	2	35 Br	$K\alpha_1$	KL_{III}	11.9242
1.03975	7	80 Hg	$L\beta_2$	$L_{III}N_{V}$	11.9241
1.04000	5	79 Au	L_{III}	Abs. Edge	11.9212
1.0404	1	75 Re	Lv	$L_{II}N_{VI}$	11.917
1.04044	3	79 Au	$L\beta_5$	$L_{III}O_{IV,V}$	11.9163
1.04151	7	80 Hg	$L\beta_{15}$	$L_{III}N_{IV}$	11.9040
1.0420	1	75 Re		$L_{I}N_{I}$	11.899
1.04230	5	87 Fr	$L\alpha_2$	$L_{III}M_{IV}$	11.8950
1.0428	6	93 Np	Ll	$L_{III}M_{I}$	11.890
1.04382	2	35 Br	$K\alpha_2$	KL_{II}	11.8776
1.04398	5	75 Re	$L\gamma_8$	$L_{II}O_{I}$	11.8758
1.0450	2	79 Au		$L_{III}O_{II,III}$	11.865
1.0450	1	33 As	K	Abs. Edge	11.865
1.04500	3	33 As	$K\beta_2$	$KN_{II,III}$	11.8642
1.0458	1	74 W	$L\gamma_{11}$	$L_{I}N_{V}$	11.856
1.0468	2	74 W		$L_{I}N_{IV}$	11.844
1.04752	5	79 Au	Lu	$L_{III}N_{VI,VII}$	11.8357
1.04868	5	80 Hg	$L\beta_1$	$L_{II}M_{IV}$	11.8226
1.0488	1	33 As	$K\beta_5$	$KM_{IV,V}$	11.822
1.04963	5	81 Tl	$L\beta_6$	$L_{III}N_{I}$	11.8118
1.04974	8	79 Au	$L\beta_7$	$L_{III}O_{I}$	11.8106
1.05446	5	78 Pt	$L\beta_9$	$L_{I}M_{V}$	11.7577
1.05609	7	81 Tl	$L\beta_{17}$	$L_{II}M_{III}$	11.7397
1.05693	5	76 Os	$L\gamma_5$	$L_{II}N_{I}$	11.7303
1.05723	5	86 Rn	$L\alpha_1$	$L_{III}M_{V}$	11.7270
1.05730	2	33 As	$K\beta_1$	KM_{III}	11.7262
1.05783	5	33 As	$K\beta_3$	KM_{II}	11.7203
1.0585	1	80 Hg		$L_{III}N_{III}$	11.713
1.05856	3	83 Bi	$L\eta$	$L_{II}M_{I}$	11.7122
1.06099	5	75 Re	$L\gamma_1$	$L_{II}N_{IV}$	11.6854
1.0613	1	73 Ta	L_{I}	Abs. Edge	11.682
1.06183	7	78 Pt	$L\beta_{10}$	$L_{I}M_{IV}$	11.6762
1.06192	9	73 Ta		$L_{I}O_{IV,V}$	11.6752
1.06200	6	74 W	$L\gamma_3$	$L_{I}N_{III}$	11.6743
1.06357	9	73 Ta		$L_{I}N_{VI,VII}$	11.6570
1.0644	2	82 Pb		$L_{II}M_{II}$	11.648
1.0644	2	81 Tl		$L_{I}M_{I}$	11.648
1.06467	3	73 Ta	$L\gamma_4$	$L_{I}O_{III}$	11.6451
1.0649	2	80 Hg		$L_{III}N_{II}$	11.642
1.06544	3	73 Ta	$L\gamma_4'$	$L_{I}O_{II}$	11.6366
1.06712	2	92 U	Ll	$L_{III}M_{I}$	11.6183
1.06771	9	73 Ta		$L_{I}O_{I}$	11.6118
1.06785	9	79 Au	$L\beta_3$	$L_{I}M_{III}$	11.6103
1.06806	3	74 W	$L\gamma_2$	$L_{I}N_{II}$	11.6080
1.06899	5	86 Rn	$L\alpha_2$	$L_{III}M_{IV}$	11.5979
1.07022	3	79 Au	$L\beta_2$	$L_{III}N_{V}$	11.5847
1.07188	5	79 Au	$L\beta_{15}$	$L_{III}N_{IV}$	11.5667
1.07222	7	80 Hg	$L\beta_4$	$L_{I}M_{II}$	11.5630
1.0723	1	78 Pt	L_{III}	Abs. Edge	11.562
1.0724	2	78 Pt	$L\beta_5$	$L_{III}O_{IV,V}$	11.561
1.07448	5	74 W	$L\gamma_6$	$L_{II}O_{IV}$	11.5387
1.0745	1	74 W	L_{II}	Abs. Edge	11.538
1.0756	2	79 Au		$L_{II}M_{V}$	11.526
1.0761	3	78 Pt		$L_{III}O_{II,III}$	11.521
1.0767	1	75 Re		$L_{II}N_{III}$	11.515
1.0771	1	74 W	Lv	$L_{II}N_{VI}$	11.510
1.07896	5	78 Pt	Lu	$L_{III}N_{VI,VII}$	11.4908
1.0792	2	74 W		$L_{II}O_{III}$	11.488
1.07975	7	80 Hg	$L\beta_6$	$L_{III}N_{I}$	11.4824
1.08009	9	90 Th	Lt	$L_{III}M_{II}$	11.4788
1.08113	4	74 W	$L\gamma_8$	$L_{II}O_{I}$	11.4677
1.08168	3	78 Pt	$L\beta_7$	$L_{III}O_{I}$	11.4619
1.08205	7	73 Ta	$L\gamma_{11}$	$L_{I}N_{V}$	11.4580
1.08353	3	79 Au	$L\beta_1$	$L_{II}M_{IV}$	11.4423
1.08377	7	73 Ta		$L_{I}N_{IV}$	11.4398
1.0839	1	75 Re		$L_{II}N_{II}$	11.438
1.08500	5	85 At	$L\alpha_1$	$L_{III}M_{V}$	11.4268
1.08975	5	77 Ir	$L\beta_9$	$L_{I}M_{V}$	11.3770
1.09026	7	79 Au		$L_{III}N_{III}$	11.3717
1.0908	1	91 Pa	Ll	$L_{III}M_{I}$	11.366

Wavelength Å*	p.e.	Element		Designation	keV
1.0916	5	80 Hg	$L\beta_{17}$	$L_{II}M_{III}$	11.358
1.09241	7	82 Pb	$L\eta$	$L_{II}M_{I}$	11.3493
1.09388	5	75 Re	$L\gamma_{5}$	$L_{II}N_{I}$	11.3341
1.09671	5	85 At	$L\alpha_{2}$	$L_{III}M_{IV}$	11.3048
1.09702	4	77 Ir	$L\beta_{10}$	$L_{I}M_{IV}$	11.3016
1.09855	3	74 W	$L\gamma_{1}$	$L_{II}N_{IV}$	11.2859
1.09936	4	73 Ta	$L\gamma_{3}$	$L_{I}N_{III}$	11.2776
1.0997	1	81 Tl		$L_{II}M_{II}$	11.274
1.0997	1	72 Hf	L_{I}	Abs. Edge	11.274
1.09968	7	79 Au		$L_{III}N_{II}$	11.2743
1.0999	2	80 Hg		$L_{I}M_{I}$	11.272
1.10086	9	72 Hf		$L_{I}O_{IV}$	11.2622
1.10200	3	78 Pt	$L\beta_{2}$	$L_{III}N_{V}$	11.2505
1.10303	5	72 Hf	$L\gamma_{4}$	$L_{I}O_{III}$	11.2401
1.10376	5	72 Hf	$L\gamma_{4}'$	$L_{I}O_{II}$	11.2326
1.10394	5	78 Pt	$L\beta_{3}$	$L_{I}M_{III}$	11.2308
1.10477	2	34 Se	$K\alpha_{1}$	KL_{III}	11.2224
1.1053	1	73 Ta	$L\gamma_{2}$	$L_{I}N_{II}$	11.217
1.1058	1	77 Ir	L_{III}	Abs. Edge	11.212
1.10585	3	77 Ir	$L\beta_{5}$	$L_{III}O_{IV,V}$	11.2114
1.10651	3	79 Au	$L\beta_{4}$	$L_{I}M_{II}$	11.2047
1.10664	9	72 Hf		$L_{I}O_{I}$	11.2034
1.10882	2	34 Se	$K\alpha_{2}$	KL_{II}	11.1814
1.10923	6	77 Ir		$L_{III}O_{II,III}$	11.1772
1.11092	3	79 Au	$L\beta_{6}$	$L_{III}N_{I}$	11.1602
1.11145	4	77 Ir	Lu	$L_{III}N_{VI,VII}$	11.1549
1.1129	2	78 Pt		$L_{II}M_{V}$	11.140
1.1137	1	73 Ta	L_{II}	Abs. Edge	11.132
1.11386	4	84 Po	$L\alpha_{1}$	$L_{III}M_{V}$	11.1308
1.11388	3	73 Ta	$L\gamma_{6}$	$L_{II}O_{IV}$	11.1306
1.11489	3	77 Ir	$L\beta_{7}$	$L_{III}O_{I}$	11.1205
1.1149	2	74 W		$L_{II}N_{III}$	11.120
1.11508	4	90 Th	Ll	$L_{III}M_{I}$	11.1186
1.11521	9	73 Ta		$L_{I}N_{I}$	11.1173
1.1158	1	73 Ta	Lv	$L_{II}N_{VI}$	11.1113
1.11658	5	32 Ge	K	Abs. Edge	11.1036
1.11686	2	32 Ge	$K\beta_{2}$	$KN_{II,III}$	11.1008
1.11693	9	73 Ta		$L_{II}O_{III}$	11.1001
1.11789	9	73 Ta		$L_{II}O_{II}$	11.0907
1.1195	1	32 Ge	$K\beta_{5}$	$KM_{IV,V}$	11.0745
1.11990	2	78 Pt	$L\beta_{1}$	$L_{II}M_{IV}$	11.0707
1.1205	1	73 Ta	$L\gamma_{8}$	$L_{II}O_{I}$	11.0646
1.12146	9	72 Hf	$L\gamma_{11}$	$L_{I}N_{V}$	11.0553
1.1218	3	74 W		$L_{II}N_{II}$	11.052
1.12250	9	72 Hf		$L_{I}N_{IV}$	11.0451
1.1226	2	78 Pt		$L_{III}N_{III}$	11.044
1.12548	5	84 Po	$L\alpha_{2}$	$L_{III}M_{IV}$	11.0158
1.12637	6	76 Os	$L\beta_{9}$	$L_{I}M_{V}$	11.0071
1.12769	3	81 Tl	$L\eta$	$L_{II}M_{I}$	10.9943
1.12798	5	79 Au	$L\beta_{17}$	$L_{II}M_{III}$	10.9915
1.12894	2	32 Ge	$K\beta_{1}$	KM_{III}	10.9821
1.12936	9	32 Ge	$K\beta_{3}$	KM_{II}	10.9780
1.1310	2	78 Pt		$L_{III}N_{II}$	10.962
1.13235	3	74 W	$L\gamma_{5}$	$L_{II}N_{I}$	10.9490
1.13353	5	76 Os	$L\beta_{10}$	$L_{I}M_{IV}$	10.9376
1.13525	5	79 Au		$L_{I}M_{I}$	10.9210
1.13532	3	77 Ir	$L\beta_{2}$	$L_{III}N_{V}$	10.9203
1.13687	9	73 Ta		$L_{II}N_{V}$	10.9055
1.13707	3	77 Ir	$L\beta_{15}$	$L_{III}N_{IV}$	10.9036
1.13794	3	73 Ta	$L\gamma_{1}$	$L_{II}N_{IV}$	10.8952
1.13841	5	72 Hf	$L\gamma_{3}$	$L_{I}N_{III}$	10.8907
1.1387	5	80 Hg		$L_{II}M_{II}$	10.888
1.1402	1	71 Lu	L_{I}	Abs. Edge	10.8740
1.1405	1	76 Os	$L\beta_{5}$	$L_{III}O_{IV,V}$	10.8711
1.1408	1	76 Os	L_{III}	Abs. Edge	10.8683
1.14085	3	77 Ir	$L\beta_{3}$	$L_{I}M_{III}$	10.8674
1.14223	5	78 Pt	$L\beta_{4}$	$L_{I}M_{II}$	10.8543
1.1435	1	71 Lu	$L\gamma_{4}$	$L_{I}O_{II,III}$	10.8425
1.14355	5	78 Pt	$L\beta_{6}$	$L_{III}N_{I}$	10.8418
1.14386	2	83 Bi	$L\alpha_{1}$	$L_{III}M_{V}$	10.8388
1.14442	5	72 Hf	$L\gamma_{2}$	$L_{I}N_{II}$	10.8335
1.14537	7	76 Os	Lu	$L_{III}N_{VI,VII}$	10.8245
1.1489	2	77 Ir		$L_{II}M_{V}$	10.791
1.14933	8	76 Os	$L\beta_{7}$	$L_{III}O_{I}$	10.7872
1.1548	1	72 Hf	L_{II}	Abs. Edge	10.7362
1.15519	5	72 Hf	$L\gamma_{6}$	$L_{II}O_{IV}$	10.7325
1.1553	1	73 Ta		$L_{II}N_{III}$	10.7316
1.15536	1	83 Bi	$L\alpha_{2}$	$L_{III}M_{IV}$	10.73091
1.1560	3	77 Ir		$L_{III}N_{III}$	10.725
1.15781	3	77 Ir	$L\beta_{1}$	$L_{II}M_{IV}$	10.7083
1.15830	9	72 Hf	Lv	$L_{II}N_{VI}$	10.7037
1.1600	2	73 Ta		$L_{II}N_{II}$	10.688
1.16107	9	71 Lu	$L\gamma_{11}$	$L_{I}N_{V}$	10.6782
1.16138	5	72 Hf	$L\gamma_{8}$	$L_{II}O_{I}$	10.6754
1.16227	9	71 Lu		$L_{I}N_{IV}$	10.6672
1.1640	1	80 Hg	$L\eta$	$L_{II}M_{I}$	10.6512
1.16487	4	75 Re	$L\beta_{9}$	$L_{I}M_{V}$	10.6433
1.16545	5	77 Ir		$L_{III}N_{II}$	10.6380
1.1667	1	78 Pt	$L\beta_{17}$	$L_{II}M_{III}$	10.6265
1.16719	5	88 Ra	Ll	$L_{III}M_{I}$	10.6222
1.16962	9	78 Pt		$L_{I}M_{I}$	10.6001
1.16979	8	76 Os	$L\beta_{2}$	$L_{III}N_{V}$	10.5985
1.1708	1	79 Au		$L_{II}M_{II}$	10.5892
1.17167	5	76 Os	$L\beta_{15}$	$L_{III}N_{IV}$	10.5816
1.17218	5	75 Re	$L\beta_{10}$	$L_{I}M_{IV}$	10.5770
1.1729	1	73 Ta	$L\gamma_{5}$	$L_{II}N_{I}$	10.5702
1.17501	2	82 Pb	$L\alpha_{1}$	$L_{III}M_{V}$	10.5515
1.17588	1	33 As	$K\alpha_{1}$	KL_{III}	10.54372
1.17721	5	75 Re	$L\beta_{5}$	$L_{III}O_{IV,V}$	10.5318
1.1773	1	75 Re	L_{III}	Abs. Edge	10.5306
1.17788	9	72 Hf		$L_{II}N_{V}$	10.5258
1.17796	3	77 Ir	$L\beta_{6}$	$L_{III}N_{I}$	10.5251
1.17900	5	72 Hf	$L\gamma_{1}$	$L_{II}N_{IV}$	10.5158
1.17953	4	71 Lu	$L\gamma_{3}$	$L_{I}N_{III}$	10.5110
1.17955	7	76 Os	$L\beta_{3}$	$L_{I}M_{III}$	10.5108
1.17958	3	77 Ir	$L\beta_{4}$	$L_{I}M_{II}$	10.5106
1.17987	1	33 As	$K\alpha_{2}$	KL_{II}	10.50799
1.1815	1	75 Re	Lu	$L_{III}N_{VI,VII}$	10.4931
1.1818	1	70 Yb	L_{I}	Abs. Edge	10.4904
1.1827	1	70 Yb		$L_{I}O_{IV,V}$	10.4833
1.1853	1	70 Yb	$L\gamma_{4}$	$L_{I}O_{II,III}$	10.4603
1.1853	2	71 Lu	$L\gamma_{2}$	$L_{I}N_{II}$	10.460
1.18610	5	75 Re	$L\beta_{7}$	$L_{III}O_{I}$	10.4529
1.18648	5	82 Pb	$L\alpha_{2}$	$L_{III}M_{IV}$	10.4495

Wavelength Å*	p.e.	Element		Designation	keV
1.1886	1	70 Yb		$L_{I}O_{I}$	10.4312
1.18977	7	76 Os		$L_{II}M_{V}$	10.4205
1.1958	1	31 Ga	K	Abs. Edge	10.3682
1.19600	2	31 Ga	$K\beta_{2}$	$KN_{II,III}$	10.3663
1.19727	7	76 Os	$L\beta_{1}$	$L_{II}M_{IV}$	10.3553
1.1981	2	31 Ga	$K\beta_{5}$	$KM_{IV,V}$	10.348
1.1985	1	71 Lu	L_{II}	Abs. Edge	10.3448
1.1987	1	71 Lu	$L\gamma_{6}$	$L_{II}O_{IV}$	10.3431
1.20086	7	76 Os		$L_{III}N_{II}$	10.3244
1.2014	1	71 Lu		$L_{II}O_{II,III}$	10.3198
1.20273	3	79 Au	$L\eta$	$L_{II}M_{I}$	10.3083
1.2047	1	71 Lu	$L\gamma_{8}$	$L_{II}O_{I}$	10.2915
1.20479	7	74 W	$L\beta_{9}$	$L_{I}M_{V}$	10.2907
1.20660	4	75 Re	$L\beta_{2}$	$L_{III}N_{V}$	10.2752
1.2069	2	77 Ir	$L\beta_{17}$	$L_{II}M_{III}$	10.273
1.20739	4	81 Tl	$L\alpha_{1}$	$L_{III}M_{V}$	10.2685
1.20789	2	31 Ga	$K\beta_{1}$	KM_{III}	10.2642
1.20819	5	75 Re	$L\beta_{15}$	$L_{III}N_{IV}$	10.2617
1.20835	5	31 Ga	$K\beta_{3}$	KM_{II}	10.2603
1.2102	2	77 Ir		$L_{I}M_{I}$	10.245
1.2105	1	83 Bi	*Ls*	$L_{III}M_{III}$	10.2421
1.21218	3	74 W	$L\beta_{10}$	$L_{I}M_{IV}$	10.2279
1.213	1	78 Pt		$L_{II}M_{II}$	10.225
1.21349	5	76 Os	$L\beta_{6}$	$L_{III}N_{I}$	10.2169
1.21537	5	72 Hf	$L\gamma_{5}$	$L_{II}N_{I}$	10.2011
1.21545	3	74 W	$L\beta_{5}$	$L_{III}O_{IV,V}$	10.2004
1.2155	1	74 W	L_{III}	Abs. Edge	10.1999
1.21844	5	76 Os	$L\beta_{4}$	$L_{I}M_{II}$	10.1754
1.21868	5	74 W	*Lu*	$L_{III}N_{VI,VII}$	10.1733
1.21875	3	81 Tl	$L\alpha_{2}$	$L_{III}M_{IV}$	10.1728
1.22031	5	75 Re	$L\beta_{3}$	$L_{I}M_{III}$	10.1598
1.2211	2	74 W		$L_{III}O_{II,III}$	10.153
1.22228	4	71 Lu	$L\gamma_{1}$	$L_{II}N_{IV}$	10.1434
1.22232	5	70 Yb	$L\gamma_{3}$	$L_{I}N_{III}$	10.1431
1.22400	4	74 W	$L\beta_{7}$	$L_{III}O_{I}$	10.1292
1.2250	1	69 Tm	L_{I}	Abs. Edge	10.1206
1.2263	3	69 Tm		$L_{I}O_{IV,V}$	10.110
1.2283	1	75 Re		$L_{III}N_{III}$	10.0933
1.22879	7	70 Yb	$L\gamma_{2}$	$L_{I}N_{II}$	10.0897
1.2294	2	69 Tm	$L\gamma_{4}$	$L_{I}O_{II,III}$	10.084
1.2305	1	75 Re		$L_{II}M_{V}$	10.0753
1.23858	2	75 Re	$L\beta_{1}$	$L_{II}M_{IV}$	10.0100
1.24120	5	80 Hg	$L\alpha_{1}$	$L_{III}M_{V}$	9.9888
1.24271	3	70 Yb	$L\gamma_{6}$	$L_{II}O_{IV}$	9.9766
1.2428	1	70 Yb	L_{II}	Abs. Edge	9.9761
1.2429	2	78 Pt	$L\eta$	$L_{II}M_{I}$	9.975
1.24385	7	82 Pb	*Ls*	$L_{III}M_{III}$	9.9675
1.24460	3	74 W	$L\beta_{2}$	$L_{III}N_{V}$	9.9615
1.2453	1	70 Yb		$L_{II}O_{II,III}$	9.9561
1.24631	3	74 W	$L\beta_{15}$	$L_{III}N_{IV}$	9.9478
1.2466	2	73 Ta	$L\beta_{9}$	$L_{I}M_{V}$	9.946
1.2480	2	76 Os	$L\beta_{17}$	$L_{II}M_{III}$	9.934
1.24923	5	70 Yb	$L\gamma_{8}$	$L_{II}O_{I}$	9.9246
1.2502	3	77 Ir		$L_{II}M_{II}$	9.917
1.25100	5	75 Re	$L\beta_{6}$	$L_{III}N_{I}$	9.9105
1.25264	7	80 Hg	$L\alpha_{2}$	$L_{III}M_{IV}$	9.8976
1.2537	2	73 Ta	$L\beta_{10}$	$L_{I}M_{IV}$	9.889
1.254054	9	32 Ge	$K\alpha_{1}$	KL_{III}	9.88642
1.2553	1	73 Ta	L_{III}	Abs. Edge	9.8766
1.2555	1	73 Ta	$L\beta_{5}$	$L_{III}O_{IV,V}$	9.8750
1.25778	4	73 Ta	*Lu*	$L_{III}N_{VI,VII}$	9.8572
1.258011	9	32 Ge	$K\alpha_{2}$	KL_{II}	9.85532
1.25917	5	75 Re	$L\beta_{4}$	$L_{I}M_{II}$	9.8463
1.2596	1	71 Lu	$L\gamma_{5}$	$L_{II}N_{I}$	9.8428
1.2601	3	73 Ta		$L_{III}O_{II,III}$	9.839
1.26269	5	74 W	$L\beta_{3}$	$L_{I}M_{III}$	9.8188
1.26385	5	73 Ta	$L\beta_{7}$	$L_{III}O_{I}$	9.8098
1.2672	2	74 W		$L_{III}N_{III}$	9.784
1.26769	5	70 Yb	$L\gamma_{1}$	$L_{II}N_{IV}$	9.7801
1.2678	2	69 Tm	$L\gamma_{3}$	$L_{I}N_{III}$	9.779
1.2706	1	68 Er	L_{I}	Abs. Edge	9.7574
1.2728	2	74 W		$L_{II}M_{V}$	9.741
1.2742	2	69 Tm	$L\gamma_{2}$	$L_{I}N_{II}$	9.730
1.2748	1	83 Bi	*Lt*	$L_{III}M_{II}$	9.7252
1.2752	2	68 Er	$L\gamma_{4}$	$L_{I}O_{II,III}$	9.722
1.27640	3	79 Au	$L\alpha_{1}$	$L_{III}M_{V}$	9.7133
1.2765	2	74 W		$L_{III}N_{II}$	9.712
1.27807	5	81 Tl	*Ls*	$L_{III}M_{III}$	9.7007
1.281809	9	74 W	$L\beta_{1}$	$L_{II}M_{IV}$	9.67235
1.2829	5	84 Po	*Ll*	$L_{III}M_{I}$	9.664
1.2834	1	30 Zn	K	Abs. Edge	9.6607
1.28372	2	30 Zn	$K\beta_{2}$	$KN_{II,III}$	9.6580
1.28448	3	77 Ir	$L\eta$	$L_{II}M_{I}$	9.6522
1.28454	2	73 Ta	$L\beta_{2}$	$L_{III}N_{V}$	9.6518
1.2848	1	30 Zn	$K\beta_{5}$	$KM_{IV,V}$	9.6501
1.28619	5	73 Ta	$L\beta_{15}$	$L_{III}N_{IV}$	9.6394
1.28772	3	79 Au	$L\alpha_{2}$	$L_{III}M_{IV}$	9.6280
1.2892	1	69 Tm	L_{II}	Abs. Edge	9.6171
1.28989	7	74 W	$L\beta_{6}$	$L_{III}N_{I}$	9.6117
1.29025	9	72 Hf	$L\beta_{9}$	$L_{I}M_{V}$	9.6090
1.2905	2	69 Tm	$L\gamma_{6}$	$L_{II}O_{IV}$	9.607
1.2927	1	75 Re	$L\beta_{17}$	$L_{II}M_{III}$	9.5910
1.2934	2	76 Os		$L_{II}M_{II}$	9.586
1.29525	2	30 Zn	$K\beta_{1,3}$	$KM_{II,III}$	9.5720
1.2972	1	72 Hf	L_{III}	Abs. Edge	9.5577
1.29761	5	72 Hf	$L\beta_{5}$	$L_{III}O_{IV,V}$	9.5546
1.29819	9	72 Hf	$L\beta_{10}$	$L_{I}M_{IV}$	9.5503
1.30162	5	74 W	$L\beta_{4}$	$L_{I}M_{II}$	9.5252
1.30165	9	72 Hf	*Lu*	$L_{III}N_{VI,VII}$	9.5249
1.30564	5	72 Hf	$L\beta_{7}$	$L_{III}O_{I}$	9.4958
1.3063	1	70 Yb	$L\gamma_{5}$	$L_{II}N_{I}$	9.4910
1.30678	3	73 Ta	$L\beta_{3}$	$L_{I}M_{III}$	9.4875
1.30767	7	82 Pb	*Lt*	$L_{III}M_{II}$	9.4811
1.3086	1	73 Ta		$L_{III}N_{III}$	9.4742
1.3112	2	80 Hg	*Ls*	$L_{III}M_{III}$	9.455
1.31304	3	78 Pt	$L\alpha_{1}$	$L_{III}M_{V}$	9.4423
1.3146	1	68 Er	$L\gamma_{3}$	$L_{I}N_{III}$	9.4309
1.3153	2	69 Tm	$L\gamma_{1}$	$L_{II}N_{IV}$	9.426
1.31610	7	83 Bi	*Ll*	$L_{III}M_{I}$	9.4204
1.3167	1	73 Ta		$L_{III}N_{II}$	9.4158
1.31897	9	73 Ta		$L_{II}M_{V}$	9.3998
1.3190	1	67 Ho	L_{I}	Abs. Edge	9.3994
1.3208	3	67 Ho		$L_{I}O_{IV,V}$	9.387
1.3210	2	68 Er	$L\gamma_{2}$	$L_{I}N_{II}$	9.385

Wavelength Å*	p.e.	Element	Designation		keV
1.3225	2	67 Ho	$L\gamma_4$	$L_{I}O_{II,III}$	9.374
1.32432	2	78 Pt	$L\alpha_2$	$L_{III}M_{IV}$	9.3618
1.32639	5	72 Hf	$L\beta_2$	$L_{III}N_{V}$	9.3473
1.32698	3	73 Ta	$L\beta_1$	$L_{II}M_{IV}$	9.3431
1.32783	5	72 Hf	$L\beta_{15}$	$L_{III}N_{IV}$	9.3371
1.32785	7	76 Os	$L\eta$	$L_{II}M_{I}$	9.3370
1.33094	8	73 Ta	$L\beta_6$	$L_{III}N_{I}$	9.3153
1.3358	1	71 Lu	$L\beta_9$	$L_{I}M_{V}$	9.2816
1.3365	3	74 W		$L_{I}M_{I}$	9.277
1.3366	1	75 Re		$L_{II}M_{II}$	9.2761
1.3386	1	68 Er	L_{II}	Abs. Edge	9.2622
1.3387	2	74 W	$L\beta_{17}$	$L_{II}M_{III}$	9.261
1.3397	3	68 Er	$L\gamma_6$	$L_{II}O_{IV}$	9.255
1.340083	9	31 Ga	$K\alpha_1$	KL_{III}	9.25174
1.3405	1	71 Lu	L_{III}	Abs. Edge	9.2490
1.34154	5	81 Tl	Lt	$L_{III}M_{II}$	9.2417
1.34183	7	71 Lu	$L\beta_5$	$L_{III}O_{IV,V}$	9.2397
1.3430	2	71 Lu	$L\beta_{10}$	$L_{I}M_{IV}$	9.232
1.34399	1	31 Ga	$K\alpha_2$	KL_{II}	9.22482
1.34524	9	71 Lu		$L_{III}O_{II,III}$	9.2163
1.34581	3	73 Ta	$L\beta_4$	$L_{I}M_{II}$	9.2124
1.34949	5	71 Lu	$L\beta_7$	$L_{III}O_{I}$	9.1873
1.34990	7	82 Pb	Ll	$L_{III}M_{I}$	9.1845
1.35053	9	72 Hf		$L_{III}N_{III}$	9.1802
1.35128	3	77 Ir	$L\alpha_1$	$L_{III}M_{V}$	9.1751
1.35131	7	79 Au	Ls	$L_{III}M_{III}$	9.1749
1.35300	5	72 Hf	$L\beta_3$	$L_{I}M_{III}$	9.1634
1.3558	2	69 Tm	$L\gamma_5$	$L_{II}N_{I}$	9.144
1.35887	9	72 Hf		$L_{III}N_{II}$	9.1239
1.36250	5	77 Ir	$L\alpha_2$	$L_{III}M_{IV}$	9.0995
1.3641	2	68 Er	$L\gamma_1$	$L_{II}N_{IV}$	9.089
1.3643	2	67 Ho	$L\gamma_3$	$L_{I}N_{III}$	9.087
1.3692	1	66 Dy	L_{I}	Abs. Edge	9.0548
1.3698	2	67 Ho	$L\gamma_2$	$L_{I}N_{II}$	9.051
1.37012	3	71 Lu	$L\beta_2$	$L_{III}N_{V}$	9.0489
1.3715	1	71 Lu	$L\beta_{15}$	$L_{III}N_{IV}$	9.0395
1.37342	5	75 Re	$L\eta$	$L_{II}M_{I}$	9.0272
1.37410	5	72 Hf	$L\beta_1$	$L_{II}M_{IV}$	9.0227
1.37410	5	72 Hf	$L\beta_6$	$L_{III}N_{I}$	9.0227
1.37459	7	66 Dy	$L\gamma_4$	$L_{I}O_{II,III}$	9.0195
1.3746	2	80 Hg	Lt	$L_{III}M_{II}$	9.019
1.38059	5	29 Cu	K	Abs. Edge	8.9803
1.38109	3	29 Cu	$K\beta_2$	$KM_{IV,V}$	8.9770
1.3838	1	70 Yb	$L\beta_9$	$L_{I}M_{V}$	8.9597
1.38477	3	81 Tl	Ll	$L_{III}M_{I}$	8.9532
1.3862	1	70 Yb	L_{III}	Abs. Edge	8.9441
1.3864	1	73 Ta	$L\beta_{17}$	$L_{II}M_{III}$	8.9428
1.38696	7	70 Yb	$L\beta_5$	$L_{III}O_{IV,V}$	8.9390
1.3895	2	78 Pt	Ls	$L_{III}M_{III}$	8.923
1.3898	1	70 Yb		$L_{III}O_{II,III}$	8.9209
1.3905	1	67 Ho	L_{II}	Abs. Edge	8.9164
1.39121	5	76 Os	$L\alpha_1$	$L_{III}M_{V}$	8.9117
1.3915	1	70 Yb	$L\beta_{10}$	$L_{I}M_{IV}$	8.9100
1.39220	5	72 Hf	$L\beta_4$	$L_{I}M_{II}$	8.9054
1.392218	9	29 Cu	$K\beta_{1,3}$	$KM_{II,III}$	8.90529
1.3923	2	67 Ho	$L\gamma_6$	$L_{II}O_{IV}$	8.905
1.3926	1	29 Cu	$K\beta_3$	KM_{II}	8.9029
1.3948	1	70 Yb	$L\beta_7$	$L_{III}O_{I}$	8.8889
1.3983	2	67 Ho	$L\gamma_8$	$L_{II}O_{I}$	8.867
1.40140	5	71 Lu	$L\beta_3$	$L_{I}M_{III}$	8.8469
1.40234	5	76 Os	$L\alpha_2$	$L_{III}M_{IV}$	8.8410
1.4067	3	68 Er	$L\gamma_5$	$L_{II}N_{I}$	8.814
1.41366	7	79 Au	Lt	$L_{III}M_{II}$	8.7702
1.41550	5	70 Yb	$L\beta_{2,15}$	$L_{III}N_{IV,V}$	8.7588
1.41640	7	66 Dy	$L\gamma_3$	$L_{I}N_{III}$	8.7532
1.4174	2	67 Ho	$L\gamma_1$	$L_{II}N_{IV}$	8.747
1.4189	1	71 Lu	$L\beta_6$	$L_{III}N_{I}$	8.7376
1.42110	3	74 W	$L\eta$	$L_{II}M_{I}$	8.7243
1.4216	1	80 Hg	Ll	$L_{III}M_{I}$	8.7210
1.4223	1	65 Tb	L_{I}	Abs. Edge	8.7167
1.42278	7	66 Dy	$L\gamma_2$	$L_{I}N_{II}$	8.7140
1.4228	3	65 Tb		$L_{I}O_{IV,V}$	8.714
1.42359	3	71 Lu	$L\beta_1$	$L_{II}M_{IV}$	8.7090
1.4276	2	65 Tb	$L\gamma_4$	$L_{I}O_{II,III}$	8.685
1.43025	9	72 Hf		$L_{I}M_{I}$	8.6685
1.43048	9	73 Ta		$L_{II}M_{II}$	8.6671
1.4318	2	77 Ir	Ls	$L_{III}M_{III}$	8.659
1.43290	4	75 Re	$L\alpha_1$	$L_{III}M_{V}$	8.6525
1.4334	1	69 Tm	L_{III}	Abs. Edge	8.6496
1.4336	3	69 Tm	$L\beta_9$	$L_{I}M_{V}$	8.648
1.4349	2	69 Tm	$L\beta_5$	$L_{III}O_{IV,V}$	8.641
1.435155	7	30 Zn	$K\alpha_1$	KL_{III}	8.63886
1.43643	9	72 Hf	$L\beta_{17}$	$L_{II}M_{III}$	8.6312
1.439000	8	30 Zn	$K\alpha_2$	KL_{II}	8.61578
1.44056	5	71 Lu	$L\beta_4$	$L_{I}M_{II}$	8.6064
1.4410	3	69 Tm	$L\beta_{10}$	$L_{I}M_{IV}$	8.604
1.44396	5	75 Re	$L\alpha_2$	$L_{III}M_{IV}$	8.5862
1.4445	1	66 Dy	L_{II}	Abs. Edge	8.5830
1.44579	7	66 Dy	$L\gamma_6$	$L_{II}O_{IV}$	8.5753
1.45233	5	70 Yb	$L\beta_3$	$L_{I}M_{III}$	8.5367
1.4530	2	78 Pt	Lt	$L_{III}M_{II}$	8.533
1.45964	9	79 Au	Ll	$L_{III}M_{I}$	8.4939
1.4618	2	67 Ho	$L\gamma_5$	$L_{II}N_{I}$	8.481
1.4640	2	69 Tm	$L\beta_{2,15}$	$L_{III}N_{IV,V}$	8.468
1.4661	1	70 Yb	$L\beta_6$	$L_{III}N_{I}$	8.4563
1.47106	5	73 Ta	$L\eta$	$L_{II}M_{I}$	8.4280
1.4718	2	65 Tb	$L\gamma_3$	$L_{I}N_{III}$	8.423
1.47266	7	66 Dy	$L\gamma_1$	$L_{II}N_{IV}$	8.4188
1.4735	2	76 Os	Ls	$L_{III}M_{III}$	8.414
1.47565	5	70 Yb	$L\beta_1$	$L_{II}M_{IV}$	8.4018
1.4764	2	65 Tb	$L\gamma_2$	$L_{I}N_{II}$	8.398
1.47639	2	74 W	$L\alpha_1$	$L_{III}M_{V}$	8.3976
1.4784	1	64 Gd	L_{I}	Abs. Edge	8.3864
1.48064	9	72 Hf		$L_{II}M_{II}$	8.3735
1.4807	3	64 Gd		$L_{I}O_{IV,V}$	8.373
1.4835	1	68 Er	L_{III}	Abs. Edge	8.3575
1.4839	2	64 Gd	$L\gamma_4$	$L_{I}O_{II,III}$	8.355
1.4848	3	68 Er	$L\beta_5$	$L_{III}O_{IV,V}$	8.350
1.4855	5	68 Er	$L\beta_9$	$L_{I}M_{V}$	8.346
1.48743	2	74 W	$L\alpha_2$	$L_{III}M_{IV}$	8.3352
1.48807	1	28 Ni	K	Abs. Edge	8.33165
1.48862	4	28 Ni	$K\beta_5$	$KM_{IV,V}$	8.3286
1.49138	3	70 Yb	$L\beta_4$	$L_{I}M_{II}$	8.3132
1.4930	3	77 Ir	Lt	$L_{III}M_{II}$	8.304

TABLE VI (*Continued*)

Wavelength Å*	p.e.	Element		Designation	keV
1.4941	3	68 Er	$L\beta_7$	$L_{III}O_I$	8.298
1.4941	3	68 Er	$L\beta_{10}$	L_IM_{IV}	8.298
1.4995	2	78 Pt	Ll	$L_{III}M_I$	8.268
1.500135	8	28 Ni	$K\beta_{1,3}$	$KM_{II,III}$	8.26466
1.5023	1	65 Tb	L_{II}	Abs. Edge	8.2527
1.5035	2	65 Tb	$L\gamma_6$	$L_{II}O_{IV}$	8.246
1.5063	2	69 Tm	$L\beta_3$	L_IM_{III}	8.231
1.5097	2	65 Tb	$L\gamma_8$	$L_{II}O_I$	8.212
1.51399	9	68 Er	$L\beta_{2,15}$	$L_{III}N_{IV,V}$	8.1890
1.5162	2	69 Tm	$L\beta_6$	$L_{III}N_I$	8.177
1.5178	1	75 Re	Ls	$L_{III}M_{III}$	8.1682
1.51824	7	66 Dy	$L\gamma_5$	$L_{II}N_I$	8.1661
1.52197	2	73 Ta	$L\alpha_1$	$L_{III}M_V$	8.1461
1.52325	5	72 Hf	$L\eta$	$L_{II}M_I$	8.1393
1.5297	2	64 Gd	$L\gamma_3$	L_IN_{III}	8.105
1.5303	2	65 Tb	$L\gamma_1$	$L_{II}N_{IV}$	8.102
1.5304	2	69 Tm	$L\beta_1$	$L_{II}M_{IV}$	8.101
1.53293	2	73 Ta	$L\alpha_2$	$L_{III}M_{IV}$	8.0879
1.5331	2	64 Gd	$L\gamma_2$	L_IN_{II}	8.087
1.53333	9	71 Lu		$L_{II}M_{II}$	8.0858
1.5347	2	76 Os	Lt	$L_{III}M_{II}$	8.079
1.5368	1	67 Ho	L_{III}	Abs. Edge	8.0676
1.5378	2	67 Ho	$L\beta_5$	$L_{III}O_{IV,V}$	8.062
1.5381	1	63 Eu	L_I	Abs. Edge	8.0607
1.540562	2	29 Cu	$K\alpha_1$	KL_{III}	8.04778
1.54094	3	77 Ir	Ll	$L_{III}M_I$	8.0458
1.5439	1	63 Eu	$L\gamma_4$	$L_IO_{II,III}$	8.0304
1.544390	9	29 Cu	$K\alpha_2$	KL_{II}	8.02783
1.5448	2	69 Tm	$L\beta_4$	L_IM_{II}	8.026
1.5486	3	67 Ho	$L\beta_{10}$	L_IM_{IV}	8.006
1.5616	1	68 Er	$L\beta_3$	L_IM_{III}	7.9392
1.5632	1	64 Gd	L_{II}	Abs. Edge	7.9310
1.5642	3	74 W	Ls	$L_{III}M_{III}$	7.926
1.5644	2	64 Gd	$L\gamma_6$	$L_{II}O_{IV}$	7.925
1.5671	2	67 Ho	$L\beta_{2,15}$	$L_{III}N_{IV,V}$	7.911
1.5675	2	68 Er	$L\beta_6$	$L_{III}N_I$	7.909
1.56958	5	72 Hf	$L\alpha_1$	$L_{III}M_V$	7.8990
1.5707	2	64 Gd	$L\gamma_8$	$L_{II}O_I$	7.894
1.5779	1	71 Lu	$L\eta$	$L_{II}M_I$	7.8575
1.5787	2	65 Tb	$L\gamma_5$	$L_{II}N_I$	7.8535
1.5789	1	75 Re	Lt	$L_{III}M_{II}$	7.8525
1.58046	5	72 Hf	$L\alpha_2$	$L_{III}M_{IV}$	7.8446
1.58498	7	76 Os	Ll	$L_{III}M_I$	7.8222
1.5873	1	68 Er	$L\beta_1$	$L_{II}M_{IV}$	7.8109
1.58837	7	66 Dy	$L\beta_5$	$L_{III}O_{IV,V}$	7.8055
1.58844	9	70 Yb		$L_{II}M_{II}$	7.8052
1.5903	2	63 Eu	$L\gamma_3$	L_IN_{III}	7.7961
1.5916	1	66 Dy	L_{III}	Abs. Edge	7.7897
1.5924	2	64 Gd	$L\gamma_1$	$L_{II}N_{IV}$	7.7858
1.5961	2	63 Eu	$L\gamma_2$	L_IN_{II}	7.7677
1.59973	9	66 Dy	$L\beta_9$	L_IM_V	7.7501
1.6002	1	62 Sm	L_I	Abs. Edge	7.7478
1.6007	1	68 Er	$L\beta_4$	L_IM_{II}	7.7453
1.60447	7	66 Dy	$L\beta_7$	$L_{III}O_I$	7.7272
1.60728	3	62 Sm	$L\gamma_4$	$L_IO_{II,III}$	7.714
1.60743	9	66 Dy	$L\beta_{10}$	L_IM_{IV}	7.7130
1.60815	1	27 Co	K	Abs. Edge	7.70954
1.60891	3	27 Co	$K\beta_5$	$KM_{IV,V}$	7.7059
1.61264	9	73 Ta	Ls	$L_{III}M_{III}$	7.6881
1.61951	3	71 Lu	$L\alpha_1$	$L_{III}M_V$	7.6555
1.6203	2	67 Ho	$L\beta_3$	L_IM_{III}	7.6519
1.62079	2	27 Co	$K\beta_{1,3}$	$KM_{II,III}$	7.64943
1.6237	2	67 Ho	$L\beta_6$	$L_{III}N_I$	7.6359
1.62369	7	66 Dy	$L\beta_{2,15}$	$L_{III}N_{IV,V}$	7.6357
1.6244	3	74 W	Lt	$L_{III}M_{II}$	7.6324
1.6271	1	63 Eu	L_{II}	Abs. Edge	7.6199
1.6282	2	63 Eu	$L\gamma_6$	$L_{II}O_{IV}$	7.6147
1.63029	5	71 Lu	$L\alpha_2$	$L_{III}M_{IV}$	7.6049
1.63056	5	75 Re	Ll	$L_{III}M_I$	7.6036
1.6346	2	63 Eu	$L\gamma_8$	$L_{II}O_I$	7.5849
1.63560	5	70 Yb	$L\eta$	$L_{II}M_I$	7.5802
1.6412	2	64 Gd	$L\gamma_5$	$L_{II}N_I$	7.5543
1.6475	2	67 Ho	$L\beta_1$	$L_{II}M_{IV}$	7.5253
1.6497	1	65 Tb	L_{III}	Abs. Edge	7.5153
1.6510	2	65 Tb	$L\beta_5$	$L_{III}O_{IV,V}$	7.5094
1.65601	3	62 Sm	$L\gamma_3$	L_IN_{III}	7.487
1.6574	2	63 Eu	$L\gamma_1$	$L_{II}N_{IV}$	7.4803
1.657910	8	28 Ni	$K\alpha_1$	KL_{III}	7.47815
1.6585	2	65 Tb	$L\beta_7$	$L_{III}O_I$	7.4753
1.6595	2	67 Ho	$L\beta_4$	L_IM_{II}	7.4708
1.66044	6	62 Sm	$L\gamma_2$	L_IN_{II}	7.467
1.661747	8	28 Ni	$K\alpha_2$	KL_{II}	7.46089
1.66346	9	72 Hf	Ls	$L_{III}M_{III}$	7.4532
1.6673	3	65 Tb	$L\beta_{10}$	L_IM_{IV}	7.436
1.6674	5	61 Pm	L_I	Abs. Edge	7.436
1.67189	4	70 Yb	$L\alpha_1$	$L_{III}M_V$	7.4156
1.67265	9	73 Ta	Lt	$L_{III}M_{II}$	7.4123
1.6782	1	74 W	Ll	$L_{III}M_I$	7.3878
1.68213	7	66 Dy	$L\beta_6$	$L_{III}N_I$	7.3705
1.6822	2	66 Dy	$L\beta_3$	L_IM_{III}	7.3702
1.68285	5	70 Yb	$L\alpha_2$	$L_{III}M_{IV}$	7.3673
1.6830	2	65 Tb	$L\beta_{2,15}$	$L_{III}N_{IV,V}$	7.3667
1.6953	1	62 Sm	L_{II}	Abs. Edge	7.3132
1.6963	2	69 Tm	$L\eta$	$L_{II}M_I$	7.3088
1.6966	9	62 Sm	$L\gamma_6$	$L_{II}O_{IV}$	7.308
1.7085	2	63 Eu	$L\gamma_5$	$L_{II}N_I$	7.2566
1.71062	7	66 Dy	$L\beta_1$	$L_{II}M_{IV}$	7.2477
1.7117	1	64 Gd	L_{III}	Abs. Edge	7.2430
1.7130	2	64 Gd	$L\beta_5$	$L_{III}O_{IV,V}$	7.2374
1.7203	2	64 Gd	$L\beta_7$	$L_{III}O_I$	7.2071
1.72103	7	66 Dy	$L\beta_4$	L_IM_{II}	7.2039
1.72305	9	72 Hf	Lt	$L_{III}M_{II}$	7.1954
1.7240	3	64 Gd	$L\beta_9$	L_IM_V	7.192
1.72724	3	62 Sm	$L\gamma_1$	$L_{II}N_{IV}$	7.178
1.7268	2	69 Tm	$L\alpha_1$	$L_{III}M_V$	7.1799
1.72841	5	73 Ta	Ll	$L_{III}M_I$	7.1731
1.7315	3	64 Gd	$L\beta_{10}$	L_IM_{IV}	7.160
1.7381	2	69 Tm	$L\alpha_2$	$L_{III}M_{IV}$	7.1331
1.7390	1	60 Nd	L_I	Abs. Edge	7.1294
1.7422	2	65 Tb	$L\beta_6$	$L_{III}N_I$	7.1163
1.74346	1	26 Fe	K	Abs. Edge	7.11120
1.7442	1	26 Fe	$K\beta_5$	$KM_{IV,V}$	7.1081
1.7445	4	60 Nd	$L\gamma_4$	$L_IO_{II,III}$	7.107
1.7455	2	64 Gd	$L\beta_{2,15}$	$L_{III}N_{IV,V}$	7.1028

Wavelength Å*	p.e.	Element	Designation		keV
1.7472	2	65 Tb	$L\beta_3$	L_IM_{III}	7.0959
1.75661	2	26 Fe	$K\beta_{1,3}$	$KM_{II,III}$	7.05798
1.7566	1	68 Er	$L\eta$	$L_{II}M_I$	7.0579
1.7676	5	61 Pm	L_{II}	Abs. Edge	7.014
1.7760	1	71 Lu	Lt	$L_{III}M_{II}$	6.9810
1.7761	1	63 Eu	L_{III}	Abs. Edge	6.9806
1.7768	3	65 Tb	$L\beta_1$	$L_{II}M_{IV}$	6.978
1.7772	2	63 Eu	$L\beta_5$	$L_{III}O_{IV,V}$	6.9763
1.77934	3	62 Sm	$L\gamma_5$	$L_{II}N_I$	6.968
1.78145	5	72 Hf	Ll	$L_{III}M_I$	6.9596
1.78425	9	68 Er	$L\alpha_1$	$L_{III}M_V$	6.9487
1.7851	2	63 Eu	$L\beta_7$	$L_{III}O_I$	6.9453
1.7864	2	65 Tb	$L\beta_4$	L_IM_{II}	6.9403
1.788965	9	27 Co	$K\alpha_1$	KL_{III}	6.93032
1.7916	3	63 Eu	$L\beta_9$	L_IM_V	6.920
1.792850	9	27 Co	$K\alpha_2$	KL_{II}	6.91530
1.7955	2	68 Er	$L\alpha_2$	$L_{III}M_{IV}$	6.9050
1.7964	4	60 Nd	$L\gamma_3$	L_IN_{III}	6.902
1.7989	9	61 Pm	$L\gamma_1$	$L_{II}N_{IV}$	6.892
1.7993	3	63 Eu	$L\beta_{10}$	L_IM_{IV}	6.890
1.8013	4	60 Nd	$L\gamma_2$	L_IN_{II}	6.883
1.8054	2	64 Gd	$L\beta_6$	$L_{III}N_I$	6.8671
1.8118	2	63 Eu	$L\beta_{2,15}$	$L_{III}N_{IV,V}$	6.8432
1.8141	5	59 Pr	L_I	Abs. Edge	6.834
1.8150	2	64 Gd	$L\beta_3$	L_IM_{III}	6.8311
1.8193	4	59 Pr	$L\gamma_4$	$L_IO_{II,III}$	6.815
1.8264	2	67 Ho	$L\eta$	$L_{II}M_I$	6.7883
1.83091	9	70 Yb	Lt	$L_{III}M_{II}$	6.7715
1.8360	1	71 Lu	Ll	$L_{III}M_I$	6.7528
1.8440	1	60 Nd	L_{II}	Abs. Edge	6.7234
1.8450	2	67 Ho	$L\alpha_1$	$L_{III}M_V$	6.7198
1.8457	1	62 Sm	L_{III}	Abs. Edge	6.7172
1.8468	2	64 Gd	$L\beta_1$	$L_{II}M_{IV}$	6.7132
1.84700	9	62 Sm	$L\beta_5$	$L_{III}O_{IV,V}$	6.7126
1.8540	2	64 Gd	$L\beta_4$	L_IM_{II}	6.6871
1.8552	5	60 Nd	$L\gamma_8$	$L_{II}O_I$	6.683
1.8561	2	67 Ho	$L\alpha_2$	$L_{III}M_{IV}$	6.6795
1.85626	3	62 Sm	$L\beta_7$	$L_{III}O_I$	6.679
1.86166	3	62 Sm	$L\beta_9$	L_IM_V	6.660
1.86990	3	62 Sm	$L\beta_{10}$	L_IM_{IV}	6.634
1.8737	2	63 Eu	$L\beta_6$	$L_{III}N_I$	6.6170
1.8740	4	59 Pr	$L\gamma_3$	L_IN_{III}	6.616
1.8779	2	60 Nd	$L\gamma_1$	$L_{II}N_{IV}$	6.6021
1.8791	4	59 Pr	$L\gamma_2$	L_IN_{II}	6.598
1.8821	3	62 Sm	$L\beta_{2,15}$	$L_{III}N_{IV,V}$	6.586
1.8867	2	63 Eu	$L\beta_3$	L_IM_{III}	6.5713
1.8934	5	58 Ce	L_I	Abs. Edge	6.548
1.89415	5	70 Yb	Ll	$L_{III}M_I$	6.5455
1.89643	5	25 Mn	K	Abs. Edge	6.5376
1.8971	1	25 Mn	$K\beta_5$	$KM_{IV,V}$	6.5352
1.89743	7	66 Dy	$L\eta$	$L_{II}M_I$	6.5342
1.8991	4	58 Ce	$L\gamma_4$	$L_IO_{II,III}$	6.528
1.90881	3	66 Dy	$L\alpha_1$	$L_{III}M_V$	6.4952
1.91021	2	25 Mn	$K\beta_{1,3}$	$KM_{II,III}$	6.49045
1.9191	1	61 Pm	L_{III}	Abs. Edge	6.4605
1.91991	3	66 Dy	$L\alpha_2$	$L_{III}M_{IV}$	6.4577
1.9203	2	63 Eu	$L\beta_1$	$L_{II}M_{IV}$	6.4564
1.9255	2	63 Eu	$L\beta_4$	L_IM_{II}	6.4389
1.9255	5	59 Pr	L_{II}	Abs. Edge	6.439
1.9355	4	60 Nd	$L\gamma_5$	$L_{II}N_I$	6.406
1.936042	9	26 Fe	$K\alpha_1$	KL_{III}	6.40384
1.9362	4	59 Pr	$L\gamma_8$	$L_{II}O_I$	6.403
1.939980	9	26 Fe	$K\alpha_2$	KL_{II}	6.39084
1.94643	3	62 Sm	$L\beta_6$	$L_{III}N_I$	6.3693
1.9550	2	69 Tm	Ll	$L_{III}M_I$	6.3419
1.9553	3	58 Ce	$L\gamma_3$	L_IN_{III}	6.3409
1.9559	6	61 Pm	$L\beta_{2,15}$	$L_{III}N_{IV,V}$	6.339
1.9602	3	58 Ce	$L\gamma_2$	L_IN_{II}	6.3250
1.9611	3	59 Pr	$L\gamma_1$	$L_{II}N_{IV}$	6.3221
1.96241	3	62 Sm	$L\beta_3$	L_IM_{III}	6.318
1.9730	2	65 Tb	$L\eta$	$L_{II}M_I$	6.2839
1.9765	2	65 Tb	$L\alpha_1$	$L_{III}M_V$	6.2728
1.9780	5	57 La	L_I	Abs. Edge	6.268
1.9830	4	57 La	$L\gamma_4$	$L_IO_{II,III}$	6.252
1.9875	2	65 Tb	$L\alpha_2$	$L_{III}M_{IV}$	6.2380
1.9967	1	60 Nd	L_{III}	Abs. Edge	6.2092
1.99806	3	62 Sm	$L\beta_1$	$L_{II}M_{IV}$	6.2051
2.00095	6	62 Sm	$L\beta_4$	L_IM_{II}	6.196
2.0092	3	60 Nd	$L\beta_7$	$L_{III}O_I$	6.1708
2.0124	5	58 Ce	L_{II}	Abs. Edge	6.161
2.015	1	68 Er	Ll	$L_{III}M_I$	6.152
2.0165	3	60 Nd	$L\beta_9$	L_IM_V	6.1484
2.0205	4	59 Pr	$L\gamma_5$	$L_{II}N_I$	6.136
2.0237	4	58 Ce	$L\gamma_8$	$L_{II}O_I$	6.126
2.0237	3	60 Nd	$L\beta_{10}$	L_IM_{IV}	6.1265
2.0360	3	60 Nd	$L\beta_{2,15}$	$L_{III}N_{IV,V}$	6.0894
2.0410	4	57 La	$L\gamma_3$	L_IN_{III}	6.074
2.0421	4	61 Pm	$L\beta_3$	L_IM_{III}	6.071
2.0460	4	57 La	$L\gamma_2$	L_IN_{II}	6.060
2.0468	2	64 Gd	$L\alpha_1$	$L_{III}M_V$	6.0572
2.0487	4	58 Ce	$L\gamma_1$	$L_{II}N_{IV}$	6.052
2.0494	1	64 Gd	$L\eta$	$L_{II}M_I$	6.0495
2.0578	2	64 Gd	$L\alpha_2$	$L_{III}M_{IV}$	6.0250
2.0678	5	56 Ba	L_I	Abs. Edge	5.996
2.07020	5	24 Cr	K	Abs. Edge	5.9888
2.07087	6	24 Cr	$K\beta_5$	$KM_{IV,V}$	5.9869
2.0756	3	56 Ba	$L\gamma_4$	$L_IO_{II,III}$	5.9733
2.0791	5	59 Pr	L_{III}	Abs. Edge	5.963
2.0797	4	61 Pm	$L\beta_1$	$L_{II}M_{IV}$	5.961
2.08487	2	24 Cr	$K\beta_{1,3}$	$KM_{II,III}$	5.94671
2.0860	2	67 Ho	Ll	$L_{III}M_I$	5.9434
2.0919	4	59 Pr	$L\beta_7$	$L_{III}O_I$	5.927
2.1004	4	59 Pr	$L\beta_9$	L_IM_V	5.903
2.101820	9	25 Mn	$K\alpha_1$	KL_{III}	5.89875
2.1039	3	60 Nd	$L\beta_6$	$L_{III}N_I$	5.8930
2.1053	5	57 La	L_{II}	Abs. Edge	5.889
2.10578	2	25 Mn	$K\alpha_2$	KL_{II}	5.88765
2.1071	4	59 Pr	$L\beta_{10}$	L_IM_{IV}	5.884
2.1103	3	58 Ce	$L\gamma_5$	$L_{II}N_I$	5.8751
2.1194	4	59 Pr	$L\beta_{2,15}$	$L_{III}N_{IV,V}$	5.850
2.1209	2	63 Eu	$L\alpha_1$	$L_{III}M_V$	5.8457
2.1268	2	60 Nd	$L\beta_3$	L_IM_{III}	5.8294
2.1315	2	63 Eu	$L\eta$	$L_{II}M_I$	5.8166
2.1315	2	63 Eu	$L\alpha_2$	$L_{III}M_{IV}$	5.8166

Wavelength Å*	p.e.	Element	Designation		keV
2.1342	2	56 Ba	$L\gamma_3$	L_IN_{III}	5.8092
2.1387	2	56 Ba	$L\gamma_2$	L_IN_{II}	5.7969
2.1418	3	57 La	$L\gamma_1$	$L_{II}N_{IV}$	5.7885
2.15877	7	66 Dy	Ll	$L_{III}M_I$	5.7431
2.166	1	58 Ce	L_{III}	Abs. Edge	5.723
2.1669	3	60 Nd	$L\beta_4$	L_IM_{II}	5.7216
2.1669	2	60 Nd	$L\beta_1$	$L_{II}M_{IV}$	5.7216
2.1673	5	55 Cs	L_I	Abs. Edge	5.721
2.1701	2	58 Ce	$L\beta_7$	$L_{III}O_I$	5.7132
2.1741	2	55 Cs	$L\gamma_4$	$L_IO_{II,III}$	5.7026
2.1885	3	58 Ce	$L\beta_9$	L_IM_V	5.6650
2.1906	4	59 Pr	$L\beta_6$	$L_{III}N_I$	5.660
2.1958	5	58 Ce	$L\beta_{10}$	L_IM_{IV}	5.646
2.1998	2	62 Sm	$L\alpha_1$	$L_{III}M_V$	5.6361
2.2048	1	56 Ba	L_{II}	Abs. Edge	5.6233
2.2056	4	57 La	$L\gamma_5$	$L_{II}N_I$	5.621
2.2087	2	58 Ce	$L\beta_{2,15}$	$L_{III}N_{IV,V}$	5.6134
2.21062	3	62 Sm	$L\alpha_2$	$L_{III}M_{IV}$	5.6090
2.2172	3	59 Pr	$L\beta_3$	L_IM_{III}	5.5918
2.21824	3	62 Sm	$L\eta$	$L_{II}M_I$	5.589
2.2328	2	55 Cs	$L\gamma_3$	L_IN_{III}	5.5527
2.2352	2	65 Tb	Ll	$L_{III}M_I$	5.5467
2.2371	2	55 Cs	$L\gamma_2$	L_IN_{II}	5.5420
2.2415	2	56 Ba	$L\gamma_1$	$L_{II}N_{IV}$	5.5311
2.253	6	92 U		M_IP_{III}	5.50
2.2550	4	59 Pr	$L\beta_4$	L_IM_{II}	5.4981
2.2588	3	59 Pr	$L\beta_1$	$L_{II}M_{IV}$	5.4889
2.261	1	57 La	L_{III}	Abs. Edge	5.484
2.2691	1	23 V	K	Abs. Edge	5.4639
2.26951	6	23 V	$K\beta_5$	$KM_{IV,V}$	5.4629
2.2737	1	54 Xe	L_I	Abs. Edge	5.4528
2.275	3	57 La	$L\beta_7$	$L_{III}O_I$	5.450
2.282	3	57 La	$L\beta_9$	L_IM_V	5.434
2.2818	3	58 Ce	$L\beta_6$	$L_{III}N_I$	5.4334
2.2822	3	61 Pm	$L\alpha_1$	$L_{III}M_V$	5.4325
2.28440	2	23 V	$K\beta_{1,3}$	$KM_{II,III}$	5.42729
2.28970	2	24 Cr	$K\alpha_1$	KL_{III}	5.41472
2.290	3	57 La	$L\beta_{10}$	L_IM_{IV}	5.415
2.2926	4	61 Pm	$L\alpha_2$	$L_{III}M_{IV}$	5.4078
2.293606	3	24 Cr	$K\alpha_2$	KL_{II}	5.405509
2.3030	3	57 La	$L\beta_{2,15}$	$L_{III}N_{IV,V}$	5.3835
2.304	7	92 U		M_IO_{III}	5.38
2.3085	3	56 Ba	$L\gamma_5$	$L_{II}N_I$	5.3707
2.3109	3	58 Ce	$L\beta_3$	L_IM_{III}	5.3651
2.3122	2	64 Gd	Ll	$L_{III}M_I$	5.3621
2.3139	1	55 Cs	L_{II}	Abs. Edge	5.3581
2.3480	2	55 Cs	$L\gamma_1$	$L_{II}N_{IV}$	5.2804
2.3497	4	58 Ce	$L\beta_4$	L_IM_{II}	5.2765
2.3561	3	58 Ce	$L\beta_1$	$L_{II}M_{IV}$	5.2622
2.3629	1	56 Ba	L_{III}	Abs. Edge	5.2470
2.3704	2	60 Nd	$L\alpha_1$	$L_{III}M_V$	5.2304
2.3764	2	56 Ba	$L\beta_9$	L_IM_V	5.2171
2.3790	4	57 La	$L\beta_6$	$L_{III}N_I$	5.2114
2.3806	2	56 Ba	$L\beta_7$	$L_{III}O_I$	5.2079
2.3807	3	60 Nd	$L\alpha_2$	$L_{III}M_{IV}$	5.2077
2.3869	2	56 Ba	$L\beta_{10}$	L_IM_{IV}	5.1941
2.3880	5	53 I	L_I	Abs. Edge	5.192
2.3913	2	53 I	$L\gamma_4$	$L_IO_{II,III}$	5.1848
2.3948	2	63 Eu	Ll	$L_{III}M_I$	5.1772
2.40435	6	56 Ba	$L\beta_{2,15}$	$L_{III}N_{IV,V}$	5.1565
2.4094	4	60 Nd	$L\eta$	$L_{II}M_I$	5.1457
2.4105	3	57 La	$L\beta_3$	L_IM_{III}	5.1434
2.4174	2	55 Cs	$L\gamma_5$	$L_{II}N_I$	5.1287
2.4292	1	54 Xe	L_{II}	Abs. Edge	5.1037
2.442	9	90 Th		M_IO_{III}	5.08
2.443	4	92 U		$M_{II}O_{IV}$	5.075
2.4475	2	53 I	$L\gamma_{2,3}$	$L_IN_{II,III}$	5.0657
2.4493	3	57 La	$L\beta_4$	L_IM_{II}	5.0620
2.45891	5	57 La	$L\beta_1$	$L_{II}M_{IV}$	5.0421
2.4630	2	59 Pr	$L\alpha_1$	$L_{III}M_V$	5.0337
2.4729	3	59 Pr	$L\alpha_2$	$L_{III}M_{IV}$	5.0135
2.4740	1	55 Cs	L_{III}	Abs. Edge	5.0113
2.4783	2	55 Cs	$L\beta_9$	L_IM_V	5.0026
2.4823	4	62 Sm	Ll	$L_{III}M_I$	4.9945
2.4826	2	56 Ba	$L\beta_6$	$L_{III}N_I$	4.9939
2.4849	2	55 Cs	$L\beta_7$	$L_{III}O_I$	4.9893
2.4920	2	55 Cs	$L\beta_{10}$	L_IM_{IV}	4.9752
2.49734	5	22 Ti	K	Abs. Edge	4.96452
2.4985	2	22 Ti	$K\beta_5$	$KM_{IV,V}$	4.9623
2.50356	2	23 V	$K\alpha_1$	KL_{III}	4.95220
2.50738	2	23 V	$K\alpha_2$	KL_{II}	4.94464
2.5099	1	52 Te	L_I	Abs. Edge	4.9397
2.5113	2	52 Te	$L\gamma_4$	$L_IO_{II,III}$	4.9369
2.5118	2	55 Cs	$L\beta_{2,15}$	$L_{III}N_{IV,V}$	4.9359
2.512	3	59 Pr	$L\eta$	$L_{II}M_I$	4.935
2.51391	2	22 Ti	$K\beta_{1,3}$	$KM_{II,III}$	4.93181
2.5164	2	56 Ba	$L\beta_3$	L_IM_{III}	4.9269
2.527	4	91 Pa		$M_{II}O_{IV}$	4.906
2.5542	5	53 I	L_{II}	Abs. Edge	4.8540
2.5553	2	56 Ba	$L\beta_4$	L_IM_{II}	4.8519
2.5615	2	58 Ce	$L\alpha_1$	$L_{III}M_V$	4.8402
2.5674	2	52 Te	$L\gamma_{2,3}$	$L_IN_{II,III}$	4.8290
2.56821	5	56 Ba	$L\beta_1$	$L_{II}M_{IV}$	4.82753
2.5706	3	58 Ce	$L\alpha_2$	$L_{III}M_{IV}$	4.8230
2.58244	8	53 I	$L\gamma_1$	$L_{II}N_{IV}$	4.8009
2.5926	1	54 Xe	L_{III}	Abs. Edge	4.7822
2.5932	2	55 Cs	$L\beta_6$	$L_{III}N_I$	4.7811
2.618	5	90 Th		$M_{II}O_{IV}$	4.735
2.6203	4	58 Ce	$L\eta$	$L_{II}M_I$	4.7315
2.6285	2	55 Cs	$L\beta_3$	L_IM_{III}	4.7167
2.6388	1	51 Sb	L_I	Abs. Edge	4.6984
2.6398	2	51 Sb	$L\gamma_4$	$L_IO_{II,III}$	4.6967
2.65710	9	53 I	$L\gamma_5$	$L_{II}N_I$	4.6660
2.66570	5	57 La	$L\alpha_1$	$L_{III}M_V$	4.65097
2.6666	2	55 Cs	$L\beta_4$	L_IM_{II}	4.6494
2.67533	5	57 La	$L\alpha_2$	$L_{III}M_{IV}$	4.63423
2.6760	4	60 Nd	Ll	$L_{III}M_I$	4.6330
2.6837	2	55 Cs	$L\beta_1$	$L_{II}M_{IV}$	4.6198
2.6879	1	52 Te	L_{II}	Abs. Edge	4.6126
2.6953	2	51 Sb	$L\gamma_{2,3}$	$L_IN_{II,III}$	4.5999
2.71241	6	52 Te	$L\gamma_1$	$L_{II}N_{IV}$	4.5709
2.71352	9	53 I	$L\beta_9$	L_IM_V	4.5690
2.7196	5	53 I	L_{III}	Abs. Edge	4.5587
2.72104	9	53 I	$L\beta_{10}$	L_IM_{IV}	4.5564

Wavelength Å*	p.e.	Element		Designation	keV
2.7288	3	53 I	$L\beta_7$	$L_{III}O_I$	4.5435
2.740	3	57 La	$L\eta$	$L_{II}M_I$	4.525
2.74851	2	22 Ti	$K\alpha_1$	KL_{III}	4.51084
2.75053	8	53 I	$L\beta_{2,15}$	$L_{III}N_{IV,V}$	4.5075
2.75216	2	22 Ti	$K\alpha_2$	KL_{II}	4.50486
2.753	8	92 U		M_IN_{III}	4.50
2.762	1	21 Sc	K	Abs. Edge	4.489
2.7634	3	21 Sc	$K\beta_5$	$KM_{IV,V}$	4.4865
2.77595	5	56 Ba	$L\alpha_1$	$L_{III}M_V$	4.46626
2.7769	1	50 Sn	L_I	Abs. Edge	4.4648
2.7775	2	50 Sn	$L\gamma_4$	$L_IO_{II,III}$	4.4638
2.7796	2	21 Sc	$K\beta_{1,3}$	$KM_{II,III}$	4.4605
2.7841	4	59 Pr	Ll	$L_{III}M_I$	4.4532
2.78553	5	56 Ba	$L\alpha_2$	$L_{III}M_{IV}$	4.45090
2.79007	9	52 Te	$L\gamma_5$	$L_{II}N_I$	4.4437
2.817	2	92 U		$M_{II}N_{IV}$	4.401
2.8294	5	51 Sb	L_{II}	Abs. Edge	4.3819
2.8327	2	50 Sn	$L\gamma_{2,3}$	$L_IN_{II,III}$	4.3768
2.83672	9	53 I	$L\beta_6$	$L_{III}N_I$	4.3706
2.83897	9	52 Te	$L\beta_9$	L_IM_V	4.3671
2.84679	9	52 Te	$L\beta_{10}$	L_IM_{IV}	4.3551
2.85159	3	51 Sb	$L\gamma_1$	$L_{II}N_{IV}$	4.34779
2.8555	1	52 Te	L_{III}	Abs. Edge	4.3418
2.8627	3	56 Ba	$L\eta$	$L_{II}M_I$	4.3309
2.8634	3	52 Te	$L\beta_7$	$L_{III}O_I$	4.3298
2.87429	9	53 I	$L\beta_3$	L_IM_{III}	4.3134
2.88217	8	52 Te	$L\beta_{2,15}$	$L_{III}N_{IV,V}$	4.3017
2.884	5	92 U	M_{III}	Abs. Edge	4.299
2.8917	4	58 Ce	Ll	$L_{III}M_I$	4.2875
2.8924	2	55 Cs	$L\alpha_1$	$L_{III}M_V$	4.2865
2.9020	2	55 Cs	$L\alpha_2$	$L_{III}M_{IV}$	4.2722
2.910	2	91 Pa		$M_{II}N_{IV}$	4.260
2.91207	9	53 I	$L\beta_4$	L_IM_{II}	4.2575
2.92	2	92 U		M_IN_{II}	4.25
2.9260	1	49 In	L_I	Abs. Edge	4.2373
2.9264	2	49 In	$L\gamma_4$	$L_IO_{II,III}$	4.2367
2.93187	9	51 Sb	$L\gamma_5$	$L_{II}N_I$	4.2287
2.934	8	90 Th		M_IN_{III}	4.23
2.93744	6	53 I	$L\beta_1$	$L_{II}M_{IV}$	4.22072
2.948	2	92 U		$M_{III}O_{IV,V}$	4.205
2.97088	9	52 Te	$L\beta_6$	$L_{III}N_I$	4.1732
2.97261	9	51 Sb	$L\beta_9$	L_IM_V	4.1708
2.97917	9	51 Sb	$L\beta_{10}$	L_IM_{IV}	4.1616
2.9800	2	49 In	$L\gamma_{2,3}$	$L_IN_{II,III}$	4.1605
2.9823	1	50 Sn	L_{II}	Abs. Edge	4.1573
2.9932	2	55 Cs	$L\eta$	$L_{II}M_I$	4.1421
3.0003	1	51 Sb	L_{III}	Abs. Edge	4.1323
3.00115	3	50 Sn	$L\gamma_1$	$L_{II}N_{IV}$	4.13112
3.0052	3	51 Sb	$L\beta_7$	$L_{III}O_I$	4.1255
3.006	3	57 La	Ll	$L_{III}M_I$	4.124
3.00893	9	52 Te	$L\beta_3$	L_IM_{III}	4.1204
3.011	2	90 Th		$M_{II}N_{IV}$	4.117
3.0166	2	54 Xe	$L\alpha_1$	$L_{III}M_V$	4.1099
3.02335	3	51 Sb	$L\beta_{2,15}$	$L_{III}N_{IV,V}$	4.10078
3.0309	1	21 Sc	$K\alpha_1$	KL_{III}	4.0906
3.0342	1	21 Sc	$K\alpha_2$	KL_{II}	4.0861
3.038	2	91 Pa		$M_{III}O_{IV,V}$	4.081

Wavelength Å*	p.e.	Element		Designation	keV
3.04661	9	52 Te	$L\beta_4$	L_IM_{II}	4.0695
3.068	5	90 Th	M_{III}	Abs. Edge	4.041
3.0703	1	20 Ca	K	Abs. Edge	4.0381
3.0746	3	20 Ca	$K\beta_5$	$KM_{IV,V}$	4.0325
3.07677	6	52 Te	$L\beta_1$	$L_{II}M_{IV}$	4.02958
3.08475	9	50 Sn	$L\gamma_5$	$L_{II}N_I$	4.0192
3.0849	1	48 Cd	L_I	Abs. Edge	4.0190
3.0897	2	20 Ca	$K\beta_{1,3}$	$KM_{II,III}$	4.0127
3.094	5	83 Bi	M_I	Abs. Edge	4.007
3.11513	9	50 Sn	$L\beta_9$	L_IM_V	3.9800
3.11513	9	51 Sb	$L\beta_6$	$L_{III}N_I$	3.9800
3.115	7	92 U		$M_{III}O_I$	3.980
3.12170	9	50 Sn	$L\beta_{10}$	L_IM_{IV}	3.9716
3.131	3	90 Th		$M_{III}O_{IV,V}$	3.959
3.1355	2	56 Ba	Ll	$L_{III}M_I$	3.9541
3.1377	2	48 Cd	$L\gamma_2$	L_IN_{II}	3.9513
3.1473	1	49 In	L_{II}	Abs. Edge	3.9393
3.14860	6	53 I	$L\alpha_1$	$L_{III}M_V$	3.93765
3.15258	9	51 Sb	$L\beta_3$	L_IM_{III}	3.9327
3.1557	1	50 Sn	L_{III}	Abs. Edge	3.9288
3.1564	3	50 Sn	$L\beta_7$	$L_{III}O_I$	3.9279
3.15791	6	53 I	$L\alpha_2$	$L_{III}M_{IV}$	3.92604
3.16213	4	49 In	$L\gamma_1$	$L_{II}N_{IV}$	3.92081
3.17505	3	50 Sn	$L\beta_{2,15}$	$L_{III}N_{IV,V}$	3.90486
3.19014	9	51 Sb	$L\beta_4$	L_IM_{II}	3.8364
3.217	5	82 Pb	M_I	Abs. Edge	3.854
3.22567	4	51 Sb	$L\beta_1$	$L_{II}M_{IV}$	3.84357
3.245	9	91 Pa		$M_{III}O_I$	3.82
3.24907	9	49 In	$L\gamma_5$	$L_{II}N_I$	3.8159
3.2564	1	47 Ag	L_I	Abs. Edge	3.8072
3.2670	2	55 Cs	Ll	$L_{III}M_I$	3.7950
3.26763	9	49 In	$L\beta_9$	L_IM_V	3.7942
3.26901	9	50 Sn	$L\beta_6$	$L_{III}N_I$	3.7926
3.27404	9	49 In	$L\beta_{10}$	L_IM_{IV}	3.7868
3.27979	9	53 I	$L\eta$	$L_{II}M_I$	3.7801
3.283	9	90 Th		$M_{III}O_I$	3.78
3.28920	6	52 Te	$L\alpha_1$	$L_{III}M_V$	3.76933
3.29846	9	52 Te	$L\alpha_2$	$L_{III}M_{IV}$	3.7588
3.30585	3	50 Sn	$L\beta_3$	L_IM_{III}	3.7500
3.30635	9	47 Ag	$L\gamma_3$	L_IN_{III}	3.7498
3.31216	9	47 Ag	$L\gamma_2$	L_IN_{II}	3.7432
3.3237	1	49 In	L_{III}	Abs. Edge	3.7302
3.324	4	49 In	$L\beta_7$	$L_{III}O_I$	3.730
3.3257	1	48 Cd	L_{II}	Abs. Edge	3.7280
3.329	4	92 U		$M_{II}N_I$	3.724
3.333	5	92 U	M_{IV}	Abs. Edge	3.720
3.33564	6	48 Cd	$L\gamma_1$	$L_{II}N_{IV}$	3.71686
3.33838	3	49 In	$L\beta_{2,15}$	$L_{III}N_{IV,V}$	3.71381
3.34335	9	50 Sn	$L\beta_4$	L_IM_{II}	3.7083
3.346	5	81 Tl	M_I	Abs. Edge	3.705
3.35839	3	20 Ca	$K\alpha_1$	KL_{III}	3.69168
3.359	5	83 Bi	M_{II}	Abs. Edge	3.691
3.36166	3	20 Ca	$K\alpha_2$	KL_{II}	3.68809
3.38487	3	50 Sn	$L\beta_1$	$L_{II}M_{IV}$	3.66280
3.42551	9	48 Cd	$L\gamma_5$	$L_{II}N_I$	3.61935
3.43015	9	48 Cd	$L\beta_9$	L_IM_V	3.61445
3.43606	9	49 In	$L\beta_6$	$L_{III}N_I$	3.60823

Wavelength Å*	p.e.	Element	Designation		keV
3.4365	1	19 K	K	Abs. Edge	3.6078
3.4367	2	48 Cd	$L\beta_{10}$	$L_{I}M_{IV}$	3.6075
3.437	1	46 Pd	L_{I}	Abs. Edge	3.607
3.43832	9	52 Te	$L\eta$	$L_{II}M_{I}$	3.60586
3.43941	4	51 Sb	$L\alpha_{1}$	$L_{III}M_{V}$	3.60472
3.441	5	91 Pa		$M_{II}N_{I}$	3.603
3.4413	4	19 K	$K\beta_{5}$	$KM_{IV,V}$	3.6027
3.44840	6	51 Sb	$L\alpha_{2}$	$L_{III}M_{IV}$	3.59532
3.4539	2	19 K	$K\beta_{1,3}$	$KM_{II,III}$	3.5896
3.46984	9	49 In	$L\beta_{3}$	$L_{I}M_{III}$	3.57311
3.478	5	80 Hg	M_{I}	Abs. Edge	3.565
3.479	1	92 U	$M\gamma$	$M_{III}N_{V}$	3.563
3.4892	2	46 Pd	$L\gamma_{2,3}$	$L_{I}N_{II,III}$	3.5533
3.492	5	82 Pb	M_{II}	Abs. Edge	3.550
3.497	5	92 U	M_{V}	Abs. Edge	3.545
3.5047	1	48 Cd	L_{III}	Abs. Edge	3.5376
3.50697	9	49 In	$L\beta_{4}$	$L_{I}M_{II}$	3.53528
3.51408	4	48 Cd	$L\beta_{2,15}$	$L_{III}N_{IV,V}$	3.52812
3.5164	1	47 Ag	L_{II}	Abs. Edge	3.5258
3.521	2	92 U		$M_{III}N_{IV}$	3.521
3.52260	4	47 Ag	$L\gamma_{1}$	$L_{II}N_{IV}$	3.51959
3.537	9	90 Th		$M_{II}N_{I}$	3.505
3.55531	4	49 In	$L\beta_{1}$	$L_{II}M_{IV}$	3.48721
3.557	5	90 Th	M_{IV}	Abs. Edge	3.485
3.55754	9	53 I	Ll	$L_{III}M_{I}$	3.48502
3.576	1	92 U		$M_{IV}O_{II}$	3.4666
3.577	1	91 Pa	$M\gamma$	$M_{III}N_{V}$	3.4657
3.59994	3	50 Sn	$L\alpha_{1}$	$L_{III}M_{V}$	3.44398
3.60497	9	47 Ag	$L\beta_{9}$	$L_{I}M_{V}$	3.43917
3.60765	9	51 Sb	$L\eta$	$L_{II}M_{I}$	3.43661
3.60891	4	50 Sn	$L\alpha_{2}$	$L_{III}M_{IV}$	3.43542
3.61158	9	47 Ag	$L\beta_{10}$	$L_{I}M_{IV}$	3.43287
3.614	2	91 Pa		$M_{III}N_{IV}$	3.430
3.61467	9	48 Cd	$L\beta_{6}$	$L_{III}N_{I}$	3.42994
3.61638	9	47 Ag	$L\gamma_{5}$	$L_{II}N_{I}$	3.42832
3.616	5	79 Au	M_{I}	Abs. Edge	3.428
3.629	5	45 Rh	L_{I}	Abs. Edge	3.417
3.634	5	81 Tl	M_{II}	Abs. Edge	3.412
3.64495	9	48 Cd	$L\beta_{3}$	$L_{I}M_{III}$	3.40145
3.679	2	90 Th	$M\gamma$	$M_{III}N_{V}$	3.370
3.68203	9	48 Cd	$L\beta_{4}$	$L_{I}M_{II}$	3.36719
3.6855	2	45 Rh	$L\gamma_{2,3}$	$L_{I}N_{II,III}$	3.3640
3.691	2	91 Pa		$M_{IV}O_{II}$	3.359
3.6999	1	47 Ag	L_{III}	Abs. Edge	3.35096
3.70335	3	47 Ag	$L\beta_{2,15}$	$L_{III}N_{IV,V}$	3.34781
3.716	1	92 U	$M\beta$	$M_{IV}N_{VI}$	3.3367
3.71696	9	52 Te	Ll	$L_{III}M_{I}$	3.33555
3.718	3	90 Th		$M_{III}N_{IV}$	3.335
3.7228	1	46 Pd	L_{II}	Abs. Edge	3.33031
3.7246	2	46 Pd	$L\gamma_{1}$	$L_{II}N_{IV}$	3.3287
3.729	5	90 Th	M_{V}	Abs. Edge	3.325
3.73823	4	48 Cd	$L\beta_{1}$	$L_{II}M_{IV}$	3.31657
3.740	9	83 Bi		$M_{I}N_{III}$	3.315
3.7414	2	19 K	$K\alpha_{1}$	KL_{III}	3.3138
3.7445	2	19 K	$K\alpha_{2}$	KL_{II}	3.3111
3.760	9	90 Th		$M_{V}P_{III}$	3.298
3.762	5	78 Pt	M_{I}	Abs. Edge	3.296
3.77192	4	49 In	$L\alpha_{1}$	$L_{III}M_{V}$	3.28694
3.78073	6	49 In	$L\alpha_{2}$	$L_{III}M_{IV}$	3.27929
3.783	5	80 Hg	M_{II}	Abs. Edge	3.277
3.78876	9	50 Sn	$L\eta$	$L_{II}M_{I}$	3.27234
3.7920	2	46 Pd	$L\beta_{9}$	$L_{I}M_{V}$	3.2696
3.7988	2	46 Pd	$L\beta_{10}$	$L_{I}M_{IV}$	3.2637
3.80774	9	47 Ag	$L\beta_{6}$	$L_{III}N_{I}$	3.25603
3.808	4	90 Th		$M_{IV}O_{II}$	3.256
3.8222	2	46 Pd	$L\gamma_{5}$	$L_{II}N_{I}$	3.2437
3.827	1	91 Pa	$M\beta$	$M_{IV}N_{VI}$	3.2397
3.83313	9	47 Ag	$L\beta_{3}$	$L_{I}M_{III}$	3.23446
3.834	4	83 Bi		$M_{II}N_{IV}$	3.234
3.835	5	44 Ru	L_{I}	Abs. Edge	3.233
3.87023	5	47 Ag	$L\beta_{4}$	$L_{I}M_{II}$	3.20346
3.87090	5	18 A	K	Abs. Edge	3.20290
3.872	9	82 Pb		$M_{I}N_{III}$	3.202
3.8860	2	18 A	$K\beta_{1,3}$	$KM_{II,III}$	3.1905
3.88826	9	51 Sb	Ll	$L_{III}M_{I}$	3.18860
3.892	9	83 Bi		$M_{I}N_{II}$	3.185
3.8977	2	44 Ru	$L\gamma_{2,3}$	$L_{I}N_{II,III}$	3.1809
3.904	5	83 Bi	M_{III}	Abs. Edge	3.176
3.9074	1	46 Pd	L_{III}	Abs. Edge	3.17298
3.90887	4	46 Pd	$L\beta_{2,15}$	$L_{III}N_{IV,V}$	3.17179
3.910	1	92 U	$M\alpha_{1}$	$M_{V}N_{VII}$	3.1708
3.915	5	77 Ir	M_{I}	Abs. Edge	3.167
3.924	1	92 U	$M\alpha_{2}$	$M_{V}N_{VI}$	3.1595
3.932	6	83 Bi		$M_{III}O_{IV,V}$	3.153
3.93473	3	47 Ag	$L\beta_{1}$	$L_{II}M_{IV}$	3.15094
3.936	5	79 Au	M_{II}	Abs. Edge	3.150
3.941	1	90 Th	$M\beta$	$M_{IV}N_{VI}$	3.1458
3.9425	5	45 Rh	L_{II}	Abs. Edge	3.1448
3.9437	2	45 Rh	$L\gamma_{1}$	$L_{II}N_{IV}$	3.1438
3.95635	4	48 Cd	$L\alpha_{1}$	$L_{III}M_{V}$	3.13373
3.96496	6	48 Cd	$L\alpha_{2}$	$L_{III}M_{IV}$	3.12691
3.968	5	82 Pb		$M_{II}N_{IV}$	3.124
3.98327	9	49 In	$L\eta$	$L_{II}M_{I}$	3.11254
4.013	9	81 Tl		$M_{I}N_{III}$	3.089
4.0162	2	46 Pd	$L\beta_{6}$	$L_{III}N_{I}$	3.0870
4.022	1	91 Pa	$M\alpha_{1}$	$M_{V}N_{VII}$	3.0823
4.0346	2	46 Pd	$L\beta_{3}$	$L_{I}M_{III}$	3.0730
4.035	3	91 Pa	$M\alpha_{2}$	$M_{V}N_{VI}$	3.072
4.0451	2	45 Rh	$L\gamma_{5}$	$L_{II}N_{I}$	3.0650
4.047	1	82 Pb	M_{III}	Abs. Edge	3.0632
4.058	5	43 Tc	L_{I}	Abs. Edge	3.055
4.069	6	82 Pb		$M_{III}O_{IV,V}$	3.047
4.0711	2	46 Pd	$L\beta_{4}$	$L_{I}M_{II}$	3.0454
4.071	5	76 Os	M_{I}	Abs. Edge	3.045
4.07165	9	50 Sn	Ll	$L_{III}M_{I}$	3.04499
4.093	5	78 Pt	M_{II}	Abs. Edge	3.029
4.105	9	83 Bi		$M_{III}O_{I}$	3.021
4.116	4	81 Tl		$M_{II}N_{IV}$	3.013
4.1299	5	45 Rh	L_{III}	Abs. Edge	3.0021
4.1310	2	45 Rh	$L\beta_{2,15}$	$L_{III}N_{IV,V}$	3.0013
4.1381	9	90 Th	$M\alpha_{1}$	$M_{V}N_{VII}$	2.9961
4.14622	5	46 Pd	$L\beta_{1}$	$L_{II}M_{IV}$	2.99022
4.151	2	90 Th	$M\alpha_{2}$	$M_{V}N_{VI}$	2.987
4.15443	3	47 Ag	$L\alpha_{1}$	$L_{III}M_{V}$	2.98431

Wavelength Å*	p.e.	Element	Designation		keV
4.16294	5	47 Ag	$L\alpha_2$	$L_{III}M_{IV}$	2.97821
4.180	1	44 Ru	L_{II}	Abs. Edge	2.9663
4.1822	2	44 Ru	$L\gamma_1$	$L_{II}N_{IV}$	2.9645
4.19180	5	18 A	$K\alpha_1$	KL_{III}	2.95770
4.19315	9	48 Cd	$L\eta$	$L_{II}M_{I}$	2.95675
4.19474	5	18 A	$K\alpha_2$	KL_{II}	2.95563
4.198	1	81 Tl	M_{III}	Abs. Edge	2.9535
4.216	6	81 Tl		$M_{III}O_{IV,V}$	2.941
4.236	5	75 Re	M_{I}	Abs. Edge	2.927
4.2417	2	45 Rh	$L\beta_6$	$L_{III}N_{I}$	2.9229
4.244	9	82 Pb		$M_{III}O_{I}$	2.921
4.2522	2	45 Rh	$L\beta_3$	$L_{I}M_{III}$	2.9157
4.260	5	77 Ir	M_{II}	Abs. Edge	2.910
4.26873	9	49 In	Ll	$L_{III}M_{I}$	2.90440
4.2873	2	44 Ru	$L\gamma_5$	$L_{II}N_{I}$	2.8918
4.2888	2	45 Rh	$L\beta_4$	$L_{I}M_{II}$	2.8908
4.300	9	79 Au		$M_{I}N_{III}$	2.883
4.304	5	42 Mo	L_{I}	Abs. Edge	2.881
4.330	2	92 U		$M_{III}N_{I}$	2.863
4.355	1	80 Hg	M_{III}	Abs. Edge	2.8469
4.36767	5	46 Pd	$L\alpha_1$	$L_{III}M_{V}$	2.83861
4.369	1	44 Ru	L_{III}	Abs. Edge	2.8377
4.3718	2	44 Ru	$L\beta_{2,15}$	$L_{III}N_{IV,V}$	2.8360
4.37414	4	45 Rh	$L\beta_1$	$L_{II}M_{IV}$	2.83441
4.37588	7	46 Pd	$L\alpha_2$	$L_{III}M_{IV}$	2.83329
4.3800	2	42 Mo	$L\gamma_{2,3}$	$L_{I}N_{II,III}$	2.8306
4.3971	1	17 Cl	K	Abs. Edge	2.81960
4.4034	3	17 Cl	$K\beta$	KM	2.8156
4.407	5	74 W	M_{I}	Abs. Edge	2.813
4.4183	2	47 Ag	$L\eta$	$L_{II}M_{I}$	2.8061
4.432	4	79 Au		$M_{II}N_{IV}$	2.797
4.433	5	76 Os	M_{II}	Abs. Edge	2.797
4.436	1	43 Te	L_{II}	Abs. Edge	2.7948
4.44	2	74 W		$M_{I}O_{II,III}$	2.79
4.450	4	91 Pa		$M_{III}N_{I}$	2.786
4.460	9	78 Pt		$M_{I}N_{III}$	2.780
4.48014	9	48 Cd	Ll	$L_{III}M_{I}$	2.76735
4.4866	3	44 Ru	$L\beta_3$	$L_{I}M_{III}$	2.7634
4.4866	3	44 Ru	$L\beta_6$	$L_{III}N_{I}$	2.7634
4.518	1	79 Au	M_{III}	Abs. Edge	2.7439
4.522	6	79 Au		$M_{III}O_{IV,V}$	2.742
4.5230	2	44 Ru	$L\beta_4$	$L_{I}M_{II}$	2.7411
4.532	2	83 Bi	$M\gamma$	$M_{III}N_{V}$	2.735
4.568	5	90 Th		$M_{III}N_{I}$	2.714
4.571	5	83 Bi		$M_{III}N_{IV}$	2.712
4.572	5	83 Bi	M_{IV}	Abs. Edge	2.711
4.575	5	41 Nb	L_{I}	Abs. Edge	2.710
4.585	5	73 Ta	M_{I}	Abs. Edge	2.704
4.59	2	83 Bi		$M_{IV}P_{II,III}$	2.70
4.59743	9	45 Rh	$L\alpha_1$	$L_{III}M_{V}$	2.69674
4.601	4	78 Pt		$M_{II}N_{IV}$	2.695
4.60545	9	45 Rh	$L\alpha_2$	$L_{III}M_{IV}$	2.69205
4.620	5	75 Re	M_{II}	Abs. Edge	2.684
4.62058	3	44 Ru	$L\beta_1$	$L_{II}M_{IV}$	2.68323
4.625	5	92 U		$M_{IV}N_{III}$	2.681
4.630	1	43 Tc	L_{III}	Abs. Edge	2.6780
4.631	9	77 Ir		$M_{I}N_{III}$	2.677

Wavelength Å*	p.e.	Element	Designation		keV
4.6542	2	41 Nb	$L\gamma_{2,3}$	$L_{I}N_{II,III}$	2.6638
4.655	8	82 Pb		$M_{II}N_{I}$	2.664
4.6605	2	46 Pd	$L\eta$	$L_{II}M_{I}$	2.6603
4.674	1	82 Pb	$M\gamma$	$M_{III}N_{V}$	2.6527
4.686	1	78 Pt	M_{III}	Abs. Edge	2.6459
4.694	8	78 Pt		$M_{III}O_{IV,V}$	2.641
4.703	9	79 Au		$M_{III}O_{I}$	2.636
4.7076	2	47 Ag	Ll	$L_{III}M_{I}$	2.6337
4.715	3	82 Pb		$M_{III}N_{IV}$	2.630
4.719	1	42 Mo	L_{II}	Abs. Edge	2.6274
4.7258	2	42 Mo	$L\gamma_1$	$L_{II}N_{IV}$	2.6235
4.7278	1	17 Cl	$K\alpha_1$	KL_{III}	2.62239
4.7307	1	17 Cl	$K\alpha_2$	KL_{II}	2.62078
4.757	5	82 Pb	M_{IV}	Abs. Edge	2.606
4.764	5	83 Bi	M_{V}	Abs. Edge	2.603
4.780	4	77 Ir		$M_{II}N_{IV}$	2.594
4.79	2	76 Os		$M_{I}N_{III}$	2.59
4.815	5	74 W	M_{II}	Abs. Edge	2.575
4.823	3	83 Bi		$M_{IV}O_{II}$	2.571
4.823	4	81 Tl	$M\gamma$	$M_{III}N_{V}$	2.571
4.8369	2	42 Mo	$L\gamma_5$	$L_{II}N_{I}$	2.5632
4.84575	5	44 Ru	$L\alpha_1$	$L_{III}M_{V}$	2.55855
4.85381	7	44 Ru	$L\alpha_2$	$L_{III}M_{IV}$	2.55431
4.861	1	77 Ir	M_{III}	Abs. Edge	2.5505
4.865	5	81 Tl		$M_{III}N_{IV}$	2.548
4.869	9	77 Ir		$M_{III}O_{IV,V}$	2.546
4.876	9	78 Pt		$M_{III}O_{I}$	2.543
4.879	5	40 Zr	L_{I}	Abs. Edge	2.541
4.8873	8	43 Tc	$L\beta_1$	$L_{II}M_{IV}$	2.5368
4.909	1	83 Bi	$M\beta$	$M_{IV}N_{VI}$	2.5255
4.911	5	90 Th		$M_{IV}N_{III}$	2.524
4.913	1	42 Mo	L_{III}	Abs. Edge	2.5234
4.9217	2	45 Rh	$L\eta$	$L_{II}M_{I}$	2.5191
4.9232	2	42 Mo	$L\beta_{2,15}$	$L_{III}N_{IV,V}$	2.5183
4.946	2	92 U	$M\zeta_1$	$M_{V}N_{III}$	2.507
4.952	5	81 Tl	M_{IV}	Abs. Edge	2.504
4.9525	3	46 Pd	Ll	$L_{III}M_{I}$	2.5034
4.9536	3	40 Zr	$L\gamma_{2,3}$	$L_{I}N_{II,III}$	2.5029
4.955	4	76 Os		$M_{II}N_{IV}$	2.502
4.955	5	82 Pb	M_{V}	Abs. Edge	2.502
4.984	2	80 Hg	$M\gamma$	$M_{III}N_{V}$	2.4875
5.004	9	82 Pb		$M_{IV}O_{II}$	2.477
5.0133	3	42 Mo	$L\beta_3$	$L_{I}M_{III}$	2.4730
5.0185	1	16 S	K	Abs. Edge	2.47048
5.020	5	73 Ta	M_{II}	Abs. Edge	2.470
5.0233	3	16 S	$K\beta_x$	KM	2.4681
5.031	1	41 Nb	L_{II}	Abs. Edge	2.4641
5.0316	2	16 S	$K\beta_1$	KM	2.46404
5.0361	3	41 Nb	$L\gamma_1$	$L_{II}N_{IV}$	2.4618
5.043	5	76 Os	M_{III}	Abs. Edge	2.458
5.0488	3	42 Mo	$L\beta_4$	$L_{I}M_{II}$	2.4557
5.0488	5	42 Mo	$L\beta_6$	$L_{III}N_{I}$	2.4557
5.050	2	92 U	$M\zeta_2$	$M_{IV}N_{II}$	2.4548
5.076	1	82 Pb	$M\beta$	$M_{IV}N_{VI}$	2.4427
5.092	2	91 Pa	$M\zeta_1$	$M_{V}N_{III}$	2.4350
5.1148	3	43 Tc	$L\alpha_1$	$L_{III}M_{V}$	2.4240
5.118	1	83 Bi	$M\alpha_1$	$M_{V}N_{VII}$	2.4226

TABLE VI (*Continued*)

Wavelength Å*	p.e.	Element	Designation		keV
5.130	2	83 Bi	$M\alpha_2$	M_VN_{VI}	2.4170
5.145	4	79 Au	$M\gamma$	$M_{III}N_V$	2.410
5.1517	3	41 Nb	$L\gamma_5$	$L_{II}N_I$	2.4066
5.153	5	81 Tl	M_V	Abs. Edge	2.406
5.157	5	80 Hg	M_{IV}	Abs. Edge	2.404
5.168	9	82 Pb		M_VO_{III}	2.399
5.172	9	74 W		M_IN_{III}	2.397
5.17708	8	42 Mo	$L\beta_1$	$L_{II}M_{IV}$	2.39481
5.186	5	79 Au		$M_{III}N_{IV}$	2.391
5.193	2	91 Pa	$M\zeta_2$	$M_{IV}N_{II}$	2.3876
5.196	9	81 Tl		$M_{IV}O_{II}$	2.386
5.2050	2	44 Ru	$L\eta$	$L_{II}M_I$	2.38197
5.217	5	39 Y	L_I	Abs. Edge	2.377
5.2169	3	45 Rh	Ll	$L_{III}M_I$	2.3765
5.230	1	41 Nb	L_{III}	Abs. Edge	2.3706
5.234	5	75 Re	M_{III}	Abs. Edge	2.369
5.2379	3	41 Nb	$L\beta_{2,15}$	$L_{III}N_{IV,V}$	2.3670
5.245	5	90 Th	$M\zeta_1$	M_VN_{III}	2.364
5.249	1	81 Tl	$M\beta$	$M_{IV}N_{VI}$	2.3621
5.2830	3	39 Y	$L\gamma_{2,3}$	$L_IN_{II,III}$	2.3468
5.286	1	82 Pb	$M\alpha_1$	M_VN_{VII}	2.3455
5.299	2	82 Pb	$M\alpha_2$	M_VN_{VI}	2.3397
5.3102	3	41 Nb	$L\beta_3$	L_IM_{III}	2.3348
5.319	4	78 Pt	$M\gamma$	$M_{III}N_V$	2.331
5.340	5	90 Th	$M\zeta_2$	$M_{IV}N_{II}$	2.322
5.3455	3	41 Nb	$L\beta_4$	L_IM_{II}	2.3194
5.357	4	74 W		$M_{II}N_{IV}$	2.314
5.357	5	78 Pt		$M_{III}N_{IV}$	2.314
5.36	1	80 Hg	M_V	Abs. Edge	2.313
5.3613	3	41 Nb	$L\beta_6$	$L_{III}N_I$	2.3125
5.37216	7	16 S	$K\alpha_1$	KL_{III}	2.30784
5.374	5	79 Au	M_{IV}	Abs. Edge	2.307
5.37496	8	16 S	$K\alpha_2$	KL_{II}	2.30664
5.378	1	40 Zr	L_{II}	Abs. Edge	2.3053
5.3843	3	40 Zr	$L\gamma_1$	$L_{II}N_{IV}$	2.3027
5.40	2	73 Ta		M_IN_{III}	2.295
5.40655	8	42 Mo	$L\alpha_1$	$L_{III}M_V$	2.29316
5.41437	8	42 Mo	$L\alpha_2$	$L_{III}M_{IV}$	2.28985
5.4318	9	80 Hg	$M\beta$	$M_{IV}N_{VI}$	2.2825
5.435	1	74 W	M_{III}	Abs. Edge	2.2811
5.460	1	81 Tl	$M\alpha_1$	M_VN_{VII}	2.2706
5.472	2	81 Tl	$M\alpha_2$	M_VN_{VI}	2.2656
5.4923	3	41 Nb	$L\beta_1$	$L_{II}M_{IV}$	2.2574
5.4977	3	40 Zr	$L\gamma_5$	$L_{II}N_I$	2.2551
5.500	4	77 Ir	$M\gamma$	$M_{III}N_V$	2.254
5.5035	3	44 Ru	Ll	$L_{III}M_I$	2.2528
5.537	8	83 Bi		$M_{III}N_I$	2.239
5.540	5	77 Ir		$M_{III}N_{IV}$	2.238
5.570	4	73 Ta		$M_{II}N_{IV}$	2.226
5.579	1	40 Zr	L_{III}	Abs. Edge	2.2225
5.584	5	79 Au	M_V	Abs. Edge	2.220
5.5863	3	40 Zr	$L\beta_{2,15}$	$L_{III}N_{IV,V}$	2.2194
5.59	1	78 Pt	M_{IV}	Abs. Edge	2.217
5.592	5	38 Sr	L_I	Abs. Edge	2.217
5.624	1	79 Au	$M\beta$	$M_{IV}N_{VI}$	2.2046
5.628	8	74 W		$M_{III}O_I$	2.203
5.6330	3	40 Zr	$L\beta_3$	L_IM_{III}	2.2010
5.6445	3	38 Sr	$L\gamma_{2,3}$	$L_IN_{II,III}$	2.1965
5.6476	9	80 Hg	$M\alpha_1$	M_VN_{VII}	2.1953
5.650	5	73 Ta	M_{III}	Abs. Edge	2.194
5.6681	3	40 Zr	$L\beta_4$	L_IM_{II}	2.1873
5.67	3	73 Ta		$M_{III}O_{IV,V}$	2.19
5.682	4	76 Os	$M\gamma$	$M_{III}N_V$	2.182
5.704	8	82 Pb		$M_{III}N_I$	2.174
5.7101	3	40 Zr	$L\beta_6$	$L_{III}N_I$	2.1712
5.724	5	76 Os		$M_{III}N_{IV}$	2.166
5.7243	2	41 Nb	$L\alpha_1$	$L_{III}M_V$	2.16589
5.7319	3	41 Nb	$L\alpha_2$	$L_{III}M_{IV}$	2.1630
5.756	1	39 Y	L_{II}	Abs. Edge	2.1540
5.767	9	79 Au		M_VO_{III}	2.150
5.784	1	15 P	K	Abs. Edge	2.1435
5.796	2	15 P	$K\beta$	KM	2.1391
5.81	2	76 Os		$M_{II}N_I$	2.133
5.81	1	78 Pt	M_V	Abs. Edge	2.133
5.828	1	78 Pt	$M\beta$	$M_{IV}N_{VI}$	2.1273
5.83	2	73 Ta		$M_{III}O_I$	2.126
5.83	1	77 Ir	M_{IV}	Abs. Edge	2.126
5.8360	3	40 Zr	$L\beta_1$	$L_{II}M_{IV}$	2.1244
5.840	1	79 Au	$M\alpha_1$	M_VN_{VII}	2.1229
5.8475	3	42 Mo	$L\eta$	$L_{II}M_I$	2.1202
5.854	3	79 Au	$M\alpha_2$	M_VN_{VI}	2.118
5.8754	3	39 Y	$L\gamma_5$	$L_{II}N_I$	2.1102
5.884	8	81 Tl		$M_{III}N_I$	2.107
5.885	2	75 Re	$M\gamma$	$M_{III}N_V$	2.1067
5.931	5	75 Re		$M_{III}N_{IV}$	2.090
5.962	1	39 Y	L_{III}	Abs. Edge	2.0794
5.9832	3	39 Y	$L\beta_3$	L_IM_{III}	2.0722
5.987	9	78 Pt		M_VO_{III}	2.071
6.008	5	37 Rb	L_I	Abs. Edge	2.063
6.0186	3	39 Y	$L\beta_4$	L_IM_{II}	2.0600
6.038	1	77 Ir	$M\beta$	$M_{IV}N_{VI}$	2.0535
6.0458	3	37 Rb	$L\gamma_{2,3}$	$L_IN_{II,III}$	2.0507
6.047	1	78 Pt	$M\alpha_1$	M_VN_{VII}	2.0505
6.05	1	77 Ir	M_V	Abs. Edge	2.048
6.058	3	78 Pt	$M\alpha_2$	M_VN_{VI}	2.047
6.0705	2	40 Zr	$L\alpha_1$	$L_{III}M_V$	2.04236
6.073	5	76 Os	M_{IV}	Abs. Edge	2.042
6.0778	3	40 Zr	$L\alpha_2$	$L_{III}M_{IV}$	2.0399
6.09	2	80 Hg		$M_{III}N_I$	2.036
6.092	3	74 W	$M\gamma$	$M_{III}N_V$	2.035
6.0942	3	39 Y	$L\beta_6$	$L_{III}N_I$	2.0344
6.134	4	74 W		$M_{III}N_{IV}$	2.021
6.1508	3	42 Mo	Ll	$L_{III}M_I$	2.01568
6.157	1	15 P	$K\alpha_1$	KL_{III}	2.0137
6.160	1	15 P	$K\alpha_2$	KL_{II}	2.0127
6.162	8	83 Bi		$M_{IV}N_{III}$	2.012
6.173	1	38 Sr	L_{II}	Abs. Edge	2.0085
6.2109	3	41 Nb	$L\eta$	$L_{II}M_I$	1.99620
6.2120	3	39 Y	$L\beta_1$	$L_{II}M_{IV}$	1.99584
6.259	9	79 Au		$M_{III}N_I$	1.981
6.262	1	77 Ir	$M\alpha_1$	M_VN_{VII}	1.9799
6.267	1	76 Os	$M\beta$	$M_{IV}N_{VI}$	1.9783
6.275	3	77 Ir	$M\alpha_2$	M_VN_{VI}	1.9758
6.28	2	74 W		$M_{II}N_I$	1.973

Wavelength Å*	p.e.	Element		Designation	keV
6.2961	3	38 Sr	$L\gamma_5$	$L_{II}N_I$	1.96916
6.30	1	76 Os	M_V	Abs. Edge	1.967
6.312	4	73 Ta	$M\gamma$	$M_{III}N_V$	1.964
6.33	1	75 Re	M_{IV}	Abs. Edge	1.958
6.353	5	73 Ta		$M_{III}N_{IV}$	1.951
6.3672	3	38 Sr	$L\beta_3$	L_IM_{III}	1.94719
6.384	7	82 Pb		$M_{IV}N_{III}$	1.942
6.387	1	38 Sr	L_{III}	Abs. Edge	1.9411
6.4026	3	38 Sr	$L\beta_4$	L_IM_{II}	1.93643
6.4488	2	39 Y	$L\alpha_1$	$L_{III}M_V$	1.92256
6.455	9	78 Pt		$M_{III}N_I$	1.921
6.4558	3	39 Y	$L\alpha_2$	$L_{III}M_{IV}$	1.92047
6.47	1	36 Kr	L_I	Abs. Edge	1.915
6.490	1	76 Os	$M\alpha$	$M_VN_{VI,VII}$	1.9102
6.504	1	75 Re	$M\beta$	$M_{IV}N_{VI}$	1.9061
6.5176	3	41 Nb	Ll	$L_{III}M_I$	1.90225
6.5191	3	38 Sr	$L\beta_6$	$L_{III}N_I$	1.90181
6.521	4	83 Bi	$M\zeta_1$	M_VN_{III}	1.901
6.544	4	72 Hf	$M\gamma$	$M_{III}N_V$	1.895
6.560	5	75 Re	M_V	Abs. Edge	1.890
6.585	5	83 Bi	$M\zeta_2$	$M_{IV}N_{II}$	1.883
6.59	1	74 W	M_{IV}	Abs. Edge	1.880
6.6069	3	40 Zr	$L\eta$	$L_{II}M_I$	1.87654
6.6239	3	38 Sr	$L\beta_1$	$L_{II}M_{IV}$	1.87172
6.644	1	37 Rb	L_{II}	Abs. Edge	1.8661
6.669	9	77 Ir		$M_{III}N_I$	1.859
6.729	1	75 Re	$M\alpha$	$M_VN_{VI,VII}$	1.8425
6.738	1	14 Si	K	Abs. Edge	1.8400
6.740	3	82 Pb	$M\zeta_1$	M_VN_{III}	1.8395
6.7530	1	14 Si	$K\beta$	KM	1.83594
6.755	3	37 Rb	$L\gamma_5$	$L_{II}N_{IV}$	1.83532
6.757	1	74 W	$M\beta$	$M_{IV}N_{VI}$	1.8349
6.768	6	71 Lu	$M\gamma$	$M_{III}N_V$	1.832
6.7876	3	37 Rb	$L\beta_3$	L_IM_{III}	1.82659
6.802	5	82 Pb	$M\zeta_2$	$M_{IV}N_{II}$	1.823
6.806	9	74 W		$M_{IV}O_{II}$	1.822
6.8207	3	37 Rb	$L\beta_4$	L_IM_{II}	1.81771
6.83	1	74 W	M_V	Abs. Edge	1.814
6.862	1	37 Rb	L_{III}	Abs. Edge	1.8067
6.8628	2	38 Sr	$L\alpha_1$	$L_{III}M_V$	1.80656
6.8697	3	38 Sr	$L\alpha_2$	$L_{III}M_{IV}$	1.80474
6.87	1	73 Ta	M_{IV}	Abs. Edge	1.804
6.87	2	80 Hg	δ	$M_{IV}N_{III}$	1.805
6.89	2	76 Os		$M_{III}N_I$	1.798
6.9185	3	40 Zr	Ll	$L_{III}M_I$	1.79201
6.959	5	35 Br	L_I	Abs. Edge	1.781
6.974	4	81 Tl	$M\zeta_1$	M_VN_{III}	1.778
6.983	1	74 W	$M\alpha_1$	M_VN_{VII}	1.7754
6.9842	3	37 Rb	$L\beta_6$	$L_{III}N_I$	1.77517
6.992	2	74 W	$M\alpha_2$	M_VN_{VI}	1.7731
7.005	9	74 W		M_VO_{III}	1.770
7.023	1	73 Ta	$M\beta$	$M_{IV}N_{VI}$	1.7655
7.024	8	70 Yb	$M\gamma$	$M_{III}N_V$	1.765
7.032	5	81 Tl	$M\zeta_2$	$M_{IV}N_{II}$	1.763
7.0406	3	39 Y	$L\eta$	$L_{II}M_I$	1.76095
7.0759	3	37 Rb	$L\beta_1$	$L_{II}M_{IV}$	1.75217
7.09	2	73 Ta		$M_{IV}O_{II,III}$	1.748
7.101	8	79 Au		$M_{IV}N_{III}$	1.746
7.11	1	73 Ta	M_V	Abs. Edge	1.743
7.12542	9	14 Si	$K\alpha_1$	KL_{III}	1.73998
7.12791	9	14 Si	$K\alpha_2$	KL_{II}	1.73938
7.168	1	36 Kr	L_{II}	Abs. Edge	1.7297
7.250	5	36 Kr		$L_{II}N_{III}$	1.710
7.252	1	73 Ta	$M\alpha$	$M_VN_{VI,VII}$	1.7096
7.264	5	36 Kr	$L\beta_3$	L_IM_{III}	1.707
7.279	5	36 Kr	$L\gamma_5$	$L_{II}N_I$	1.703
7.30	2	73 Ta		M_VO_{III}	1.700
7.303	1	72 Hf	$M\beta$	$M_{IV}N_{VI}$	1.6976
7.304	5	36 Kr	$L\beta_4$	L_IM_{II}	1.697
7.3183	2	37 Rb	$L\alpha_1$	$L_{III}M_V$	1.69413
7.3251	3	37 Rb	$L\alpha_2$	$L_{III}M_{IV}$	1.69256
7.3563	3	39 Y	Ll	$L_{III}M_I$	1.68536
7.360	8	74 W		$M_{III}N_I$	1.684
7.371	8	78 Pt		$M_{IV}N_{III}$	1.682
7.392	1	36 Kr	L_{III}	Abs. Edge	1.6772
7.466	4	79 Au	$M\zeta_1$	M_VN_{III}	1.6605
7.503	1	34 Se	L_I	Abs. Edge	1.6525
7.510	4	36 Kr	$L\beta_6$	$L_{III}N_I$	1.6510
7.5171	3	38 Sr	$L\eta$	$L_{II}M_I$	1.64933
7.523	5	79 Au	$M\zeta_2$	$M_{IV}N_{II}$	1.648
7.539	1	72 Hf	$M\alpha$	$M_VN_{VI,VII}$	1.6446
7.546	8	68 Er	$M\gamma$	$M_{III}N_V$	1.643
7.576	3	36 Kr	$L\beta_1$	$L_{II}M_{IV}$	1.6366
7.60	1	68 Er		$M_{III}N_{IV}$	1.632
7.601	2	71 Lu	$M\beta$	$M_{IV}N_{VI}$	1.6312
7.612	9	73 Ta		$M_{III}N_I$	1.629
7.645	8	77 Ir		$M_{IV}N_{III}$	1.622
7.738	4	78 Pt	$M\zeta_1$	M_VN_{III}	1.6022
7.753	5	35 Br	L_{II}	Abs. Edge	1.599
7.767	9	35 Br	$L\beta_{3,4}$	$L_IM_{II,III}$	1.596
7.790	5	78 Pt	$M\zeta_2$	$M_{IV}N_{II}$	1.592
7.817	3	36 Kr	$L\alpha_{1,2}$	$L_{III}M_{IV,V}$	1.5860
7.8362	3	38 Sr	Ll	$L_{III}M_I$	1.58215
7.840	2	71 Lu	$M\alpha$	$M_VN_{VI,VII}$	1.5813
7.865	9	67 Ho	$M\gamma$	$M_{III}N_{IV,V}$	1.576
7.887	9	72 Hf		$M_{III}N_I$	1.572
7.909	2	70 Yb	$M\beta$	$M_{IV}N_{VI}$	1.5675
7.94813	5	13 Al	K	Abs. Edge	1.55988
7.960	2	13 Al	$K\beta$	KM	1.55745
7.984	5	35 Br	L_{III}	Abs. Edge	1.5530
8.021	4	77 Ir	$M\zeta_1$	M_VN_{III}	1.5458
8.0415	4	37 Rb	$L\eta$	$L_{II}M_I$	1.54177
8.065	5	77 Ir	$M\zeta_2$	$M_{IV}N_{II}$	1.5373
8.107	1	33 As	L_I	Abs. Edge	1.5293
8.1251	5	35 Br	$L\beta_1$	$L_{II}M_{IV}$	1.52590
8.144	9	66 Dy	$M\gamma$	$M_{III}N_{IV,V}$	1.522
8.149	5	70 Yb	$M\alpha$	$M_VN_{VI,VII}$	1.5214
8.239	8	75 Re		$M_{IV}N_{III}$	1.505
8.249	7	69 Tm	$M\beta$	$M_{IV}N_{VI}$	1.503
8.310	4	76 Os	$M\zeta_1$	M_VN_{III}	1.4919
8.321	9	34 Se	$L\beta_{3,4}$	$L_IM_{II,III}$	1.490
8.33934	9	13 Al	$K\alpha_1$	KL_{III}	1.48670
8.34173	9	13 Al	$K\alpha_2$	KL_{II}	1.48627
8.359	5	76 Os	$M\zeta_2$	$M_{IV}N_{II}$	1.4831

Wavelength Å*	p.e.	Element		Designation	keV
8.3636	4	37 Rb	Ll	$L_{III}M_I$	1.48238
8.3746	5	35 Br	$L\alpha_{1,2}$	$L_{III}M_{IV,V}$	1.48043
8.407	1	34 Se	L_{II}	Abs. Edge	1.4747
8.470	9	70 Yb		$M_{III}N_I$	1.464
8.48	1	69 Tm	$M\alpha$	$M_VN_{VI,VII}$	1.462
8.486	9	65 Tb	$M\gamma$	$M_{III}N_{IV,V}$	1.461
8.487	5	69 Tm	M_V	Abs. Edge	1.4609
8.573	8	74 W		$M_{IV}N_{III}$	1.446
8.592	3	68 Er	$M\beta$	$M_{IV}N_{VI}$	1.4430
8.60	7	92 U		$N_IP_{IV,V}$	1.44
8.601	5	68 Er	M_{IV}	Abs. Edge	1.4415
8.629	4	75 Re	$M\zeta_1$	M_VN_{III}	1.4368
8.646	1	34 Se	L_{III}	Abs. Edge	1.4340
8.664	5	75 Re	$M\zeta_2$	$M_{IV}N_{II}$	1.4310
8.7358	5	34 Se	$L\beta_1$	$L_{II}M_{IV}$	1.41923
8.76	7	92 U		N_IP_{III}	1.42
8.773	1	32 Ge	L_I	Abs. Edge	1.4132
8.81	7	92 U		N_IP_{II}	1.41
8.82	1	68 Er	$M\alpha$	$M_VN_{VI,VII}$	1.406
8.844	9	64 Gd	$M\gamma$	$M_{III}N_{IV,V}$	1.402
8.847	5	68 Er	M_V	Abs. Edge	1.4013
8.90	2	73 Ta		$M_{IV}N_{III}$	1.393
8.929	1	33 As	$L\beta_{3,4}$	$L_IM_{II,III}$	1.3884
8.962	4	74 W	$M\zeta_1$	M_VN_{III}	1.3835
8.965	4	67 Ho	$M\beta$	$M_{IV}N_{VI}$	1.3830
8.9900	5	34 Se	$L\alpha_{1,2}$	$L_{III}M_{IV,V}$	1.37910
8.993	5	74 W	$M\zeta_2$	$M_{IV}N_{II}$	1.3787
9.125	1	33 As	L_{II}	Abs. Edge	1.3587
9.20	2	67 Ho	$M\alpha$	$M_VN_{VI,VII}$	1.348
9.211	9	63 Eu	$M\gamma$	$M_{III}N_{IV,V}$	1.346
9.255	1	35 Br	$L\eta$	$L_{II}M_I$	1.3396
9.316	4	73 Ta	$M\zeta_1$	M_VN_{III}	1.3308
9.330	5	73 Ta	$M\zeta_2$	$M_{IV}N_{II}$	1.3288
9.357	6	66 Dy	$M\beta$	$M_{IV}N_{VI}$	1.3250
9.367	1	33 As	L_{III}	Abs. Edge	1.3235
9.40	7	90 Th		N_IP_{III}	1.319
9.4141	8	33 As	$L\beta_1$	$L_{II}M_{IV}$	1.3170
9.44	7	90 Th		N_IP_{II}	1.313
9.5122	1	12 Mg	K	Abs. Edge	1.30339
9.517	5	31 Ga	L_I	Abs. Edge	1.3028
9.521	2	12 Mg	$K\beta$	KM	1.3022
9.581	2	32 Ge	$L\beta_3$	L_IM_{III}	1.2941
9.585	1	35 Br	Ll	$L_{III}M_I$	1.2935
9.59	2	66 Dy	$M\alpha$	$M_VN_{VI,VII}$	1.293
9.600	9	62 Sm	$M\gamma$	$M_{III}N_{IV,V}$	1.291
9.640	2	32 Ge	$L\beta_4$	L_IM_{II}	1.2861
9.6709	8	33 As	$L\alpha_{1,2}$	$L_{III}M_{IV,V}$	1.2820
9.686	7	72 Hf	$M\zeta_2$	$M_{IV}N_{II}$	1.2800
9.686	7	72 Hf	$M\zeta_1$	M_VN_{III}	1.2800
9.792	6	65 Tb	$M\beta$	$M_{IV}N_{VI}$	1.2661
9.8900	2	12 Mg	$K\alpha_{1,2}$	$KL_{II,III}$	1.25360
9.924	1	32 Ge	L_{II}	Abs. Edge	1.2494
9.962	1	34 Se	$L\eta$	$L_{II}M_I$	1.2446
10.00	2	65 Tb	$M\alpha$	$M_VN_{VI,VII}$	1.240
10.09	7	92 U		N_IO_{III}	1.229
10.175	1	32 Ge	$L\beta_1$	$L_{II}M_{IV}$	1.2185
10.187	1	32 Ge	L_{III}	Abs. Edge	1.2170

Wavelength Å*	p.e.	Element		Designation	keV
10.254	6	64 Gd	$M\beta$	$M_{IV}N_{VI}$	1.2091
10.294	1	34 Se	Ll	$L_{III}M_I$	1.2044
10.359	9	31 Ga	$L\beta_{3,4}$	$L_IM_{II,III}$	1.197
10.40	7	92 U		$N_{II}P_I$	1.192
10.4361	8	32 Ge	$L\alpha_{1,2}$	$L_{III}M_{IV,V}$	1.18800
10.46	3	64 Gd	$M\alpha$	$M_VN_{VI,VII}$	1.185
10.48	1	70 Yb	$M\zeta$	M_VN_{III}	1.183
10.505	9	60 Nd	$M\gamma$	$M_{III}N_{IV,V}$	1.180
10.711	5	63 Eu	M_{IV}	Abs. Edge	1.1575
10.734	1	33 As	$L\eta$	$L_{II}M_I$	1.1550
10.750	7	63 Eu	$M\beta$	$M_{IV}N_{VI}$	1.1533
10.828	5	31 Ga	L_{II}	Abs. Edge	1.1450
10.96	3	63 Eu	$M\alpha$	$M_VN_{VI,VII}$	1.131
10.998	9	59 Pr	$M\gamma$	$M_{III}N_{IV,V}$	1.1273
11.013	5	63 Eu	M_V	Abs. Edge	1.1258
11.023	2	31 Ga	$L\beta_1$	$L_{II}M_{IV}$	1.1248
11.072	1	33 As	Ll	$L_{III}M_I$	1.1198
11.07	7	90 Th		$N_{II}P_I$	1.120
11.100	1	31 Ga	L_{III}	Abs. Edge	1.1169
11.200	7	30 Zn	$L\beta_{3,4}$	$L_IM_{II,III}$	1.1070
11.27	1	62 Sm	$M\beta$	$M_{IV}N_{VI}$	1.0998
11.288	5	62 Sm	M_{IV}	Abs. Edge	1.0983
11.292	1	31 Ga	$L\alpha_{1,2}$	$L_{III}M_{IV,V}$	1.09792
11.37	1	68 Er	$M\zeta$	M_VN_{III}	1.0901
11.47	3	62 Sm	$M\alpha$	$M_VN_{VI,VII}$	1.081
11.53	1	58 Ce	$M\gamma$	$M_{III}N_{IV,V}$	1.0749
11.552	5	62 Sm	M_V	Abs. Edge	1.0732
11.56	5	90 Th		$N_{II}O_{IV}$	1.072
11.569	1	11 Na	K	Abs. Edge	1.07167
11.575	2	11 Na	$K\beta$	KM	1.0711
11.609	2	32 Ge	$L\eta$	$L_{II}M_I$	1.0680
11.862	1	30 Zn	L_{II}	Abs. Edge	1.04523
11.86	1	67 Ho	$M\zeta$	M_VN_{III}	1.0450
11.9101	9	11 Na	$K\alpha_{1,2}$	$KL_{II,III}$	1.04098
11.965	2	32 Ge	Ll	$L_{III}M_I$	1.0362
11.983	3	30 Zn	$L\beta_1$	$L_{II}M_{IV}$	1.0347
12.08	4	57 La	$M\gamma$	$M_{III}N_{IV,V}$	1.027
12.122	3	29 Cu	$L\beta_{3,4}$	$L_IM_{II,III}$	1.0228
12.131	1	30 Zn	L_{III}	Abs. Edge	1.02201
12.254	3	30 Zn	$L\alpha_{1,2}$	$L_{III}M_{IV,V}$	1.0117
12.43	2	66 Dy	$M\zeta$	M_VN_{III}	0.998
12.44	2	60 Nd	$M\beta$	$M_{IV}N_{VI}$	0.997
12.459	5	60 Nd	M_{IV}	Abs. Edge	0.9951
12.597	2	31 Ga	$L\eta$	$L_{II}M_I$	0.9842
12.68	2	60 Nd	$M\alpha$	$M_VN_{VI,VII}$	0.978
12.737	5	60 Nd	M_V	Abs. Edge	0.9734
12.75	3	56 Ba	$M\gamma$	$M_{III}N_{IV,V}$	0.973
12.90	9	92 U		$N_{III}O_V$	0.961
12.953	2	31 Ga	Ll	$L_{III}M_I$	0.9572
12.98	2	65 Tb	$M\zeta$	M_VN_{III}	0.955
13.014	1	29 Cu	L_{II}	Abs. Edge	0.95268
13.053	3	29 Cu	$L\beta_1$	$L_{II}M_{IV}$	0.9498
13.06	2	59 Pr	$M\beta$	$M_{IV}N_{VI}$	0.950
10.31	1	30 Zn	L_I	Abs. Edge	1.197
13.122	5	59 Pr	M_{IV}	Abs. Edge	0.9448
13.18	2	28 Ni	$L\beta_{3,4}$	$L_IM_{II,III}$	0.941
13.288	1	29 Cu	L_{III}	Abs. Edge	0.93306

Wavelength Å*	p.e.	Element	Designation		keV
13.30	6	83 Bi		$N_IP_{II,III}$	0.932
13.336	3	29 Cu	$L\alpha_{1,2}$	$L_{III}M_{IV,V}$	0.9297
13.343	5	59 Pr	$M\alpha$	$M_VN_{VI,VII}$	0.9292
13.394	5	59 Pr	M_V	Abs. Edge	0.9257
13.57	2	64 Gd	$M\zeta$	M_VN_{III}	0.914
13.68	2	30 Zn	$L\eta$	$L_{II}M_I$	0.906
13.75	4	58 Ce	$M\beta$	$M_{IV}N_{VI}$	0.902
13.8	1	90 Th		$N_{III}O_V$	0.897
14.02	2	30 Zn	Ll	$L_{III}M_I$	0.884
14.04	2	58 Ce	$M\alpha$	$M_VN_{VI,VII}$	0.883
14.22	2	63 Eu	$M\zeta$	M_VN_{III}	0.872
14.242	5	28 Ni	L_{II}	Abs. Edge	0.8706
14.271	6	28 Ni	$L\beta_1$	$L_{II}M_{IV}$	0.8688
14.3018	1	10 Ne	K	Abs. Edge	0.866889
14.31	3	27 Co	$L\beta_{3,4}$	$L_IM_{II,III}$	0.870
14.39	5	58 Ce		$M_VO_{II,III}$	0.862
14.452	5	10 Ne	$K\beta$	KM	0.8579
14.51	5	57 La	$M\beta$	$M_{IV}N_{VI}$	0.854
14.525	5	28 Ni	L_{III}	Abs. Edge	0.8536
14.561	3	28 Ni	$L\alpha_{1,2}$	$L_{III}M_{IV,V}$	0.8515
14.610	3	10 Ne	$K\alpha_{1,2}$	$KL_{II,III}$	0.8486
14.88	5	57 La	$M\alpha$	$M_VN_{VI,VII}$	0.833
14.90	2	29 Cu	$L\eta$	$L_{II}M_I$	0.832
14.91	4	62 Sm	$M\zeta$	M_VN_{III}	0.831
15.286	9	29 Cu	Ll	$L_{III}M_I$	0.8111
15.56	1	56 Ba	M_{IV}	Abs. Edge	0.7967
15.618	5	27 Co	L_{II}	Abs. Edge	0.7938
15.65	4	26 Fe	$L\beta_{3,4}$	$L_IM_{II,III}$	0.792
15.666	8	27 Co	$L\beta_1$	$L_{II}M_{IV}$	0.7914
15.72	9	56 Ba		$M_{IV}O_{III}$	0.789
15.89	1	56 Ba	M_V	Abs. Edge	0.7801
15.91	5	56 Ba		$M_{IV}O_{II}$	0.779
15.915	5	27 Co	L_{III}	Abs. Edge	0.7790
15.93	4	52 Te	$M\gamma$	$M_{III}N_{IV,V}$	0.778
15.972	6	27 Co	$L\alpha_{1,2}$	$L_{III}M_{IV,V}$	0.7762
15.98	5	51 Sb		$M_{II}N_{IV}$	0.776
16.20	5	56 Ba		M_VO_{III}	0.765
16.27	3	28 Ni	$L\eta$	$L_{II}M_I$	0.762
16.46	4	60 Nd	$M\zeta$	M_VN_{III}	0.753
16.693	9	28 Ni	Ll	$L_{III}M_I$	0.7427
16.7	1	24 Cr	L_I	Abs. Edge	0.741
16.92	4	51 Sb	$M\gamma$	$M_{III}N_{IV,V}$	0.733
16.93	5	50 Sn		$M_{II}N_{IV}$	0.733
17.19	4	25 Mn	$L\beta_{3,4}$	$L_IM_{II,III}$	0.721
17.202	5	26 Fe	L_{II}	Abs. Edge	0.7208
17.26	1	26 Fe	$L\beta_1$	$L_{II}M_{IV}$	0.7185
17.38	4	59 Pr	$M\zeta$	M_VN_{III}	0.714
17.525	5	26 Fe	L_{III}	Abs. Edge	0.7074
17.59	2	26 Fe	$L\alpha_{1,2}$	$L_{III}M_{IV,V}$	0.7050
17.6	1	52 Te		$M_{II}N_I$	0.703
17.87	3	27 Co	$L\eta$	$L_{II}M_I$	0.694
17.94	5	50 Sn	$M\gamma$	$M_{III}N_{IV,V}$	0.691
17.9	1	24 Cr	L_{II}	Abs. Edge	0.691
18.292	8	27 Co	Ll	$L_{III}M_I$	0.6778
18.32	2	9 F	$K\alpha$	KL	0.6768
18.35	4	58 Ce	$M\zeta$	M_VN_{III}	0.676
18.8	1	51 Sb		$M_{II}N_I$	0.658
18.8	2	47 Ag		$M_IN_{II,III}$	0.658
18.96	4	24 Cr	$L\beta_{3,4}$	$L_IM_{II,III}$	0.654
19.11	2	25 Mn	$L\beta_1$	$L_{II}M_{IV}$	0.6488
19.1	1	52 Te		$M_{III}N_I$	0.648
19.40	7	48 Cd		$M_{II}N_{IV}$	0.639
19.44	5	57 La	$M\zeta$	M_VN_{III}	0.638
19.45	1	25 Mn	$L\alpha_{1,2}$	$L_{III}M_{IV,V}$	0.6374
19.66	5	53 I	$M_{IV,V}$	Abs. Edge	0.631
19.75	4	26 Fe	$L\eta$	$L_{II}M_I$	0.628
20.0	1	50 Sn		$M_{II}N_I$	0.619
20.1	2	46 Pd		$M_IN_{II,III}$	0.616
20.15	1	26 Fe	Ll	$L_{III}M_I$	0.6152
20.2	1	51 Sb		$M_{III}N_I$	0.612
20.47	7	48 Cd	$M\gamma$	$M_{III}N_{IV,V}$	0.606
20.64	4	56 Ba	$M\zeta$	M_VN_{III}	0.601
20.66	7	47 Ag		$M_{II}N_{IV}$	0.600
20.7	1	24 Cr	L_{III}	Abs. Edge	0.598
21.19	5	23 Va	$L\beta_{3,4}$	$L_IM_{II,III}$	0.585
21.27	1	24 Cr	$L\beta_1$	$L_{II}M_{IV}$	0.5828
21.34	5	52 Te		$M_{IV}O_{II,III}$	0.581
21.5	1	50 Sn		$M_{III}N_I$	0.575
21.64	3	24 Cr	$L\alpha_{1,2}$	$L_{III}M_{IV,V}$	0.5728
21.78	5	52 Te		M_VO_{III}	0.569
21.82	7	47 Ag	$M\gamma$	$M_{III}N_{IV,V}$	0.568
21.85	2	25 Mn	$L\eta$	$L_{II}M_I$	0.5675
22.1	1	46 Pd		$M_{II}N_{IV}$	0.560
22.29	1	25 Mn	Ll	$L_{III}M_I$	0.5563
22.9	2	48 Cd		$M_{II}N_I$	0.540
23.32	1	8 O	K	Abs. Edge	0.5317
23.3	1	46 Pd	$M\gamma$	$M_{III}N_{IV,V}$	0.531
23.62	3	8 O	$K\alpha$	KL	0.5249
23.88	4	23 Va	$L\beta_1$	$L_{II}M_{IV}$	0.5192
24.25	3	23 Va	$L\alpha_{1,2}$	$L_{III}M_{IV,V}$	0.5113
24.28	5	50 Sn	$M_{IV,V}$	Abs. Edge	0.511
24.30	3	24 Cr	$L\eta$	$L_{II}M_I$	0.5102
24.4	2	47 Ag		M_VN_I	0.509
24.5	1	48 Cd		$M_{III}N_I$	0.507
24.78	1	24 Cr	Ll	$L_{III}M_I$	0.5003
25.01	9	45 Rh	$M\gamma$	$M_{III}N_{IV,V}$	0.496
25.3	1	50 Sn		$M_{IV}O_{II,III}$	0.491
25.50	9	44 Ru		$M_{II}N_{IV}$	0.486
25.7	1	50 Sn		M_VO_{III}	0.483
26.0	1	47 Ag		$M_{III}N_I$	0.478
26.2	2	46 Pd		$M_{II}N_I$	0.474
26.72	9	52 Te	$M\zeta$	$M_{IV,V}N_{II,III}$	0.464
26.9	1	44 Ru	$M\gamma$	$M_{III}N_{IV,V}$	0.462
27.05	2	22 Ti	$L\beta_1$	$L_{II}M_{IV}$	0.4584
27.29	1	22 Ti	$L_{II,III}$	Abs. Edge	0.4544
27.34	3	23 Va	$L\eta$	$L_{II}M_I$	0.4535
27.42	2	22 Ti	$L\alpha_{1,2}$	$L_{III}M_{IV,V}$	0.4522
27.77	1	23 Va	Ll	$L_{III}M_I$	0.4465
27.9	1	46 Pd		$M_{III}N_I$	0.445
28.1	2	45 Rh		$M_{II}N_I$	0.442
28.13	5	48 Cd	$M_{IV,V}$	Abs. Edge	0.4408
28.88	8	51 Sb	$M\zeta$	$M_{IV,V}N_{II,III}$	0.429
29.8	1	45 Rh		$M_{III}N_I$	0.417
30.4	1	48 Cd		$M_{IV}O_{II,III}$	0.408

Wavelength Å*	p.e.	Element	Designation		keV
30.8	1	48 Cd		$M_{V}O_{III}$	0.403
30.82	5	47 Ag	M_{IV}	Abs. Edge	0.4022
30.89	3	22 Ti	$L\eta$	$L_{II}M_{I}$	0.4013
30.99	1	7 N	K	Abs. Edge	0.4000
31.02	2	21 Sc	$L\beta_1$	$L_{II}M_{IV}$	0.3996
31.14	5	47 Ag	M_{V}	Abs. Edge	0.3981
31.24	9	50 Sn	$M\zeta$	$M_{IV,V}N_{II,III}$	0.397
31.35	3	21 Sc	$L\alpha_{1,2}$	$L_{III}M_{IV,V}$	0.3954
31.36	2	22 Ti	Ll	$L_{III}M_{I}$	0.3953
31.60	4	7 N	$K\alpha$	KL	0.3924
31.8	1	92 U		$N_{IV}N_{VI}$	0.390
32.3	2	44 Ru		$M_{II}N_{I}$	0.384
33.1	2	41 Nb		$M_{II}N_{IV}$	0.375
33.5	3	47 Ag		$M_{IV,V}O_{II,III}$	0.370
33.57	9	90 Th		$N_{IV}N_{VI}$	0.3693
34.8	1	92 U		$N_{V}N_{VI,VII}$	0.357
34.9	2	41 Nb	$M\gamma$	$M_{III}N_{IV,V}$	0.356
35.13	2	21 Sc	$L\eta$	$L_{II}M_{I}$	0.3529
35.13	1	20 Ca	L_{II}	Abs. Edge	0.3529
35.3	3	42 Mo		$M_{II}N_{I}$	0.351
35.49	1	20 Ca	L_{III}	Abs. Edge	0.34931
35.59	3	21 Sc	Ll	$L_{III}M_{I}$	0.3483
35.63	1	20 Ca	$L_{II,III}$	Abs. Edge	0.34793
35.94	2	20 Ca	$L\beta_1$	$L_{II}M_{IV}$	0.3449
36.32	9	90 Th		$N_{V}N_{VI,VII}$	0.3414
36.33	2	20 Ca	$L\alpha_{1,2}$	$L_{III}M_{IV,V}$	0.3413
36.8	1	48 Cd	$M\zeta$	$M_{IV,V}N_{II,III}$	0.3371
37.4	2	46 Pd		$M_{IV,V}O_{II,III}$	0.332
37.5	2	42 Mo		$M_{III}N_{I}$	0.331
38.4	3	41 Nb		$M_{II}N_{I}$	0.323
39.77	7	47 Ag	$M\zeta$	$M_{IV,V}N_{II,III}$	0.3117
40.46	2	20 Ca	$L\eta$	$L_{II}M_{I}$	0.3064
40.7	2	41 Nb		$M_{III}N_{I}$	0.305
40.9	2	45 Rh		$M_{IV,V}O_{II,III}$	0.303
40.96	2	20 Ca	Ll	$L_{III}M_{I}$	0.3027
42.1	2	92 U		$N_{VI}O_{V}$	0.295
42.1	1	19 K	$L_{II,III}$	Abs. Edge	0.2946
42.3	2	82 Pb		$N_{IV}N_{VI}$	0.293
43.3	2	92 U		$N_{VI}O_{IV}$	0.286
43.6	1	46 Pd	$M\zeta$	$M_{IV,V}N_{II,III}$	0.2844
43.68	1	6 C	K	Abs. Edge	0.28384
44.7	3	6 C	$K\alpha$	KL	0.277
44.8	1	44 Ru		$M_{IV,V}O_{II,III}$	0.2768
45.0	1	82 Pb		$N_{V}N_{VI,VII}$	0.2756
45.2	3	80 Hg		$N_{IV}N_{VI}$	0.274
45.2	1	51 Sb		$M_{II}M_{IV}$	0.2743
46.48	9	39 Y		$M_{II}N_{I}$	0.267
46.5	2	81 Tl		$N_{V}N_{VI,VII}$	0.267
46.8	2	79 Au		$N_{IV}N_{VI}$	0.265
47.24	2	19 K	Ll	$L_{II}M_{I}$	0.2625
47.3	1	50 Sn		$M_{II}M_{IV}$	0.2621
47.67	9	45 Rh	$M\zeta$	$M_{IV,V}N_{II,III}$	0.2601
47.74	1	19 K	Ll	$L_{III}M_{I}$	0.25971
47.9	3	80 Hg		$N_{V}N_{VI,VII}$	0.259
48.1	2	78 Pt		$N_{IV}N_{VI}$	0.258
48.2	1	90 Th		$N_{VI}O_{V}$	0.2572
48.5	2	39 Y		$M_{III}N_{I}$	0.256

Wavelength Å*	p.e.	Element	Designation		keV
49.4	1	79 Au		$N_{V}N_{VI,VII}$	0.2510
49.5	1	90 Th		$N_{VI}O_{IV}$	0.2505
50.0	1	90 Th		$N_{VII}O_{V}$	0.2479
50.2	1	77 Ir		$N_{IV}N_{VI}$	0.2470
50.3	1	52 Te		$M_{III}M_{V}$	0.2465
50.9	1	78 Pt		$N_{V}N_{VI,VII}$	0.2436
51.3	1	38 Sr		$M_{II}N_{I}$	0.2416
51.9	1	76 Os		$N_{IV}N_{VI}$	0.2388
52.0	2	48 Cd		$M_{II}M_{IV}$	0.2384
52.2	1	51 Sb		$M_{III}M_{V}$	0.2375
52.34	7	44 Ru	$M\zeta$	$M_{IV,V}N_{II,III}$	0.2369
52.8	1	77 Ir		$N_{V}N_{VI,VII}$	0.2348
53.6	1	38 Sr		$M_{III}N_{I}$	0.2313
54.0	2	74 W		$N_{II}N_{IV}$	0.2295
54.0	1	47 Ag		$M_{II}M_{IV}$	0.2295
54.2	1	50 Sn		$M_{III}M_{V}$	0.2287
54.7	2	76 Os		$N_{V}N_{VI,VII}$	0.2266
54.8	2	42 Mo		$M_{IV,V}O_{II,III}$	0.2262
55.8	1	74 W		$N_{IV}N_{VI}$	0.2221
55.9	1	18 A	$L\eta$	$L_{II}M_{I}$	0.2217
56.3	1	18 A	Ll	$L_{III}M_{I}$	0.2201
56.5	1	46 Pd		$M_{II}M_{IV}$	0.2194
57.0	2	37 Rb		$M_{II}N_{I}$	0.2174
58.2	1	73 Ta		$N_{IV}N_{VI}$	0.2130
58.4	1	74 W		$N_{V}N_{VII}$	0.2122
58.7	2	48 Cd		$M_{III}M_{V}$	0.2111
59.3	1	45 Rh		$M_{II}M_{IV}$	0.2090
59.5	3	74 W		$N_{V}N_{VI}$	0.208
59.5	2	37 Rb		$M_{III}N_{I}$	0.2083
60.5	1	47 Ag		$M_{III}M_{V}$	0.2048
61.1	2	73 Ta		$N_{V}N_{VI,VII}$	0.2028
61.9	2	41 Nb		$M_{IV,V}O_{II,III}$	0.2002
62.2	1	44 Ru		$M_{II}M_{IV}$	0.1992
62.9	1	46 Pd		$M_{III}M_{V}$	0.1970
63.0	5	71 Lu		$N_{IV}N_{VI}$	0.197
64.38	7	42 Mo	$M\zeta$	$M_{IV,V}N_{II,III}$	0.1926
65.1	7	70 Yb		$N_{IV}N_{VI}$	0.190
65.5	1	45 Rh		$M_{III}M_{V}$	0.1892
65.7	2	71 Lu		$N_{V}N_{VI,VII}$	0.1886
67.33	9	17 Cl	$L\eta$	$L_{II}M_{I}$	0.1841
67.6	3	5 B	$K\alpha$	KL	0.1833
67.90	9	17 Cl	Ll	$L_{III}M_{I}$	0.1826
68.2	3	90 Th		$O_{III}P_{IV,V}$	0.1817
68.3	1	44 Ru		$M_{III}M_{V}$	0.1814
68.9	2	42 Mo		$M_{II}M_{IV}$	0.1798
69.3	5	70 Yb		$N_{V}N_{VI,VII}$	0.179
70.0	4	40 Zr		$M_{IV,V}O_{II,III}$	0.177
72.1	3	41 Nb		$M_{II}M_{IV}$	0.1718
72.19	9	41 Nb	$M\zeta$	$M_{IV,V}N_{II,III}$	0.1717
72.7	9	68 Er		$N_{IV}N_{VI}$	0.171
74.9	1	42 Mo		$M_{III}M_{V}$	0.1656
76.3	7	68 Er		$N_{V}N_{VI,VII}$	0.163
76.7	2	40 Zr		$M_{II}M_{IV}$	0.1617
76.9	2	35 Br		$M_{II}N_{I}$	0.1613
78.4	2	41 Nb		$M_{III}M_{V}$	0.1582
79.8	3	35 Br		$M_{III}N_{I}$	0.1554
80.9	3	40 Zr		$M_{III}M_{V}$	0.1533

Wavelength Å*	p.e.	Element	Designation		keV
81.5	2	39 Y		$M_{II}M_{IV}$	0.1522
82.1	2	40 Zr	$M\zeta$	$M_{IV,V}N_{II,III}$	0.1511
83.	1	66 Dy		$N_{IV,V}N_{VI,VII}$	0.149
83.4	3	16 S	Ll, η	$L_{II,III}M_I$	0.1487
85.7	2	38 Sr		$M_{II}M_{IV}$	0.1447
86.	1	65 Tb		$N_{IV,V}N_{VI,VII}$	0.144
86.5	2	39 Y		$M_{III}M_{IV,V}$	0.1434
91.4	2	38 Sr		$M_{III}M_{IV,V}$	0.1357
91.5	2	37 Rb		$M_{II}M_{IV}$	0.1355
91.6	1	83 Bi		$N_{VI}O_{IV}$	0.1354
93.2	1	83 Bi		$N_{VII}O_V$	0.1330
93.4	2	39 Y	$M\zeta$	$M_{IV,V}N_{II,III}$	0.1328
94.	1	15 P	$L_{II,III}$	Abs. Edge	0.132
96.7	2	37 Rb		$M_{III}M_{IV,V}$	0.1282
97.2	8	66 Dy		$N_{IV,V}O_{II,III}$	0.128
98.	1	62 Sm		$N_{IV,V}N_{VI,VII}$	0.126
100.2	2	82 Pb		$N_{VI}O_V$	0.1237
102.2	4	65 Tb		$N_{IV,V}O_{II,III}$	0.1213
102.4	1	82 Pb		$N_{VI}O_{IV}$	0.1211
103.8	4	15 P		$L_{II,III}M$	0.1194
104.3	1	82 Pb		$N_{VII}O_V$	0.1189
107.	1	60 Nd		$N_{IV,V}N_{VI,VII}$	0.116
108.0	2	38 Sr	$M\zeta_2$	$M_{IV}N_{II,III}$	0.1148
108.7	1	38 Sr	$M\zeta_1$	M_VN_{III}	0.1140
109.4	3	35 Br		$M_{II}M_{IV}$	0.1133
110.6	5	29 Cu	M_I	Abs. Edge	0.1121
111.	1	4 Be	K	Abs. Edge	0.111
112.0	6	63 Eu		$N_{IV,V}O_{II,III}$	0.1107
113.0	1	81 Tl		$N_{VI}O_V$	0.10968
113.	1	59 Pr		$N_{IV,V}N_{VI,VII}$	0.1095
113.8	3	35 Br		$M_{III}M_{IV,V}$	0.1089
114.	1	4 Be	$K\alpha$	KL	0.1085
115.3	2	81 Tl		$N_{VI}O_{IV}$	0.1075
117.4	4	62 Sm		$N_{IV,V}O_{II,III}$	0.1056
117.7	1	81 Tl		$N_{VII}O_V$	0.10530
123.	1	14 Si	$L_{II,III}$	Abs. Edge	0.1006
126.8	2	37 Rb		$M_{IV}N_{III}$	0.0978
127.8	2	37 Rb	$M\zeta_2$	$M_{IV}N_{II}$	0.0970
128.7	2	37 Rb	$M\zeta_1$	M_VN_{III}	0.0964
128.9	7	60 Nd		$N_{IV,V}O_{II,III}$	0.0962
135.5	4	14 Si		$L_{II,III}M$	0.0915
136.5	4	59 Pr		$N_{IV,V}O_{II,III}$	0.0908
137.0	5	30 Zn	M_{II}	Abs. Edge	0.0905
142.5	1	13 Al	L_I	Abs. Edge	0.08701
143.9	5	30 Zn	M_{III}	Abs. Edge	0.0862
144.4	6	58 Ce		$N_{IV,V}O_{II,III}$	0.0859
144.4	3	37 Rb		M_IM_{III}	0.0859
152.6	6	57 La		$N_{IV,V}O_{II,III}$	0.0812

Wavelength Å*	p.e.	Element	Designation		keV
157.	3	30 Zn		$M_{II,III}M_{IV,V}$	0.079
159.0	2	56 Ba		$N_{IV}O_{III}$	0.07796
159.5	5	29 Cu	M_{II}	Abs. Edge	0.0777
163.3	2	56 Ba		$N_{IV}O_{II}$	0.07590
164.6	2	56 Ba		N_VO_{III}	0.07530
164.7	3	35 Br		M_IM_{III}	0.0753
166.0	5	29 Cu	M_{III}	Abs. Edge	0.0747
170.4	1	13 Al	$L_{II,III}$	Abs. Edge	0.07278
171.4	5	13 Al		$L_{II,III}M$	0.0724
173.	3	29 Cu		$M_{II,III}M_{IV,V}$	0.072
181.	5	90 Th		$O_{IV,V}Q_{II,III}$	0.068
183.8	1	55 Cs		$N_{IV}O_{III}$	0.06746
184.6	3	35 Br		M_IM_{II}	0.0672
188.4	1	28 Ni	M_{III}	Abs. Edge	0.06581
188.6	1	55 Cs		$N_{IV}O_{II}$	0.06574
189.5	3	35 Br		$M_{IV}N_{III}$	0.0654
190.3	1	55 Cs		N_VO_{III}	0.06515
190.	2	28 Ni		$M_{II,III}M_{IV,V}$	0.0651
191.1	2	35 Br	$M\zeta_2$	$M_{IV}N_{II}$	0.06488
192.6	2	35 Br	$M\zeta_1$	M_VN_{III}	0.06437
197.3	1	12 Mg	L_I	Abs. Edge	0.06284
202.	5	27 Co	$M_{II,III}$	Abs. Edge	0.061
203.	1	16 S		$L_IL_{II,III}$	0.061
214.	6	27 Co		$M_{II,III}M_{IV,V}$	0.058
224.	1	53 I	$N_{IV,V}$	Abs. Edge	0.0552
226.5	1	3 Li	K	Abs. Edge	0.05475
227.8	1	34 Se	M_V	Abs. Edge	0.05443
228.	1	3 Li	$K\alpha$	KL	0.0543
230.	2	34 Se		M_VN_{III}	0.0538
230.	1	26 Fe	$M_{II,III}$	Abs. Edge	0.0538
243.	5	26 Fe		$M_{II,III}M_{IV,V}$	0.051
249.3	1	12 Mg	L_{II}	Abs. Edge	0.04973
250.7	1	12 Mg	L_{III}	Abs. Edge	0.04945
251.5	5	12 Mg		$L_{II,III}M$	0.04929
273.	6	25 Mn		$M_{II,III}M_{IV,V}$	0.045
290.	1	13 Al		$L_IL_{II,III}$	0.0428
309.	9	24 Cr		$M_{II,III}M_{IV,V}$	0.040
317.	1	12 Mg		$L_IL_{II,III}$	0.0392
337.	9	23 V		$M_{II,III}M_{IV,V}$	0.0368
376.	1	11 Na		$L_IL_{II,III}$	0.03299
399.	5	35 Br	N_I	Abs. Edge	0.0311
405.	5	11 Na	$L_{II,III}$	Abs. Edge	0.0306
407.1	5	11 Na		$L_{II,III}M$	0.03045
417.	5	17 Cl	M_I	Abs. Edge	0.0297
444.	5	53 I	O_I	Abs. Edge	0.0279
525.	9	20 Ca		$M_{II,III}N_I$	0.0236
692.	9	19 K		$M_{II,III}N_I$	0.0179

W $K\alpha_1$=0.2090100 Å*) and the probable errors in the third column, which apply to the last listed figure, are based on the error in the wavelength relative to the W $K\alpha_1$ line. The probable error on an absolute scale (angstroms) can be easily calculated by converting the listed error into parts per million and adding statistically an error of five ppm which is due to the uncertainty in the wavelength of the primary W $K\alpha_1$ standard. In more than 98% of the listed wavelengths, the errors shown in the third column are so large that the added error due to the primary standard is insignificant. The energy of the lines in keV ($V\lambda$= 12398.10± 0.13 eV — Å*) are shown in column four. This probable error includes that of the primary wavelength standard, and hence this ten ppm error combined with that in the last figure in the wavelength values yields the absolute probable errors in the keV energy values. The values for a second element are likewise shown in columns five, six, and seven. Data for other elements follow in a similar format.

In the study of the x-ray literature, the wavelengths of a number of lines were noted which appeared inconsistent with the remaining data. A Moseley-type diagram was constructed, and if the value was clearly outside estimated probable error, it was assumed that an experimental or typographical error had occurred, and the interpolated value was listed in the table. Such cases are marked with a dagger† as a superscript to the wavelength. For elements of atomic number 85 through 89 and 91, there are no measured lines of the *K* series and very few of other series except for 88 radium and 91 protactinium. Likewise there are very few measurements for 43 technetium and 54 xenon. In these cases, interpolated values are listed for the more prominent lines and marked with a dagger †. More recent measurements[46] of the *L* lines of 61 samarium have been brought to our attention. Since these appear to be substantially more accurate than all the *L* data previously used for samarium[12], they are listed in Tables V and VI (corrected to Å* units) in place of the former values. A few misprints and incorrect line designations, discussed in the appendices of Ref. 12 of the succeeding paper, have been corrected in Tables V and VI.

For the convenience of those interested in x-ray chemical analysis and nuclear conversion problems, the x-ray wavelengths of both the emission lines and absorption edges are listed in numerical order in Table VI. The wavelengths are given in Å* units, together with their energy equivalents in keV. The probable error applies to the last wavelength figure. The interpolated lines and edges have not been marked by a dagger † in this table.

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ACKNOWLEDGMENTS

The author is deeply indebted to colleagues and former students who have contributed much to the development of the x-ray techniques which made possible the measurements on which this review is primarily based. The assistance of Dr. J. S. Thomsen, Dr. A. F. Burr, Dr. F. N. Huffman, F. Y. Yap, Albert Henins, and G. D. Mathews in the preparation of the original detailed report is greatly appreciated. The suggestions of Dr. Alan J. Bearden have been most helpful in the preparation of the review. The support of the U. S. Atomic Energy Commission, Division of Metallurgy and Materials made possible the redevelopment of the x-ray program and facilities at The Johns Hopkins University which supplied the new x-ray data on which the above review is based. Since 1965 the financial aid of the National Science Foundation and the National Bureau of Standards (Office of Standard Reference Data) has made possible the continuation of our work.

Reevaluation of X-Ray Atomic Energy Levels

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All of the x-ray emission wavelengths have recently been reevaluated and placed on a consistent Å* scale. For most elements these data give a highly overdetermined set of equations for energy level differences, which have been solved by least-squares adjustment for each case. This procedure makes "best" use of all x-ray wavelength data, and also permits calculation of the probable error for each energy difference. Photoelectron measurements of absolute energy levels are more precise than x-ray absorption edge data. These have been used to establish the absolute scale for eighty-one elements and, in many cases, to provide additional energy level difference data. The x-ray absorption wavelengths were used for eight elements and ionization measurements for two; the remaining five were interpolated by a Moseley diagram involving the output values of energy levels from adjacent elements. Probable errors are listed on an absolute energy basis. In the original source of the present data, a table of energy levels in Rydberg units is given. Difference tables in volts, Rydbergs, and milli-Å* wavelength units, with the respective probable errors, are also included there.

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INTRODUCTION

Manne Siegbahn[1,2] developed the first extensive evaluation of atomic energy levels from x-ray absorption edges and emission lines. The energy of the well-defined L_{III} absorption edge was chosen as the fundamental reference level for most of the periodic system; K edges were used for the lower atomic numbers. Other levels of each element were determined from the wavelengths of the emission lines as suggested by Idei.[3]

As improved x-ray data have become available, several reviews have appeared.[4–9] Different energy units have been used to facilitate use by special groups. Cauchois[6,7] improved the consistency of the rare-earth evaluations by a series of controlled absorption measurements. Theoretical calculations of many parameters often require ionization energies. Slater[9] has calculated these for all atomic numbers less than 42. For the outer electrons he used optical data, for the inner electrons, x-ray data.

Magnetic spectrometer[10] measurements of the kinetic energy of photoelectrons released by irradiation with x rays of known wavelength furnish a method for direct measurement of energy levels. Recently Kai Siegbahn[11] and co-workers have used a high-precision iron-free spectrometer to determine energy levels directly from x-ray photoelectron measurements. For elements where photoelectron values are not available and x-ray absorption edge values existed, the latter are used to help complete the table; in other instances, interpolated or extrapolated values are listed. All values are given to the nearest eV.

X-ray emission wavelengths provide accurate data for evaluating the atomic energy levels on a relative scale,[3] but only recently[12] has full advantage been taken of all the information available. The number of available lines is usually considerably greater than the number of energy levels involved. For such problems, which yield an overdetermined set of linear equations, the method of least squares furnishes a convenient and consistent means of obtaining "best" values and also probable errors for each of the values. Recently reevaluated wavelengths[13] of the x-ray emission lines provide most of the input data. In place of the x-ray absorption edge values, previously used to establish the absolute scale, photoelectron measurements are substituted, wherever available.

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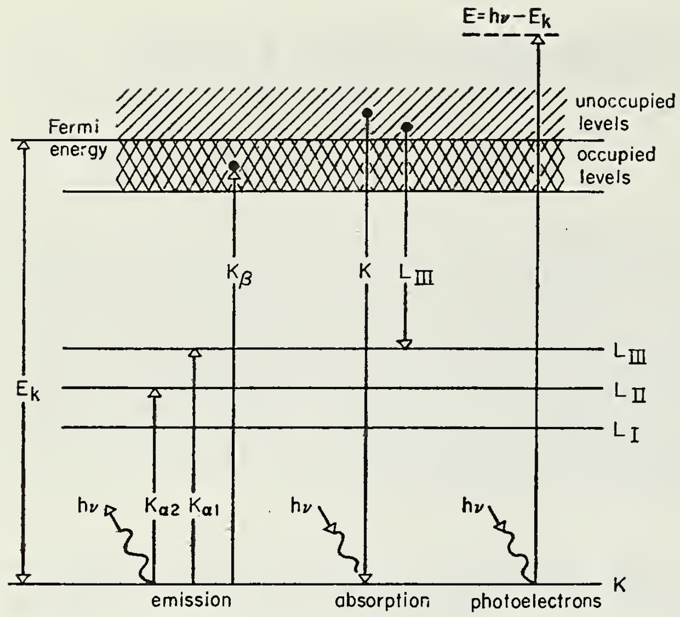

FIG. 1. Schematic of the principles involved in evaluating atomic energy levels.

METHODS OF EVALUATING ENERGY LEVELS

The principles involved in evaluating atomic energy levels are shown schematically in Fig. 1. The energy of a $K\alpha_1$ emission photon is just the difference between the K and L_{III} levels; similarly the $K\alpha_2$ corresponds to that difference between K and L_{II}. Usually the energy difference between a pair of levels can be obtained in two or more ways. For example, the difference between L_{II} and L_{III} can be evaluated from $K\alpha_1 - K\alpha_2$ (expressed in energy units). Alternatively it can be found from $L\beta_1 - L\alpha_2$, which represent the $L_{II}M_{IV}$ and $L_{III}M_{IV}$ transitions, respectively (omitted from Fig. 1 in the interest of simplicity). In the case of thorium, ninety-nine equations (including sixteen photoelectron measurements as discussed below) can be set up with only twenty-five unknown levels. A least-squares solution of this set yields the desired energy levels.

In order to determine these values on an absolute scale, the energy required to raise an electron from at least one energy state to the Fermi level energy (zero) must be included among the input data. In the center of Fig. 1 a K and an L_{III} absorption edge are indicated; experimental measurements of these edges give (approximately) the energy difference between the Fermi level and the K and L_{III} states, respectively. The theoretical corrections that must be made to these values for fine structure effects in the edges (due to differing transition probabilities and other causes) constitutes the principal uncertainty[8,14] in the use of present x-ray absorption edge measurements.

The photoelectron method measures the energy of various states relative to the Fermi level. In this case the incident photon (usually originating from an x-ray spectral line) has an energy $h\nu$, normally much larger than that of the energy level under study. If, for example, the photoelectron comes from the K level, it emerges with an energy $(h\nu - E_K)$. To determine the exact kinetic energy, a work function correction is required. This is more amenable to analysis[15] than the corrections to x-ray absorption measurements. This fact constitutes a major advantage of this method. This procedure is discussed in a later section.

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EXPERIMENTAL MEASUREMENTS

X-Ray Measurements of Wavelengths and Absorption Edges

The principles of precise measurement of x-ray wavelengths have been summarized in the foregoing paper.[13] Absorption edge wavelength measurements require the same techniques, but are subject to additional complications. The thickness[14,16] of the absorber can displace the observed edge and, of course, the chemical state of the absorber is important. However, in spite of the uncertainty in the correction for fine-structure effects and difficulties of precise x-ray measurements, a number of the results are in excellent agreement with the photoelectron values. Thus it appears that with sufficient care the x-ray absorption measurements could be made competitive with the photoelectron method.

X-Ray Photoelectron Measurements

The precision β-ray spectrograph developed by Kai Siegbahn[17] and his collaborators at Uppsala provides an instrument of high accuracy for the measurement of photoelectron energies. The precision of these measurements is approximately one hundred times that of the older magnetic spectrometer values[10]; for some elements they are an order of magnitude better than existing x-ray ones.

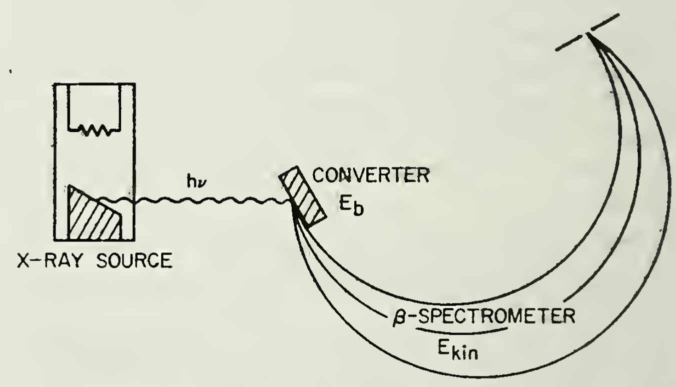

FIG. 2. Schematic of the use of a β-ray spectrometer for determining energy levels.

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The use of a β-ray spectrometer for determining energy levels is shown schematically in Fig. 2. X rays strike the material under study (the converter) and release photoelectrons, whose kinetic energy is measured by the spectrometer. In its simplest form Einstein's photoelectric law states that $E_{pe}=h\nu-E_B$, where E_{pe} is the kinetic energy of the photoelectron, $h\nu$ that of the incident photon, and E_B the binding energy of the electron.

However, the measured photoelectron energy is decreased by the work function of the converter, ϕ. Since the converter and the slit are electrically connected, their Fermi levels are identical. Thus, if ϕ_s is the work function of the spectrometer slit system, there is an increase in kinetic energy, $\phi-\phi_s$, due to contact potential. With these corrections, the photoelectric equation becomes

$$E_{pe}=h\nu-E_B-\phi+(\phi-\phi_s)=h\nu-E_B-\phi_s.$$

Hence the net correction involves only the work function of the slits (oxidized Cu) and is independent of the work function of the converter.

In general, intense K lines were used to produce photoelectrons. Each x-ray line ejects photoelectrons from all levels whose energies are less than $h\nu-\phi$ in absolute value (e.g., photons energetic enough to remove K electrons also eject these from L_{I}, L_{II}, L_{III}, and other levels). The observed β-ray spectrum is composed of a number of lines due to the multiplicity in both the primary x-ray wavelengths and the energy levels of the converter. The resolution of the spectrometer was sufficient to exclude the influence of the α_2 lines on α_1 measurements.[11] Likewise the electrons undergoing discrete energy losses did not displace the observed spectra to lower energies.

Calculation of the electron energy in terms of the observed current in the magnetic coils of the spectrometer requires an involved procedure which has been discussed in several papers and recently reviewed, in detail, by Kai Siegbahn.[17] This treatise should be consulted for theory, procedures, and resulting reference standards, which are used for all subsequent measurements.

Hagström and Karlsson[18] showed that the method is not limited to conductors or even semiconductors. They found that, if the sample under study was insulated with thin mylar from the aluminum backing plate, (which was electrically connected to the spectrometer slit), the intense ionization due to the direct x-ray beam kept the potential of the insulating sample constant. Hence, even in this case, the observed binding energies were still measured with respect to the zero or Fermi energy. Thus insulating compounds could be attached in thin layers directly to the aluminum backing plate and their level energies measured in this manner.

[18] S. Hagström and S.-E. Karlsson, Arkiv Fysik **26**, 451 (1964); and S. Hagström, Z. Physik **178**, 82 (1964).

INPUT DATA USED IN EVALUATING ENERGY LEVEL VALUES

A separate least-squares evaluation was carried out on each element for which an overdetermined set of data was available. Wavelengths and probable errors of emission lines (all expressed in eV units) are taken from the previous paper.[13] If photoelectron measurements are available for two or more levels, they are included in the least-squares adjustment for that element. If only a single level is determined by the photoelectron method, this establishes one energy level; the others are found from energy differences obtained by a least-squares adjustment of the emission line data.

Wavelength measurements[13] of critical absorption edges are used to establish the absolute scale for eight elements for which no photoelectron measurements are available. In a few cases, where neither photoelectron nor x-ray measurements exist, a Moseley diagram of the final output values of adjacent elements is used to establish one level of the element. The remaining levels are then calculated with emission lines as above. If two or more absorption wavelengths are available for an element, these are also treated by the least-squares method.

The values of the x-ray photoelectron measurements used are listed in brackets in Table I, together with references to the original publications. The published values have been adjusted slightly to make them consistent with the new x-ray emission wavelengths[13] and more recent values of the atomic constants.[19] In the original data most of the errors are 2σ values; these have been changed to probable errors as shown in Table I. For comparison, all the more accurately measured x-ray absorption wavelengths (converted to eV by the factor 12398.1 Å*−eV) are listed in parentheses in Table I. The x-ray absorption data are used for establishing the absolute energy level scale in only eight elements; the other listed values are for comparison only.

EVALUATION OF THE ATOMIC ENERGY LEVELS

Since nearly all elements involve many emission line measurements interconnecting a lesser number of energy levels, an overdetermined set of equations results. As indicated above, a least-squares adjustment provides an appropriate way of solving this set of equations in order to obtain maximum information from the available data. Justification for this procedure and derivations of the equations involved have been presented in many sources.[20–22] A clear explanation of

[19] E. R. Cohen and J. W. M. DuMond, Rev. Mod. Phys. **37**, 537 (1965).

[20] E. Whittaker and G. Robinson, *The Calculus of Observations* (New York, 1944), 4th ed., Chap. 9.

[21] I. F. Sokolnikoff and R. M. Radheffer, *Mathematics of Physics and Modern Engineering* (McGraw-Hill Book Co., Inc., New York, 1958), Chap. IX, Sec. 11.

[22] E. R. Cohen, Rev. Mod. Phys. **25**, 709 (1953).

Table I. Recommended values of the atomic energy levels, and probable errors in eV. Where available, photoelectron direct measurements are listed in brackets [ ] immediately under the recommended values. The measured values of the x-ray absorption energies (from Ref. 13) are shown in parentheses ( ). Interpolated values are enclosed in angle brackets ⟨ ⟩.

Level	1 H	2 He	3 Li	4 Be	5 B	6 C	7 N	8 O
K	13.59811[a]	24.58678[b]	54.75±0.02 (54.75)	111.0±1.0 (111.0)	188.0±0.4 [188.0][c]	283.8±0.4 [283.8][c] (283.8)	401.6±0.4 [401.6][c]	532.0±0.4 [532.0][c]
L_{I}								23.7±0.4 [23.7][d]
$L_{II,III}$					4.7±0.9	6.4±1.9	9.2±0.6	7.1±0.8

Level	9 F	10 Ne	11 Na	12 Mg	13 Al	14 Si	15 P	16 S
K	685.4±0.4 [685.4][c]	866.9±0.3 (866.9)	1072.1±0.4 [1072.1][c] (1072.)	1305.0±0.4 [1305.0][c] (1303.)	1559.6±0.4 [1559.6][c] (1559.8)	1838.9±0.4 [1838.9][c]	2145.5±0.4 [2145.5][d]	2472.0±0.4 [2472.0][c] (2470.)
L_{I}	⟨31.⟩	⟨45.⟩	63.3±0.4 [63.3][d]	89.4±0.4 [89.4][d] (63.)	117.7±0.4 [117.7][d] (87.)	148.7±0.4 [148.7][d]	189.3±0.4 [189.3][d]	229.2±0.4 [229.2][d]
$L_{II,III}$	8.6±0.8	18.3±0.4	31.1±0.4 (31.)	51.4±0.5 (50.)	73.1±0.5 (72.8)	99.2±0.5 (100.6)	132.2±0.5 (132.)	164.8±0.7

Level	17 Cl	18 Ar	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr
K	2822.4±0.3 [2822.4][c] (2020.)	3202.9±0.3 (3202.9)	3607.4±0.4 [3607.4][c] (3607.8)	4038.1±0.4 [4038.1][c] (4038.1)	4492.8±0.4 [4492.8][c]	4966.4±0.4 [4966.4][d] (4964.5)	5465.1±0.3 [5465.1][c] (5464.)	5989.2±0.3 [5989.2][c] (5989.)
L_{I}	270.2±0.4 [270.2][d]	320. ⟨320.⟩[d]	377.1±0.4 [377.1][d]	437.8±0.4 [437.8][d]	500.4±0.4 [500.4][d]	563.7±0.4 [563.7][d]	628.2±0.4 [628.2][d]	694.6±0.4 [694.6][d]
L_{II}	201.6±0.3	247.3±0.3	296.3±0.4	350.0±0.4	406.7±0 4	461.5±0.4	520.5±0.3	583.7±0.3
L_{III}	200.0±0.3	245.2±0.3	293.6±0.4	346.4±0.4	402.2±0.4	455.5±0.4	512.9±0.3	574.5±0.3
M_{I}	17.5±0.4	25.3±0.4	33.9±0.4	43.7±0.4	53.8±0.4	60.3±0.4	66.5±0.4	74.1±0.4
$M_{II,III}$	6.8±0.4	12.4±0.3	17.8±0.4	25.4±0.4	32.3±0.5	34.6±0.4	37.8±0.3	42.5±0.3
$M_{IV,V}$					6.6±0.5	3.7	2.2±0.3	2.3±0.4

Table I (*Continued*)

	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge
K	6539.0±0.4 [6539.0][e] (6538.)	7112.0±0.9 [7111.3][e,f] (7111.2)	7708.9±0.3 [7708.9][e] (7709.5)	8332.8±0.4 [8332.8][e] (8331.6)	8978.9±0.4 [8978.9][e,g] (8980.3)	9658.6±0.6 [9658.6][g] (9660.7)	10367.1±0.5 [10367.1][g] (10368.2)	11103.1±0.7 [11103.8][g] (11103.6)
L_I	769.0±0.4 [769.0][d]	846.1±0.4 [846.1][d]	925.6±0.4 [925.6][d]	1008.1±0.4 [1008.1][d]	1096.1±0.4 [1096.0][d]	1193.6±0.9	1297.7±1.1	1414.3±0.7 [1413.6][g]
L_{II}	651.4±0.4	721.1±0.9 (720.8)	793.6±0.3 (793.8)	871.9±0.4 (870.6)	951.0±0.4 [950.0][h] (953.)	1042.8±0.6 (1045.)	1142.3±0.5	1247.8±0.7 (1249.)
L_{III}	640.3±0.4	708.1±0.9 (707.4)	778.6±0.3 (779.0)	854.7±0.4 (853.6)	931.1±0.4 [931.4][h] (933.)	1019.7±0.6 (1022.)	1115.4±0.5 (1117.)	1216.7±0.7 (1217.0)
M_I	83.9±0.5	92.9±0.9	100.7±0.4	111.8±0.6	119.8±0.6	135.9±1.1	158.1±0.5	180.0±0.8
M_{II}							106.8±0.7	127.9±0.9
M_{II}, M_{III}	48.6±0.4	54.0±0.9 (54.)	59.5±0.3 (61.)	68.1±0.4 (66.)	73.6±0.4 (75.)	86.6±0.6 (86.)		
M_{III}							102.9±0.5	120.8±0.7
$M_{IV,V}$	3.3±0.5	3.6±0.9	2.9±0.3	3.6±0.4	1.6±0.4	8.1±0.6	17.4±0.5	28.7±0.7

	33 As	34 Se	35 Br	36 Kr	37 Rb	38 Sr	39 Y	40 Zr
K	11866.7±0.7 [11866.7][i] (11865.)	12657.8±0.7 [12657.8][g] (12654.5)	13473.7±0.4 (13470.)	14325.6±0.8 (14324.4)	15199.7±0.3 (15202.)	16104.6±0.3 (16107.)	17038.4±0.3 (17038.)	17997.6±0.4 (17999.)
L_I	1526.5±0.8 (1529.)	1653.9±3.5 (1652.5)	1782.0±0.4 [1782.0][j]	1921.0±0.6 [1921.2][k]	2065.1±0.3 [2065.4][j]	2216.3±0.3 [2216.2][l]	2372.5±0.3 [2372.7][l]	2531.6±0.3 [2531.6][l]
L_{II}	1358.6±0.7 (1358.7)	1476.2±0.7 (1474.7)	1596.0±0.4 [1596.2][j]	1727.2±0.5 [1727.2][k] (1730.)	1863.9±0.3 [1863.4][j]	2006.8±0.3 [2006.6][l] (2008.5)	2155.5±0.3 [2155.0][l] (2154.0)	2306.7±0.3 [2306.5][l] (2305.3)
L_{III}	1323.1±0.7 (1323.5)	1435.8±0.7 (1434.0)	1549.9±0.4 [1549.7][j]	1674.9±0.5 [1674.8][k] (1677.)	1804.4±0.3 [1804.6][j]	1939.6±0.3 [1939.9][l] (1941.)	2080.0±0.3 [2080.2][l] (2079.4)	2222.3±0.3 [2222.5][l] (2222.5)
M_I	203.5±0.7	231.5±0.7	256.5±0.4		322.1±0.3	357.5±0.3	393.6±0.3	430.3±0.3
M_{II}	146.4±1.2	168.2±1.3	189.3±0.4	222.7±1.1	247.4±0.3	279.8±0.3	312.4±0.4	344.2±0.4

TABLE I (*Continued*)

	33 As	34 Se	35 Br	36 Kr	37 Rb	38 Sr	39 Y	40 Zr
M_{III}	140.5±0.8	161.9±1.0	181.5±0.4	213.8±1.1	238.5±0.3	269.1±0.3	300.3±0.4	330.5±0.4
M_{IV}			70.1±0.4		111.8±0.3	135.0±0.3	159.6±0.3	182.4±0.3
M_{IV}, M_V	41.2±0.7	56.7±0.8		88.9±0.8				
M_V			69.0±0.4		110.3±0.3	133.1±0.3	157.4±0.3	180.0±0.3
N_I			27.3±0.5	24.0±0.8	29.3±0.3	37.7±0.3	45.4±0.3	51.3±0.3
N_{II}			5.2±0.4		14.8±0.4			
N_{II}, N_{III}	2.5±1.0	5.6±1.3		10.6±1.9		19.9±0.3	25.6±0.4	28.7±0.4
N_{III}			4.6±0.4		14.0±0.3			

	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd
K	18985.6±0.4 (18987.)	19999.5±0.3 (20004.)	21044.0±0.7	22117.2±0.3 (22119.)	23219.9±0.3 (23219.8)	24350.3±0.3 (24348.)	25514.0±0.3 (25516.)	26711.2±0.3 (26716.)
L_I	2697.7±0.3 [2697.7][l]	2865.5±0.3 [2866.0][l]	3042.5±0.4 [3042.5][l]	3224.0±0.3 [3224.3][l]	3411.9±0.3 [3412.0][l] (3417.)	3604.3±0.3 [3604.6][l] (3607.)	3805.8±0.3 [3806.2][m] (3807.)	4018.0±0.3 [4018.1][m] (4019.)
L_{II}	2464.7±0.3 [2464.7][l]	2625.1±0.3 [2624.5][l] (2627.)	2793.2±0.4 [2973.2][l]	2966.9±0.3 [2966.8][l] (2966.3)	3146.1±0.3 [3146.3][l] (3145.)	3330.3±0.3 [3330.3][l] (3330.3)	3523.7±0.3 [3523.6][g,m] (3526.)	3727.0±0.3 [3727.1][m] (3728.)
L_{III}	2370.5±0.3 [2370.6][l]	2520.2±0.3 [2520.2][l] (2523.2)	2676.9±0.4 [2676.9][l]	2837.9±0.3 [2837.7][l] (2837.7)	3003.8±0.3 [3003.5][g,l] (3002.)	3173.3±0.3 [3173.0][g,l] (3173.0)	3351.1±0.3 [3350.8][g] (3351.0)	3537.5±0.3 [3537.3][g] (3537.6)
M_I	468.4±0.3	504.6±0.3		585.0±0.3	627.1±0.3	669.9±0.3	717.5±0.3	770.2±0.3
M_{II}	378.4±0.4	409.7±0.4	444.9±1.5	482.8±0.3	521.0±0.3	559.1±0.3	602.4±0.3	650.7±0.3
M_{III}	363.0±0.4	392.3±0.3	425.0±1.5	460.6±0.3	496.2±0.3	531.5±0.3	571.4±0.3	616.5±0.3
M_{IV}	207.4±0.3	230.3±0.3	256.4±0.5	283.6±0.3	311.7±0.3	340.0±0.3	372.8±0.3	410.5±0.3
M_V	204.6±0.3	227.0±0.3	252.9±0.4	279.4±0.3	307.0±0.3	334.7±0.3	366.7±0.3	403.7±0.3
N_I	58.1±0.3	61.8±0.3		74.9±0.3	81.0±0.3	86.4±0.3	95.2±0.3	107.6±0.3
N_{II}							62.6±0.3	
N_{II}, N_{III}	33.9±0.4	34.8±0.4	38.9±1.9	43.1±0.4	47.9±0.4	51.1±0.4		66.9±0.4
N_{III}							55.9±0.3	
$N_{IV,V}$	3.2±0.3	1.8±0.3		2.0±0.3	2.5±0.4	1.5±0.3	3.3±0.3	9.3±0.3

Table I (*Continued*)

	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe	55 Cs	56 Ba
K	27939.9±0.3	29200.1±0.4 (29195.)	30491.2±0.3 (30486.)	31813.8±0.3 (31811.)	33169.4±0.4 (33167.)	34561.4±1.1 (34590.)	35984.6±0.4 (35987.)	37440.6±0.4 (37452.)
L_I	4237.5±0.3 [4237.7][m] (4237.3)	4464.7±0.3 [4464.5][g] (4464.8)	4698.3±0.3 [4698.3][m] (4698.4)	4939.2±0.3 [4939.3][m] (4939.7)	5188.1±0.3 [5188.1][j]	5452.8±0.4 (5452.8)	5714.3±0.4 [5712.7][j] (5721.)	5988.8±0.4 [5986.8][j] (5996.)
L_{II}	3938.0±0.3 [3937.8][m] (3939.3)	4156.1±0.3 [4156.2][g] (4157.)	4380.4±0.3 [4380.6][m] (4382.)	4612.0±0.3 [4612.0][m] (4612.6)	4852.1±0.3 [4852.0][j]	5103.7±0.4 (5103.7)	5359.4±0.3 [5359.5][j] (5358.)	5623.6±0.3 [5623.6][j] (5623.3)
L_{III}	3730.1±0.3 [3730.0][g] (3730.2)	3928.8±0.3 [3928.8][g] (3928.8)	4132.2±0.3 [4132.2][g] (4132.3)	4341.4±0.3 [4341.2][g] (4341.8)	4557.1±0.3 [4557.1][j]	4782.2±0.4 (4782.2)	5011.9±0.3 [5012.0][j] (5011.3)	5247.0±0.3 [5247.3][j] (5247.0)
M_I	825.6±0.3	883.8±0.3	943.7±0.3	1006.0±0.3	1072.1±0.3		1217.1±0.4	1292.8±0.4
M_{II}	702.2±0.3	756.4±0.4	811.9±0.3	869.7±0.3	930.5±0.3	999.0±2.1	1065.0±0.5	1136.7±0.5
M_{III}	664.3±0.3	714.4±0.3	765.6±0.3	818.7±0.3	874.6±0.3	937.0±2.1	997.6±0.5	1062.2±0.5
M_{IV}	450.8±0.3	493.3±0.3	536.9±0.3	582.5±0.3	631.3±0.3		739.5±0.4	796.1±0.3
M_V	443.1±0.3	484.8±0.3	527.5±0.3	572.1±0.3	619.4±0.3	672.3±0.5	725.5±0.5	780.7±0.3
N_I	121.9±0.3	136.5±0.4	152.0±0.3	168.3±0.3	186.4±0.3		230.8±0.4	253.0±0.5
N_{II}							172.3±0.6	191.8±0.7
N_{II}, N_{III}	77.4±0.4	88.6±0.4	98.4±0.5	110.2±0.5	122.7±0.5	146.7±3.1		
N_{III}							161.6±0.6	179.7±0.6
N_{IV}							78.8±0.5	92.5±0.5
N_{IV}, N_V	16.2±0.3	23.9±0.3	31.4±0.3	39.8±0.3	49.6±0.3			
N_V							76.5±0.5	89.9±0.5
O_I	0.1±4.5	0.9±0.5	6.7±0.5	11.6±0.6	13.6±0.6		22.7±0.5	39.1±0.6
O_{II}							13.1±0.5	16.6±0.5
O_{II}, O_{III}	0.8±0.4	1.1±0.5	2.1±0.4	2.3±0.5	3.3±0.5			
O_{III}							11.4±0.5	14.6±0.5

	57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd
K	38924.6±0.4 (38934.)	40443.0±0.4 (40453.)	41990.6±0.5 (42002.)	43568.9±0.4 (43574.)	45184.0±0.7 (45198.)	46834.2±0.5 (46849.)	48519.0±0.4 (48519.)	50239.1±0.5 (50233.)

Table I (*Continued*)

	57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd
L_{I}	6266.3±0.5 [6266.3][n]	6548.8±0.5 [6548.5][n]	6834.8±0.5 [6834.9][n]	7126.0±0.4 [7125.8][n] (7129.)	7427.9±0.8 [7427.9][o]	7736.8±0.5 [7736.2][n] (7748.)	8052.0±0.4 [8051.7][n] (8061.)	8375.6±0.5 [8375.4][n] (8386.)
L_{II}	5890.6±0.4 [5890.7][n]	6164.2±0.4 [6164.3][n]	6440.4±0.5 [6440.2][n]	6721.5±0.4 [6721.8][n] (6723.)	7012.8±0.6 [7012.8][o]	7311.8±0.4 [7312.0][n] (7313.)	7617.1±0.4 [7617.6][n] (7620.)	7930.3±0.4 [7930.5][n] (7931.)
L_{III}	5482.7±0.4 [5482.6][n]	5723.4±0.4 [5723.6][n]	5964.3±0.4 [5964.3][n]	6207.9±0.4 [6208.0][n] (6209.)	6459.3±0.6 [6459.4][o]	6716.2±0.5 [6716.8][n] (6717.)	6976.9±0.4 [6976.7][n] (6981.)	7242.8±0.4 [7242.8][n] (7243.)
M_{I}	1361.3±0.3	1434.6±0.6	1511.0±0.8	1575.3±0.7		1722.8±0.8	1800.0±0.5	1880.8±0.5
M_{II}	1204.4±0.6	1272.8±0.6	1337.4±0.7	1402.8±0.6	1471.4±6.2	1540.7±1.2	1613.9±0.7	1688.3±0.7
M_{III}	1123.4±0.5	1185.4±0.5	1242.2±0.6	1297.4±0.5	1356.9±1.4	1419.8±1.1	1480.6±0.6	1544.0±0.8
M_{IV}	848.5±0.4	901.3±0.6	951.1±0.6	999.9±0.6	1051.5±0.9	1106.0±0.8	1160.6±0.6	1217.2±0.6
M_{V}	831.7±0.4	883.3±0.5	931.0±0.6	977.7±0.6	1026.9±1.0	1080.2±0.6	1130.9±0.6	1185.2±0.6
N_{I}	270.4±0.8	289.6±0.7	304.5±0.9	315.2±0.8		345.7±0.9	360.2±0.7	375.8±0.7
N_{II}	205.8±1.2	223.3±1.1	236.3±1.5	243.3±1.6	242.±16.	265.6±1.9	283.9±1.0	288.5±1.2
N_{III}	191.4±0.9	207.2±0.9	217.6±1.1	224.6±1.3		247.4±1.5	256.6±0.8	270.9±0.9
$N_{IV,V}$	98.9±0.8	110.0±0.6	113.2±0.7	117.5±0.7	120.4±2.0	129.0±1.2	133.2±0.6	140.5±0.8
$N_{VI,VII}$		0.1±1.2	2.0±0.6	1.5±0.9		5.5±1.1	0.0±3.2	0.1±3.5
O_{I}	32.3±7.2	37.8±1.3	37.4±1.0	37.5±0.9		37.4±1.5	31.8±0.7	36.1±0.8
$O_{II,III}$	14.4±1.2	19.8±1.2	22.3±0.7	21.1±0.8		21.3±1.5	22.0±0.6	20.3±1.2

	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu	72 Hf
K	51995.7±0.5 (52002.)	53788.5±0.5 (53793.)	55617.7±0.5 (55619.)	57485.5±0.5 (57487.)	59389.6±0.5	61332.3±0.5 (61300.)	63313.8±0.5 (63310.)	65350.8±0.6 (65310.)
L_{I}	8708.0±0.5 [8707.6][n] (8717.)	9045.8±0.5 [9046.5][n]	9394.2±0.4 [9394.3][n] (9399.)	9751.3±0.4 [9751.5][n] (9757.)	10115.7±0.4 [10115.6][n] (10121.)	10486.4±0.4 [10487.3][n] (10490.)	10870.4±0.4 [10870.1][n] (10874.)	11270.7±0.4 [11271.6][o] (11274.)

Table I (*Continued*)

	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu	72 Hf
L_{II}	8251.6±0.4 [8251.8][n] (8253.)	8580.6±0.4 [8580.4][n] (8583.)	8917.8±0.4 [8918.2][n] (8916.)	9264.3±0.4 [9264.3][n] (9262.)	9616.9±0.4 [9617.1][n] (9617.1)	9978.2±0.4 [9977.9][n] (9976.)	10348.6±0.4 [10349.0][n] (10345.)	10739.4±0.4 [10738.9][o] (10736.)
L_{III}	7514.0±0.4 [7514.2][n] (7515.)	7790.1±0.4 [7789.6][n] (7789.7)	8071.1±0.4 [8070.6][n] (8068.)	8357.9±0.4 [8357.6][n] (8357.5)	8648.0±0.4 [8647.8][n] (8649.6)	8943.6±0.4 [8942.6][n] (8944.1)	9244.1±0.4 [9243.8][n]	9560.7±0.4 [9560.4][o] (9558.)
M_I	1967.5±0.6	2046.8±0.4	2128.3±0.6	2206.5±0.6	2306.8±0.7	2398.1±0.4	2491.2±0.5	2600.9±0.4
M_{II}	1767.7±0.9	1841.8±0.5	1922.8±1.0	2005.8±0.6	2089.8±1.1	2173.0±0.4	2263.5±0.4	2365.4±0.4
M_{III}	1611.3±0.8	1675.6±0.9	1741.2±0.9	1811.8±0.6	1884.5±1.1	1949.8±0.5	2023.6±0.5	2107.6±0.4
M_{IV}	1275.0±0.6	1332.5±0.4	1391.5±0.7	1453.3±0.5	1514.6±0.7	1576.3±0.4	1639.4±0.4	1716.4±0.4
M_V	1241.2±0.7	1294.9±0.4	1351.4±0.8	1409.3±0.5	1467.7±0.9	1527.8±0.4	1588.5±0.4	1661.7±0.4
N_I	397.9±0.8	416.3±0.5	435.7±0.8	449.1±1.0	471.7±0.9	487.2±0.6	506.2±0.6	538.1±0.4
N_{II}	310.2±1.2	331.8±0.6	343.5±1.4	366.2±1.5	385.9±1.6	396.7±0.7	410.1±1.8	437.0±0.5
N_{III}	385.0±1.0	292.9±0.6	306.6±0.9	320.0±0.7	336.6±1.6	343.5±0.5	359.3±0.5	380.4±0.5
N_{IV} }	147.0±0.8	154.2±0.5	161.0±1.0	176.7±1.2	179.6±1.2	198.1±0.5	204.8±0.5	223.8±0.4
N_V }				167.6±1.5		184.9±1.3	195.0±0.4	213.7±0.5
$N_{VI,VII}$	2.6±1.5	4.2±1.6	3.7±3.0	4.3±1.4	5.3±1.9	6.3±1.0	6.9±0.5	17.1±0.5
O_I	39.0±0.8	62.9±0.5	51.2±1.3	59.8±1.7	53.2±3.0	54.1±0.5	56.8±0.5	64.9±0.4
O_{II} }	25.4±0.8	26.3±0.6	20.3±1.5	29.4±1.6	32.3±1.6	23.4±0.6	28.0±0.6	38.1±0.6
O_{III} }								30.6±0.6

	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg
K	67416.4±0.6 (67403.)	69525.0±0.3 (69508.)	71676.4±0.4 (71658.)	73870.8±0.5	76111.0±0.5	78394.8±0.7 (78381.)	80724.9±0.5 (80720.)	83102.3±0.8
L_I	11681.5±0.3 [11680.2][p] (11682.)	12099.8±0.3 [12098.2][p] (12099.6)	12526.7±0.4 (12530.)	12968.0±0.4 (12972.)	13418.5±0.3 (13423.)	13879.9±0.4 (13883.)	14352.8±0.4 (14353.7)	14839.3±1.0 (14842.)

TABLE I (*Continued*)

	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg
L_{II}	11136.1±0.3 [11136.1][p] (11132.)	11544.0±0.3 [11541.4][p] (11538.)	11958.7±0.3 [11956.9][p] (11954.)	12385.0±0.4 (12381.)	12824.1±0.3 [12824.0][e,p] (12820.)	13272.6±0.3 [13272.6][e,p] (13272.3)	13733.6±0.3 [13733.5][e,p] (13736.)	14208.7±0.7 (14215.)
L_{III}	9881.1±0.3 [9880.3][p] (9877.7)	10206.8±0.3 [10204.2][p] (10200.)	10535.3±0.3 [10534.2][p] (10531.)	10870.9±0.3 [10870.7][p] (10868.)	11215.2±0.3 [11215.1][e,p] (11212.)	11563.7±0.3 [11563.7][e,p] (11562.)	11918.7±0.3 [11918.2][e,p] (11921.)	12283.9±0.4 [12284.0][e,p] (12286.)
M_{I}	2708.0±0.4	2819.6±0.4	2931.7±0.4	3048.5±0.4	3173.7±1.7	3296.0±0.9	3424.9±0.3 [3424.8][p]	3561.6±1.1
M_{II}	2468.7±0.3 [2468.6][p]	2574.9±0.3 [2575.0][p]	2681.6±0.4	2792.2±0.3 [2791.9][p]	2908.7±0.3 [2909.1][p]	3026.5±0.4 [3026.5][p] (3029.)	3147.8±0.4 [3149.5][p]	3278.5±1.3
M_{III}	2194.0±0.3 [2194.1][p]	2281.0±0.3 [2281.0][p]	2367.3±0.3 [2367.3][p]	2457.2±0.4 [2457.4][p]	2550.7±0.3 [2550.5][p] (2550.5)	2645.4±0.4 [2645.5][p] (2645.9)	2743.0±0.3 [2743.1][p] (2744.0)	2847.1±0.4 [2847.1][p]
M_{IV}	1793.2±0.3 [1793.1][p]	1871.6±0.3 [1871.4][p]	1948.9±0.3 [1948.9][p]	2030.8±0.3 [2031.0][p]	2116.1±0.3 [2116.1][p]	2201.9±0.3 [2201.9][p]	2291.1±0.3 [2291.2][p] (2307.)	2384.9±0.3 [2384.9][p]
M_{V}	1735.1±0.3 [1735.2][p]	1809.2±0.3 [1809.3][p]	1882.9±0.3 [1882.9][p]	1960.1±0.3 [1960.2][p]	2040.4±0.3 [2040.5][p]	2121.6±0.3 [2121.6][p]	2205.7±0.3 [2206.1][p] (2220.)	2294.9±0.3 [2294.9][p]
N_{I}	565.5±0.5	595.0±0.4	625.0±0.4	654.3±0.5	690.1±0.4	722.0±0.6	758.8±0.4	800.3±1.0
N_{II}	464.8±0.5	491.6±0.4	517.9±0.5	546.5±0.5	577.1±0.4	609.2±0.6	643.7±0.5	676.9±2.4
N_{III}	404.5±0.4	425.3±0.5	444.4±0.5	468.2±0.6	494.3±0.6	519.0±0.6	545.4±0.5	571.0±1.4
N_{IV}	241.3±0.4	258.8±0.4	273.7±0.5	289.4±0.5	311.4±0.4	330.8±0.5	352.0±0.4	378.3±1.0
N_{V}	229.3±0.3	245.4±0.4	260.2±0.4	272.8±0.6	294.9±0.4	313.3±0.4	333.9±0.4	359.8±1.2
N_{VI}, N_{VII} (combined)	25.0±0.4		40.6±0.4	46.3±0.6				
N_{VI}		36.5±0.4			63.4±0.4	74.3±0.4	86.4±0.4	102.2±0.5
N_{VII}		33.6±0.4			60.5±0.4	71.1±0.5	82.8±0.5	98.5±0.5
O_{I}	71.1±0.5	77.1±0.4	82.8±0.5	83.7±0.6	95.2±0.4	101.7±0.4	107.8±0.7	120.3±1.3
O_{II}	44.9±0.4	46.8±0.5	45.6±0.7	58.0±1.1	63.0±0.6	65.3±0.7	71.7±0.7	80.5±1.3
O_{III}	36.4±0.4	35.6±0.5	34.6±0.6	45.4±1.0	50.5±0.6	51.7±0.7	53.7±0.7	57.6±1.3
$O_{IV,V}$	5.7±0.4	6.1±0.4	3.5±0.5		3.8±0.4	2.2±1.3	2.5±0.5	6.4±1.4

Table I (*Continued*)

	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn	87 Fr	88 Ra
K	85530.4±0.6	88004.5±0.7 (88005.)	90525.9±0.7 (90534.)	93105.0±3.8	95729.9±7.7	98404.±12.	101137.±13.	103921.9±7.2
L_{I}	15346.7±0.4 (15343.)	15860.8±0.5 (15855.)	16387.5±0.4 (16376.)	16939.3±9.8	17493.±29.	18049.±38.	18639.±40.	19236.7±1.5 (19236.0)
L_{II}	14697.9±0.3 [14697.3][p] (14699.)	15200.0±0.4 (15205.)	15711.1±0.3 [15708.4][p] (15719.)	16244.3±2.4	16784.7±2.5	17337.1±3.4	17906.5±3.5	18484.3±1.5 (18486.0)
L_{III}	12657.5±0.3 [12656.3][e,p] (12660.)	13035.2±0.3 [13034.9][e,p] (13041.)	13418.6±0.3 [13418.3][e,p] (13426.)	13813.8±1.0 ⟨13813.8⟩	14213.5±2.0 ⟨14213.5⟩	14619.4±3.0 ⟨14619.4⟩	15031.2±3.0 ⟨15031.2⟩	15444.4±1.5 (15444.0)
M_{I}	3704.1±0.4	3850.7±0.5	3999.1±0.3 [3999.1][p]	4149.4±3.9	⟨4317.⟩	⟨4482.⟩	⟨4652.⟩	4822.0±1.5
M_{II}	3415.7±0.3 [3415.7][p]	3554.2±0.3 [3554.2][p]	3696.3±0.3 [3696.4][p]	3854.1±9.8	4008.±28.	4159.±38.	4327.±40.	4489.5±1.8
M_{III}	2956.6±0.3 [2956.5][p]	3066.4±0.4 [3066.3][p]	3176.9±0.3 [3176.8][p]	3301.9±9.9	3426.±29.	3538.±38.	3663.±40.	3791.8±1.7
M_{IV}	2485.1±0.3 [2485.2][p]	2585.6±0.3 [2585.5][p] (2606.)	2687.6±0.3 [2687.4][p]	2798.0±1.2	2908.7±2.1	3021.5±3.1	3136.2±3.1	3248.4±1.6
M_{V}	2389.3±0.3 [2389.4][p]	2484.0±0.3 [2484.2][p] (2502.)	2579.6±0.3 [2579.5][p]	2683.0±1.1	2786.7±2.1	2892.4±3.1	2999.9±3.1	3104.9±1.6
N_{I}	845.5±0.5	893.6±0.7	938.2±0.3 [938.7][p]	995.3±2.9	⟨1042.⟩	⟨1097.⟩	⟨1153.⟩	1208.4±1.6
N_{II}	721.3±0.8	763.9±0.8	805.3±0.3 [805.3][p]	851.±12.	886.±30.	929.±40.	980±42.	1057.6±1.8
N_{III}	609.0±0.5	644.5±0.6	678.9±0.3 [678.9][p]	705.±14.	740.±30.	768.±40.	810±43.	879.1±1.8
N_{IV}	406.6±0.4	435.2±0.5	463.6±0.3 [463.6][p]	500.2±2.4	533.2±3.2	566.6±4.0	603.3±4.1	635.9±1.6
N_{V}	386.2±0.5	412.9±0.6	440.0±0.3 [440.1][p]	473.4±1.3			577.±34.	602.7±1.7

TABLE I (*Continued*)

	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn	87 Fr	88 Ra
N_{VI}	122.8±0.4	142.9±0.4	161.9±0.5					298.9±2.4
N_{VII}	118.5±0.4	138.1±0.4	157.4±0.6					
O_{I}	136.3±0.7	147.3±0.8	159.3±0.7					254.4±2.1
O_{II}	99.6±0.6	104.8±1.0	116.8±0.7					200.4±2.0
O_{III}	75.4±0.6	86.0±1.0	92.8±0.6					152.8±2.0
O_{IV}	15.3±0.4	21.8±0.4	26.5±0.5	31.4±3.2				67.2±1.7
O_{V}	13.1±0.4	19.2±0.4	24.4±0.6					
P_{I}		3.1±1.0						43.5±2.2
$P_{II,III}$		0.7±1.0	2.7±0.7					18.8±1.8

	89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm
K	106755.3±5.3	109650.9±0.9	112601.4±2.4	115606.1±1.6	118678.±33.	121818.±44.	125027.±55.	128220
L_{I}	19840.±18.	20472.1±0.5 (20464.)	21104.6±1.8 (21128.)	21757.4±0.3 (21771.)	22426.8±0.9	23097.2±1.6 (23109.)	23772.9±2.0 (23772.9)	24460
L_{II}	19083.2±2.8	19693.2±0.4 (19683.)	20313.7±1.5 (20319.)	20947.6±0.3 (20945.)	21600.5±0.4	22266.2±0.7 (22253.)	22944.0±1.0	23779
L_{III}	15871.0±2.0 (15871.0)	16300.3±0.3 [16299.6][q] (16299.)	16733.1±1.4 (16733.)	17166.3±0.3 [17168.5][r] (17165.)	17610.0±0.4 (17606.2)	18056.8±0.6 (18053.1)	18504.1±0.9 (18504.1)	18930
M_{I}	(5002.)	5182.3±0.3 [5182.3][q]	5366.9±1.6	5548.0±0.4	5723.2±3.6	5932.9±1.4	6120.5±7.5	6288
M_{II}	4656.±18.	4830.4±0.4 [4830.6][q]	5000.9±2.3	5182.2±0.4 [5180.9][r]	5366.2±0.7 [5366.4][s]	5541.2±1.7	5710.2±2.1	5895
M_{III}	3909.±18.	4046.1±0.4 [4046.1][q] (4041.)	4173.8±1.8	4303.4±0.3 [4303.6][r] (4299.)	4434.7±0.5 [4434.6][s]	4556.6±1.5	4667.0±2.1	4797
M_{IV}	3370.2±2.1	3490.8±0.3 [3490.7][q] (3485.)	3611.2±1.4 (3608.)	3727.6±0.3 [3728.1][r] (3720.)	3850.3±0.4 [3849.8][s]	3972.6±0.6 [3972.7][t]	4092.1±1.0	4227

TABLE I (*Continued*)

	89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm
M_V	3219.0±2.1	3332.0±0.3 [3332.1][q] (3325.)	3441.8±1.4 (3436.)	3551.7±0.3 [3551.7][r] (3545.)	3665.8±0.4 [3664.2][s]	3778.1±0.6 [3778.0][t]	3886.9±1.0	3971
N_I	⟨1269.⟩	1329.5±0.4 [1329.8][q]	1387.1±1.9	1440.8±0.4 [1441.3][r]	1500.7±0.8 [1500.7][s]	1558.6±0.8	1617.1±1.1	1643
N_{II}	1080.±19.	1168.2±0.4 [1168.3][q]	1224.3±1.6	1272.6±0.3 [1272.5][r]	1327.7±0.8 [1327.7][s]	1372.1±1.8	1411.8±8.3	1440
N_{III}	890.±19.	967.3±0.4 [967.6][q]	1006.7±1.7	1044.9±0.3 [1044.9][r]	1086.8±0.7 [1086.8][s]	1114.8±1.6	⟨1135.7⟩	1154
N_{IV}	674.9±3.7	714.1±0.4 [714.4][q]	743.4±2.1	780.4±0.3 [779.7][r]	815.9±0.5 [817.1][s]	848.9±0.6 [848.9][t]	878.7±1.0	
N_V		676.4±0.4 [676.4][q]	708.2±1.8	737.7±0.3 [737.6][r]	770.3±0.4 [773.2][s]	801.4±0.6 [801.4][t]	827.6±1.0	
N_{VI}		344.4±0.3 [344.2][q]	371.2±1.6	391.3±0.6	415.0±0.8 [415.0][s]	445.8±1.7		
N_{VII}		335.2±0.4 [335.0][q]	359.5±1.6	380.9±0.9	404.4±0.5 [404.4][s]	432.4±2.1		
O_I		290.2±0.8	309.6±4.3	323.7±1.1		351.9±2.4		385
O_{II}		229.4±1.1 }	222.9±3.9	{ 259.3±0.5	283.4±0.8 [283.4][s]	274.1±4.7		
O_{III}		181.8±0.4 [181.8][q] }		{ 195.1±1.3	206.1±0.7 [206.1][s]	206.5±4.7		
O_{IV}		94.3±0.4 [94.4][q] }	94.1±2.8	{ 105.0±0.5	109.3±0.7 [108.8][s]	116.0±1.2	115.8±1.3	
O_V		87.9±0.3 [88.1][q] }		{ 96.3±1.4	101.3±0.5 [101.4][s]	105.4±1.0	103.3±1.1	
P_I		59.5±1.1		70.7±1.2				
P_{II}		49.0±2.5		42.3±9.0				
P_{III}		43.0±2.5		32.3±9.0				

TABLE I (*Continued*)

	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lw
K	[131590±40][u]	135960	139490	143090	146780	150540	154380
L_{I}	[25275±17][u]	26110	26900	27700	28530	29380	30240
L_{II}	[24385±17][u]	25250	26020	26810	27610	28440	29280
L_{III}	[19452±20][u]	19930	20410	20900	21390	21880	22360
M_{I}	[6556±21][u]	6754	6977	7205	7441	7675	7900
M_{II}	[6147±31][u]	6359	6574	6793	7019	7245	7460
M_{III}	[4977±31][u]	5109	5252	5397	5546	5688	5710
M_{IV}	4366	4497	4630	4766	4903	5037	5150
M_{V}	4132	4253	4374	4498	4622	4741	4860
N_{I}	[1755±22][u]	1799	1868	1937	2010	2078	2140
N_{II}	1554	1616	1680	1747	1814	1876	1930
N_{III}	1235	1279	1321	1366	1410	1448	1480
O_{I}	[398±22][u]	419	435	454	472	484	490

[a] J. E. Mack, 1949, as given in C. E. Moore, *Atomic Energy Levels* (U. S. National Bureau of Standards, Washington, D. C., 1949), Vol. 1, p. 1.

[b] G. Herzberg, 1957, as given in C. E. Moore, *Atomic Energy Levels* (U. S. National Bureau of Standards, Washington, D. C., 1958), Vol. 3, p. 238.

[c] See Ref. 18.

[d] A. Fahlman, D. Hamrin, R. Nordberg, C. Nordling, and K. Siegbahn, Phys. Rev. Letters **14**, 127 (1965). See also Ref. 26.

[e] See Ref. 15.

[f] See Ref. 11.

[g] C. Nordling, Arkiv Fysik **15**, 397 (1959).

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the procedure followed here is given by Bearden and Thomsen.[23]

Two methods are used to check the consistency of the input data with the output data. The first is the use of the χ^2 test, where

$$\chi^2 = \sum (d_i/\sigma_i)^2, \quad (1)$$

with d_i representing the difference between the ith experimental input value and that computed from the adjusted energy levels, and σ_i representing the corresponding standard deviation. It is well known[23] that, in any least-squares adjustment of data with Gaussian error distribution, χ^2 can be expected to equal the number of degrees of freedom; that is, the difference between the number of equations and the number of unknowns which the system possesses. When all the data for all elements are considered as a group, the resultant system possesses about 1300 degrees of freedom and a χ^2 of approximately 3300.

The procedure discussed above is strictly applicable only when the errors are known to be Gaussian.[24] A second check is made by calculating the ratio, r, of the residuals, d_i, to the value to be expected from consideration of the input errors. This ratio can be estimated by following and extending the arguments presented by Cohen and DuMond.[25] Let y stand for a particular energy level difference and p stand for the corresponding probable error. Let a subscript 1 indicate the experimental input value, either an emission line or a photoelectric measurement, subscript 2 indicate the least-squares output value, and subscript 3 indicate the output value of a least-squares adjustment made *without* including the experimental datum y_1. The probable error of the difference $y_1 - y_2$ is desired; however, this error cannot be found directly, since the fact that y_1 was included in the set of data which produced y_2 means that their errors are correlated. However, y_2 can also be obtained by an appropriate average of y_1 and y_3. Since y_3 is obtained from a set of data which excludes y_1, they are independent, and y_2 and p_2 can be computed by simply taking a weighted average of y_1 and y_3, with weights inversely proportional to the squares of the probable errors. Hence the sum of the weights is

$$1/p_2^2 = 1/p_1^2 + 1/p_3^2 \quad (2)$$

and

$$y_2 = p_2^2[(y_1/p_1^2) + (y_3/p_3^2)]. \quad (3)$$

From (2) one obtains

$$p_2^2 = p_1^2 p_3^2/(p_1^2 + p_3^2) \quad (4)$$

and

$$p_3^2 = p_1^2 p_2^2/(p_1^2 - p_2^2). \quad (5)$$

Since y_1 and y_3 are independent, the probable error squared of the difference $y_1 - y_3$ can be written down immediately as $p_1^2 + p_3^2$, but the probable error squared of the difference $y_1 - y_2$ must be computed by first expressing $y_1 - y_2$ in terms of y_1 and y_3. By using (3) and (4) to express y_2 we obtain

$$y_1 - y_2 = [p_1^2/(p_1^2 + p_3^2)](y_1 - y_3). \quad (6)$$

hence p_{12}^2, the probable error squared of $y_1 - y_2$, is

$$p_{12}^2 = [p_1^2/(p_1^2 + p_3^2)]^2 (p_1^2 + p_3^2). \quad (7)$$

Substituting (5) into (7) to eliminate p_3^2 gives the desired probable error in the form

$$p_{12} = (p_1^2 - p_2^2)^{\frac{1}{2}}. \quad (8)$$

Thus the desired ratio r between the actual difference and its statistically expected value is given by

$$r = (y_1 - y_2)/(p_1^2 - p_2^2)^{\frac{1}{2}}. \quad (9)$$

A study of r as calculated for each input datum reveals the extent to which each datum fitted in with the data as a whole. If the input errors are chosen properly, then according to the definition of probable error, fifty percent of the ratios should be less than one. For all the elements as a group, the actual percentage of error ratios less than one is just 50; the extremely close agreement is doubtless partly fortuitous.

The conclusion from this percentage is that the errors assigned to the input data, including the data from the previous article, are substantially correct. On the other hand, from the fact that χ^2 exceeded the degrees of freedom, it would appear that there are a greater number of large deviations than would be expected from a Gaussian error distribution. The likelihood of this had been emphasized by the authors.

Not only are half the error ratios less than one for the whole mass of the data, but the figure for each element individually is usually close to 50%; hence output errors as calculated directly by the computer (on the basis of internal consistency) are used. In a few cases (32 Ge, 33 As, 34 Se, and 80 Hg) the percentages are unusually low; in order to avoid understating any errors, all errors for these elements are reported on the basis of external consistency.

The comparison of the residuals (differences between the input values and the corresponding values as calculated on the basis of the adjusted energy levels) with the statistically expected differences proved very useful in other ways. When this error ratio is very large, a renewed investigation of that input often revealed a misprint, misidentification, or other mistake. However, in some cases this ratio is uncomfortably large, and no specific reason can be found for rejecting that input item. Those items which have an error ratio greater than 5.0 are rejected.[12]

There appears to be no significant pattern in these rejected input data. Almost as many have negative

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[23] J. A. Bearden and J. S. Thomsen, Nuovo Cimento 5, 267 (1957).

[24] J. S. Thomsen, Bull. Am. Phys. Soc. 10, 547 (1965).

[25] E. R. Cohen and J. W. M. DuMond, *Proc. of International Conference on Nuclidic Masses 1963*, W. H. Johnson, Jr., Ed. (Springer-Verlag, Wien, 1964).

error ratios as positive ones; no level or pair of levels predominates in the list. The rejected data are distributed among the K, L, and M, and photoelectron categories roughly in proportion to the amount of input data in each category. As one progresses up the periodic table, it seems that the initial measurement of various lines is often accompanied by high errors. This is not surprising, since these lines are weak and sometimes diffuse, making their identification and detection unusually difficult and subject to errors which are easy to underestimate.

It is interesting to note that no $K\alpha_1$, $K\alpha_2$, nor any of the best measured L lines appear in the rejected group, despite the fact that they had been assigned the lowest errors. Furthermore, in no case did the error ratio for these lines become suspiciously large. A few difficulties, particularly with the value of the L_{I} level in the light elements, did appear, and are discussed further in the detailed energy level report.[12]

ENERGY LEVEL TABLE

The adjusted values for the various energy levels, together with the respective probable errors, are listed in Table I. These errors are primarily due to three causes: (1) those due to the photoelectron measurements, which may be subdivided into two parts: (a) random variations introduced by counting statistics which affects *even* the spacing between levels of a single element, and (b) systematic errors in the main calibration line (usually common to a group of elements) and the spectrometer slit work function, which affect the absolute accuracy relative to the Fermi level energy and amount to approximately 0.3 eV for all elements; (2) the probable errors in the x-ray emission wavelengths relative to the W $K\alpha_1$ standard and that of the primary standard to the absolute angstrom scale (5 parts per million); (3) the probable error in the wavelength to energy ($V\lambda = 12398.10 \pm 0.13$ eV—Å*) conversion factor.

Recently[26] photoelectron measurements of the L_{I} energy in the elements sodium ($Z=11$) to copper ($Z=29$) have been reported. The values from sodium ($Z=11$) to vanadium ($Z=23$) have been used to replace the interpolated values shown in our previous report.[12] The remaining new values have been used with the older K-level values to redetermine new level energies for the elements vanadium ($Z=23$) to copper ($Z=29$). The K-level energies of the elements from sodium to chromium were also redetermined. Agreement with previous values[18] to within 0.5 eV was obtained for all elements except titanium. The new value for titanium is 1.2 eV higher than that of the earlier work, and while no explanation of the discrepancy is available, this new value has been substituted for the older value. This indicates a need for further redeterminations of all the older values as a check on the estimated accuracies and on unsuspected experimental variations.

For some elements the K level alone has been used to determine the absolute values. In these cases when new photoelectron measurements are available, all the remaining levels can be adjusted by the difference in the new and old values for each element. However, three or more level energies have been measured for the heavier elements (sixteen for thorium) and when new measurements are available for these, a new least-squares readjustment will be necessary to obtain corrected energy level values for an element.

Some energy levels were obtained by interpolation or calculation. The interpolation was performed by passing a fourth order polynomial through the nearest fifteen energy values. The level for atomic numbers 96 and 98 through 103 were obtained from a relativistic self-consistent Slater–Dirac energy level calculation.[27] The results of an extrapolation vary greatly with the order of the polynomial used, and therefore should be considered rough values only.

The best of the x-ray absorption edge measurements, listed in parentheses ( ), are generally in good agreement with the photoelectron values. From these it would appear that the x-ray measurements have been made relative to the Fermi energy level with higher accuracy than previously estimated. New x-ray measurements with modern techniques should certainly be competitive with the photoelectron measurements.

ERROR CORRELATION AND ENERGY DIFFERENCES

The errors shown in Table I are not statistically independent and hence can not be combined without some knowledge of the correlation coefficients. For example, consider the L_{II}–L_{III} energy difference of chromium. As in the case of other lighter elements, the K level energy was determined by the photoelectron method. The error involved in this measurement, item (1) in the first paragraph of the preceding section, is considerably greater than that in the emission line wavelengths, item (2); consequently all stated errors are strongly correlated through this common source. Thus, since in Table I the value of the L_{II} level is (583.7 ± 0.3) eV, and that for the L_{III} level is (574.5 ± 0.3) eV, one might erroneously conclude that the difference is (9.2 ± 0.4) eV, which would be true only if the major errors were uncorrelated. However, the wavelengths of chromium $K\alpha_1$ and $K\alpha_2$ emission lines which connect the L_{III} and L_{II} levels to the K level are known with probable errors of ten and one parts per million respectively; hence most of the errors in both the L_{II} and L_{III} levels come from the errors in the absolute value of the K level.

[26] R. Nordberg, K. Hamrin, A. Fahlman, C. Nordling, and K. Siegbahn, Z. Physik **192**, 462 (1966).

[27] J. T. Waber (private communication, 1964); D. Liberman, J. T. Waber, and D. T. Cromer, Phys. Rev. **137**, A27 (1965).

TABLE II. Examples of energy level differences and corresponding probable errors for the case of 24 chromium. Entries above the principal diagonal represent differences while those below give corresponding probable errors.

24 Cr	Energy level differences in electron volts						
	K	*L*1	*L*2	*L*3	*M*1	*M*23	*M*45
K		5292.77	5405.51	5414.72	5915.09	5946.71	5986.93
*L*1	0.70		112.74	121.95	622.31	653.93	694.16
*L*2	0.05	0.69		9.21	509.58	541.20	581.42
*L*3	0.07	0.70	0.05		500.36	531.98	572.21
*M*1	0.21	0.72	0.20	0.19		31.62	71.85
*M*23	0.08	0.69	0.06	0.07	0.21		40.23
*M*45	0.18	0.71	0.17	0.17	0.26	0.18	
24 Cr	Energy level difference errors in electron volts						

24 Cr	Energy level differences in Rydberg units						
	K	*L*1	*L*2	*L*3	*M*1	*M*23	*M*45
K		389.022	397.308	397.985	434.762	437.086	440.043
*L*1	131		8.286	8.963	45.740	48.064	51.021
*L*2	5.1	6152		0.677	37.454	39.778	42.735
*L*3	10	5700	5179		36.777	39.101	42.058
*M*1	33	1158	387	385		2.324	5.281
*M*23	10	1057	106	139	6497		2.957
*M*45	28	1028	289	304	3603	4403	
24 Cr	Energy level difference errors in ppm Rydberg units						

24 Cr	Energy level differences in wavelength (mÅ*)						
	K	*L*1	*L*2	*L*3	*M*1	*M*23	*M*45
K		2342.459	2293.606	2289.703	2096.01	2084.86	2070.86
*L*1	131		109975	101666	19922	18959	17860
*L*2	1.3	6152		1345646	24330	22908	21323
*L*3	8.7	5700	5179		24778	23305	21667
*M*1	33	1158	387	385		392094	172564
*M*23	9.6	1057	106	139	6497		308210
*M*45	28	1028	289	304	3603	4403	
24 Cr	Energy level difference errors in ppm Å*						

Indeed the correlation coefficient between these two levels is almost unity. When this is taken into account, the value of the above difference becomes (9.21±0.05) eV.

Thus energy level differences and corresponding errors can not in general be accurately obtained from the data in Table I alone. For this reason the original report included three tables of energy level differences, in units of electron-volts, Rydbergs, and equivalent wavelength in milli Å* (abbreviated mÅ*). Table II shows examples of each, presented in matrix form, for the specific case of chromium ($Z=24$).

For example, the $L_{II}L_{III}$ difference which was discussed above is found in the first matrix at the intersection of the *L*2 row and the *L*3 column, above the principal diagonal, and is 9.21 eV. The correspond ing element in the lower half of the matrix gives the probable error (calculated with proper consideration of error correlation), viz. 0.05 eV. The last two matrices are similar in form, but errors are given in parts per million rather than absolute units.

It will be noted that the equivalent wavelength values in the mÅ* units carry the smallest probable errors. Since all the x-ray emission line input data used in this report were given in Å*, values on this scale involve little or no error due to conversion factor uncertainties. These energy level differences represent possible x-ray emission lines; therefore this table should be of value to investigators looking for new lines or seeking possible identification of observed lines. One should note, however, that all possible differences are listed, no matter how the transition may be forbidden by selection rules. The values in this table will differ slightly from the corresponding entries in the preceding article,[12] because the latter values are a weighted mean of the *actual* observations on a given *line*, while the former represent values based on all the available information for the given *element*. Usually any difference is within the experimental error; in the few cases where a definite disagreement arose, the value based on direct observation was discarded in this work.

ACKNOWLEDGMENTS

The support of the U. S. Atomic Energy Commission, Division of Metallurgy and Materials, made possible the redevelopment of the x-ray facilities at The Johns Hopkins University which supplied the new x-ray wavelength data on which the above review is based. Since 1965 the financial aid of the National Science Foundation and the National Bureau of Standards (Office of Standard Reference Data) has made possible the continuation of our work. The authors are also indebted to Dr. J. S. Thomsen for his assistance both with the original report and also with this review.

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