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Dirac–Fock photoionization parameters for HAXPES applications

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HIGHLIGHTS

- Photoionization parameters are presented in the photon energy range 1.5–10 keV.
- Theoretical data are intended for use in experimental studies by HAXPES spectroscopy.
- Relativistic calculations were performed by the Dirac–Fock method.
- Photoionization cross sections were calculated including all multipoles.
- The angular distribution parameters were obtained in the quadrupole approximation.

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ABSTRACT

Presented here are the photoionization cross sections and parameters of the photoelectron angular distribution for atomic subshells with binding energies lower than 1.5 keV of all elements with $1 \leq Z \leq 100$ in the photon energy range 1.5–10 keV. The calculations were performed in an effort to provide handy theoretical data for experimental studies by hard X-ray photoelectron spectroscopy (HAXPES). We used the relativistic treatment of atomic photoeffect and the Dirac–Fock method with proper consideration of the electron exchange for computing the electron wave functions. The photoionization cross sections were determined including all multipoles of the radiative field while the photoelectron angular distribution parameters were obtained within the quadrupole approximation. The effect of the hole resulting in the atomic subshell after photoionization was taken into account by the use of the frozen orbital model.

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Contents

1. Introduction

Theoretical values of the photoionization cross sections and the photoelectron angular distribution parameters are widely used in traditional X-ray photoelectron spectroscopy. Early extensive calculations [1–3] contain only photoionization cross sections for two photon energies associated with the Al and Mg K_α-line energies. More recent calculations include photoionization cross sections along with the dipole angular distribution parameters β [4,5]. Our papers [6–8] include the angular distribution parameters β, γ, and δ obtained within the quadrupole approximation to give an essential correction to photoelectron angular distribution. Calculations [1,2,6–9] were pioneered by academician Vadim I. Nefedov (1937–2008) who was deeply involved in the studies.

The present paper is a revision and extension of the calculations to provide theoretical data required for handling of data obtained by methods of the hard X-ray photoelectron spectroscopy (HAXPES). The HAXPES spectroscopy is a powerful technique for the investigation of bulk electron structure of functional materials [10] and their interfaces [11]. In particular, it was applied for investigation of the electron structure of magnetic semiconductors [12] and strongly correlated materials [13]. Investigations in this new energy region revealed some new effects in behavior of intensities of the main [14] and satellite photoelectron lines [15,16]. HAXPES is also intended for study of the valence-band density of the material buried layers because of the large analysis depth (see [11] and references therein). Theoretical photoionization parameters are required for the interpretation of HAXPES data [15]. Our previous calculations [6,7] were performed for the kinetic electron energies $E_k \leq 5$ keV what is not cover modern energy region of HAXPES spectroscopy which extends to 7 keV [13] and even to 9 keV [15].

In Table 1, we present calculations in the photon energy range 1.5 keV $\leq k \leq$ 10 keV for all elements with atomic numbers $1 \leq Z \leq 100$. The comparatively outer atomic shells with binding energies less than 1.5 keV are taken into consideration. Although the method of calculations has been described before [6,8], we will remind below basic assumptions which provide the foundation for the calculations and will give basic expressions for the sake of convenience.

The main advantage of the present calculations over previous ones lies in the fact that electron wave functions are calculated using the Dirac–Fock (DF) method where the electron exchange interaction is considered exactly between bound electrons as well as between bound and free electrons. Previous calculations [1–9] were performed with the Dirac–Slater (DS) method where the electron exchange was considered approximately. Adequate calculations of electron wave functions may be essential for outer shells and for low photoelectron energies. As in papers [6,7], the subshell photoionization cross sections were calculated including all multipoles of the radiative field while the photoelectron angular distribution parameters were obtained in the quadrupole approximation.

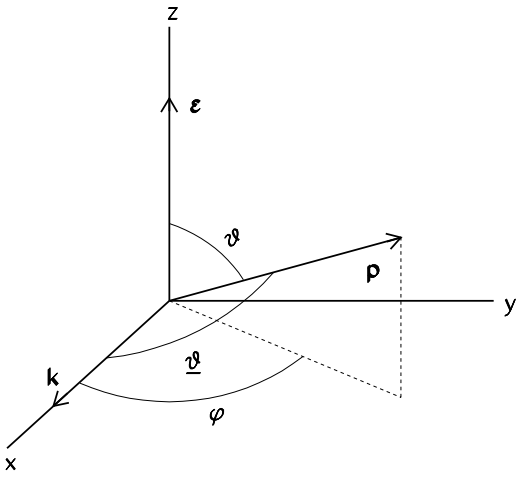

Fig. 1. Notations of angles and directions: **k** is the photon momentum vector; **p** is the direction of the photoelectron; ε is the photon polarization vector; $\underline{\theta}$ is the angle between vectors **k** and **p**; θ is the angle between **p** and ε; and φ is the angle between **k** and the plane passing through **p** and ε.

2. Basic formulas and method of calculation

The calculations were carried out for a free atom in the one–electron approximation. The fully relativistic formalism was used in the photoeffect studies. The relativistic treatment leads to the following expressions for the differential cross section in the ith atomic subshell for unpolarized and circularly polarized radiation:

$$\frac{d\sigma_i}{d\Omega}(\underline{\theta}) = \frac{\sigma_i}{4\pi}\sum_n B_n P_n(\cos\underline{\theta}). \quad (1)$$

Here $P_n(\cos\underline{\theta})$ is the Legendre polynomial, $\underline{\theta}$ is the angle between the vectors of photon and photoelectron propagation. Angle designations are given in Fig. 1.

In Eq. (1), the total photoionization cross section σ_i for the ith subshell is written as

$$\sigma_i = \frac{4\pi^2\alpha}{k}\sum_L\sum_\kappa (2L+1)[Q_{LL}(\kappa)]^2 + L[Q_{L+1L}(\kappa)]^2 + (L+1)[Q_{L-1L}(\kappa)]^2 - 2\sqrt{L(L+1)}\,Q_{L-1L}(\kappa)Q_{L+1L}(\kappa), \quad (2)$$

the coefficient $B_0 = 1$, and coefficients B_n for $n \geq 1$ are given by

$$B_n = \frac{4\pi^2\alpha}{k\sigma_i}\sum_{L_1L_2}\sum_{\kappa_1\kappa_2}\sum_{\Lambda_1\Lambda_2}(-1)^{j_1+j_2+L_1+L_2+\Lambda_1+\Lambda_2+j_i+1/2}e^{i(\delta_{\kappa_1}-\delta_{\kappa_2})} \times \frac{1+(-1)^{\ell_1+\ell_2+n}}{2}\cdot\frac{1+(-1)^{\ell_1+\Lambda_1+\ell_i+1}}{2}$$

$$\cdot \frac{1+(-1)^{\ell_2+\Lambda_2+\ell_i+1}}{2} \cdot i^{\Lambda_1-\Lambda_2}$$
$$\times [j_1 j_2 \Lambda_1 \Lambda_2]^{\frac{1}{2}} [n L_1 L_2] \begin{pmatrix} j_1 & j_2 & n \\ 1/2 & -1/2 & 0 \end{pmatrix} \begin{pmatrix} L_1 & L_2 & n \\ q & -q & 0 \end{pmatrix}$$
$$\times \begin{pmatrix} \Lambda_1 & 1 & L_1 \\ 0 & q & -q \end{pmatrix} \begin{pmatrix} \Lambda_2 & 1 & L_2 \\ 0 & q & -q \end{pmatrix} \begin{Bmatrix} L_1 & L_2 & n \\ j_2 & j_1 & j_i \end{Bmatrix}$$
$$\times Q_{\Lambda_1 L_1}(\kappa_1) Q_{\Lambda_2 L_2}(\kappa_2). \quad (3)$$

All formulas are presented in relativistic units, in which the Compton wavelength $\hbar/m_0c$ is defined as the unit of length, and the electron rest mass m_0c^2 is the unit of energy. In Eqs. (2) and (3), k is the photon energy, L is the multipolarity of the radiative field, $\kappa = (\ell - j)(2j+1)$ is the relativistic quantum number, ℓ and j are quantum numbers of the orbital and total angular momenta of the electron, α is the fine-structure constant, $(\delta_{\kappa_1} - \delta_{\kappa_2})$ is the corresponding phase shift for two final continuum states characterized by κ_1 and κ_2, $q = \pm 1$. We use the conventional notation $[ab]$ for the expression $(2a+1)(2b+1)$. The reduced matrix element $Q_{\Lambda L}(\kappa)$ has the form

$$Q_{\Lambda L}(\kappa) = (-1)^{\bar{\ell}_\kappa - \ell_i} \left[\bar{\ell}_\kappa \ell_i j_\kappa j_i \Lambda 1\right]^{1/2} \begin{pmatrix} \bar{\ell}_\kappa & \ell_i & \Lambda \\ 0 & 0 & 0 \end{pmatrix} \times \begin{Bmatrix} \bar{\ell}_\kappa & 1/2 & j_\kappa \\ \ell_i & 1/2 & j_i \\ \Lambda & 1 & L \end{Bmatrix} R_{1\Lambda}$$
$$+ (-1)^{\ell_\kappa - \bar{\ell}_i} \left[\ell_\kappa \bar{\ell}_i j_\kappa j_i \Lambda 1\right]^{1/2} \begin{pmatrix} \ell_\kappa & \bar{\ell}_i & \Lambda \\ 0 & 0 & 0 \end{pmatrix} \times \begin{Bmatrix} \ell_\kappa & 1/2 & j_\kappa \\ \bar{\ell}_i & 1/2 & j_i \\ \Lambda & 1 & L \end{Bmatrix} R_{2\Lambda}, \quad (4)$$

where $\bar{\ell} = 2j - \ell$. The radial integrals $R_{1\Lambda}$ and $R_{2\Lambda}$ are written as

$$R_{1\Lambda} = \int_0^\infty G_i(r) F_\kappa(r) j_\Lambda(kr) dr,$$
$$R_{2\Lambda} = \int_0^\infty F_i(r) G_\kappa(r) j_\Lambda(kr) dr. \quad (5)$$

Here $j_\Lambda(kr)$ is the spherical Bessel function of order Λ, $G(r) = rg(r)$ and $F(r) = rf(r)$ are the large and small components of the Dirac radial electron wave function. Indices i and κ refer to bound and continuum states, respectively.

It was shown in paper [17] that at the moderately high photon energy, the photoelectron angular distribution is adequately described by simple expressions involving three parameters β, γ, and δ where β is the dipole parameter while γ and δ are non-dipole parameters associated with the terms of the first order $O(kr)$ where r is the radius of the ionized atomic shell. In the case of circular polarized and unpolarized photons, the relevant equation is written as

$$\frac{d\sigma_i}{d\Omega} = \frac{\sigma_i}{4\pi} \left[1 - \frac{\beta}{2} P_2(\cos\underline{\theta}) + \left(\frac{\gamma}{2} \sin^2\underline{\theta} + \delta\right) \cos\underline{\theta}\right], \quad (6)$$

where $P_2(\cos\underline{\theta})$ is the second order Legendre polynomial.

For linear polarized photons, the angular distribution may be represented by the equation involving the same three parameters

$$\frac{d\sigma_i}{d\Omega} = \frac{\sigma_i}{4\pi} \left[1 + \beta P_2(\cos\theta) + (\delta + \gamma \cos^2\theta) \sin\theta \cos\varphi\right], \quad (7)$$

where θ is the angle between the vector $\mathbf{p}$ and the photon polarization direction $\boldsymbol{\varepsilon}$, vector $\boldsymbol{\varepsilon}$ being coincident with the z axis; $\boldsymbol{\varphi}$ is the angle between the vector $\mathbf{k}$ and the plane going through the z axis and the vector $\mathbf{p}$ (see Fig. 1). Non-dipole asymmetry of the angular distribution for the case of the partially linear polarized photons is described by the same photoionization parameters σ_i, β, γ, and δ [18].

Parameters β, γ, and δ are related with coefficients $B_n^{(q)}$, $n = 1, 2, 3$ (Eq. (3)) obtained in the quadrupole approximation as follows:

$$\beta = -2B_2^{(q)}, \quad \gamma = -5B_3^{(q)}, \quad \delta = B_1^{(q)} + B_3^{(q)}. \quad (8)$$

The coefficients $B_n^{(q)}$ may be expressed in the explicit form:

$$B_1^{(q)} = \sum_{\kappa_1\kappa_2} A_1 \left\{ 3\sqrt{6} \begin{Bmatrix} 1 & 1 & 1 \\ j_2 & j_1 & j_i \end{Bmatrix} [\sqrt{2} Q_{01}(\kappa_1) Q_{11}(\kappa_2) + Q_{11}(\kappa_1) Q_{21}(\kappa_2)] - 3\sqrt{2} \begin{Bmatrix} 1 & 2 & 1 \\ j_2 & j_1 & j_i \end{Bmatrix} \Big[Q_{01}(\kappa_1) [\sqrt{6} Q_{12}(\kappa_2) - 2Q_{32}(\kappa_2)] + \sqrt{15} Q_{11}(\kappa_1) Q_{22}(\kappa_2) - Q_{21}(\kappa_1) [\sqrt{3} Q_{12}(\kappa_2) - \sqrt{2} Q_{32}(\kappa_2)] \Big] - 5 \begin{Bmatrix} 2 & 2 & 1 \\ j_2 & j_1 & j_i \end{Bmatrix} [\sqrt{6} Q_{12}(\kappa_1) Q_{22}(\kappa_2) + 2Q_{22}(\kappa_1) Q_{32}(\kappa_2)] \right\}, \quad (9)$$

$$B_2^{(q)} = \sum_{\kappa_1\kappa_2} A_2 \left\{ \sqrt{\frac{3}{2}} \begin{Bmatrix} 1 & 1 & 2 \\ j_2 & j_1 & j_i \end{Bmatrix} \Big[2Q_{01}(\kappa_1) [-Q_{01}(\kappa_2) + \sqrt{2} Q_{21}(\kappa_2)] - 3Q_{11}(\kappa_1) Q_{11}(\kappa_2) - Q_{21}(\kappa_1) Q_{21}(\kappa_2) \Big] - \sqrt{30} \begin{Bmatrix} 1 & 2 & 2 \\ j_2 & j_1 & j_i \end{Bmatrix} \Big[\sqrt{10}\, Q_{01}(\kappa_1) Q_{22}(\kappa_2) - Q_{11}(\kappa_1) [3Q_{12}(\kappa_2) - \sqrt{6}\, Q_{32}(\kappa_2)] - \sqrt{5}\, Q_{21}(\kappa_1) Q_{22}(\kappa_2) \Big] - \frac{5}{\sqrt{14}} \begin{Bmatrix} 1 & 2 & 2 \\ j_2 & j_1 & j_i \end{Bmatrix} \times \Big[Q_{12}(\kappa_1) [3Q_{12}(\kappa_2) - 2\sqrt{6} Q_{32}(\kappa_2)] + 5Q_{22}(\kappa_1) Q_{22}(\kappa_2) + 2Q_{32}(\kappa_1) Q_{32}(\kappa_2) \Big] \right\}, \quad (10)$$

$$B_3^{(q)} = \sum_{\kappa_1\kappa_2} A_3 \left\{ -2\sqrt{3} \begin{Bmatrix} 1 & 2 & 3 \\ j_2 & j_1 & j_i \end{Bmatrix} \Big[Q_{01}(\kappa_1) [\sqrt{6} Q_{12}(\kappa_2) - 2Q_{32}(\kappa_2)] + \sqrt{15}\, Q_{11}(\kappa_1) Q_{22}(\kappa_2) - Q_{21}(\kappa_1) [\sqrt{3}\, Q_{12}(\kappa_2) - \sqrt{2}\, Q_{32}(\kappa_2)] \Big] + 10\sqrt{2} \begin{Bmatrix} 2 & 2 & 3 \\ j_2 & j_1 & j_i \end{Bmatrix} [\sqrt{3}\, Q_{12}(\kappa_1) Q_{22}(\kappa_2) + \sqrt{2} Q_{22}(\kappa_1) Q_{32}(\kappa_2)] \right\}. \quad (11)$$

The factor A_n $(n = 1, 2, 3)$ in Eqs. (9)–(11) is written in the following form

$$A_n = \frac{\pi^2 \alpha}{k\sigma_i} (-1)^{j_1+j_2+j_i-1/2} [j_1 j_2 n]^{1/2} \begin{pmatrix} j_1 & j_2 & n \\ 1/2 & -1/2 & 0 \end{pmatrix} \times \begin{cases} \sin(\delta_{\kappa_1} - \delta_{\kappa_2}) \text{ for } n = 1, 3 \\ \cos(\delta_{\kappa_1} - \delta_{\kappa_2}) \text{ for } n = 2. \end{cases} \quad (12)$$

Consequently, the photoionization cross section σ_i is computed including all multipoles L of the radiative field f according to

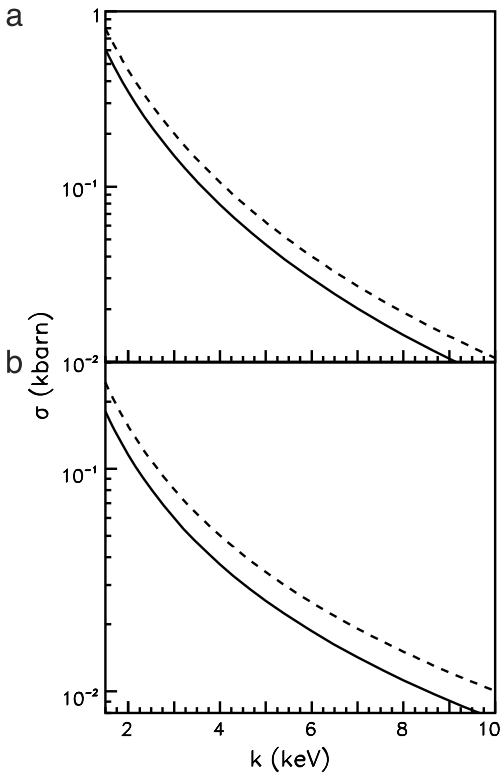

Fig. 2. Photoionization cross sections calculated by the DF (solid) and DS (dashed) methods for the $5p_{1/2}$ subshell of Sn, $Z = 50$ (a) and for the 7*s* shell of Cm, $Z = 96$ (b).

Eq. (2) while the photoelectron angular distribution parameters are computed in the quadrupole approximation, that is, taking into account terms of the first order $O(kr)$ according to Eqs. (8)–(12). It should be noted that the influence of the second-order terms $O[(kr)^2]$ on photoelectron angular distribution in both cases of unpolarized and linearly polarized radiation was considered in paper [9]. It was shown that the inclusion of the second-order terms may contribute significantly, up to 20%–30%, into angular distribution of photoelectrons at high photon energies $k \geq 10$ keV.

As opposed to calculations [1–7,9] where the electron wave functions were computed by the DS method with the approximate consideration of the electron exchange, we used here the DF method with the proper consideration of the exchange between bound electrons as well as between bound and free electrons [19,20]. The exact consideration of the exchange is essential for outer shells for which the difference between the two calculations

$$\Delta_\sigma = [(\sigma_i^{\rm DS} - \sigma_i^{\rm DF})/\sigma_i^{\rm DF}] \times 100\% \qquad (13)$$

may be large at any photon energy. In addition, the difference Δ_σ may be essential for inner shells in the event that the photon energy k is close to the subshell binding energy ε_i and the photoelectron energy $E_k = k - \varepsilon_i$ turns out to be low [8].

In Fig. 2, photoionization cross sections σ_i obtained by the DF method (solid curves) and the DS method (dashed curves) are shown for the $5p_{1/2}$ subshell of Sn ($Z = 50$) (Fig. 2(a)) and for the $7s_{1/2}$ shell of Cm ($Z = 96$) (Fig. 2 (b)). As is seen, the difference Δ_σ is large and slightly increases with increasing the photon energy. It reaches ~40% for Sn and more than 30% for Cm in the photon energy range under consideration. Consequently, photoionization cross sections $\sigma_i^{\rm DF}$ may differ considerably from $\sigma_i^{\rm DS}$ for outer atomic shells of interest. For inner shells, both calculations are usually close to one another.

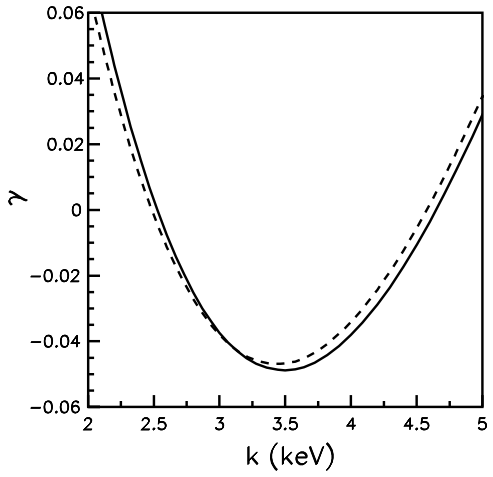

Fig. 3. The non-dipole angular distribution parameter γ calculated by the DF method (solid) and DS method (dashed) for the $5p_{3/2}$ subshell of Hg, $Z = 80$.

The difference between the angular distribution parameters calculated by the DF and DS methods may be also considerable when the parameters become small in magnitude and change a sign. The parameter γ obtained by the two methods in the range 2 keV $\leq k \leq$ 5 keV is displayed in Fig. 3. It is seen that the DF and DS values of γ, even if small, differ considerably, being sometimes opposite in sign. As a rule, the difference between the DF and DS calculations for the β parameter is less than for γ and δ in the energy range under consideration.

Experimental values of the electron binding energies involved in the calculations were taken from work [21]. The values may differ slightly from those used in [6,7]. Binding energies for all subshells under consideration are listed in Table 1. As in our previous calculations, the hole in the atomic shell from which a photoelectron has been emitted is taken into account in the framework of the frozen orbital model. It implies that the bound wave function is calculated in the self-consistent DF field of the neutral atom while the continuum wave function is calculated in the ion field which is constructed using the bound wave functions of the neutral atom. The computational accuracy of our calculations is better than 0.1%. This accuracy does not include possible uncertainties due to the physical approximations mentioned above.

3. Relation between theoretical photoionization parameters and experimental data

Theoretical photoionization cross sections of deep atomic shells are used in traditional X-ray photoelectron spectroscopy as reliable sensitivity factors [2]. For photoionization cross sections of molecular orbitals (MO), the additive formula was proposed [22]:

$$\sigma_{MO}(\hbar\omega) = \sum_{n,i} p_{ni}\sigma_{ni}(\hbar\omega), \qquad (14)$$

where the sum runs over all n atoms in a molecule and over all i valence shells of each an atom, p_{ni} is the population of atomic orbital in MO and σ_{ni} is the atomic shell photoionization cross section. This approximation was shown to be reliable for the photon energy regions in the vicinity of $k \approx 1500$ eV [23] and $k \approx 150$ eV [24]. The approximation is also used in HAXPES energy region [12].

Photoionization of the *i*th atomic shell is accompanied by satellite excitation of electrons from other shells j into discrete and continuum states q. Theoretical photoionization cross sections correspond to the main line i^{-1} together with shake-up and shake-off

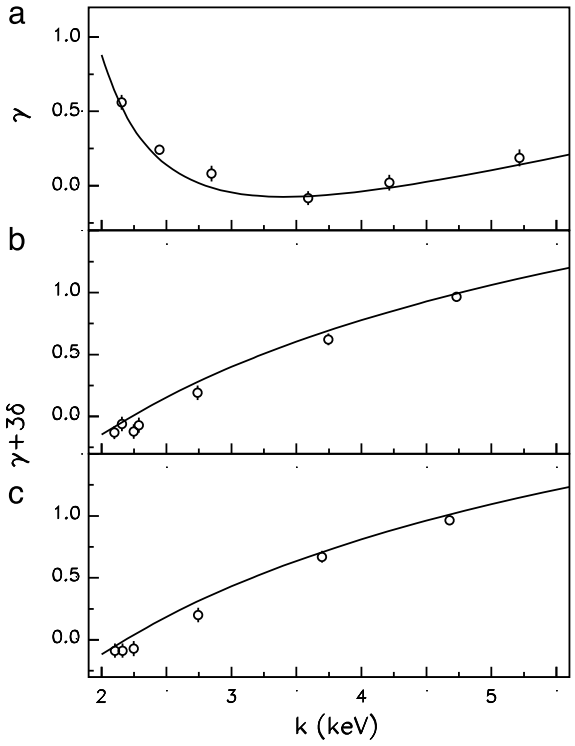

Fig. 4. The non-dipole photoelectron angular distribution parameters for inner shells of Kr versus the photon energy k. (a), the parameter γ for the 2s shell; (b) and (c), the combined parameter $\gamma + 3\delta$ for the $2p_{1/2}$ and $2p_{3/2}$ subshells, respectively. Solid curves, present DF calculations; open circles, experiment [32].

satellites $i^{-1}j^{-1}q$. Photoionization cross sections of the main line and the shake-up satellite states may be represented as:

$$\sigma_i^{\nu}(\omega) = f_i^{\nu}\sigma_i(\omega) \tag{15}$$

where $\sigma_i(\omega)$ is the photoionization cross section given in the present work and f_i^{ν} are spectroscopic factors, which were calculated in the second order of perturbation theory in papers [25–27]. The upper index ν denotes components of the satellite structure, which includes the main line also. Theoretical spectroscopic factors of all main photoelectron lines are close to 0.8 [28]. Experiments on solids generally, but not in detailed confirmed this theoretical result [29] (see also [30]). That is why one can use theoretical photoionization cross sections of the present work for estimation of relative photoionization cross section of different shells. On the other hand, some deviations from this universal value for the spectroscopic factors of the main lines were obtained in paper [14]. For the satellite excitations from the outer shell, one can use Eq. (15). On the other hand, when the satellite state is excited from the core shell, the photoionization cross section should be corrected for the satellite excitation energy [27].

The angular distribution of the core level photoemission usually reveals the atomic character. Some violations of this general rule were found for the d-orbital core-level excitations in strongly correlated materials [31].

To check a reliability of the DF non-dipole photoelectron distribution parameters our values were compared with the experimental data obtained for inner shells of Kr in the electron energy range $E_k \leq 3$ keV [32]. In Fig. 4, our calculations of the parameter γ for the 2s shell as well as the combined non-dipole asymmetry parameter $\gamma + 3\delta$ for the $2p_{1/2}$ and $2p_{3/2}$ subshells of Kr are presented along with the experimental data in the photon energy range 2 keV $\leq k \leq$ 5.5 keV. As evident from Fig. 4, our DF calculations are in good agreement with experimental data [32].

4. Conclusions

We present the atomic subshell photoionization cross sections along with parameters of the photoelectron angular distribution in the photon energy range 1.5 keV $\leq k \leq$ 10 keV. The theoretical data are intended for use in experimental studies by methods of HAXPES spectroscopy which is a powerful technique for the investigation of the electron structure and interface of functional materials. Calculations were performed for subshells with binding energies lower than 1.5 keV of all atoms with $1 \leq Z \leq 100$.

Relativistic calculations were performed within the framework of the DF method with the proper consideration of the electron exchange as distinct from previous calculations using the DS method with approximate consideration of the exchange. The subshell photoionization cross sections calculated with the DF and DS methods may differ considerably for outer atomic shells we are interested in. The difference between the angular distribution parameters obtained by the two methods may be also noticeable.

The photoionization cross sections were calculated taking into account all multipoles of the radiative field. The photoelectron angular distribution parameters were obtained using the quadrupole approximation. The hole resulting in the atomic subshell after photoionization is taken into account using the frozen orbital model.

Theoretical photoionization parameters presented here are in good agreement with available experimental data and are reliable to be used in experimental HAXPES studies.

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Explanation of Tables

Table 1. **Subshell photoionization cross sections and photoelectron angular distribution parameters**

Z	Atomic number
Shell	Atomic subshell from which an electron is emitted
E_b	Experimental subshell binding energy in eV
k	Photon energy in eV
σ	Subshell photoionization cross section in kb ($= 10^{-21}$cm^2)
β, γ, δ	Parameters of the photoelectron angular distribution

Notes: The photoionization cross sections σ_i are always given for completely filled subshells. To obtain σ_i for an open atomic subshell i, the value from the Table should be divided by $2j_i + 1$ (j_i is the electron total momentum) and multiplied by the actual occupation number of the ith subshell. In the Table, the decimal order is presented to the right of an entry.

Example

In the Table, the first data block gives the parameters for the $1s_{1/2}$ shell of the hydrogen atom, whose electron configuration has one $1s_{1/2}$ electron. The experimental binding energy is equal to 13.6 eV. At the photon energy $k = 1500$ eV, the photoionization cross section for the completely filled 1s shell is $\sigma_{1s} = 5.866\text{–}3 = 5.866 \times 10^{-3}$ kb $= 5.866 \times 10^{-24}$ cm^2, the angular distribution parameters $\beta = 1.984$, $\gamma = 9.11\text{–}1 = 0.911$, and $\delta = 1.96\text{–}8 = 1.96 \times 10^{-8}$. Because the hydrogen 1$s$ shell is half-filled one, the real photoionization cross section is $\sigma_{1s} = 2.933 \times 10^{-3}$ kb.

Table 1
Subshell photoionization cross sections and photoelectron angular distribution parameters.

Z= 1, H : $1s^1_{1/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$1s_{1/2}$	σ	5.866−3	2.223−3	5.619−4	2.110−4	9.839−5	5.270−5	3.108−5	1.966−5	1.311−5	9.123−6
E_b =	β	1.984	1.979	1.968	1.958	1.947	1.937	1.927	1.917	1.907	1.896
13.6 eV	γ	9.11−1	1.05+0	1.28+0	1.48+0	1.65+0	1.80+0	1.94+0	2.07+0	2.18+0	2.30+0
	δ	1.96−8	5.98−8	1.17−7	2.30−7	2.14−7	4.26−7	8.87−7	9.82−7	1.41−6	2.21−6
Z= 2, He: $1s^2_{1/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$1s_{1/2}$	σ	1.017−1	3.991−2	1.050−2	4.037−3	1.914−3	1.038−3	6.179−4	3.938−4	2.643−4	1.850−4
E_b =	β	1.985	1.979	1.969	1.958	1.948	1.937	1.927	1.917	1.907	1.897
24.6 eV	γ	8.90−1	1.03+0	1.27+0	1.47+0	1.64+0	1.79+0	1.93+0	2.06+0	2.18+0	2.29+0
	δ	6.95−8	7.83−8	1.93−7	3.14−7	5.38−7	7.71−7	1.16−6	1.50−6	2.06−6	2.72−6
Z= 3, Li: $1s^2_{1/2}\,2s^1_{1/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$1s_{1/2}$	σ	6.613−1	2.690−1	7.391−2	2.914−2	1.406−2	7.723−3	4.640−3	2.980−3	2.014−3	1.418−3
E_b =	β	1.986	1.980	1.970	1.959	1.949	1.938	1.928	1.918	1.908	1.898
54.8 eV	γ	8.59−1	1.01+0	1.25+0	1.45+0	1.62+0	1.78+0	1.92+0	2.05+0	2.17+0	2.28+0
	δ	1.22−7	1.78−7	3.22−7	5.35−7	8.26−7	1.19−6	1.65−6	2.25−6	2.91−6	3.75−6
$2s_{1/2}$	σ	1.663−2	6.710−3	1.826−3	7.156−4	3.440−4	1.885−4	1.131−4	7.253−5	4.895−5	3.441−5
E_b =	β	1.985	1.980	1.969	1.959	1.948	1.938	1.927	1.917	1.907	1.897
5.4 eV	γ	8.73−1	1.02+0	1.26+0	1.46+0	1.63+0	1.79+0	1.93+0	2.06+0	2.18+0	2.29+0
	δ	3.80−9	1.04−8	8.50−8	2.12−7	4.70−7	6.95−7	1.23−6	1.29−6	2.49−6	2.95−6
Z= 4, Be: $1s^2_{1/2}\,2s^2_{1/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$1s_{1/2}$	σ	2.310+0	9.667−1	2.754−1	1.110−1	5.440−2	3.022−2	1.832−2	1.185−2	8.062−3	5.703−3
E_b =	β	1.986	1.981	1.971	1.960	1.950	1.939	1.929	1.919	1.909	1.899
111.9 eV	γ	8.26−1	9.77−1	1.22+0	1.43+0	1.60+0	1.76+0	1.90+0	2.03+0	2.15+0	2.27+0
	δ	9.85−8	2.02−7	4.16−7	7.05−7	1.05−6	1.53−6	2.13−6	2.84−6	3.65−6	4.55−6
$2s_{1/2}$	σ	7.882−2	3.292−2	9.335−3	3.753−3	1.834−3	1.017−3	6.157−4	3.979−4	2.704−4	1.911−4
E_b =	β	1.986	1.981	1.970	1.959	1.949	1.938	1.928	1.918	1.908	1.898
9.3 eV	γ	8.44−1	9.94−1	1.24+0	1.44+0	1.62+0	1.77+0	1.91+0	2.04+0	2.16+0	2.28+0
	δ	−8.61−9	1.22−8	9.17−8	2.35−7	4.76−7	8.07−7	1.29−6	1.75−6	2.52−6	3.23−6
Z= 5, B : $1s^2_{1/2}\,2s^2_{1/2}\,2p^1_{1/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$1s_{1/2}$	σ	5.815+0	2.490+0	7.311−1	3.006−1	1.494−1	8.389−2	5.133−2	3.344−2	2.287−2	1.625−2
E_b =	β	1.987	1.982	1.972	1.961	1.951	1.941	1.930	1.920	1.910	1.900
188.0 eV	γ	7.90−1	9.44−1	1.19+0	1.40+0	1.58+0	1.74+0	1.88+0	2.01+0	2.14+0	2.25+0
	δ	−2.76−8	1.44−7	4.63−7	8.48−7	1.28−6	1.85−6	2.49−6	3.26−6	4.21−6	5.34−6
$2s_{1/2}$	σ	2.366−1	1.018−1	3.003−2	1.235−2	6.139−3	3.446−3	2.107−3	1.372−3	9.381−4	6.666−4
E_b =	β	1.987	1.981	1.971	1.960	1.950	1.940	1.929	1.919	1.909	1.899
12.6 eV	γ	8.15−1	9.64−1	1.21+0	1.42+0	1.60+0	1.75+0	1.90+0	2.03+0	2.15+0	2.26+0
	δ	−3.80−9	1.75−8	1.06−7	2.83−7	5.57−7	9.38−7	1.40−6	1.95−6	2.77−6	3.67−6
$2p_{1/2}$	σ	3.894−3	1.278−3	2.552−4	7.947−5	3.179−5	1.493−5	7.854−6	4.491−6	2.740−6	1.759−6
E_b =	β	0.145	0.112	0.077	0.052	0.030	0.012	−.005	−.020	−.035	−.049
4.7 eV	γ	3.32−1	3.79−1	4.61−1	5.26−1	5.79−1	6.25−1	6.67−1	7.04−1	7.37−1	7.65−1
	δ	1.29−1	1.55−1	1.96−1	2.30−1	2.59−1	2.85−1	3.08−1	3.29−1	3.49−1	3.68−1
Z= 6, C : $1s^2_{1/2}\,2s^2_{1/2}\,2p^2_{1/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$1s_{1/2}$	σ	1.203+1	5.248+0	1.580+0	6.609−1	3.327−1	1.886−1	1.163−1	7.627−2	5.245−2	3.746−2
E_b =	β	1.988	1.983	1.973	1.963	1.952	1.942	1.932	1.922	1.911	1.901
284.1 eV	γ	7.46−1	9.04−1	1.16+0	1.37+0	1.55+0	1.71+0	1.86+0	1.99+0	2.11+0	2.23+0
	δ	−2.42−7	−3.01−8	3.83−7	8.72−7	1.38−6	2.04−6	2.82−6	3.71−6	4.78−6	6.05−6
$2s_{1/2}$	σ	5.324−1	2.348−1	7.160−2	3.011−2	1.520−2	8.628−3	5.322−3	3.492−3	2.402−3	1.716−3
E_b =	β	1.987	1.982	1.972	1.962	1.951	1.941	1.930	1.920	1.910	1.900
18.1 eV	γ	7.83−1	9.35−1	1.19+0	1.39+0	1.57+0	1.73+0	1.88+0	2.01+0	2.13+0	2.25+0
	δ	2.70−8	4.47−8	1.43−7	3.12−7	6.02−7	9.99−7	1.55−6	2.20−6	3.08−6	4.05−6
$2p_{1/2}$	σ	1.459−2	4.913−3	1.019−3	3.254−4	1.325−4	6.311−5	3.355−5	1.935−5	1.188−5	7.672−6

(*continued on next page*)

Table 1 (*continued*)

E_b =	β	0.217	0.163	0.109	0.077	0.053	0.031	0.013	−.004	−.019	−.034
9.0 eV	γ	3.57−1	3.98−1	4.73−1	5.37−1	5.90−1	6.36−1	6.76−1	7.12−1	7.45−1	7.75−1
	δ	1.22−1	1.47−1	1.89−1	2.23−1	2.53−1	2.79−1	3.03−1	3.25−1	3.45−1	3.63−1
Z= 7, N : $1s^2_{1/2}\,2s^2_{1/2}\,2p^2_{1/2}\,2p^1_{3/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$1s_{1/2}$	σ	2.185+1	9.680+0	2.980+0	1.265+0	6.438−1	3.682−1	2.286−1	1.507−1	1.042−1	7.472−2
E_b =	β	1.990	1.985	1.974	1.964	1.954	1.944	1.933	1.923	1.913	1.903
400.5 eV	γ	6.90−1	8.56−1	1.12+0	1.34+0	1.52+0	1.68+0	1.83+0	1.96+0	2.09+0	2.21+0
	δ	−6.23−7	−3.66−7	1.69−7	6.91−7	1.33−6	2.08−6	2.97−6	4.05−6	5.27−6	6.57−6
$2s_{1/2}$	σ	1.002+0	4.517−1	1.417−1	6.077−2	3.111−2	1.786−2	1.111−2	7.341−3	5.080−3	3.647−3
E_b =	β	1.988	1.983	1.973	1.963	1.952	1.942	1.932	1.921	1.911	1.901
24.3 eV	γ	7.47−1	9.03−1	1.16+0	1.37+0	1.55+0	1.71+0	1.85+0	1.99+0	2.11+0	2.23+0
	δ	5.73−8	7.18−8	1.56−7	3.62−7	6.60−7	1.10−6	1.71−6	2.39−6	3.32−6	4.41−6
$2p_{1/2}$	σ	4.103−2	1.412−2	3.026−3	9.881−4	4.090−4	1.973−4	1.060−4	6.163−5	3.811−5	2.475−5
E_b =	β	0.310	0.232	0.155	0.111	0.080	0.055	0.034	0.015	−.002	−.017
8.9 eV	γ	3.92−1	4.28−1	4.94−1	5.53−1	6.04−1	6.49−1	6.90−1	7.25−1	7.57−1	7.87−1
	δ	1.13−1	1.39−1	1.81−1	2.16−1	2.47−1	2.73−1	2.97−1	3.19−1	3.40−1	3.58−1
$2p_{3/2}$	σ	8.343−2	2.867−2	6.131−3	1.998−3	8.258−4	3.977−4	2.133−4	1.239−4	7.649−5	4.961−5
E_b =	β	0.314	0.237	0.163	0.123	0.095	0.073	0.055	0.040	0.026	0.013
9.7 eV	γ	3.91−1	4.27−1	4.93−1	5.51−1	6.01−1	6.45−1	6.84−1	7.19−1	7.50−1	7.78−1
	δ	1.13−1	1.39−1	1.81−1	2.16−1	2.46−1	2.72−1	2.96−1	3.18−1	3.38−1	3.57−1
Z= 8, O : $1s^2_{1/2}\,2s^2_{1/2}\,2p^2_{1/2}\,2p^2_{3/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$1s_{1/2}$	σ	3.583+1	1.615+1	5.078+0	2.186+0	1.124+0	6.478−1	4.047−1	2.684−1	1.863−1	1.342−1
E_b =	β	1.991	1.986	1.976	1.966	1.955	1.945	1.935	1.925	1.915	1.905
532.0 eV	γ	6.19−1	7.99−1	1.08+0	1.30+0	1.49+0	1.65+0	1.80+0	1.94+0	2.06+0	2.18+0
	δ	−1.16−6	−8.48−7	−2.51−7	3.79−7	1.13−6	1.98−6	3.00−6	4.22−6	5.54−6	6.97−6
$2s_{1/2}$	σ	1.665+0	7.672−1	2.475−1	1.081−1	5.610−2	3.255−2	2.043−2	1.359−2	9.460−3	6.827−3
E_b =	β	1.989	1.984	1.974	1.964	1.954	1.943	1.933	1.923	1.913	1.902
23.7 eV	γ	7.07−1	8.67−1	1.13+0	1.34+0	1.52+0	1.68+0	1.83+0	1.96+0	2.09+0	2.21+0
	δ	5.38−8	7.35−8	1.94−7	4.35−7	7.87−7	1.27−6	1.91−6	2.68−6	3.67−6	4.83−6
$2p_{1/2}$	σ	9.557−2	3.356−2	7.396−3	2.463−3	1.035−3	5.051−4	2.738−4	1.605−4	9.993−5	6.527−5
E_b =	β	0.413	0.316	0.211	0.153	0.113	0.083	0.059	0.037	0.018	0.001
6.8 eV	γ	4.32−1	4.65−1	5.22−1	5.75−1	6.23−1	6.67−1	7.06−1	7.41−1	7.73−1	8.02−1
	δ	1.05−1	1.30−1	1.74−1	2.09−1	2.40−1	2.67−1	2.91−1	3.13−1	3.34−1	3.53−1
$2p_{3/2}$	σ	1.920−1	6.733−2	1.480−2	4.920−3	2.063−3	1.005−3	5.441−4	3.184−4	1.980−4	1.291−4
E_b =	β	0.417	0.321	0.220	0.164	0.128	0.101	0.079	0.061	0.045	0.031
7.4 eV	γ	4.31−1	4.63−1	5.21−1	5.73−1	6.20−1	6.62−1	7.00−1	7.34−1	7.65−1	7.92−1
	δ	1.05−1	1.30−1	1.73−1	2.09−1	2.39−1	2.66−1	2.90−1	3.12−1	3.33−1	3.52−1
Z= 9, F : $1s^2_{1/2}\,2s^2_{1/2}\,2p^2_{1/2}\,2p^3_{3/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$1s_{1/2}$	σ	5.476+1	2.509+1	8.044+0	3.505+0	1.818+0	1.056+0	6.637−1	4.423−1	3.084−1	2.230−1
E_b =	β	1.993	1.988	1.977	1.967	1.957	1.947	1.937	1.927	1.917	1.906
685.4 eV	γ	5.35−1	7.29−1	1.03+0	1.25+0	1.45+0	1.62+0	1.77+0	1.91+0	2.03+0	2.15+0
	δ	−1.84−6	−1.49−6	−8.51−7	−8.73−8	7.66−7	1.72−6	2.83−6	4.14−6	5.57−6	7.20−6
$2s_{1/2}$	σ	2.572+0	1.207+0	3.985−1	1.769−1	9.286−2	5.438−2	3.438−2	2.302−2	1.611−2	1.168−2
E_b =	β	1.990	1.985	1.975	1.965	1.955	1.945	1.934	1.924	1.914	1.904
34.0 eV	γ	6.63−1	8.27−1	1.09+0	1.30+0	1.49+0	1.65+0	1.80+0	1.94+0	2.07+0	2.18+0
	δ	6.00−9	3.69−8	1.90−7	4.60−7	8.27−7	1.37−6	2.06−6	2.89−6	3.92−6	5.16−6
$2p_{1/2}$	σ	1.965−1	7.019−2	1.583−2	5.358−3	2.280−3	1.124−3	6.146−4	3.628−4	2.273−4	1.492−4
E_b =	β	0.523	0.410	0.277	0.202	0.153	0.116	0.087	0.063	0.042	0.023
8.4 eV	γ	4.71−1	5.03−1	5.56−1	6.04−1	6.48−1	6.89−1	7.26−1	7.60−1	7.91−1	8.20−1
	δ	9.63−2	1.22−1	1.66−1	2.02−1	2.33−1	2.60−1	2.84−1	3.07−1	3.28−1	3.47−1
$2p_{3/2}$	σ	3.908−1	1.394−1	3.135−2	1.059−2	4.498−3	2.214−3	1.208−3	7.121−4	4.453−4	2.919−4
E_b =	β	0.527	0.415	0.285	0.213	0.166	0.133	0.107	0.086	0.067	0.051
8.7 eV	γ	4.70−1	5.03−1	5.54−1	6.01−1	6.44−1	6.84−1	7.20−1	7.53−1	7.83−1	8.09−1
	δ	9.63−2	1.22−1	1.66−1	2.01−1	2.32−1	2.59−1	2.84−1	3.06−1	3.27−1	3.46−1
Z= 10, Ne: $1s^2_{1/2}\,2s^2_{1/2}\,2p^2_{1/2}\,2p^4_{3/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$1s_{1/2}$	σ	7.981+1	3.715+1	1.211+1	5.332+0	2.787+0	1.628+0	1.028+0	6.883−1	4.817−1	3.493−1
E_b =	β	1.994	1.989	1.979	1.969	1.959	1.949	1.939	1.928	1.918	1.908
870.1 eV	γ	4.23−1	6.47−1	9.64−1	1.20+0	1.40+0	1.58+0	1.73+0	1.87+0	2.00+0	2.12+0

(*continued on next page*)

Table 1 (*continued*)

	δ	−2.61−6	−2.39−6	−1.66−6	−8.24−7	5.67−8	1.05−6	2.41−6	3.64−6	5.29−6	6.96−6
$2s_{1/2}$	σ	3.732+0	1.782+0	6.018−1	2.710−1	1.438−1	8.490−2	5.406−2	3.640−2	2.560−2	1.864−2
E_b =	β	1.991	1.986	1.976	1.966	1.956	1.946	1.936	1.926	1.916	1.905
48.5 eV	γ	6.15−1	7.83−1	1.05+0	1.27+0	1.46+0	1.62+0	1.77+0	1.91+0	2.04+0	2.16+0
	δ	−9.81−8	−5.45−8	1.08−7	4.15−7	8.30−7	1.41−6	2.14−6	3.05−6	4.16−6	5.42−6
$2p_{1/2}$	σ	3.728−1	1.348−1	3.090−2	1.059−2	4.551−3	2.262−3	1.246−3	7.398−4	4.658−4	3.072−4
E_b =	β	0.636	0.509	0.348	0.257	0.198	0.154	0.120	0.092	0.068	0.046
21.7 eV	γ	5.08−1	5.43−1	5.94−1	6.38−1	6.79−1	7.17−1	7.51−1	7.84−1	8.13−1	8.41−1
	δ	8.84−2	1.14−1	1.58−1	1.94−1	2.25−1	2.53−1	2.77−1	3.00−1	3.21−1	3.40−1
$2p_{3/2}$	σ	7.345−1	2.653−1	6.068−2	2.075−2	8.899−3	4.416−3	2.427−3	1.439−3	9.042−4	5.954−4
E_b =	β	0.639	0.513	0.356	0.267	0.211	0.170	0.139	0.114	0.093	0.074
21.6 eV	γ	5.08−1	5.43−1	5.93−1	6.36−1	6.75−1	7.12−1	7.45−1	7.76−1	8.04−1	8.30−1
	δ	8.83−2	1.14−1	1.57−1	1.93−1	2.25−1	2.52−1	2.77−1	2.99−1	3.20−1	3.40−1
Z= 11, Na: [Ne]$3s^1_{1/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$1s_{1/2}$	σ	1.085+2	5.157+1	1.720+1	7.674+0	4.046+0	2.380+0	1.512+0	1.016+0	7.141−1	5.196−1
E_b =	β	1.996	1.991	1.981	1.971	1.961	1.951	1.941	1.931	1.921	1.911
1072.1 eV	γ	2.81−1	5.46−1	8.89−1	1.14+0	1.35+0	1.53+0	1.69+0	1.83+0	1.97+0	2.09+0
	δ	−3.21−6	−3.12−6	−2.51−6	−1.68−6	−6.22−7	4.76−7	1.74−6	3.28−6	4.85−6	6.83−6
$2s_{1/2}$	σ	5.352+0	2.608+0	9.037−1	4.131−1	2.218−1	1.321−1	8.470−2	5.737−2	4.055−2	2.965−2
E_b =	β	1.992	1.988	1.978	1.968	1.958	1.948	1.937	1.927	1.917	1.907
63.3 eV	γ	5.65−1	7.33−1	1.01+0	1.23+0	1.42+0	1.59+0	1.75+0	1.89+0	2.01+0	2.13+0
	δ	−1.65−7	−1.18−7	7.41−8	4.17−7	8.97−7	1.51−6	2.30−6	3.29−6	4.45−6	5.81−6
$2p_{1/2}$	σ	7.146−1	2.635−1	6.186−2	2.154−2	9.361−3	4.696−3	2.606−3	1.557−3	9.861−4	6.536−4
E_b =	β	0.738	0.598	0.423	0.316	0.244	0.194	0.155	0.123	0.095	0.072
31.1 eV	γ	5.33−1	5.75−1	6.33−1	6.74−1	7.13−1	7.49−1	7.82−1	8.13−1	8.42−1	8.68−1
	δ	8.10−2	1.06−1	1.49−1	1.85−1	2.16−1	2.44−1	2.69−1	2.92−1	3.13−1	3.33−1
$2p_{3/2}$	σ	1.406+0	5.179−1	1.213−1	4.215−2	1.827−2	9.150−3	5.066−3	3.023−3	1.910−3	1.264−3
E_b =	β	0.741	0.603	0.430	0.326	0.257	0.209	0.173	0.144	0.119	0.098
31.0 eV	γ	5.34−1	5.75−1	6.32−1	6.72−1	7.10−1	7.45−1	7.76−1	8.05−1	8.32−1	8.57−1
	δ	8.09−2	1.06−1	1.48−1	1.85−1	2.16−1	2.43−1	2.68−1	2.91−1	3.12−1	3.32−1
$3s_{1/2}$	σ	1.224−1	5.933−2	2.045−2	9.331−3	5.000−3	2.975−3	1.906−3	1.291−3	9.119−4	6.666−4
E_b =	β	1.992	1.987	1.977	1.967	1.957	1.947	1.937	1.927	1.917	1.907
0.7 eV	γ	5.76−1	7.44−1	1.02+0	1.24+0	1.43+0	1.60+0	1.75+0	1.89+0	2.02+0	2.14+0
	δ	−8.73−8	−7.66−8	1.19−7	4.34−7	8.77−7	1.49−6	2.25−6	3.05−6	4.20−6	5.74−6
Z= 12, Mg: [Ne]$3s^2_{1/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$1s_{1/2}$	σ	1.419+2	6.917+1	2.359+1	1.066+1	5.665+0	3.353+0	2.141+0	1.445+0	1.019+0	7.434−1
E_b =	β	1.998	1.994	1.984	1.973	1.963	1.953	1.943	1.933	1.923	1.913
1305.0 eV	γ	7.97−2	4.16−1	8.06−1	1.08+0	1.29+0	1.48+0	1.65+0	1.79+0	1.93+0	2.05+0
	δ	−3.88−6	−4.04−6	−3.55−6	−2.71−6	−1.69−6	−4.77−7	8.37−7	2.44−6	4.20−6	6.29−6
$2s_{1/2}$	σ	7.384+0	3.667+0	1.299+0	6.023−1	3.266−1	1.961−1	1.265−1	8.613−2	6.115−2	4.489−2
E_b =	β	1.993	1.989	1.979	1.969	1.959	1.949	1.939	1.929	1.919	1.909
89.4 eV	γ	5.10−1	6.86−1	9.66−1	1.19+0	1.39+0	1.56+0	1.71+0	1.85+0	1.98+0	2.10+0
	δ	−3.01−7	−2.14−7	7.80−9	3.60−7	8.78−7	1.55−6	2.44−6	3.51−6	4.78−6	6.26−6
$2p_{1/2}$	σ	1.263+0	4.736−1	1.136−1	4.006−2	1.758−2	8.893−3	4.967−3	2.986−3	1.900−3	1.265−3
E_b =	β	0.835	0.684	0.499	0.377	0.298	0.242	0.197	0.160	0.128	0.101
51.5 eV	γ	5.54−1	6.05−1	6.68−1	7.11−1	7.50−1	7.84−1	8.14−1	8.41−1	8.67−1	8.92−1
	δ	7.43−2	9.78−2	1.40−1	1.76−1	2.07−1	2.36−1	2.61−1	2.85−1	3.06−1	3.26−1
$2p_{3/2}$	σ	2.481+0	9.291−1	2.223−1	7.824−2	3.426−2	1.729−2	9.637−3	5.782−3	3.672−3	2.440−3
E_b =	β	0.839	0.689	0.506	0.386	0.310	0.256	0.215	0.180	0.151	0.127
51.3 eV	γ	5.55−1	6.05−1	6.68−1	7.09−1	7.47−1	7.80−1	8.08−1	8.34−1	8.58−1	8.80−1
	δ	7.42−2	9.77−2	1.40−1	1.76−1	2.07−1	2.35−1	2.61−1	2.84−1	3.06−1	3.25−1
$3s_{1/2}$	σ	2.787−1	1.377−1	4.854−2	2.246−2	1.216−2	7.292−3	4.703−3	3.201−3	2.273−3	1.668−3
E_b =	β	1.993	1.988	1.979	1.969	1.959	1.949	1.938	1.928	1.918	1.908
2.1 eV	γ	5.25−1	6.99−1	9.78−1	1.21+0	1.40+0	1.57+0	1.72+0	1.86+0	1.99+0	2.11+0
	δ	−1.92−7	−9.96−8	7.74−8	4.52−7	9.27−7	1.59−6	2.44−6	3.40−6	4.55−6	6.13−6
Z= 13, Al: [Ne]$3s^2_{1/2}$ $3p^1_{1/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$2s_{1/2}$	σ	9.742+0	4.925+0	1.785+0	8.397−1	4.597−1	2.780−1	1.805−1	1.236−1	8.815−2	6.497−2
E_b =	β	1.994	1.990	1.981	1.971	1.961	1.951	1.941	1.931	1.921	1.911
117.7 eV	γ	4.55−1	6.31−1	9.21−1	1.15+0	1.35+0	1.52+0	1.68+0	1.82+0	1.96+0	2.08+0
	δ	−4.80−7	−3.63−7	−1.09−7	2.91−7	8.50−7	1.60−6	2.53−6	3.67−6	4.99−6	6.53−6

(*continued on next page*)

Table 1 (*continued*)

$2p_{1/2}$	σ	2.073+0	7.915−1	1.940−1	6.936−2	3.076−2	1.568−2	8.811−3	5.325−3	3.403−3	2.275−3
E_b =	β	0.925	0.771	0.567	0.442	0.357	0.291	0.238	0.195	0.160	0.131
73.2 eV	γ	5.68−1	6.28−1	7.01−1	7.49−1	7.87−1	8.18−1	8.46−1	8.74−1	9.00−1	9.25−1
	δ	6.82−2	9.07−2	1.32−1	1.67−1	1.99−1	2.28−1	2.53−1	2.76−1	2.98−1	3.17−1
$2p_{3/2}$	σ	4.049+0	1.544+0	3.776−1	1.347−1	5.960−2	3.031−2	1.700−2	1.025−2	6.539−3	4.363−3
E_b =	β	0.929	0.776	0.574	0.451	0.368	0.305	0.255	0.214	0.182	0.156
72.7 eV	γ	5.69−1	6.29−1	7.01−1	7.48−1	7.84−1	8.13−1	8.40−1	8.66−1	8.91−1	9.14−1
	δ	6.82−2	9.06−2	1.31−1	1.67−1	1.99−1	2.27−1	2.53−1	2.76−1	2.97−1	3.17−1
$3s_{1/2}$	σ	5.263−1	2.648−1	9.548−2	4.483−2	2.452−2	1.482−2	9.620−3	6.586−3	4.697−3	3.462−3
E_b =	β	1.994	1.990	1.980	1.970	1.960	1.950	1.940	1.930	1.920	1.910
0.7 eV	γ	4.79−1	6.51−1	9.34−1	1.17+0	1.36+0	1.53+0	1.69+0	1.83+0	1.96+0	2.08+0
	δ	−2.68−7	−2.03−7	4.79−9	4.25−7	9.59−7	1.69−6	2.58−6	3.66−6	4.92−6	6.48−6
$3p_{1/2}$	σ	6.664−2	2.543−2	6.214−3	2.217−3	9.813−4	4.995−4	2.803−4	1.693−4	1.082−4	7.226−5
E_b =	β	0.909	0.757	0.559	0.438	0.350	0.283	0.232	0.190	0.157	0.127
6.0 eV	γ	5.68−1	6.28−1	7.02−1	7.50−1	7.86−1	8.17−1	8.47−1	8.74−1	9.00−1	9.24−1
	δ	6.86−2	9.12−2	1.32−1	1.68−1	2.00−1	2.29−1	2.54−1	2.77−1	2.98−1	3.18−1

Z= 14, Si: [Ne]$3s^2_{1/2}$ $3p^2_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$2s_{1/2}$	σ	1.241+1	6.383+0	2.365+0	1.128+0	6.238−1	3.802−1	2.484−1	1.708−1	1.224−1	9.051−2
E_b =	β	1.995	1.991	1.982	1.972	1.962	1.953	1.943	1.932	1.922	1.913
148.7 eV	γ	4.01−1	5.78−1	8.70−1	1.11+0	1.31+0	1.49+0	1.65+0	1.79+0	1.92+0	2.04+0
	δ	−7.16−7	−5.73−7	−2.26−7	1.90−7	7.81−7	1.55−6	2.56−6	3.79−6	5.24−6	6.91−6
$2p_{1/2}$	σ	3.220+0	1.251+0	3.131−1	1.135−1	5.078−2	2.607−2	1.474−2	8.954−3	5.750−3	3.858−3
E_b =	β	1.001	0.850	0.641	0.505	0.409	0.338	0.284	0.239	0.201	0.167
99.5 eV	γ	5.75−1	6.45−1	7.30−1	7.83−1	8.23−1	8.56−1	8.86−1	9.11−1	9.34−1	9.55−1
	δ	6.25−2	8.39−2	1.24−1	1.59−1	1.90−1	2.18−1	2.44−1	2.68−1	2.90−1	3.11−1
$2p_{3/2}$	σ	6.247+0	2.424+0	6.056−1	2.189−1	9.775−2	5.007−2	2.825−2	1.712−2	1.097−2	7.349−3
E_b =	β	1.006	0.856	0.648	0.514	0.420	0.352	0.300	0.258	0.222	0.191
98.9 eV	γ	5.78−1	6.47−1	7.31−1	7.82−1	8.20−1	8.52−1	8.80−1	9.04−1	9.25−1	9.44−1
	δ	6.24−2	8.37−2	1.23−1	1.59−1	1.90−1	2.18−1	2.44−1	2.67−1	2.89−1	3.10−1
$3s_{1/2}$	σ	8.339−1	4.263−1	1.570−1	7.465−2	4.121−2	2.510−2	1.639−2	1.127−2	8.074−3	5.972−3
E_b =	β	1.995	1.991	1.981	1.972	1.962	1.952	1.942	1.932	1.922	1.912
7.6 eV	γ	4.31−1	6.04−1	8.89−1	1.12+0	1.32+0	1.50+0	1.66+0	1.80+0	1.93+0	2.05+0
	δ	−3.82−7	−3.07−7	−8.23−8	3.18−7	9.19−7	1.69−6	2.65−6	3.81−6	5.17−6	6.81−6
$3p_{1/2}$	σ	1.387−1	5.423−2	1.362−2	4.938−3	2.209−3	1.134−3	6.408−4	3.892−4	2.499−4	1.677−4
E_b =	β	0.976	0.834	0.631	0.495	0.399	0.329	0.276	0.232	0.195	0.163
3.0 eV	γ	5.73−1	6.44−1	7.29−1	7.81−1	8.21−1	8.54−1	8.84−1	9.10−1	9.34−1	9.55−1
	δ	6.28−2	8.47−2	1.25−1	1.60−1	1.91−1	2.19−1	2.45−1	2.68−1	2.90−1	3.11−1

Z= 15, P : [Ne]$3s^2_{1/2}$ $3p^2_{1/2}$ $3p^1_{3/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$2s_{1/2}$	σ	1.545+1	8.069+0	3.050+0	1.474+0	8.224−1	5.048−1	3.316−1	2.292−1	1.648−1	1.224−1
E_b =	β	1.996	1.992	1.984	1.974	1.964	1.954	1.944	1.934	1.924	1.914
189.3 eV	γ	3.47−1	5.25−1	8.20−1	1.06+0	1.27+0	1.45+0	1.61+0	1.76+0	1.89+0	2.02+0
	δ	−1.15−6	−8.89−7	−4.95−7	−3.59−8	5.79−7	1.43−6	2.47−6	3.74−6	5.25−6	7.00−6
$2p_{1/2}$	σ	4.801+0	1.892+0	4.826−1	1.770−1	7.988−2	4.128−2	2.346−2	1.432−2	9.228−3	6.214−3
E_b =	β	1.071	0.923	0.712	0.570	0.467	0.389	0.328	0.278	0.237	0.202
136.2 eV	γ	5.79−1	6.59−1	7.57−1	8.16−1	8.58−1	8.92−1	9.22−1	9.48−1	9.72−1	9.94−1
	δ	5.72−2	7.75−2	1.16−1	1.51−1	1.82−1	2.10−1	2.36−1	2.59−1	2.81−1	3.01−1
$2p_{3/2}$	σ	9.311+0	3.665+0	9.327−1	3.412−1	1.536−1	7.920−2	4.491−2	2.735−2	1.759−2	1.182−2
E_b =	β	1.077	0.930	0.720	0.579	0.478	0.402	0.344	0.296	0.258	0.225
135.3 eV	γ	5.82−1	6.61−1	7.58−1	8.16−1	8.57−1	8.89−1	9.16−1	9.41−1	9.63−1	9.83−1
	δ	5.72−2	7.73−2	1.16−1	1.50−1	1.81−1	2.09−1	2.35−1	2.58−1	2.80−1	3.00−1
$3s_{1/2}$	σ	1.197+0	6.206−1	2.331−1	1.123−1	6.255−2	3.836−2	2.518−2	1.740−2	1.251−2	9.288−3
E_b =	β	1.996	1.992	1.983	1.973	1.963	1.953	1.943	1.933	1.924	1.914
16.2 eV	γ	3.85−1	5.55−1	8.43−1	1.08+0	1.28+0	1.46+0	1.62+0	1.76+0	1.90+0	2.02+0
	δ	−5.85−7	−5.12−7	−2.59−7	1.70−7	8.07−7	1.61−6	2.66−6	3.91−6	5.39−6	7.07−6
$3p_{1/2}$	σ	2.517−1	1.004−1	2.584−2	9.504−3	4.296−3	2.221−3	1.263−3	7.711−4	4.971−4	3.348−4
E_b =	β	1.044	0.902	0.699	0.560	0.459	0.382	0.320	0.270	0.228	0.193
9.6 eV	γ	5.76−1	6.55−1	7.54−1	8.13−1	8.55−1	8.89−1	9.17−1	9.43−1	9.66−1	9.89−1
	δ	5.76−2	7.83−2	1.17−1	1.52−1	1.83−1	2.12−1	2.37−1	2.61−1	2.82−1	3.02−1
$3p_{3/2}$	σ	5.038−1	2.004−1	5.139−2	1.884−2	8.492−3	4.380−3	2.484−3	1.513−3	9.732−4	6.540−4
E_b =	β	1.050	0.910	0.707	0.570	0.471	0.396	0.336	0.289	0.249	0.216
10.1 eV	γ	5.78−1	6.57−1	7.55−1	8.13−1	8.53−1	8.85−1	9.11−1	9.35−1	9.57−1	9.77−1
	δ	5.72−2	7.79−2	1.17−1	1.51−1	1.83−1	2.11−1	2.36−1	2.60−1	2.81−1	3.01−1

(*continued on next page*)

Table 1 (*continued*)

Z= 16, S : [Ne]$3s^2_{1/2}$ $3p^2_{1/2}$ $3p^2_{3/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$2s_{1/2}$	σ	1.872+1	9.921+0	3.826+0	1.873+0	1.055+0	6.520−1	4.307−1	2.991−1	2.160−1	1.609−1
E_b =	β	1.997	1.993	1.985	1.976	1.966	1.956	1.946	1.936	1.926	1.917
229.2 eV	γ	2.93−1	4.69−1	7.67−1	1.01+0	1.22+0	1.40+0	1.57+0	1.72+0	1.85+0	1.98+0
	δ	−1.74−6	−1.31−6	−8.52−7	−3.82−7	2.99−7	1.17−6	2.30−6	3.66−6	5.27−6	7.11−6
$2p_{1/2}$	σ	6.778+0	2.715+0	7.078−1	2.631−1	1.199−1	6.242−2	3.569−2	2.188−2	1.416−2	9.571−3
E_b =	β	1.135	0.994	0.781	0.633	0.524	0.441	0.375	0.321	0.276	0.237
165.4 eV	γ	5.76−1	6.66−1	7.78−1	8.45−1	8.91−1	9.27−1	9.57−1	9.83−1	1.01+0	1.03+0
	δ	5.30−2	7.21−2	1.09−1	1.42−1	1.73−1	2.01−1	2.27−1	2.51−1	2.73−1	2.93−1
$2p_{3/2}$	σ	1.315+1	5.260+0	1.368+0	5.071−1	2.305−1	1.197−1	6.827−2	4.176−2	2.697−2	1.819−2
E_b =	β	1.141	1.001	0.789	0.642	0.535	0.455	0.391	0.339	0.296	0.259
164.2 eV	γ	5.80−1	6.70−1	7.80−1	8.46−1	8.91−1	9.25−1	9.53−1	9.76−1	9.98−1	1.02+0
	δ	5.30−2	7.19−2	1.08−1	1.42−1	1.73−1	2.01−1	2.26−1	2.50−1	2.72−1	2.92−1
$3s_{1/2}$	σ	1.607+0	8.445−1	3.234−1	1.579−1	8.883−2	5.487−2	3.624−2	2.516−2	1.816−2	1.353−2
E_b =	β	1.996	1.993	1.984	1.975	1.965	1.955	1.945	1.935	1.925	1.916
15.8 eV	γ	3.40−1	5.07−1	7.94−1	1.03+0	1.24+0	1.42+0	1.58+0	1.73+0	1.86+0	1.99+0
	δ	−8.31−7	−7.86−7	−5.42−7	−7.20−8	6.12−7	1.50−6	2.59−6	3.95−6	5.54−6	7.38−6
$3p_{1/2}$	σ	4.069−1	1.657−1	4.384−2	1.639−2	7.493−3	3.907−3	2.236−3	1.372−3	8.888−4	6.009−4
E_b =	β	1.102	0.963	0.760	0.619	0.514	0.433	0.369	0.316	0.271	0.232
7.8 eV	γ	5.74−1	6.61−1	7.72−1	8.40−1	8.88−1	9.24−1	9.54−1	9.79−1	1.00+0	1.02+0
	δ	5.29−2	7.25−2	1.10−1	1.44−1	1.75−1	2.03−1	2.28−1	2.52−1	2.74−1	2.95−1
$3p_{3/2}$	σ	8.054−1	3.272−1	8.619−2	3.212−2	1.463−2	7.609−3	4.344−3	2.659−3	1.718−3	1.159−3
E_b =	β	1.110	0.972	0.769	0.629	0.526	0.447	0.385	0.334	0.291	0.254
8.2 eV	γ	5.77−1	6.64−1	7.74−1	8.40−1	8.86−1	9.21−1	9.49−1	9.72−1	9.93−1	1.01+0
	δ	5.25−2	7.19−2	1.09−1	1.43−1	1.74−1	2.02−1	2.28−1	2.51−1	2.73−1	2.94−1

Z= 17, Cl: [Ne]$3s^2_{1/2}$ $3p^2_{1/2}$ $3p^3_{3/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$2s_{1/2}$	σ	2.220+1	1.193+1	4.689+0	2.325+0	1.322+0	8.228−1	5.466−1	3.813−1	2.764−1	2.066−1
E_b =	β	1.998	1.995	1.987	1.977	1.968	1.958	1.948	1.938	1.929	1.919
270.2 eV	γ	2.39−1	4.12−1	7.11−1	9.59−1	1.17+0	1.36+0	1.52+0	1.68+0	1.81+0	1.94+0
	δ	−2.38−6	−1.87−6	−1.35−6	−8.31−7	−5.94−8	8.39−7	1.99−6	3.42−6	5.12−6	7.09−6
$2p_{1/2}$	σ	9.318+0	3.786+0	1.006+0	3.788−1	1.742−1	9.130−2	5.249−2	3.234−2	2.101−2	1.425−2
E_b =	β	1.195	1.060	0.849	0.697	0.582	0.494	0.424	0.366	0.317	0.276
201.6 eV	γ	5.70−1	6.69−1	7.95−1	8.71−1	9.23−1	9.62−1	9.93−1	1.02+0	1.04+0	1.06+0
	δ	4.92−2	6.71−2	1.02−1	1.35−1	1.65−1	1.93−1	2.18−1	2.42−1	2.64−1	2.85−1
$2p_{3/2}$	σ	1.808+1	7.335+0	1.944+0	7.298−1	3.347−1	1.750−1	1.004−1	6.167−2	3.998−2	2.705−2
E_b =	β	1.203	1.068	0.858	0.707	0.594	0.508	0.439	0.383	0.337	0.297
200.0 eV	γ	5.75−1	6.74−1	7.98−1	8.73−1	9.23−1	9.60−1	9.90−1	1.01+0	1.03+0	1.05+0
	δ	4.92−2	6.69−2	1.02−1	1.34−1	1.64−1	1.92−1	2.17−1	2.41−1	2.63−1	2.84−1
$3s_{1/2}$	σ	2.072+0	1.101+0	4.294−1	2.123−1	1.205−1	7.498−2	4.980−2	3.474−2	2.518−2	1.882−2
E_b =	β	1.997	1.994	1.986	1.976	1.967	1.957	1.947	1.937	1.927	1.918
17.5 eV	γ	2.97−1	4.60−1	7.45−1	9.86−1	1.19+0	1.38+0	1.54+0	1.69+0	1.83+0	1.96+0
	δ	−1.18−6	−1.14−6	−9.12−7	−4.23−7	3.14−7	1.24−6	2.42−6	3.86−6	5.55−6	7.49−6
$3p_{1/2}$	σ	6.130−1	2.546−1	6.914−2	2.628−2	1.214−2	6.385−3	3.678−3	2.269−3	1.476−3	1.002−3
E_b =	β	1.154	1.018	0.818	0.675	0.567	0.483	0.415	0.358	0.311	0.270
6.7 eV	γ	5.69−1	6.63−1	7.86−1	8.63−1	9.16−1	9.56−1	9.88−1	1.02+0	1.04+0	1.06+0
	δ	4.83−2	6.68−2	1.03−1	1.36−1	1.66−1	1.94−1	2.20−1	2.43−1	2.65−1	2.86−1
$3p_{3/2}$	σ	1.202+0	4.980−1	1.346−1	5.099−2	2.349−2	1.231−2	7.075−3	4.353−3	2.825−3	1.913−3
E_b =	β	1.163	1.026	0.826	0.686	0.579	0.497	0.430	0.376	0.330	0.292
6.7 eV	γ	5.73−1	6.66−1	7.88−1	8.64−1	9.15−1	9.54−1	9.84−1	1.01+0	1.03+0	1.05+0
	δ	4.80−2	6.63−2	1.02−1	1.35−1	1.66−1	1.93−1	2.19−1	2.42−1	2.64−1	2.85−1

Z= 18, Ar: [Ne]$3s^2_{1/2}$ $3p^2_{1/2}$ $3p^4_{3/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$2s_{1/2}$	σ	2.609+1	1.418+1	5.668+0	2.843+0	1.630+0	1.021+0	6.820−1	4.778−1	3.476−1	2.606−1
E_b =	β	1.998	1.996	1.988	1.979	1.970	1.960	1.950	1.941	1.931	1.921
326.0 eV	γ	1.84−1	3.55−1	6.54−1	9.04−1	1.12+0	1.31+0	1.48+0	1.63+0	1.77+0	1.90+0
	δ	−3.15−6	−2.72−6	−2.04−6	−1.47−6	−6.31−7	2.95−7	1.52−6	3.00−6	4.74−6	6.75−6
$2p_{1/2}$	σ	1.263+1	5.184+0	1.400+0	5.326−1	2.468−1	1.302−1	7.520−2	4.651−2	3.033−2	2.063−2
E_b =	β	1.250	1.117	0.912	0.760	0.643	0.549	0.474	0.412	0.360	0.315
250.6 eV	γ	5.60−1	6.69−1	8.08−1	8.94−1	9.52−1	9.95−1	1.03+0	1.06+0	1.08+0	1.10+0
	δ	4.55−2	6.20−2	9.58−2	1.28−1	1.57−1	1.84−1	2.10−1	2.33−1	2.55−1	2.76−1
$2p_{3/2}$	σ	2.451+1	1.004+1	2.703+0	1.026+0	4.740−1	2.493−1	1.437−1	8.863−2	5.766−2	3.913−2
E_b =	β	1.259	1.126	0.921	0.771	0.655	0.563	0.489	0.429	0.379	0.337

(*continued on next page*)

Table 1 (*continued*)

248.5 eV	γ	5.65−1	6.75−1	8.13−1	8.97−1	9.54−1	9.95−1	1.03+0	1.05+0	1.07+0	1.09+0
	δ	4.55−2	6.18−2	9.53−2	1.27−1	1.56−1	1.83−1	2.09−1	2.32−1	2.54−1	2.75−1
$3s_{1/2}$	σ	2.609+0	1.399+0	5.533−1	2.766−1	1.583−1	9.913−2	6.619−2	4.637−2	3.374−2	2.530−2
E_b =	β	1.997	1.994	1.987	1.978	1.969	1.959	1.949	1.939	1.930	1.920
29.2 eV	γ	2.56−1	4.16−1	6.97−1	9.38−1	1.15+0	1.33+0	1.50+0	1.65+0	1.79+0	1.92+0
	δ	−1.56−6	−1.51−6	−1.32−6	−9.21−7	−1.73−7	8.03−7	2.04−6	3.56−6	5.34−6	7.38−6
$3p_{1/2}$	σ	8.876−1	3.743−1	1.039−1	4.007−2	1.871−2	9.912−3	5.744−3	3.560−3	2.326−3	1.584−3
E_b =	β	1.202	1.069	0.870	0.728	0.619	0.532	0.461	0.401	0.351	0.307
15.9 eV	γ	5.64−1	6.63−1	7.97−1	8.83−1	9.42−1	9.86−1	1.02+0	1.05+0	1.07+0	1.10+0
	δ	4.40−2	6.16−2	9.61−2	1.29−1	1.59−1	1.86−1	2.11−1	2.35−1	2.56−1	2.77−1
$3p_{3/2}$	σ	1.729+0	7.267−1	2.008−1	7.715−2	3.590−2	1.896−2	1.096−2	6.774−3	4.414−3	2.999−3
E_b =	β	1.212	1.078	0.881	0.740	0.632	0.546	0.477	0.419	0.370	0.329
15.8 eV	γ	5.68−1	6.68−1	8.01−1	8.85−1	9.43−1	9.85−1	1.02+0	1.04+0	1.07+0	1.09+0
	δ	4.37−2	6.10−2	9.53−2	1.28−1	1.58−1	1.85−1	2.10−1	2.34−1	2.55−1	2.76−1
Z= 19, K : [Ar]$4s^1_{1/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$2s_{1/2}$	σ	2.990+1	1.647+1	6.699+0	3.400+0	1.967+0	1.241+0	8.332−1	5.865−1	4.283−1	3.222−1
E_b =	β	1.999	1.997	1.989	1.981	1.972	1.962	1.953	1.943	1.933	1.923
377.1 eV	γ	1.34−1	3.03−1	5.99−1	8.51−1	1.07+0	1.26+0	1.43+0	1.58+0	1.73+0	1.86+0
	δ	−4.32−6	−3.67−6	−2.87−6	−2.17−6	−1.34−6	−3.42−7	9.12−7	2.47−6	4.31−6	6.45−6
$2p_{1/2}$	σ	1.639+1	6.823+0	1.877+0	7.236−1	3.386−1	1.799−1	1.045−1	6.495−2	4.252−2	2.902−2
E_b =	β	1.291	1.168	0.963	0.810	0.693	0.599	0.523	0.460	0.406	0.359
296.3 eV	γ	5.42−1	6.63−1	8.15−1	9.09−1	9.74−1	1.02+0	1.06+0	1.09+0	1.11+0	1.14+0
	δ	4.18−2	5.79−2	8.94−2	1.20−1	1.49−1	1.76−1	2.02−1	2.25−1	2.47−1	2.68−1
$2p_{3/2}$	σ	3.177+1	1.319+1	3.617+0	1.390+0	6.485−1	3.435−1	1.991−1	1.234−1	8.059−2	5.488−2
E_b =	β	1.301	1.178	0.974	0.821	0.705	0.613	0.539	0.477	0.425	0.380
293.6 eV	γ	5.49−1	6.69−1	8.21−1	9.14−1	9.77−1	1.02+0	1.06+0	1.09+0	1.11+0	1.13+0
	δ	4.17−2	5.77−2	8.88−2	1.19−1	1.48−1	1.75−1	2.01−1	2.24−1	2.46−1	2.67−1
$3s_{1/2}$	σ	3.349+0	1.811+0	7.274−1	3.677−1	2.123−1	1.338−1	8.982−2	6.322−2	4.617−2	3.474−2
E_b =	β	1.998	1.995	1.988	1.980	1.970	1.961	1.951	1.941	1.932	1.922
33.9 eV	γ	2.20−1	3.73−1	6.53−1	8.94−1	1.10+0	1.29+0	1.46+0	1.61+0	1.75+0	1.88+0
	δ	−2.03−6	−2.04−6	−1.84−6	−1.41−6	−6.55−7	3.53−7	1.63−6	3.22−6	5.10−6	7.28−6
$3p_{1/2}$	σ	1.337+0	5.738−1	1.632−1	6.397−2	3.022−2	1.615−2	9.425−3	5.875−3	3.856−3	2.637−3
E_b =	β	1.244	1.119	0.917	0.773	0.662	0.573	0.500	0.438	0.386	0.340
18.1 eV	γ	5.55−1	6.61−1	8.04−1	8.97−1	9.63−1	1.01+0	1.05+0	1.08+0	1.11+0	1.13+0
	δ	4.05−2	5.72−2	8.98−2	1.21−1	1.50−1	1.77−1	2.02−1	2.26−1	2.48−1	2.68−1
$3p_{3/2}$	σ	2.603+0	1.114+0	3.151−1	1.230−1	5.792−2	3.086−2	1.796−2	1.116−2	7.306−3	4.984−3
E_b =	β	1.254	1.130	0.929	0.785	0.675	0.587	0.515	0.456	0.405	0.361
17.8 eV	γ	5.59−1	6.65−1	8.08−1	9.01−1	9.65−1	1.01+0	1.05+0	1.08+0	1.10+0	1.12+0
	δ	4.02−2	5.66−2	8.89−2	1.20−1	1.49−1	1.76−1	2.01−1	2.24−1	2.46−1	2.67−1
$4s_{1/2}$	σ	1.262−1	6.800−2	2.718−2	1.371−2	7.902−3	4.977−3	3.339−3	2.349−3	1.715−3	1.290−3
E_b =	β	1.998	1.995	1.988	1.979	1.970	1.961	1.951	1.941	1.931	1.922
0.7 eV	γ	2.25−1	3.80−1	6.59−1	8.99−1	1.11+0	1.29+0	1.46+0	1.61+0	1.75+0	1.88+0
	δ	−1.83−6	−1.74−6	−1.71−6	−1.28−6	−6.33−7	2.89−7	1.48−6	3.16−6	5.15−6	6.81−6
Z= 20, Ca: [Ar]$4s^2_{1/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$2s_{1/2}$	σ	3.399+1	1.894+1	7.830+0	4.019+0	2.344+0	1.488+0	1.005+0	7.104−1	5.207−1	3.930−1
E_b =	β	1.999	1.997	1.991	1.983	1.974	1.964	1.955	1.945	1.935	1.926
437.8 eV	γ	8.76−2	2.47−1	5.45−1	7.97−1	1.01+0	1.21+0	1.38+0	1.54+0	1.68+0	1.82+0
	δ	−5.47−6	−4.71−6	−3.85−6	−3.01−6	−2.16−6	−1.11−6	1.89−7	1.77−6	3.65−6	5.91−6
$2p_{1/2}$	σ	2.099+1	8.832+0	2.470+0	9.637−1	4.549−1	2.433−1	1.422−1	8.873−2	5.831−2	3.993−2
E_b =	β	1.330	1.216	1.014	0.866	0.750	0.654	0.575	0.508	0.451	0.401
350.0 eV	γ	5.23−1	6.53−1	8.19−1	9.24−1	9.96−1	1.05+0	1.09+0	1.12+0	1.15+0	1.17+0
	δ	3.92−2	5.37−2	8.37−2	1.14−1	1.42−1	1.69−1	1.93−1	2.17−1	2.38−1	2.59−1
$2p_{3/2}$	σ	4.060+1	1.704+1	4.748+0	1.846+0	8.689−1	4.634−1	2.700−1	1.681−1	1.102−1	7.525−2
E_b =	β	1.341	1.227	1.025	0.879	0.764	0.669	0.592	0.526	0.470	0.423
346.4 eV	γ	5.30−1	6.60−1	8.26−1	9.30−1	1.00+0	1.05+0	1.09+0	1.12+0	1.15+0	1.17+0
	δ	3.92−2	5.34−2	8.31−2	1.13−1	1.41−1	1.67−1	1.92−1	2.15−1	2.37−1	2.57−1
$3s_{1/2}$	σ	4.202+0	2.290+0	9.314−1	4.754−1	2.766−1	1.755−1	1.184−1	8.369−2	6.135−2	4.630−2
E_b =	β	1.998	1.996	1.989	1.981	1.972	1.963	1.953	1.944	1.934	1.924
43.7 eV	γ	1.82−1	3.33−1	6.08−1	8.46−1	1.05+0	1.24+0	1.41+0	1.57+0	1.71+0	1.84+0
	δ	−2.61−6	−2.71−6	−2.45−6	−2.05−6	−1.30−6	−3.18−7	1.03−6	2.68−6	4.62−6	6.95−6
$3p_{1/2}$	σ	1.908+0	8.306−1	2.415−1	9.613−2	4.592−2	2.475−2	1.454−2	9.109−3	6.004−3	4.122−3
E_b =	β	1.288	1.160	0.967	0.829	0.717	0.625	0.550	0.485	0.431	0.383
25.8 eV	γ	5.45−1	6.55−1	8.09−1	9.11−1	9.82−1	1.04+0	1.08+0	1.11+0	1.14+0	1.16+0
	δ	3.71−2	5.25−2	8.43−2	1.15−1	1.43−1	1.70−1	1.95−1	2.18−1	2.40−1	2.60−1

(*continued on next page*)

Table 1 (*continued*)

$3p_{3/2}$	σ	3.713+0	1.611+0	4.658−1	1.846−1	8.787−2	4.720−2	2.764−2	1.727−2	1.135−2	7.773−3
E_b =	β	1.299	1.172	0.980	0.842	0.730	0.640	0.566	0.503	0.450	0.404
25.5 eV	γ	5.50−1	6.61−1	8.14−1	9.15−1	9.85−1	1.04+0	1.08+0	1.11+0	1.13+0	1.15+0
	δ	3.68−2	5.19−2	8.34−2	1.14−1	1.42−1	1.69−1	1.93−1	2.17−1	2.39−1	2.59−1
$4s_{1/2}$	σ	2.451−1	1.329−1	5.373−2	2.736−2	1.590−2	1.008−2	6.795−3	4.801−3	3.518−3	2.654−3
E_b =	β	1.998	1.996	1.989	1.981	1.972	1.963	1.953	1.943	1.934	1.924
1.8 eV	γ	1.90−1	3.41−1	6.12−1	8.50−1	1.06+0	1.25+0	1.42+0	1.57+0	1.72+0	1.85+0
	δ	−2.34−6	−2.28−6	−2.29−6	−1.85−6	−1.16−6	−2.48−7	9.46−7	2.68−6	4.92−6	6.22−6

Z= 21, Sc: [Ar]$3d^1_{3/2}$ $4s^2_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$2s_{1/2}$	σ	3.830+1	2.158+1	9.054+0	4.695+0	2.759+0	1.763+0	1.196+0	8.494−1	6.249−1	4.731−1
E_b =	β	2.000	1.998	1.992	1.984	1.976	1.967	1.957	1.948	1.938	1.928
500.4 eV	γ	4.28−2	1.94−1	4.88−1	7.40−1	9.60−1	1.15+0	1.33+0	1.49+0	1.64+0	1.77+0
	δ	−7.11−6	−6.28−6	−4.96−6	−4.16−6	−3.23−6	−2.14−6	−7.86−7	8.17−7	2.77−6	5.15−6
$2p_{1/2}$	σ	2.657+1	1.129+1	3.202+0	1.262+0	6.005−1	3.232−1	1.898−1	1.190−1	7.846−2	5.390−2
E_b =	β	1.366	1.258	1.064	0.918	0.801	0.704	0.623	0.554	0.494	0.442
406.7 eV	γ	4.97−1	6.38−1	8.20−1	9.35−1	1.01+0	1.07+0	1.12+0	1.15+0	1.18+0	1.21+0
	δ	3.65−2	4.98−2	7.85−2	1.07−1	1.35−1	1.61−1	1.85−1	2.08−1	2.30−1	2.50−1
$2p_{3/2}$	σ	5.139+1	2.176+1	6.146+0	2.414+0	1.145+0	6.142−1	3.597−1	2.248−1	1.479−1	1.013−1
E_b =	β	1.378	1.270	1.077	0.932	0.815	0.719	0.639	0.572	0.514	0.463
402.2 eV	γ	5.04−1	6.46−1	8.29−1	9.43−1	1.02+0	1.08+0	1.12+0	1.15+0	1.18+0	1.20+0
	δ	3.65−2	4.96−2	7.79−2	1.06−1	1.34−1	1.60−1	1.84−1	2.07−1	2.28−1	2.49−1
$3s_{1/2}$	σ	5.000+0	2.742+0	1.127+0	5.801−1	3.399−1	2.169−1	1.471−1	1.044−1	7.678−2	5.813−2
E_b =	β	1.999	1.997	1.990	1.982	1.974	1.965	1.955	1.946	1.936	1.926
53.8 eV	γ	1.47−1	2.92−1	5.63−1	7.98−1	1.01+0	1.20+0	1.37+0	1.52+0	1.67+0	1.80+0
	δ	−3.33−6	−3.43−6	−3.23−6	−2.83−6	−2.12−6	−1.11−6	2.51−7	1.94−6	3.96−6	6.36−6
$3p_{1/2}$	σ	2.514+0	1.108+0	3.284−1	1.325−1	6.393−2	3.472−2	2.052−2	1.293−2	8.559−3	5.896−3
E_b =	β	1.325	1.201	1.014	0.875	0.763	0.671	0.594	0.528	0.471	0.422
33.8 eV	γ	5.32−1	6.49−1	8.12−1	9.21−1	9.99−1	1.06+0	1.10+0	1.14+0	1.17+0	1.19+0
	δ	3.36−2	4.83−2	7.89−2	1.08−1	1.36−1	1.62−1	1.87−1	2.10−1	2.31−1	2.52−1
$3p_{3/2}$	σ	4.871+0	2.140+0	6.304−1	2.532−1	1.217−1	6.590−2	3.883−2	2.439−2	1.610−2	1.106−2
E_b =	β	1.337	1.213	1.027	0.889	0.778	0.686	0.610	0.546	0.491	0.443
31.5 eV	γ	5.37−1	6.55−1	8.18−1	9.27−1	1.00+0	1.06+0	1.10+0	1.14+0	1.16+0	1.19+0
	δ	3.33−2	4.77−2	7.79−2	1.07−1	1.35−1	1.61−1	1.85−1	2.08−1	2.30−1	2.50−1
$3d_{3/2}$	σ	1.526−1	4.998−2	9.699−3	2.880−3	1.092−3	4.868−4	2.434−4	1.327−4	7.740−5	4.767−5
E_b =	β	0.663	0.566	0.452	0.377	0.317	0.265	0.221	0.181	0.148	0.116
6.6 eV	γ	5.34−1	5.85−1	6.62−1	7.12−1	7.40−1	7.53−1	7.57−1	7.54−1	7.48−1	7.36−1
	δ	1.34−1	1.71−1	2.36−1	2.95−1	3.47−1	3.93−1	4.36−1	4.75−1	5.11−1	5.43−1
$4s_{1/2}$	σ	2.888−1	1.575−1	6.434−2	3.304−2	1.934−2	1.233−2	8.354−3	5.927−3	4.358−3	3.298−3
E_b =	β	1.999	1.996	1.990	1.982	1.974	1.964	1.955	1.945	1.936	1.926
1.7 eV	γ	1.56−1	3.02−1	5.69−1	8.04−1	1.01+0	1.20+0	1.38+0	1.53+0	1.68+0	1.81+0
	δ	−3.02−6	−3.00−6	−2.95−6	−2.62−6	−1.88−6	−9.83−7	2.88−7	2.00−6	4.31−6	5.85−6

Z= 22, Ti: [Ar]$3d^2_{3/2}$ $4s^2_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$2s_{1/2}$	σ	4.265+1	2.430+1	1.035+1	5.418+0	3.209+0	2.063+0	1.406+0	1.003+0	7.403−1	5.622−1
E_b =	β	2.000	1.999	1.993	1.986	1.978	1.969	1.959	1.950	1.940	1.931
563.7 eV	γ	4.05−3	1.43−1	4.31−1	6.83−1	9.03−1	1.10+0	1.28+0	1.44+0	1.59+0	1.73+0
	δ	−8.88−6	−7.91−6	−6.58−6	−5.60−6	−4.63−6	−3.46−6	−2.01−6	−3.55−7	1.63−6	4.09−6
$2p_{1/2}$	σ	3.291+1	1.413+1	4.066+0	1.620+0	7.767−1	4.207−1	2.483−1	1.564−1	1.035−1	7.133−2
E_b =	β	1.395	1.294	1.111	0.968	0.850	0.752	0.669	0.598	0.537	0.483
461.5 eV	γ	4.65−1	6.18−1	8.17−1	9.43−1	1.03+0	1.09+0	1.14+0	1.18+0	1.21+0	1.24+0
	δ	3.40−2	4.63−2	7.38−2	1.02−1	1.28−1	1.54−1	1.78−1	2.00−1	2.22−1	2.42−1
$2p_{3/2}$	σ	6.365+1	2.722+1	7.795+0	3.093+0	1.478+0	7.980−1	4.696−1	2.948−1	1.946−1	1.338−1
E_b =	β	1.408	1.308	1.126	0.983	0.865	0.768	0.686	0.617	0.557	0.505
455.5 eV	γ	4.73−1	6.28−1	8.27−1	9.52−1	1.04+0	1.10+0	1.15+0	1.18+0	1.21+0	1.24+0
	δ	3.40−2	4.60−2	7.32−2	1.01−1	1.27−1	1.52−1	1.76−1	1.98−1	2.20−1	2.40−1
$3s_{1/2}$	σ	5.813+0	3.208+0	1.331+0	6.911−1	4.077−1	2.616−1	1.782−1	1.270−1	9.376−2	7.120−2
E_b =	β	1.999	1.997	1.991	1.984	1.975	1.967	1.957	1.948	1.938	1.929
60.3 eV	γ	1.13−1	2.53−1	5.17−1	7.51−1	9.60−1	1.15+0	1.32+0	1.48+0	1.62+0	1.76+0
	δ	−4.23−6	−4.30−6	−4.21−6	−3.77−6	−3.12−6	−2.09−6	−7.25−7	1.02−6	3.12−6	5.56−6
$3p_{1/2}$	σ	3.193+0	1.427+0	4.307−1	1.761−1	8.587−2	4.702−2	2.797−2	1.771−2	1.178−2	8.146−3
E_b =	β	1.357	1.238	1.058	0.919	0.807	0.714	0.636	0.569	0.511	0.459
35.6 eV	γ	5.16−1	6.39−1	8.12−1	9.28−1	1.01+0	1.08+0	1.12+0	1.16+0	1.20+0	1.22+0
	δ	3.04−2	4.46−2	7.39−2	1.02−1	1.29−1	1.55−1	1.79−1	2.02−1	2.23−1	2.43−1
$3p_{3/2}$	σ	6.149+0	2.737+0	8.212−1	3.343−1	1.623−1	8.856−2	5.251−2	3.315−2	2.198−2	1.516−2

(*continued on next page*)

Table 1 (*continued*)

E_b =	β	1.369	1.252	1.072	0.934	0.822	0.730	0.653	0.587	0.531	0.481
32.2 eV	γ	5.21−1	6.46−1	8.19−1	9.35−1	1.02+0	1.08+0	1.13+0	1.16+0	1.19+0	1.22+0
	δ	3.01−2	4.40−2	7.29−2	1.01−1	1.28−1	1.53−1	1.77−1	2.00−1	2.21−1	2.42−1
$3d_{3/2}$	σ	2.580−1	8.560−2	1.698−2	5.131−3	1.971−3	8.872−4	4.470−4	2.452−4	1.437−4	8.880−5
E_b =	β	0.699	0.595	0.475	0.398	0.336	0.285	0.240	0.200	0.165	0.132
3.7 eV	γ	5.46−1	5.99−1	6.77−1	7.30−1	7.62−1	7.80−1	7.87−1	7.87−1	7.83−1	7.74−1
	δ	1.29−1	1.64−1	2.29−1	2.86−1	3.38−1	3.84−1	4.26−1	4.65−1	5.01−1	5.34−1
$4s_{1/2}$	σ	3.261−1	1.788−1	7.369−2	3.814−2	2.247−2	1.440−2	9.807−3	6.985−3	5.154−3	3.913−3
E_b =	β	1.999	1.997	1.991	1.984	1.975	1.966	1.957	1.948	1.938	1.928
1.6 eV	γ	1.23−1	2.63−1	5.25−1	7.59−1	9.68−1	1.16+0	1.33+0	1.49+0	1.63+0	1.77+0
	δ	−3.83−6	−3.80−6	−3.79−6	−3.48−6	−2.78−6	−1.86−6	−5.75−7	1.16−6	3.51−6	5.19−6

Z= 23, V : [Ar]$3d^3_{3/2}$ $4s^2_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$2s_{1/2}$	σ	4.700+1	2.709+1	1.170+1	6.186+0	3.690+0	2.386+0	1.635+0	1.170+0	8.671−1	6.605−1
E_b =	β	2.000	1.999	1.995	1.988	1.979	1.971	1.962	1.952	1.943	1.933
628.2 eV	γ	−2.68−2	9.48−2	3.73−1	6.24−1	8.46−1	1.04+0	1.22+0	1.39+0	1.54+0	1.68+0
	δ	−1.15−5	−1.01−5	−8.32−6	−7.26−6	−6.24−6	−5.04−6	−3.59−6	−1.88−6	2.03−7	2.67−6
$2p_{1/2}$	σ	4.025+1	1.745+1	5.092+0	2.048+0	9.893−1	5.390−1	3.198−1	2.022−1	1.343−1	9.286−2
E_b =	β	1.418	1.326	1.156	1.015	0.896	0.798	0.714	0.642	0.579	0.524
520.5 eV	γ	4.28−1	5.94−1	8.10−1	9.47−1	1.04+0	1.11+0	1.16+0	1.21+0	1.24+0	1.27+0
	δ	3.17−2	4.32−2	6.95−2	9.59−2	1.22−1	1.46−1	1.70−1	1.92−1	2.13−1	2.33−1
$2p_{3/2}$	σ	7.788+1	3.361+1	9.749+0	3.904+0	1.879+0	1.020+0	6.035−1	3.805−1	2.520−1	1.738−1
E_b =	β	1.432	1.342	1.171	1.031	0.913	0.815	0.732	0.661	0.600	0.546
512.9 eV	γ	4.36−1	6.05−1	8.22−1	9.58−1	1.05+0	1.12+0	1.17+0	1.21+0	1.24+0	1.27+0
	δ	3.17−2	4.30−2	6.88−2	9.48−2	1.20−1	1.45−1	1.68−1	1.90−1	2.11−1	2.31−1
$3s_{1/2}$	σ	6.658+0	3.696+0	1.548+0	8.096−1	4.807−1	3.101−1	2.122−1	1.518−1	1.125−1	8.565−2
E_b =	β	1.999	1.998	1.992	1.985	1.977	1.968	1.959	1.950	1.941	1.931
66.5 eV	γ	8.24−2	2.15−1	4.72−1	7.04−1	9.13−1	1.10+0	1.27+0	1.43+0	1.58+0	1.71+0
	δ	−5.33−6	−5.34−6	−5.32−6	−4.95−6	−4.31−6	−3.30−6	−1.91−6	−1.49−7	2.00−6	4.52−6
$3p_{1/2}$	σ	3.978+0	1.799+0	5.525−1	2.288−1	1.126−1	6.213−2	3.719−2	2.367−2	1.581−2	1.097−2
E_b =	β	1.387	1.275	1.099	0.961	0.848	0.755	0.676	0.608	0.549	0.497
40.0 eV	γ	4.97−1	6.28−1	8.10−1	9.33−1	1.02+0	1.09+0	1.14+0	1.19+0	1.22+0	1.25+0
	δ	2.77−2	4.12−2	6.91−2	9.63−2	1.22−1	1.47−1	1.71−1	1.94−1	2.15−1	2.35−1
$3p_{3/2}$	σ	7.603+0	3.424+0	1.045+0	4.304−1	2.110−1	1.160−1	6.918−2	4.390−2	2.923−2	2.023−2
E_b =	β	1.400	1.289	1.115	0.977	0.865	0.772	0.694	0.627	0.569	0.519
35.0 eV	γ	5.04−1	6.36−1	8.19−1	9.42−1	1.03+0	1.10+0	1.15+0	1.19+0	1.22+0	1.25+0
	δ	2.74−2	4.07−2	6.80−2	9.49−2	1.21−1	1.46−1	1.69−1	1.91−1	2.13−1	2.33−1
$3d_{3/2}$	σ	4.046−1	1.357−1	2.742−2	8.413−3	3.271−3	1.486−3	7.542−4	4.161−4	2.450−4	1.520−4
E_b =	β	0.735	0.625	0.499	0.419	0.356	0.304	0.258	0.218	0.182	0.149
2.2 eV	γ	5.58−1	6.13−1	6.93−1	7.48−1	7.83−1	8.04−1	8.15−1	8.18−1	8.16−1	8.09−1
	δ	1.23−1	1.58−1	2.21−1	2.78−1	3.29−1	3.75−1	4.17−1	4.56−1	4.92−1	5.25−1
$4s_{1/2}$	σ	3.603−1	1.986−1	8.256−2	4.303−2	2.550−2	1.643−2	1.124−2	8.035−3	5.949−3	4.529−3
E_b =	β	1.999	1.998	1.992	1.985	1.977	1.968	1.959	1.950	1.940	1.931
1.7 eV	γ	9.19−2	2.25−1	4.81−1	7.13−1	9.21−1	1.11+0	1.28+0	1.44+0	1.59+0	1.73+0
	δ	−4.87−6	−4.80−6	−4.80−6	−4.52−6	−3.88−6	−2.95−6	−1.66−6	9.17−8	2.47−6	4.29−6

Z= 24, Cr: [Ar]$3d^4_{3/2}$ $3d^1_{5/2}$ $4s^1_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$2s_{1/2}$	σ	5.147+1	3.001+1	1.313+1	7.010+0	4.211+0	2.738+0	1.884+0	1.354+0	1.006+0	7.688−1
E_b =	β	1.999	1.999	1.996	1.989	1.981	1.973	1.964	1.955	1.945	1.936
694.6 eV	γ	−4.86−2	4.94−2	3.16−1	5.68−1	7.93−1	9.93−1	1.17+0	1.34+0	1.49+0	1.63+0
	δ	−1.44−5	−1.25−5	−1.08−5	−9.29−6	−8.17−6	−6.93−6	−5.36−6	−3.60−6	−1.62−6	9.05−7
$2p_{1/2}$	σ	4.904+1	2.145+1	6.325+0	2.564+0	1.247+0	6.830−1	4.070−1	2.584−1	1.722−1	1.194−1
E_b =	β	1.435	1.359	1.194	1.052	0.934	0.835	0.751	0.679	0.616	0.560
583.7 eV	γ	3.83−1	5.66−1	7.99−1	9.46−1	1.05+0	1.12+0	1.18+0	1.23+0	1.27+0	1.30+0
	δ	2.94−2	4.10−2	6.46−2	8.97−2	1.15−1	1.39−1	1.62−1	1.84−1	2.05−1	2.25−1
$2p_{3/2}$	σ	9.483+1	4.124+1	1.208+1	4.875+0	2.362+0	1.289+0	7.657−1	4.845−1	3.220−1	2.226−1
E_b =	β	1.451	1.376	1.211	1.070	0.952	0.854	0.770	0.699	0.637	0.582
574.5 eV	γ	3.93−1	5.78−1	8.12−1	9.59−1	1.06+0	1.14+0	1.19+0	1.24+0	1.27+0	1.30+0
	δ	2.95−2	4.08−2	6.38−2	8.86−2	1.13−1	1.37−1	1.60−1	1.81−1	2.03−1	2.22−1
$3s_{1/2}$	σ	7.446+0	4.155+0	1.755+0	9.242−1	5.518−1	3.577−1	2.458−1	1.765−1	1.311−1	1.001−1
E_b =	β	1.999	1.998	1.993	1.986	1.979	1.970	1.961	1.952	1.943	1.933
74.1 eV	γ	5.16−2	1.76−1	4.29−1	6.61−1	8.70−1	1.06+0	1.23+0	1.39+0	1.54+0	1.67+0
	δ	−6.64−6	−6.73−6	−6.75−6	−6.29−6	−5.62−6	−4.59−6	−3.23−6	−1.49−6	6.69−7	3.19−6
$3p_{1/2}$	σ	4.784+0	2.187+0	6.812−1	2.851−1	1.415−1	7.862−2	4.733−2	3.027−2	2.030−2	1.414−2
E_b =	β	1.419	1.311	1.132	0.995	0.883	0.790	0.710	0.642	0.582	0.529
45.9 eV	γ	4.77−1	6.13−1	8.05−1	9.36−1	1.03+0	1.10+0	1.16+0	1.21+0	1.25+0	1.28+0

(*continued on next page*)

Table 1 (*continued*)

	δ	2.55−2	3.75−2	6.38−2	9.01−2	1.15−1	1.40−1	1.63−1	1.85−1	2.06−1	2.26−1
$3p_{3/2}$	σ	9.141+0	4.158+0	1.287+0	5.356−1	2.647−1	1.465−1	8.787−2	5.602−2	3.745−2	2.601−2
E_b =	β	1.434	1.326	1.149	1.012	0.900	0.808	0.729	0.662	0.603	0.551
39.9 eV	γ	4.84−1	6.22−1	8.15−1	9.45−1	1.04+0	1.11+0	1.17+0	1.21+0	1.25+0	1.28+0
	δ	2.53−2	3.70−2	6.27−2	8.86−2	1.14−1	1.38−1	1.61−1	1.83−1	2.04−1	2.24−1
$3d_{3/2}$	σ	5.225−1	1.764−1	3.609−2	1.120−2	4.398−3	2.014−3	1.029−3	5.708−4	3.375−4	2.102−4
E_b =	β	0.777	0.665	0.524	0.438	0.373	0.321	0.275	0.234	0.198	0.165
2.9 eV	γ	5.71−1	6.29−1	7.09−1	7.65−1	8.03−1	8.27−1	8.41−1	8.47−1	8.47−1	8.42−1
	δ	1.19−1	1.53−1	2.15−1	2.70−1	3.20−1	3.66−1	4.08−1	4.47−1	4.83−1	5.16−1
$3d_{5/2}$	σ	7.458−1	2.509−1	5.111−2	1.581−2	6.189−3	2.828−3	1.441−3	7.977−4	4.710−4	2.927−4
E_b =	β	0.774	0.665	0.532	0.453	0.394	0.347	0.306	0.271	0.238	0.210
2.2 eV	γ	5.70−1	6.29−1	7.12−1	7.72−1	8.14−1	8.42−1	8.61−1	8.72−1	8.76−1	8.78−1
	δ	1.20−1	1.54−1	2.15−1	2.70−1	3.20−1	3.65−1	4.06−1	4.44−1	4.79−1	5.13−1
$4s_{1/2}$	σ	2.903−1	1.609−1	6.747−2	3.540−2	2.109−2	1.365−2	9.375−3	6.727−3	4.996−3	3.815−3
E_b =	β	1.999	1.998	1.993	1.986	1.978	1.970	1.961	1.952	1.942	1.933
1.0 eV	γ	6.13−2	1.88−1	4.40−1	6.70−1	8.77−1	1.06+0	1.23+0	1.39+0	1.54+0	1.68+0
	δ	−6.22−6	−6.12−6	−6.03−6	−5.80−6	−5.16−6	−4.44−6	−3.18−6	−1.43−6	9.54−7	2.92−6
Z= 25, Mn: [Ar]$3d^4_{3/2}$ $3d^1_{5/2}$ $4s^2_{1/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$2s_{1/2}$	σ	5.574+1	3.288+1	1.460+1	7.860+0	4.754+0	3.108+0	2.149+0	1.550+0	1.156+0	8.859−1
E_b =	β	1.999	2.000	1.997	1.991	1.983	1.975	1.966	1.957	1.948	1.939
769.0 eV	γ	−5.81−2	1.06−2	2.60−1	5.07−1	7.31−1	9.33−1	1.12+0	1.28+0	1.44+0	1.58+0
	δ	−1.85−5	−1.57−5	−1.33−5	−1.18−5	−1.06−5	−9.28−6	−7.71−6	−5.91−6	−3.79−6	−1.24−6
$2p_{1/2}$	σ	5.833+1	2.576+1	7.705+0	3.152+0	1.544+0	8.505−1	5.093−1	3.246−1	2.171−1	1.510−1
E_b =	β	1.448	1.382	1.234	1.098	0.981	0.882	0.797	0.723	0.659	0.602
651.4 eV	γ	3.37−1	5.32−1	7.84−1	9.43−1	1.05+0	1.14+0	1.20+0	1.25+0	1.29+0	1.32+0
	δ	2.77−2	3.81−2	6.13−2	8.52−2	1.09−1	1.32−1	1.55−1	1.76−1	1.97−1	2.17−1
$2p_{3/2}$	σ	1.128+2	4.951+1	1.470+1	5.981+0	2.917+0	1.601+0	9.554−1	6.069−1	4.048−1	2.807−1
E_b =	β	1.465	1.400	1.252	1.117	1.000	0.902	0.818	0.745	0.681	0.625
640.3 eV	γ	3.46−1	5.44−1	7.99−1	9.58−1	1.07+0	1.15+0	1.21+0	1.26+0	1.30+0	1.33+0
	δ	2.79−2	3.80−2	6.06−2	8.39−2	1.07−1	1.30−1	1.53−1	1.74−1	1.95−1	2.14−1
$3s_{1/2}$	σ	8.464+0	4.753+0	2.024+0	1.073+0	6.440−1	4.194−1	2.894−1	2.085−1	1.554−1	1.190−1
E_b =	β	2.000	1.999	1.994	1.988	1.980	1.972	1.963	1.954	1.945	1.936
83.9 eV	γ	2.59−2	1.41−1	3.84−1	6.12−1	8.19−1	1.01+0	1.18+0	1.34+0	1.49+0	1.63+0
	δ	−8.35−6	−8.27−6	−8.32−6	−8.09−6	−7.45−6	−6.43−6	−5.05−6	−3.30−6	−1.12−6	1.52−6
$3p_{1/2}$	σ	5.856+0	2.711+0	8.584−1	3.633−1	1.820−1	1.018−1	6.167−2	3.964−2	2.670−2	1.867−2
E_b =	β	1.442	1.342	1.173	1.036	0.925	0.831	0.751	0.683	0.622	0.568
53.1 eV	γ	4.55−1	5.98−1	7.99−1	9.37−1	1.04+0	1.12+0	1.18+0	1.23+0	1.27+0	1.30+0
	δ	2.30−2	3.49−2	5.98−2	8.50−2	1.10−1	1.33−1	1.56−1	1.78−1	1.99−1	2.18−1
$3p_{3/2}$	σ	1.112+1	5.119+0	1.609+0	6.771−1	3.375−1	1.881−1	1.135−1	7.270−2	4.880−2	3.401−2
E_b =	β	1.458	1.359	1.191	1.055	0.943	0.850	0.771	0.704	0.643	0.591
46.4 eV	γ	4.62−1	6.06−1	8.10−1	9.48−1	1.05+0	1.13+0	1.19+0	1.23+0	1.27+0	1.30+0
	δ	2.29−2	3.45−2	5.88−2	8.34−2	1.08−1	1.31−1	1.54−1	1.75−1	1.96−1	2.16−1
$3d_{3/2}$	σ	8.708−1	2.971−1	6.182−2	1.945−2	7.720−3	3.567−3	1.836−3	1.024−3	6.087−4	3.807−4
E_b =	β	0.809	0.694	0.553	0.463	0.396	0.341	0.294	0.253	0.215	0.181
3.5 eV	γ	5.78−1	6.41−1	7.26−1	7.83−1	8.23−1	8.50−1	8.66−1	8.75−1	8.78−1	8.75−1
	δ	1.14−1	1.47−1	2.08−1	2.63−1	3.13−1	3.58−1	3.99−1	4.37−1	4.73−1	5.06−1
$3d_{5/2}$	σ	1.263+0	4.291−1	8.884−2	2.784−2	1.102−2	5.080−3	2.608−3	1.452−3	8.613−4	5.375−4
E_b =	β	0.805	0.694	0.560	0.477	0.416	0.367	0.325	0.288	0.255	0.226
2.7 eV	γ	5.76−1	6.40−1	7.29−1	7.89−1	8.33−1	8.64−1	8.86−1	9.00−1	9.07−1	9.10−1
	δ	1.15−1	1.48−1	2.09−1	2.63−1	3.12−1	3.57−1	3.97−1	4.35−1	4.70−1	5.03−1
$4s_{1/2}$	σ	4.254−1	2.370−1	1.001−1	5.282−2	3.164−2	2.058−2	1.419−2	1.022−2	7.611−3	5.827−3
E_b =	β	2.000	1.998	1.994	1.987	1.980	1.972	1.963	1.954	1.945	1.935
1.9 eV	γ	3.60−2	1.53−1	3.96−1	6.22−1	8.28−1	1.02+0	1.19+0	1.35+0	1.50+0	1.64+0
	δ	−7.68−6	−7.60−6	−7.55−6	−7.40−6	−6.86−6	−5.92−6	−4.66−6	−2.91−6	−4.68−7	1.58−6
Z= 26, Fe: [Ar]$3d^4_{3/2}$ $3d^2_{5/2}$ $4s^2_{1/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$2s_{1/2}$	σ	6.004+1	3.584+1	1.613+1	8.764+0	5.335+0	3.506+0	2.435+0	1.763+0	1.319+0	1.013+0
E_b =	β	1.998	1.999	1.997	1.992	1.985	1.977	1.969	1.960	1.951	1.941
846.1 eV	γ	−5.19−2	−2.26−2	2.06−1	4.49−1	6.74−1	8.76−1	1.06+0	1.23+0	1.38+0	1.53+0
	δ	−2.26−5	−1.93−5	−1.63−5	−1.48−5	−1.34−5	−1.20−5	−1.04−5	−8.51−6	−6.39−6	−3.80−6
$2p_{1/2}$	σ	6.905+1	3.079+1	9.319+0	3.843+0	1.894+0	1.049+0	6.311−1	4.037−1	2.710−1	1.890−1
E_b =	β	1.454	1.404	1.267	1.135	1.019	0.921	0.836	0.762	0.697	0.639
721.1 eV	γ	2.85−1	4.93−1	7.64−1	9.35−1	1.06+0	1.14+0	1.21+0	1.27+0	1.31+0	1.35+0
	δ	2.59−2	3.58−2	5.75−2	8.02−2	1.03−1	1.26−1	1.48−1	1.69−1	1.89−1	2.09−1

(*continued on next page*)

Table 1 (*continued*)

$2p_{3/2}$	σ	1.335+2	5.907+1	1.773+1	7.270+0	3.567+0	1.968+0	1.179+0	7.518−1	5.030−1	3.497−1
E_b =	β	1.473	1.423	1.287	1.155	1.040	0.942	0.858	0.784	0.720	0.663
708.1 eV	γ	2.94−1	5.06−1	7.80−1	9.52−1	1.07+0	1.16+0	1.23+0	1.28+0	1.32+0	1.36+0
	δ	2.61−2	3.58−2	5.68−2	7.89−2	1.01−1	1.24−1	1.45−1	1.66−1	1.86−1	2.06−1
$3s_{1/2}$	σ	9.411+0	5.316+0	2.282+0	1.217+0	7.342−1	4.802−1	3.326−1	2.405−1	1.797−1	1.380−1
E_b =	β	2.000	1.999	1.995	1.989	1.982	1.974	1.965	1.956	1.947	1.938
92.9 eV	γ	1.89−3	1.07−1	3.42−1	5.67−1	7.73−1	9.61−1	1.13+0	1.29+0	1.44+0	1.58+0
	δ	−1.02−5	−1.02−5	−1.03−5	−1.01−5	−9.41−6	−8.45−6	−7.05−6	−5.32−6	−3.11−6	−4.63−7
$3p_{1/2}$	σ	6.920+0	3.241+0	1.042+0	4.457−1	2.250−1	1.268−1	7.721−2	4.987−2	3.372−2	2.366−2
E_b =	β	1.466	1.371	1.205	1.070	0.960	0.867	0.787	0.718	0.657	0.602
58.1 eV	γ	4.30−1	5.78−1	7.89−1	9.35−1	1.04+0	1.13+0	1.19+0	1.24+0	1.29+0	1.33+0
	δ	2.09−2	3.20−2	5.54−2	7.97−2	1.04−1	1.27−1	1.49−1	1.70−1	1.91−1	2.10−1
$3p_{3/2}$	σ	1.316+1	6.130+0	1.954+0	8.308−1	4.174−1	2.341−1	1.420−1	9.139−2	6.159−2	4.308−2
E_b =	β	1.483	1.389	1.224	1.090	0.980	0.887	0.808	0.740	0.680	0.626
52.0 eV	γ	4.37−1	5.87−1	8.01−1	9.47−1	1.05+0	1.14+0	1.20+0	1.25+0	1.29+0	1.33+0
	δ	2.09−2	3.15−2	5.43−2	7.81−2	1.02−1	1.24−1	1.46−1	1.68−1	1.88−1	2.07−1
$3d_{3/2}$	σ	1.214+0	4.179−1	8.804−2	2.798−2	1.121−2	5.220−3	2.704−3	1.517−3	9.058−4	5.686−4
E_b =	β	0.848	0.730	0.580	0.485	0.415	0.359	0.311	0.269	0.232	0.197
3.9 eV	γ	5.84−1	6.53−1	7.42−1	8.01−1	8.42−1	8.71−1	8.90−1	9.01−1	9.06−1	9.06−1
	δ	1.09−1	1.42−1	2.02−1	2.56−1	3.05−1	3.49−1	3.90−1	4.28−1	4.64−1	4.97−1
$3d_{5/2}$	σ	1.764+0	6.047−1	1.268−1	4.014−2	1.603−2	7.446−3	3.847−3	2.154−3	1.283−3	8.039−4
E_b =	β	0.842	0.728	0.586	0.497	0.434	0.384	0.341	0.304	0.271	0.241
3.1 eV	γ	5.82−1	6.52−1	7.44−1	8.06−1	8.52−1	8.85−1	9.09−1	9.25−1	9.35−1	9.40−1
	δ	1.11−1	1.43−1	2.03−1	2.56−1	3.05−1	3.48−1	3.89−1	4.26−1	4.61−1	4.93−1
$4s_{1/2}$	σ	4.569−1	2.560−1	1.089−1	5.780−2	3.479−2	2.272−2	1.572−2	1.136−2	8.487−3	6.515−3
E_b =	β	2.000	1.999	1.995	1.989	1.981	1.973	1.965	1.956	1.947	1.938
2.1 eV	γ	1.17−2	1.20−1	3.55−1	5.78−1	7.82−1	9.69−1	1.14+0	1.30+0	1.45+0	1.59+0
	δ	−9.45−6	−9.43−6	−9.46−6	−9.29−6	−8.77−6	−7.88−6	−6.62−6	−4.91−6	−2.50−6	−3.33−7

Z= 27, Co: [Ar]$3d^4_{3/2}$ $3d^3_{5/2}$ $4s^2_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$2s_{1/2}$	σ	6.420+1	3.879+1	1.770+1	9.702+0	5.945+0	3.927+0	2.738+0	1.990+0	1.493+0	1.150+0
E_b =	β	1.996	1.999	1.998	1.993	1.987	1.979	1.971	1.962	1.953	1.944
925.6 eV	γ	−2.56−2	−4.74−2	1.54−1	3.92−1	6.16−1	8.19−1	1.00+0	1.17+0	1.33+0	1.47+0
	δ	−2.66−5	−2.32−5	−2.04−5	−1.86−5	−1.69−5	−1.52−5	−1.36−5	−1.16−5	−9.35−6	−6.87−6
$2p_{1/2}$	σ	8.089+1	3.642+1	1.115+1	4.638+0	2.300+0	1.280+0	7.734−1	4.966−1	3.343−1	2.339−1
E_b =	β	1.454	1.421	1.296	1.169	1.056	0.959	0.874	0.800	0.734	0.676
793.6 eV	γ	2.27−1	4.49−1	7.39−1	9.24−1	1.05+0	1.15+0	1.22+0	1.28+0	1.33+0	1.37+0
	δ	2.40−2	3.36−2	5.40−2	7.55−2	9.76−2	1.19−1	1.41−1	1.62−1	1.81−1	2.01−1
$2p_{3/2}$	σ	1.562+2	6.975+1	2.116+1	8.745+0	4.316+0	2.392+0	1.440+0	9.210−1	6.180−1	4.309−1
E_b =	β	1.474	1.442	1.318	1.191	1.078	0.981	0.897	0.824	0.758	0.701
778.6 eV	γ	2.37−1	4.62−1	7.56−1	9.42−1	1.07+0	1.17+0	1.24+0	1.30+0	1.34+0	1.38+0
	δ	2.44−2	3.37−2	5.33−2	7.42−2	9.57−2	1.17−1	1.38−1	1.59−1	1.78−1	1.98−1
$3s_{1/2}$	σ	1.037+1	5.894+0	2.551+0	1.368+0	8.296−1	5.449−1	3.788−1	2.747−1	2.059−1	1.585−1
E_b =	β	1.999	1.999	1.996	1.990	1.983	1.975	1.967	1.959	1.950	1.941
100.7 eV	γ	−1.87−2	7.63−2	3.01−1	5.22−1	7.27−1	9.15−1	1.09+0	1.25+0	1.40+0	1.54+0
	δ	−1.22−5	−1.24−5	−1.27−5	−1.25−5	−1.18−5	−1.08−5	−9.40−6	−7.66−6	−5.48−6	−2.82−6
$3p_{1/2}$	σ	8.071+0	3.825+0	1.248+0	5.393−1	2.745−1	1.556−1	9.530−2	6.183−2	4.198−2	2.956−2
E_b =	β	1.488	1.397	1.235	1.103	0.994	0.902	0.822	0.753	0.691	0.636
63.2 eV	γ	4.03−1	5.56−1	7.77−1	9.31−1	1.04+0	1.13+0	1.20+0	1.26+0	1.31+0	1.35+0
	δ	1.90−2	2.91−2	5.14−2	7.47−2	9.79−2	1.20−1	1.42−1	1.63−1	1.83−1	2.02−1
$3p_{3/2}$	σ	1.539+1	7.249+0	2.344+0	1.006+0	5.094−1	2.874−1	1.753−1	1.133−1	7.664−2	5.378−2
E_b =	β	1.505	1.416	1.255	1.124	1.016	0.924	0.845	0.776	0.715	0.660
57.7 eV	γ	4.10−1	5.66−1	7.90−1	9.44−1	1.06+0	1.15+0	1.21+0	1.27+0	1.32+0	1.35+0
	δ	1.90−2	2.88−2	5.03−2	7.31−2	9.58−2	1.18−1	1.39−1	1.60−1	1.80−1	1.99−1
$3d_{3/2}$	σ	1.646+0	5.714−1	1.219−1	3.912−2	1.581−2	7.415−3	3.865−3	2.180−3	1.308−3	8.240−4
E_b =	β	0.885	0.766	0.608	0.507	0.435	0.377	0.328	0.286	0.247	0.212
2.7 eV	γ	5.87−1	6.63−1	7.57−1	8.18−1	8.61−1	8.92−1	9.13−1	9.27−1	9.34−1	9.35−1
	δ	1.06−1	1.37−1	1.96−1	2.48−1	2.97−1	3.41−1	3.82−1	4.19−1	4.55−1	4.88−1
$3d_{5/2}$	σ	2.399+0	8.297−1	1.760−1	5.624−2	2.265−2	1.059−2	5.508−3	3.099−3	1.855−3	1.166−3
E_b =	β	0.878	0.762	0.612	0.518	0.452	0.400	0.357	0.320	0.286	0.256
3.3 eV	γ	5.85−1	6.61−1	7.58−1	8.22−1	8.70−1	9.05−1	9.31−1	9.49−1	9.62−1	9.69−1
	δ	1.07−1	1.39−1	1.97−1	2.49−1	2.97−1	3.40−1	3.80−1	4.18−1	4.52−1	4.84−1
$4s_{1/2}$	σ	4.871−1	2.745−1	1.176−1	6.278−2	3.796−2	2.489−2	1.728−2	1.252−2	9.383−3	7.221−3
E_b =	β	1.999	1.999	1.995	1.990	1.983	1.975	1.967	1.958	1.949	1.940
1.9 eV	γ	−9.69−3	8.89−2	3.15−1	5.34−1	7.37−1	9.23−1	1.09+0	1.25+0	1.40+0	1.54+0
	δ	−1.13−5	−1.16−5	−1.18−5	−1.15−5	−1.10−5	−1.02−5	−9.02−6	−7.19−6	−4.89−6	−2.60−6

(*continued on next page*)

Table 1 (*continued*)

Z= 28, Ni: [Ar] $3d^4_{3/2}$ $3d^4_{5/2}$ $4s^2_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$2s_{1/2}$	σ	6.817+1	4.171+1	1.931+1	1.067+1	6.582+0	4.369+0	3.059+0	2.231+0	1.679+0	1.297+0
E_b =	β	1.995	1.998	1.999	1.995	1.988	1.981	1.973	1.965	1.956	1.947
1008.1 eV	γ	2.51−2	−6.15−2	1.05−1	3.35−1	5.57−1	7.61−1	9.47−1	1.12+0	1.28+0	1.42+0
	δ	−2.98−5	−2.72−5	−2.46−5	−2.27−5	−2.08−5	−1.90−5	−1.73−5	−1.52−5	−1.30−5	−1.03−5
$2p_{1/2}$	σ	9.410+1	4.278+1	1.325+1	5.550+0	2.769+0	1.549+0	9.392−1	6.051−1	4.087−1	2.866−1
E_b =	β	1.446	1.434	1.323	1.201	1.092	0.996	0.912	0.837	0.771	0.712
871.9 eV	γ	1.62−1	4.00−1	7.10−1	9.09−1	1.05+0	1.15+0	1.23+0	1.30+0	1.35+0	1.39+0
	δ	2.19−2	3.15−2	5.06−2	7.12−2	9.25−2	1.14−1	1.34−1	1.55−1	1.74−1	1.93−1
$2p_{3/2}$	σ	1.816+2	8.180+1	2.508+1	1.043+1	5.178+0	2.883+0	1.741+0	1.118+0	7.523−1	5.258−1
E_b =	β	1.467	1.456	1.346	1.225	1.116	1.020	0.937	0.863	0.797	0.738
854.7 eV	γ	1.72−1	4.13−1	7.28−1	9.29−1	1.07+0	1.17+0	1.25+0	1.31+0	1.36+0	1.40+0
	δ	2.24−2	3.17−2	5.00−2	6.99−2	9.06−2	1.11−1	1.32−1	1.52−1	1.71−1	1.89−1
$3s_{1/2}$	σ	1.137+1	6.500+0	2.835+0	1.529+0	9.312−1	6.139−1	4.282−1	3.115−1	2.341−1	1.806−1
E_b =	β	1.999	1.999	1.996	1.991	1.985	1.977	1.969	1.961	1.952	1.943
111.8 eV	γ	−3.66−2	4.71−2	2.61−1	4.78−1	6.81−1	8.68−1	1.04+0	1.20+0	1.35+0	1.49+0
	δ	−1.43−5	−1.49−5	−1.54−5	−1.52−5	−1.46−5	−1.36−5	−1.22−5	−1.04−5	−8.23−6	−5.55−6
$3p_{1/2}$	σ	9.330+0	4.473+0	1.481+0	6.459−1	3.312−1	1.889−1	1.163−1	7.577−2	5.163−2	3.648−2
E_b =	β	1.507	1.420	1.263	1.135	1.028	0.937	0.857	0.787	0.725	0.669
71.2 eV	γ	3.73−1	5.32−1	7.64−1	9.25−1	1.04+0	1.14+0	1.21+0	1.27+0	1.32+0	1.37+0
	δ	1.71−2	2.65−2	4.76−2	7.01−2	9.26−2	1.14−1	1.36−1	1.56−1	1.76−1	1.95−1
$3p_{3/2}$	σ	1.790+1	8.520+0	2.791+0	1.208+0	6.159−1	3.495−1	2.141−1	1.389−1	9.433−2	6.640−2
E_b =	β	1.526	1.441	1.286	1.158	1.051	0.960	0.881	0.812	0.750	0.695
69.7 eV	γ	3.81−1	5.42−1	7.77−1	9.40−1	1.06+0	1.15+0	1.23+0	1.29+0	1.33+0	1.37+0
	δ	1.73−2	2.62−2	4.66−2	6.85−2	9.04−2	1.12−1	1.33−1	1.53−1	1.72−1	1.91−1
$3d_{3/2}$	σ	2.190+0	7.669−1	1.654−1	5.353−2	2.179−2	1.029−2	5.395−3	3.058−3	1.842−3	1.165−3
E_b =	β	0.921	0.800	0.635	0.530	0.454	0.395	0.345	0.302	0.263	0.228
3.9 eV	γ	5.88−1	6.70−1	7.71−1	8.35−1	8.80−1	9.13−1	9.36−1	9.51−1	9.60−1	9.64−1
	δ	1.02−1	1.33−1	1.89−1	2.41−1	2.89−1	3.32−1	3.73−1	4.10−1	4.45−1	4.78−1
$3d_{5/2}$	σ	3.187+0	1.112+0	2.387−1	7.695−2	3.122−2	1.470−2	7.687−3	4.347−3	2.613−3	1.649−3
E_b =	β	0.912	0.795	0.637	0.539	0.470	0.417	0.373	0.335	0.301	0.270
3.3 eV	γ	5.85−1	6.68−1	7.71−1	8.38−1	8.88−1	9.25−1	9.53−1	9.73−1	9.87−1	9.96−1
	δ	1.03−1	1.34−1	1.91−1	2.42−1	2.89−1	3.32−1	3.72−1	4.09−1	4.43−1	4.75−1
$4s_{1/2}$	σ	5.162−1	2.926−1	1.263−1	6.778−2	4.116−2	2.709−2	1.887−2	1.371−2	1.030−2	7.945−3
E_b =	β	1.999	1.999	1.996	1.991	1.984	1.977	1.969	1.960	1.951	1.942
2.2 eV	γ	−2.83−2	6.00−2	2.76−1	4.91−1	6.92−1	8.77−1	1.05+0	1.21+0	1.36+0	1.50+0
	δ	−1.34−5	−1.40−5	−1.44−5	−1.42−5	−1.37−5	−1.29−5	−1.17−5	−9.98−6	−7.74−6	−5.40−6

Z= 29, Cu: [Ar]$3d^4_{3/2}$ $3d^6_{5/2}$ $4s^1_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$2s_{1/2}$	σ	7.216+1	4.476+1	2.101+1	1.171+1	7.259+0	4.841+0	3.403+0	2.489+0	1.879+0	1.455+0
E_b =	β	1.992	1.997	1.999	1.996	1.990	1.983	1.975	1.967	1.959	1.950
1096.1 eV	γ	1.15−1	−6.29−2	5.85−2	2.77−1	4.94−1	6.96−1	8.83−1	1.06+0	1.22+0	1.37+0
	δ	−2.66−5	−3.04−5	−2.90−5	−2.70−5	−2.55−5	−2.38−5	−2.18−5	−1.97−5	−1.70−5	−1.45−5
$2p_{1/2}$	σ	1.092+2	5.008+1	1.567+1	6.609+0	3.315+0	1.862+0	1.133+0	7.323−1	4.959−1	3.486−1
E_b =	β	1.427	1.443	1.346	1.236	1.132	1.038	0.955	0.880	0.813	0.751
951.0 eV	γ	9.26−2	3.44−1	6.78−1	8.92−1	1.04+0	1.15+0	1.24+0	1.31+0	1.36+0	1.41+0
	δ	1.97−2	2.96−2	4.80−2	6.82−2	8.86−2	1.09−1	1.29−1	1.49−1	1.68−1	1.86−1
$2p_{3/2}$	σ	2.101+2	9.547+1	2.955+1	1.238+1	6.173+0	3.451+0	2.091+0	1.346+0	9.084−1	6.364−1
E_b =	β	1.451	1.466	1.372	1.262	1.158	1.065	0.982	0.907	0.840	0.779
931.1 eV	γ	1.04−1	3.58−1	6.98−1	9.14−1	1.07+0	1.18+0	1.26+0	1.33+0	1.38+0	1.43+0
	δ	2.03−2	2.99−2	4.76−2	6.69−2	8.67−2	1.07−1	1.26−1	1.46−1	1.64−1	1.82−1
$3s_{1/2}$	σ	1.226+1	7.056+0	3.101+0	1.680+0	1.027+0	6.799−1	4.757−1	3.470−1	2.615−1	2.023−1
E_b =	β	1.999	1.999	1.997	1.992	1.986	1.979	1.971	1.963	1.954	1.945
119.8 eV	γ	−5.19−2	2.01−2	2.21−1	4.30−1	6.30−1	8.16−1	9.89−1	1.15+0	1.30+0	1.44+0
	δ	−1.64−5	−1.75−5	−1.84−5	−1.86−5	−1.81−5	−1.71−5	−1.56−5	−1.38−5	−1.15−5	−8.68−6
$3p_{1/2}$	σ	1.053+1	5.109+0	1.715+0	7.552−1	3.899−1	2.237−1	1.383−1	9.049−2	6.188−2	4.385−2
E_b =	β	1.524	1.441	1.295	1.172	1.067	0.977	0.898	0.827	0.763	0.706
75.3 eV	γ	3.42−1	5.07−1	7.49−1	9.18−1	1.04+0	1.14+0	1.22+0	1.29+0	1.34+0	1.38+0
	δ	1.51−2	2.43−2	4.49−2	6.65−2	8.82−2	1.10−1	1.30−1	1.50−1	1.69−1	1.88−1
$3p_{3/2}$	σ	2.028+1	9.761+0	3.243+0	1.417+0	7.268−1	4.147−1	2.552−1	1.663−1	1.133−1	7.997−2
E_b =	β	1.543	1.463	1.319	1.197	1.093	1.003	0.924	0.854	0.790	0.733
72.8 eV	γ	3.50−1	5.18−1	7.63−1	9.35−1	1.06+0	1.16+0	1.24+0	1.30+0	1.35+0	1.40+0
	δ	1.54−2	2.42−2	4.40−2	6.48−2	8.60−2	1.07−1	1.27−1	1.47−1	1.66−1	1.84−1
$3d_{3/2}$	σ	2.632+0	9.277−1	2.018−1	6.580−2	2.695−2	1.280−2	6.742−3	3.839−3	2.322−3	1.474−3
E_b =	β	0.953	0.828	0.663	0.555	0.477	0.415	0.363	0.318	0.278	0.241

(*continued on next page*)

Table 1 (*continued*)

1.8 eV	γ	5.85−1	6.74−1	7.85−1	8.54−1	9.02−1	9.37−1	9.62−1	9.78−1	9.88−1	9.93−1
	δ	9.85−2	1.27−1	1.83−1	2.34−1	2.81−1	3.24−1	3.63−1	4.01−1	4.35−1	4.68−1
$3d_{5/2}$	σ	3.820+0	1.343+0	2.909−1	9.449−2	3.858−2	1.826−2	9.596−3	5.450−3	3.289−3	2.083−3
E_b =	β	0.943	0.821	0.663	0.563	0.492	0.436	0.390	0.350	0.315	0.283
1.5 eV	γ	5.83−1	6.72−1	7.85−1	8.57−1	9.09−1	9.48−1	9.77−1	9.99−1	1.01+0	1.02+0
	δ	9.97−2	1.29−1	1.85−1	2.36−1	2.82−1	3.24−1	3.63−1	3.99−1	4.33−1	4.66−1
$4s_{1/2}$	σ	3.946−1	2.252−1	9.798−2	5.285−2	3.224−2	2.130−2	1.488−2	1.084−2	8.162−3	6.309−3
E_b =	β	1.999	1.999	1.997	1.992	1.985	1.978	1.970	1.962	1.954	1.945
1.2 eV	γ	−4.50−2	3.26−2	2.36−1	4.46−1	6.45−1	8.32−1	1.00+0	1.16+0	1.31+0	1.45+0
	δ	−1.53−5	−1.63−5	−1.72−5	−1.72−5	−1.67−5	−1.58−5	−1.46−5	−1.30−5	−1.08−5	−8.71−6
Z= 30, Zn: [Ar]$3d^4_{3/2}$ $3d^6_{5/2}$ $4s^2_{1/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$2s_{1/2}$	σ	7.551+1	4.758+1	2.266+1	1.274+1	7.949+0	5.326+0	3.758+0	2.758+0	2.088+0	1.621+0
E_b =	β	1.990	1.996	1.999	1.997	1.991	1.985	1.978	1.970	1.961	1.952
1193.6 eV	γ	2.49−1	−4.64−2	1.75−2	2.23−1	4.37−1	6.39−1	8.27−1	1.00+0	1.16+0	1.31+0
	δ	−2.82−5	−3.48−5	−3.47−5	−3.29−5	−3.09−5	−2.89−5	−2.68−5	−2.46−5	−2.21−5	−1.94−5
$2p_{1/2}$	σ	1.245+2	5.776+1	1.829+1	7.770+0	3.918+0	2.211+0	1.351+0	8.758−1	5.948−1	4.193−1
E_b =	β	1.396	1.446	1.369	1.261	1.159	1.068	0.985	0.911	0.844	0.784
1042.8 eV	γ	2.09−2	2.83−1	6.38−1	8.68−1	1.03+0	1.15+0	1.24+0	1.32+0	1.38+0	1.43+0
	δ	1.69−2	2.74−2	4.48−2	6.38−2	8.36−2	1.03−1	1.23−1	1.42−1	1.60−1	1.78−1
$2p_{3/2}$	σ	2.399+2	1.101+2	3.443+1	1.452+1	7.277+0	4.085+0	2.485+0	1.605+0	1.086+0	7.625−1
E_b =	β	1.423	1.471	1.395	1.288	1.187	1.096	1.014	0.940	0.873	0.813
1019.7 eV	γ	3.31−2	2.99−1	6.59−1	8.92−1	1.05+0	1.17+0	1.27+0	1.34+0	1.40+0	1.45+0
	δ	1.77−2	2.79−2	4.44−2	6.26−2	8.16−2	1.01−1	1.20−1	1.38−1	1.57−1	1.74−1
$3s_{1/2}$	σ	1.341+1	7.764+0	3.440+0	1.874+0	1.151+0	7.642−1	5.363−1	3.922−1	2.963−1	2.297−1
E_b =	β	1.998	1.999	1.997	1.993	1.987	1.980	1.973	1.965	1.956	1.948
135.9 eV	γ	−6.24−2	−3.45−3	1.85−1	3.90−1	5.87−1	7.71−1	9.44−1	1.11+0	1.26+0	1.40+0
	δ	−1.90−5	−2.08−5	−2.21−5	−2.22−5	−2.17−5	−2.08−5	−1.93−5	−1.75−5	−1.53−5	−1.26−5
$3p_{1/2}$	σ	1.210+1	5.939+0	2.023+0	8.993−1	4.676−1	2.698−1	1.676−1	1.101−1	7.561−2	5.376−2
E_b =	β	1.540	1.461	1.317	1.196	1.093	1.004	0.925	0.856	0.793	0.735
88.6 eV	γ	3.12−1	4.78−1	7.29−1	9.07−1	1.04+0	1.14+0	1.23+0	1.29+0	1.35+0	1.40+0
	δ	1.37−2	2.18−2	4.11−2	6.20−2	8.29−2	1.04−1	1.24−1	1.43−1	1.62−1	1.80−1
$3p_{3/2}$	σ	2.329+1	1.134+1	3.820+0	1.684+0	8.698−1	4.990−1	3.085−1	2.018−1	1.380−1	9.771−2
E_b =	β	1.560	1.485	1.343	1.223	1.120	1.032	0.953	0.883	0.821	0.764
85.6 eV	γ	3.20−1	4.89−1	7.45−1	9.25−1	1.06+0	1.16+0	1.24+0	1.31+0	1.37+0	1.41+0
	δ	1.41−2	2.18−2	4.03−2	6.04−2	8.07−2	1.01−1	1.20−1	1.40−1	1.58−1	1.76−1
$3d_{3/2}$	σ	3.676+0	1.310+0	2.884−1	9.481−2	3.910−2	1.868−2	9.894−3	5.660−3	3.437−3	2.190−3
E_b =	β	0.986	0.864	0.690	0.577	0.496	0.432	0.380	0.334	0.294	0.257
7.9 eV	γ	5.81−1	6.78−1	7.96−1	8.68−1	9.18−1	9.55−1	9.81−1	1.00+0	1.01+0	1.02+0
	δ	9.57−2	1.24−1	1.77−1	2.27−1	2.73−1	3.16−1	3.56−1	3.92−1	4.27−1	4.60−1
$3d_{5/2}$	σ	5.350+0	1.901+0	4.166−1	1.364−1	5.606−2	2.670−2	1.410−2	8.046−3	4.875−3	3.099−3
E_b =	β	0.975	0.856	0.689	0.583	0.509	0.452	0.405	0.365	0.330	0.298
8.0 eV	γ	5.78−1	6.75−1	7.94−1	8.70−1	9.24−1	9.65−1	9.96−1	1.02+0	1.04+0	1.05+0
	δ	9.70−2	1.25−1	1.79−1	2.29−1	2.75−1	3.17−1	3.56−1	3.92−1	4.25−1	4.58−1
$4s_{1/2}$	σ	5.706−1	3.273−1	1.435−1	7.781−2	4.763−2	3.156−2	2.212−2	1.616−2	1.220−2	9.451−3
E_b =	β	1.999	1.999	1.997	1.993	1.987	1.980	1.972	1.964	1.956	1.947
1.3 eV	γ	−5.63−2	9.86−3	2.02−1	4.06−1	6.02−1	7.85−1	9.56−1	1.11+0	1.26+0	1.40+0
	δ	−1.79−5	−1.95−5	−2.08−5	−2.09−5	−2.04−5	−1.97−5	−1.86−5	−1.69−5	−1.48−5	−1.24−5
Z= 31, Ga: [Ar]$3d^4_{3/2}$ $3d^6_{5/2}$ $4s^2_{1/2}$ $4p^1_{1/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$2s_{1/2}$	σ	7.822+1	5.030+1	2.433+1	1.379+1	8.655+0	5.825+0	4.126+0	3.038+0	2.306+0	1.795+0
E_b =	β	1.987	1.994	1.999	1.997	1.993	1.987	1.980	1.972	1.964	1.955
1297.7 eV	γ	4.43−1	−1.08−2	−1.72−2	1.69−1	3.76−1	5.76−1	7.63−1	9.37−1	1.10+0	1.25+0
	δ	−2.67−5	−3.97−5	−4.13−5	−3.94−5	−3.72−5	−3.53−5	−3.33−5	−3.11−5	−2.85−5	−2.58−5
$2p_{1/2}$	σ	1.407+2	6.616+1	2.120+1	9.076+0	4.601+0	2.607+0	1.599+0	1.040+0	7.083−1	5.005−1
E_b =	β	1.344	1.443	1.388	1.291	1.194	1.103	1.021	0.948	0.880	0.820
1142.3 eV	γ	−5.18−2	2.17−1	5.98−1	8.41−1	1.01+0	1.14+0	1.24+0	1.32+0	1.38+0	1.44+0
	δ	1.35−2	2.52−2	4.28−2	6.08−2	7.93−2	9.83−2	1.17−1	1.36−1	1.54−1	1.72−1
$2p_{3/2}$	σ	2.715+2	1.260+2	3.985+1	1.692+1	8.520+0	4.802+0	2.931+0	1.898+0	1.288+0	9.066−1
E_b =	β	1.376	1.470	1.416	1.320	1.223	1.133	1.051	0.978	0.911	0.852
1115.4 eV	γ	−3.89−2	2.33−1	6.20−1	8.66−1	1.04+0	1.17+0	1.27+0	1.35+0	1.41+0	1.46+0
	δ	1.46−2	2.59−2	4.26−2	5.95−2	7.74−2	9.56−2	1.14−1	1.32−1	1.50−1	1.67−1
$3s_{1/2}$	σ	1.464+1	8.527+0	3.805+0	2.083+0	1.284+0	8.553−1	6.020−1	4.415−1	3.342−1	2.596−1
E_b =	β	1.998	1.999	1.998	1.994	1.988	1.982	1.975	1.967	1.959	1.950
158.1 eV	γ	−7.08−2	−2.43−2	1.48−1	3.44−1	5.38−1	7.21−1	8.93−1	1.05+0	1.20+0	1.34+0
	δ	−2.25−5	−2.42−5	−2.61−5	−2.67−5	−2.65−5	−2.57−5	−2.44−5	−2.26−5	−2.04−5	−1.78−5

(*continued on next page*)

Table 1 (*continued*)

$3p_{1/2}$	σ	1.385+1	6.882+0	2.379+0	1.067+0	5.587−1	3.241−1	2.023−1	1.335−1	9.196−2	6.559−2
E_b =	β	1.552	1.481	1.346	1.228	1.125	1.036	0.957	0.887	0.825	0.769
106.8 eV	γ	2.83−1	4.51−1	7.09−1	8.93−1	1.03+0	1.14+0	1.23+0	1.30+0	1.36+0	1.41+0
	δ	1.23−2	2.02−2	3.83−2	5.79−2	7.79−2	9.79−2	1.18−1	1.37−1	1.55−1	1.73−1
$3p_{3/2}$	σ	2.662+1	1.312+1	4.481+0	1.993+0	1.036+0	5.973−1	3.710−1	2.436−1	1.671−1	1.187−1
E_b =	β	1.574	1.505	1.373	1.256	1.153	1.065	0.986	0.917	0.855	0.799
102.9 eV	γ	2.91−1	4.62−1	7.25−1	9.13−1	1.05+0	1.16+0	1.25+0	1.32+0	1.38+0	1.43+0
	δ	1.29−2	2.04−2	3.75−2	5.63−2	7.56−2	9.51−2	1.14−1	1.33−1	1.51−1	1.69−1
$3d_{3/2}$	σ	5.009+0	1.803+0	4.015−1	1.330−1	5.518−2	2.650−2	1.410−2	8.103−3	4.939−3	3.158−3
E_b =	β	1.010	0.893	0.722	0.607	0.523	0.456	0.402	0.355	0.313	0.275
20.7 eV	γ	5.73−1	6.78−1	8.08−1	8.86−1	9.39−1	9.77−1	1.00+0	1.02+0	1.04+0	1.05+0
	δ	9.19−2	1.19−1	1.72−1	2.22−1	2.67−1	3.09−1	3.48−1	3.85−1	4.19−1	4.51−1
$3d_{5/2}$	σ	7.255+0	2.608+0	5.792−1	1.912−1	7.913−2	3.790−2	2.012−2	1.153−2	7.012−3	4.473−3
E_b =	β	0.997	0.882	0.718	0.611	0.533	0.474	0.425	0.384	0.347	0.314
15.7 eV	γ	5.70−1	6.74−1	8.05−1	8.86−1	9.42−1	9.85−1	1.02+0	1.04+0	1.06+0	1.07+0
	δ	9.32−2	1.21−1	1.74−1	2.24−1	2.69−1	3.10−1	3.49−1	3.84−1	4.18−1	4.49−1
$4s_{1/2}$	σ	8.343−1	4.814−1	2.127−1	1.158−1	7.114−2	4.728−2	3.323−2	2.434−2	1.842−2	1.430−2
E_b =	β	1.998	1.999	1.998	1.994	1.988	1.981	1.974	1.966	1.958	1.949
5.6 eV	γ	−6.51−2	−1.04−2	1.68−1	3.65−1	5.56−1	7.37−1	9.06−1	1.07+0	1.21+0	1.36+0
	δ	−2.09−5	−2.33−5	−2.47−5	−2.48−5	−2.45−5	−2.39−5	−2.26−5	−2.10−5	−1.88−5	−1.61−5
$4p_{1/2}$	σ	3.670−1	1.822−1	6.290−2	2.820−2	1.476−2	8.565−3	5.349−3	3.530−3	2.432−3	1.735−3
E_b =	β	1.555	1.479	1.342	1.223	1.121	1.033	0.956	0.887	0.825	0.769
0.8 eV	γ	2.98−1	4.63−1	7.17−1	8.99−1	1.04+0	1.14+0	1.23+0	1.30+0	1.36+0	1.41+0
	δ	1.16−2	1.96−2	3.79−2	5.78−2	7.81−2	9.83−2	1.18−1	1.38−1	1.56−1	1.74−1

Z= 32, Ge: [Ar]$3d^4_{3/2}$ $3d^6_{5/2}$ $4s^2_{1/2}$ $4p^2_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$2s_{1/2}$	σ	7.948+1	5.300+1	2.604+1	1.489+1	9.400+0	6.356+0	4.518+0	3.336+0	2.539+0	1.981+0
E_b =	β	1.983	1.992	1.999	1.998	1.994	1.988	1.982	1.974	1.966	1.958
1414.3 eV	γ	7.53−1	5.53−2	−4.58−2	1.18−1	3.18−1	5.16−1	7.02−1	8.75−1	1.04+0	1.19+0
	δ	−1.48−5	−4.39−5	−4.84−5	−4.65−5	−4.42−5	−4.20−5	−3.98−5	−3.76−5	−3.50−5	−3.22−5
$2p_{1/2}$	σ	1.570+2	7.529+1	2.442+1	1.053+1	5.366+0	3.054+0	1.879+0	1.226+0	8.374−1	5.932−1
E_b =	β	1.258	1.433	1.403	1.313	1.221	1.135	1.056	0.984	0.918	0.858
1247.8 eV	γ	−1.21−1	1.48−1	5.51−1	8.11−1	9.94−1	1.13+0	1.24+0	1.32+0	1.39+0	1.45+0
	δ	8.80−3	2.30−2	4.03−2	5.77−2	7.58−2	9.42−2	1.13−1	1.31−1	1.48−1	1.66−1
$2p_{3/2}$	σ	3.041+2	1.433+2	4.581+1	1.958+1	9.909+0	5.607+0	3.433+0	2.230+0	1.517+0	1.070+0
E_b =	β	1.300	1.462	1.433	1.344	1.253	1.167	1.089	1.017	0.951	0.891
1216.7 eV	γ	−1.09−1	1.65−1	5.74−1	8.38−1	1.02+0	1.16+0	1.27+0	1.35+0	1.42+0	1.48+0
	δ	1.03−2	2.40−2	4.02−2	5.66−2	7.39−2	9.15−2	1.09−1	1.27−1	1.44−1	1.61−1
$3s_{1/2}$	σ	1.592+1	9.328+0	4.195+0	2.308+0	1.428+0	9.544−1	6.735−1	4.951−1	3.757−1	2.924−1
E_b =	β	1.997	1.999	1.998	1.995	1.990	1.983	1.976	1.969	1.961	1.952
180.0 eV	γ	−7.50−2	−4.19−2	1.15−1	3.04−1	4.93−1	6.73−1	8.43−1	1.00+0	1.15+0	1.29+0
	δ	−2.60−5	−2.86−5	−3.07−5	−3.15−5	−3.13−5	−3.07−5	−2.94−5	−2.76−5	−2.56−5	−2.29−5
$3p_{1/2}$	σ	1.578+1	7.937+0	2.784+0	1.260+0	6.642−1	3.874−1	2.429−1	1.609−1	1.112−1	7.955−2
E_b =	β	1.565	1.498	1.368	1.254	1.155	1.069	0.992	0.923	0.861	0.804
127.9 eV	γ	2.51−1	4.21−1	6.87−1	8.80−1	1.02+0	1.14+0	1.23+0	1.31+0	1.37+0	1.42+0
	δ	1.09−2	1.83−2	3.56−2	5.46−2	7.42−2	9.37−2	1.13−1	1.32−1	1.50−1	1.67−1
$3p_{3/2}$	σ	3.022+1	1.507+1	5.221+0	2.342+0	1.226+0	7.104−1	4.431−1	2.920−1	2.010−1	1.432−1
E_b =	β	1.587	1.523	1.396	1.283	1.186	1.100	1.023	0.955	0.893	0.836
120.8 eV	γ	2.60−1	4.33−1	7.04−1	9.00−1	1.05+0	1.16+0	1.25+0	1.33+0	1.39+0	1.44+0
	δ	1.17−2	1.86−2	3.50−2	5.31−2	7.19−2	9.07−2	1.09−1	1.28−1	1.45−1	1.63−1
$3d_{3/2}$	σ	6.595+0	2.402+0	5.422−1	1.811−1	7.563−2	3.652−2	1.953−2	1.127−2	6.896−3	4.424−3
E_b =	β	1.036	0.920	0.746	0.628	0.541	0.473	0.417	0.369	0.327	0.289
29.2 eV	γ	5.63−1	6.75−1	8.14−1	8.98−1	9.54−1	9.95−1	1.03+0	1.05+0	1.06+0	1.07+0
	δ	8.87−2	1.15−1	1.66−1	2.14−1	2.59−1	3.01−1	3.39−1	3.75−1	4.09−1	4.41−1
$3d_{5/2}$	σ	9.640+0	3.502+0	7.869−1	2.617−1	1.089−1	5.242−2	2.795−2	1.608−2	9.817−3	6.283−3
E_b =	β	1.023	0.909	0.742	0.630	0.550	0.489	0.440	0.397	0.361	0.327
28.5 eV	γ	5.61−1	6.72−1	8.12−1	8.97−1	9.58−1	1.00+0	1.04+0	1.06+0	1.08+0	1.10+0
	δ	9.01−2	1.17−1	1.69−1	2.17−1	2.61−1	3.02−1	3.40−1	3.75−1	4.08−1	4.39−1
$4s_{1/2}$	σ	1.106+0	6.412−1	2.852−1	1.560−1	9.620−2	6.415−2	4.521−2	3.320−2	2.517−2	1.958−2
E_b =	β	1.998	1.999	1.998	1.994	1.989	1.983	1.976	1.968	1.960	1.952
9.0 eV	γ	−7.17−2	−2.77−2	1.35−1	3.26−1	5.15−1	6.95−1	8.65−1	1.02+0	1.17+0	1.31+0
	δ	−2.44−5	−2.69−5	−2.92−5	−2.98−5	−2.95−5	−2.86−5	−2.73−5	−2.55−5	−2.33−5	−2.06−5
$4p_{1/2}$	σ	5.863−1	2.947−1	1.033−1	4.677−2	2.466−2	1.439−2	9.026−3	5.980−3	4.135−3	2.959−3
E_b =	β	1.569	1.495	1.360	1.244	1.145	1.059	0.982	0.914	0.851	0.795
2.3 eV	γ	2.69−1	4.35−1	6.97−1	8.86−1	1.03+0	1.14+0	1.23+0	1.31+0	1.37+0	1.42+0
	δ	1.01−2	1.73−2	3.47−2	5.40−2	7.37−2	9.34−2	1.13−1	1.31−1	1.49−1	1.67−1

(*continued on next page*)

Table 1 (*continued*)

Z= 33, As: [Ar]$3d^4_{3/2}$ $3d^6_{5/2}$ $4s^2_{1/2}$ $4p^2_{1/2}$ $4p^1_{3/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$2p_{1/2}$	σ	1.705+2	8.503+1	2.794+1	1.213+1	6.217+0	3.552+0	2.194+0	1.436+0	9.829−1	6.979−1
E_b =	β	1.098	1.414	1.416	1.335	1.246	1.161	1.083	1.012	0.946	0.886
1358.6 eV	γ	−1.67−1	7.30−2	4.98−1	7.75−1	9.70−1	1.12+0	1.23+0	1.32+0	1.40+0	1.46+0
	δ	3.60−3	2.03−2	3.79−2	5.45−2	7.17−2	8.93−2	1.07−1	1.25−1	1.42−1	1.59−1
$2p_{3/2}$	σ	3.345+2	1.620+2	5.236+1	2.252+1	1.145+1	6.504+0	3.995+0	2.602+0	1.774+0	1.254+0
E_b =	β	1.169	1.445	1.448	1.368	1.280	1.195	1.117	1.046	0.981	0.921
1323.1 eV	γ	−1.64−1	9.21−2	5.23−1	8.04−1	1.00+0	1.15+0	1.26+0	1.35+0	1.43+0	1.49+0
	δ	4.65−3	2.17−2	3.81−2	5.36−2	6.98−2	8.66−2	1.04−1	1.21−1	1.37−1	1.54−1
$3s_{1/2}$	σ	1.726+1	1.017+1	4.608+0	2.548+0	1.583+0	1.061+0	7.508−1	5.532−1	4.207−1	3.281−1
E_b =	β	1.997	1.998	1.998	1.995	1.991	1.985	1.978	1.971	1.963	1.955
203.5 eV	γ	−7.59−2	−5.65−2	8.36−2	2.65−1	4.51−1	6.29−1	7.98−1	9.57−1	1.11+0	1.25+0
	δ	−3.05−5	−3.33−5	−3.59−5	−3.71−5	−3.68−5	−3.61−5	−3.50−5	−3.32−5	−3.10−5	−2.82−5
$3p_{1/2}$	σ	1.778+1	9.052+0	3.224+0	1.473+0	7.816−1	4.583−1	2.887−1	1.919−1	1.331−1	9.552−2
E_b =	β	1.576	1.514	1.388	1.277	1.179	1.093	1.016	0.949	0.887	0.831
146.4 eV	γ	2.22−1	3.91−1	6.63−1	8.62−1	1.01+0	1.13+0	1.23+0	1.31+0	1.38+0	1.43+0
	δ	9.73−3	1.66−2	3.28−2	5.08−2	6.96−2	8.84−2	1.07−1	1.25−1	1.43−1	1.60−1
$3p_{3/2}$	σ	3.414+1	1.722+1	6.049+0	2.737+0	1.441+0	8.395−1	5.258−1	3.478−1	2.401−1	1.715−1
E_b =	β	1.598	1.540	1.418	1.308	1.211	1.125	1.049	0.982	0.920	0.864
140.5 eV	γ	2.30−1	4.03−1	6.81−1	8.84−1	1.04+0	1.16+0	1.25+0	1.33+0	1.40+0	1.46+0
	δ	1.06−2	1.71−2	3.23−2	4.94−2	6.73−2	8.55−2	1.03−1	1.21−1	1.39−1	1.55−1
$3d_{3/2}$	σ	8.552+0	3.150+0	7.202−1	2.424−1	1.018−1	4.943−2	2.655−2	1.538−2	9.446−3	6.080−3
E_b =	β	1.061	0.948	0.774	0.652	0.563	0.493	0.435	0.385	0.342	0.303
41.7 eV	γ	5.52−1	6.71−1	8.21−1	9.10−1	9.70−1	1.01+0	1.04+0	1.07+0	1.08+0	1.10+0
	δ	8.60−2	1.11−1	1.61−1	2.08−1	2.52−1	2.93−1	3.32−1	3.67−1	4.01−1	4.32−1
$3d_{5/2}$	σ	1.248+1	4.584+0	1.043+0	3.496−1	1.463−1	7.078−2	3.790−2	2.189−2	1.341−2	8.609−3
E_b =	β	1.047	0.936	0.768	0.653	0.570	0.507	0.455	0.412	0.374	0.340
40.9 eV	γ	5.50−1	6.68−1	8.17−1	9.09−1	9.72−1	1.02+0	1.05+0	1.08+0	1.10+0	1.12+0
	δ	8.74−2	1.13−1	1.64−1	2.11−1	2.55−1	2.95−1	3.33−1	3.68−1	4.01−1	4.31−1
$4s_{1/2}$	σ	1.386+0	8.080−1	3.619−1	1.989−1	1.230−1	8.226−2	5.811−2	4.277−2	3.250−2	2.533−2
E_b =	β	1.997	1.999	1.998	1.995	1.990	1.984	1.977	1.970	1.962	1.954
12.5 eV	γ	−7.57−2	−4.26−2	1.05−1	2.87−1	4.70−1	6.47−1	8.14−1	9.72−1	1.12+0	1.26+0
	δ	−2.84−5	−3.12−5	−3.40−5	−3.53−5	−3.52−5	−3.46−5	−3.36−5	−3.19−5	−2.98−5	−2.71−5
$4p_{1/2}$	σ	8.431−1	4.290−1	1.528−1	6.984−2	3.708−2	2.176−2	1.371−2	9.122−3	6.330−3	4.544−3
E_b =	β	1.581	1.512	1.383	1.270	1.172	1.085	1.009	0.940	0.878	0.822
2.5 eV	γ	2.43−1	4.08−1	6.73−1	8.69−1	1.02+0	1.13+0	1.23+0	1.31+0	1.37+0	1.43+0
	δ	8.98−3	1.56−2	3.17−2	4.99−2	6.88−2	8.77−2	1.06−1	1.25−1	1.43−1	1.60−1
$4p_{3/2}$	σ	1.632+0	8.225−1	2.890−1	1.308−1	6.891−2	4.016−2	2.517−2	1.666−2	1.150−2	8.222−3
E_b =	β	1.604	1.539	1.413	1.301	1.204	1.118	1.041	0.973	0.911	0.855
2.5 eV	γ	2.51−1	4.19−1	6.91−1	8.90−1	1.04+0	1.16+0	1.26+0	1.33+0	1.40+0	1.45+0
	δ	9.79−3	1.60−2	3.12−2	4.84−2	6.64−2	8.46−2	1.03−1	1.21−1	1.38−1	1.55−1

Z= 34, Se: [Ar]$3d^4_{3/2}$ $3d^6_{5/2}$ $4s^2_{1/2}$ $4p^2_{1/2}$ $4p^2_{3/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$2p_{1/2}$	σ	1.611+2	9.549+1	3.181+1	1.391+1	7.164+0	4.110+0	2.546+0	1.671+0	1.147+0	8.162−1
E_b =	β	0.628	1.381	1.426	1.355	1.271	1.188	1.112	1.041	0.976	0.916
1476.2 eV	γ	−1.25−1	−5.99−3	4.40−1	7.35−1	9.43−1	1.10+0	1.22+0	1.32+0	1.40+0	1.46+0
	δ	1.76−2	1.71−2	3.56−2	5.16−2	6.80−2	8.47−2	1.02−1	1.19−1	1.36−1	1.52−1
$2p_{3/2}$	σ	3.463+2	1.821+2	5.956+1	2.577+1	1.316+1	7.503+0	4.622+0	3.019+0	2.063+0	1.461+0
E_b =	β	0.866	1.417	1.459	1.390	1.306	1.224	1.148	1.077	1.012	0.953
1435.8 eV	γ	−1.56−1	1.32−2	4.66−1	7.66−1	9.77−1	1.13+0	1.26+0	1.35+0	1.43+0	1.50+0
	δ	4.76−3	1.88−2	3.61−2	5.09−2	6.63−2	8.20−2	9.82−2	1.14−1	1.31−1	1.47−1
$3s_{1/2}$	σ	1.867+1	1.106+1	5.047+0	2.805+0	1.748+0	1.175+0	8.337−1	6.156−1	4.691−1	3.665−1
E_b =	β	1.996	1.998	1.998	1.996	1.992	1.986	1.980	1.973	1.965	1.957
231.5 eV	γ	−7.35−2	−6.81−2	5.40−2	2.26−1	4.07−1	5.83−1	7.51−1	9.09−1	1.06+0	1.20+0
	δ	−3.47−5	−3.83−5	−4.18−5	−4.34−5	−4.35−5	−4.30−5	−4.20−5	−4.02−5	−3.80−5	−3.52−5
$3p_{1/2}$	σ	1.992+1	1.026+1	3.710+0	1.711+0	9.138−1	5.386−1	3.407−1	2.274−1	1.582−1	1.139−1
E_b =	β	1.585	1.528	1.409	1.300	1.203	1.118	1.042	0.974	0.913	0.856
168.2 eV	γ	1.92−1	3.59−1	6.37−1	8.43−1	1.00+0	1.12+0	1.23+0	1.31+0	1.38+0	1.44+0
	δ	8.62−3	1.50−2	3.02−2	4.74−2	6.52−2	8.33−2	1.01−1	1.19−1	1.36−1	1.53−1
$3p_{3/2}$	σ	3.833+1	1.955+1	6.964+0	3.178+0	1.684+0	9.854−1	6.197−1	4.113−1	2.848−1	2.040−1
E_b =	β	1.609	1.556	1.441	1.333	1.237	1.153	1.077	1.009	0.948	0.891
161.9 eV	γ	2.00−1	3.72−1	6.56−1	8.66−1	1.03+0	1.15+0	1.25+0	1.34+0	1.41+0	1.47+0
	δ	9.68−3	1.56−2	2.99−2	4.60−2	6.30−2	8.03−2	9.76−2	1.15−1	1.32−1	1.48−1
$3d_{3/2}$	σ	1.091+1	4.064+0	9.407−1	3.189−1	1.348−1	6.571−2	3.544−2	2.061−2	1.270−2	8.197−3
E_b =	β	1.085	0.977	0.802	0.678	0.587	0.515	0.456	0.405	0.360	0.320

(*continued on next page*)

Table 1 (*continued*)

57.4 eV	γ	5.40−1	6.66−1	8.26−1	9.22−1	9.86−1	1.03+0	1.06+0	1.09+0	1.11+0	1.12+0
	δ	8.37−2	1.08−1	1.56−1	2.02−1	2.46−1	2.87−1	3.25−1	3.60−1	3.93−1	4.25−1
$3d_{5/2}$	σ	1.589+1	5.903+0	1.360+0	4.591−1	1.932−1	9.389−2	5.048−2	2.926−2	1.798−2	1.158−2
E_b =	β	1.070	0.963	0.794	0.677	0.592	0.527	0.474	0.430	0.390	0.356
56.4 eV	γ	5.39−1	6.63−1	8.22−1	9.20−1	9.87−1	1.04+0	1.07+0	1.10+0	1.13+0	1.14+0
	δ	8.50−2	1.10−1	1.59−1	2.05−1	2.49−1	2.89−1	3.26−1	3.61−1	3.94−1	4.24−1
$4s_{1/2}$	σ	1.681+0	9.839−1	4.437−1	2.450−1	1.521−1	1.020−1	7.220−2	5.325−2	4.054−2	3.165−2
E_b =	β	1.997	1.998	1.998	1.996	1.991	1.985	1.979	1.972	1.964	1.956
16.2 eV	γ	−7.74−2	−5.50−2	7.79−2	2.51−1	4.30−1	6.04−1	7.69−1	9.25−1	1.07+0	1.21+0
	δ	−3.23−5	−3.60−5	−3.94−5	−4.11−5	−4.12−5	−4.06−5	−3.95−5	−3.79−5	−3.61−5	−3.34−5
$4p_{1/2}$	σ	1.131+0	5.826−1	2.107−1	9.724−2	5.198−2	3.066−2	1.941−2	1.296−2	9.025−3	6.498−3
E_b =	β	1.592	1.528	1.404	1.295	1.200	1.116	1.041	0.973	0.912	0.856
5.6 eV	γ	2.17−1	3.80−1	6.50−1	8.52−1	1.01+0	1.13+0	1.23+0	1.31+0	1.38+0	1.44+0
	δ	7.83−3	1.40−2	2.93−2	4.68−2	6.52−2	8.37−2	1.02−1	1.20−1	1.37−1	1.54−1
$4p_{3/2}$	σ	2.174+0	1.108+0	3.949−1	1.804−1	9.563−2	5.602−2	3.525−2	2.341−2	1.622−2	1.163−2
E_b =	β	1.616	1.555	1.436	1.329	1.234	1.151	1.076	1.009	0.947	0.891
5.6 eV	γ	2.25−1	3.92−1	6.68−1	8.75−1	1.03+0	1.16+0	1.26+0	1.34+0	1.41+0	1.47+0
	δ	8.80−3	1.45−2	2.88−2	4.54−2	6.28−2	8.05−2	9.80−2	1.15−1	1.32−1	1.49−1

Z= 35, Br: [Ar]$3d^4_{3/2}$ $3d^6_{5/2}$ $4s^2_{1/2}$ $4p^2_{1/2}$ $4p^3_{3/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$3s_{1/2}$	σ	2.008+1	1.196+1	5.499+0	3.071+0	1.921+0	1.295+0	9.210−1	6.817−1	5.204−1	4.074−1
E_b =	β	1.995	1.997	1.998	1.996	1.993	1.987	1.981	1.974	1.967	1.959
256.5 eV	γ	−6.78−2	−7.62−2	2.74−2	1.90−1	3.65−1	5.37−1	7.02−1	8.59−1	1.01+0	1.15+0
	δ	−4.01−5	−4.33−5	−4.82−5	−5.05−5	−5.09−5	−5.07−5	−4.96−5	−4.84−5	−4.61−5	−4.35−5
$3p_{1/2}$	σ	2.213+1	1.154+1	4.236+0	1.972+0	1.060+0	6.281−1	3.991−1	2.673−1	1.866−1	1.347−1
E_b =	β	1.594	1.542	1.429	1.323	1.228	1.144	1.070	1.003	0.941	0.886
189.3 eV	γ	1.63−1	3.28−1	6.09−1	8.22−1	9.85−1	1.11+0	1.22+0	1.31+0	1.38+0	1.44+0
	δ	7.56−3	1.34−2	2.79−2	4.42−2	6.12−2	7.86−2	9.61−2	1.13−1	1.30−1	1.47−1
$3p_{3/2}$	σ	4.266+1	2.200+1	7.951+0	3.661+0	1.951+0	1.148+0	7.247−1	4.827−1	3.353−1	2.408−1
E_b =	β	1.618	1.570	1.462	1.357	1.264	1.180	1.106	1.039	0.978	0.922
181.5 eV	γ	1.71−1	3.40−1	6.29−1	8.47−1	1.01+0	1.14+0	1.25+0	1.34+0	1.41+0	1.47+0
	δ	8.76−3	1.43−2	2.77−2	4.30−2	5.90−2	7.56−2	9.24−2	1.09−1	1.26−1	1.42−1
$3d_{3/2}$	σ	1.361+1	5.130+0	1.204+0	4.116−1	1.750−1	8.572−2	4.643−2	2.709−2	1.675−2	1.085−2
E_b =	β	1.107	1.004	0.830	0.704	0.610	0.537	0.477	0.425	0.379	0.338
70.1 eV	γ	5.27−1	6.59−1	8.29−1	9.32−1	1.00+0	1.05+0	1.08+0	1.11+0	1.13+0	1.14+0
	δ	8.14−2	1.05−1	1.51−1	1.96−1	2.39−1	2.80−1	3.17−1	3.52−1	3.85−1	4.16−1
$3d_{5/2}$	σ	1.979+1	7.442+0	1.738+0	5.915−1	2.504−1	1.223−1	6.599−2	3.839−2	2.367−2	1.529−2
E_b =	β	1.092	0.989	0.819	0.700	0.614	0.547	0.493	0.447	0.407	0.372
69.0 eV	γ	5.26−1	6.55−1	8.24−1	9.29−1	1.00+0	1.05+0	1.09+0	1.12+0	1.15+0	1.17+0
	δ	8.27−2	1.07−1	1.54−1	2.00−1	2.42−1	2.82−1	3.19−1	3.54−1	3.86−1	4.17−1
$4s_{1/2}$	σ	1.997+0	1.173+0	5.319−1	2.949−1	1.836−1	1.234−1	8.759−2	6.473−2	4.936−2	3.861−2
E_b =	β	1.996	1.998	1.998	1.996	1.992	1.987	1.980	1.973	1.966	1.958
27.3 eV	γ	−7.75−2	−6.59−2	5.15−2	2.16−1	3.90−1	5.61−1	7.26−1	8.82−1	1.03+0	1.17+0
	δ	−3.63−5	−4.10−5	−4.55−5	−4.78−5	−4.81−5	−4.77−5	−4.65−5	−4.49−5	−4.27−5	−4.01−5
$4p_{1/2}$	σ	1.444+0	7.526−1	2.765−1	1.289−1	6.937−2	4.114−2	2.616−2	1.754−2	1.225−2	8.846−3
E_b =	β	1.603	1.541	1.423	1.318	1.224	1.141	1.066	1.000	0.938	0.883
5.2 eV	γ	1.93−1	3.53−1	6.25−1	8.34−1	9.94−1	1.12+0	1.23+0	1.31+0	1.38+0	1.45+0
	δ	6.80−3	1.25−2	2.69−2	4.38−2	6.15−2	7.94−2	9.72−2	1.15−1	1.32−1	1.48−1
$4p_{3/2}$	σ	2.759+0	1.422+0	5.145−1	2.372−1	1.266−1	7.453−2	4.710−2	3.139−2	2.182−2	1.568−2
E_b =	β	1.627	1.570	1.456	1.353	1.260	1.178	1.104	1.037	0.976	0.920
4.6 eV	γ	2.01−1	3.65−1	6.44−1	8.57−1	1.02+0	1.15+0	1.26+0	1.34+0	1.41+0	1.48+0
	δ	7.91−3	1.32−2	2.66−2	4.24−2	5.92−2	7.63−2	9.34−2	1.10−1	1.27−1	1.43−1

Z= 36, Kr: [Ar]$3d^4_{3/2}$ $3d^6_{5/2}$ $4s^2_{1/2}$ $4p^2_{1/2}$ $4p^4_{3/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$3s_{1/2}$	σ	2.162+1	1.293+1	5.986+0	3.358+0	2.107+0	1.425+0	1.015+0	7.528−1	5.758−1	4.514−1
E_b =	β	1.994	1.996	1.998	1.997	1.993	1.989	1.983	1.976	1.969	1.961
292.1 eV	γ	−5.89−2	−8.21−2	2.23−3	1.53−1	3.22−1	4.91−1	6.54−1	8.09−1	9.57−1	1.10+0
	δ	−4.51−5	−4.98−5	−5.55−5	−5.82−5	−5.92−5	−5.93−5	−5.86−5	−5.74−5	−5.54−5	−5.29−5
$3p_{1/2}$	σ	2.463+1	1.298+1	4.829+0	2.267+0	1.226+0	7.299−1	4.656−1	3.129−1	2.191−1	1.585−1
E_b =	β	1.601	1.554	1.448	1.346	1.253	1.170	1.097	1.031	0.971	0.915
222.1 eV	γ	1.33−1	2.94−1	5.79−1	7.99−1	9.69−1	1.10+0	1.21+0	1.31+0	1.38+0	1.45+0
	δ	6.50−3	1.19−2	2.55−2	4.12−2	5.76−2	7.43−2	9.12−2	1.08−1	1.25−1	1.41−1
$3p_{3/2}$	σ	4.765+1	2.481+1	9.079+0	4.213+0	2.258+0	1.334+0	8.450−1	5.645−1	3.931−1	2.831−1
E_b =	β	1.626	1.584	1.482	1.382	1.290	1.208	1.135	1.069	1.010	0.954
214.4 eV	γ	1.40−1	3.07−1	5.99−1	8.25−1	9.99−1	1.14+0	1.25+0	1.34+0	1.42+0	1.48+0
	δ	7.86−3	1.29−2	2.55−2	4.01−2	5.55−2	7.13−2	8.74−2	1.04−1	1.20−1	1.36−1

(*continued on next page*)

Table 1 (*continued*)

$3d_{3/2}$	σ	1.701+1	6.468+0	1.534+0	5.278−1	2.253−1	1.108−1	6.022−2	3.525−2	2.185−2	1.418−2
E_b =	β	1.129	1.031	0.859	0.730	0.634	0.559	0.497	0.444	0.397	0.355
95.0 eV	γ	5.12−1	6.50−1	8.32−1	9.41−1	1.01+0	1.07+0	1.11+0	1.13+0	1.15+0	1.17+0
	δ	7.90−2	1.02−1	1.47−1	1.91−1	2.33−1	2.73−1	3.10−1	3.44−1	3.77−1	4.08−1
$3d_{5/2}$	σ	2.471+1	9.372+0	2.212+0	7.573−1	3.220−1	1.578−1	8.545−2	4.986−2	3.082−2	1.995−2
E_b =	β	1.114	1.015	0.847	0.724	0.635	0.567	0.511	0.464	0.423	0.387
93.8 eV	γ	5.11−1	6.47−1	8.27−1	9.37−1	1.01+0	1.07+0	1.11+0	1.14+0	1.17+0	1.19+0
	δ	8.03−2	1.04−1	1.50−1	1.94−1	2.36−1	2.76−1	3.12−1	3.46−1	3.78−1	4.08−1
$4s_{1/2}$	σ	2.316+0	1.365+0	6.232−1	3.471−1	2.169−1	1.462−1	1.040−1	7.702−2	5.885−2	4.610−2
E_b =	β	1.996	1.997	1.998	1.996	1.993	1.988	1.982	1.975	1.968	1.960
27.5 eV	γ	−7.58−2	−7.36−2	2.87−2	1.83−1	3.52−1	5.20−1	6.82−1	8.37−1	9.84−1	1.12+0
	δ	−4.13−5	−4.68−5	−5.23−5	−5.56−5	−5.59−5	−5.60−5	−5.47−5	−5.33−5	−5.11−5	−4.84−5
$4p_{1/2}$	σ	1.797+0	9.456−1	3.523−1	1.657−1	8.975−2	5.349−2	3.415−2	2.297−2	1.610−2	1.165−2
E_b =	β	1.613	1.555	1.441	1.339	1.247	1.165	1.090	1.023	0.962	0.906
14.7 eV	γ	1.69−1	3.26−1	5.99−1	8.13−1	9.79−1	1.11+0	1.22+0	1.31+0	1.39+0	1.45+0
	δ	5.83−3	1.10−2	2.45−2	4.06−2	5.77−2	7.50−2	9.21−2	1.09−1	1.26−1	1.42−1
$4p_{3/2}$	σ	3.419+0	1.779+0	6.521−1	3.032−1	1.627−1	9.625−2	6.104−2	4.082−2	2.845−2	2.050−2
E_b =	β	1.638	1.584	1.475	1.376	1.285	1.203	1.129	1.062	1.002	0.946
14.0 eV	γ	1.76−1	3.38−1	6.18−1	8.38−1	1.01+0	1.14+0	1.25+0	1.34+0	1.42+0	1.48+0
	δ	7.09−3	1.19−2	2.44−2	3.94−2	5.55−2	7.19−2	8.83−2	1.05−1	1.20−1	1.36−1
Z= 37, Rb: [Kr]$5s^1_{1/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$3s_{1/2}$	σ	2.307+1	1.387+1	6.465+0	3.644+0	2.295+0	1.556+0	1.112+0	8.266−1	6.335−1	4.976−1
E_b =	β	1.993	1.996	1.998	1.997	1.994	1.990	1.984	1.978	1.971	1.963
322.1 eV	γ	−4.91−2	−8.44−2	−1.87−2	1.20−1	2.81−1	4.44−1	6.05−1	7.59−1	9.07−1	1.05+0
	δ	−5.05−5	−5.60−5	−6.37−5	−6.75−5	−6.91−5	−6.91−5	−6.85−5	−6.71−5	−6.50−5	−6.24−5
$3p_{1/2}$	σ	2.694+1	1.437+1	5.427+0	2.573+0	1.402+0	8.394−1	5.378−1	3.628−1	2.548−1	1.849−1
E_b =	β	1.606	1.564	1.463	1.366	1.278	1.199	1.127	1.061	1.001	0.945
247.4 eV	γ	1.09−1	2.65−1	5.49−1	7.73−1	9.49−1	1.09+0	1.21+0	1.30+0	1.38+0	1.45+0
	δ	5.65−3	1.07−2	2.30−2	3.77−2	5.39−2	7.06−2	8.75−2	1.04−1	1.20−1	1.36−1
$3p_{3/2}$	σ	5.220+1	2.748+1	1.020+1	4.776+0	2.578+0	1.531+0	9.738−1	6.528−1	4.560−1	3.292−1
E_b =	β	1.631	1.595	1.499	1.404	1.318	1.239	1.168	1.102	1.042	0.986
238.5 eV	γ	1.17−1	2.78−1	5.69−1	8.00−1	9.81−1	1.13+0	1.24+0	1.34+0	1.42+0	1.49+0
	δ	7.17−3	1.19−2	2.32−2	3.68−2	5.19−2	6.76−2	8.36−2	9.94−2	1.15−1	1.30−1
$3d_{3/2}$	σ	2.047+1	7.891+0	1.904+0	6.610−1	2.840−1	1.403−1	7.656−2	4.497−2	2.797−2	1.821−2
E_b =	β	1.144	1.052	0.888	0.760	0.661	0.581	0.515	0.459	0.411	0.368
111.8 eV	γ	4.95−1	6.38−1	8.31−1	9.49−1	1.03+0	1.08+0	1.12+0	1.15+0	1.17+0	1.19+0
	δ	7.63−2	9.86−2	1.43−1	1.86−1	2.27−1	2.65−1	3.01−1	3.35−1	3.68−1	3.98−1
$3d_{5/2}$	σ	2.972+1	1.142+1	2.742+0	9.476−1	4.055−1	1.996−1	1.085−1	6.353−2	3.939−2	2.557−2
E_b =	β	1.128	1.035	0.874	0.752	0.660	0.587	0.528	0.478	0.435	0.398
110.3 eV	γ	4.95−1	6.36−1	8.25−1	9.45−1	1.03+0	1.08+0	1.13+0	1.16+0	1.19+0	1.21+0
	δ	7.75−2	1.01−1	1.46−1	1.90−1	2.31−1	2.69−1	3.05−1	3.38−1	3.70−1	3.99−1
$4s_{1/2}$	σ	2.784+0	1.646+0	7.562−1	4.231−1	2.653−1	1.793−1	1.279−1	9.487−2	7.262−2	5.699−2
E_b =	β	1.995	1.997	1.998	1.997	1.993	1.989	1.983	1.977	1.970	1.962
29.3 eV	γ	−7.29−2	−7.87−2	8.84−3	1.54−1	3.15−1	4.77−1	6.35−1	7.87−1	9.33−1	1.07+0
	δ	−4.65−5	−5.29−5	−6.01−5	−6.43−5	−6.53−5	−6.58−5	−6.50−5	−6.38−5	−6.18−5	−5.93−5
$4p_{1/2}$	σ	2.357+0	1.254+0	4.743−1	2.253−1	1.230−1	7.370−2	4.728−2	3.192−2	2.245−2	1.630−2
E_b =	β	1.622	1.567	1.455	1.354	1.265	1.185	1.113	1.047	0.988	0.933
14.8 eV	γ	1.49−1	3.01−1	5.74−1	7.90−1	9.61−1	1.10+0	1.21+0	1.30+0	1.38+0	1.45+0
	δ	5.14−3	9.82−3	2.22−2	3.71−2	5.32−2	6.98−2	8.65−2	1.03−1	1.20−1	1.36−1
$4p_{3/2}$	σ	4.517+0	2.373+0	8.829−1	4.144−1	2.240−1	1.332−1	8.483−2	5.693−2	3.980−2	2.876−2
E_b =	β	1.647	1.597	1.491	1.393	1.304	1.225	1.153	1.088	1.029	0.973
14.0 eV	γ	1.56−1	3.12−1	5.94−1	8.16−1	9.91−1	1.13+0	1.25+0	1.34+0	1.42+0	1.49+0
	δ	6.54−3	1.09−2	2.24−2	3.61−2	5.11−2	6.67−2	8.26−2	9.85−2	1.14−1	1.30−1
$5s_{1/2}$	σ	1.261−1	7.433−2	3.400−2	1.898−2	1.189−2	8.029−3	5.722−3	4.244−3	3.247−3	2.548−3
E_b =	β	1.995	1.997	1.998	1.997	1.993	1.989	1.983	1.976	1.970	1.962
4.0 eV	γ	−7.47−2	−7.97−2	9.60−3	1.55−1	3.15−1	4.78−1	6.38−1	7.91−1	9.38−1	1.08+0
	δ	−4.60−5	−5.26−5	−6.05−5	−6.36−5	−6.47−5	−6.47−5	−6.39−5	−6.21−5	−6.03−5	−5.66−5
Z= 38, Sr: [Kr]$5s^2_{1/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$3s_{1/2}$	σ	2.458+1	1.485+1	6.972+0	3.949+0	2.496+0	1.697+0	1.216+0	9.053−1	6.950−1	5.468−1
E_b =	β	1.992	1.995	1.997	1.997	1.995	1.991	1.985	1.979	1.973	1.966
357.5 eV	γ	−3.51−2	−8.43−2	−3.78−2	8.99−2	2.44−1	4.04−1	5.62−1	7.16−1	8.63−1	1.00+0
	δ	−5.66−5	−6.46−5	−7.29−5	−7.70−5	−7.91−5	−7.92−5	−7.89−5	−7.78−5	−7.58−5	−7.31−5
$3p_{1/2}$	σ	2.943+1	1.587+1	6.083+0	2.912+0	1.597+0	9.608−1	6.181−1	4.184−1	2.947−1	2.144−1

(*continued on next page*)

Table 1 (*continued*)

E_b =	β	1.611	1.574	1.477	1.384	1.297	1.218	1.147	1.081	1.021	0.965
279.8 eV	γ	8.38−2	2.35−1	5.20−1	7.49−1	9.30−1	1.08+0	1.19+0	1.29+0	1.38+0	1.45+0
	δ	4.86−3	9.41−3	2.12−2	3.55−2	5.09−2	6.67−2	8.27−2	9.86−2	1.14−1	1.30−1
$3p_{3/2}$	σ	5.711+1	3.036+1	1.143+1	5.399+0	2.931+0	1.749+0	1.117+0	7.510−1	5.260−1	3.806−1
E_b =	β	1.636	1.605	1.515	1.424	1.339	1.261	1.189	1.124	1.064	1.008
269.1 eV	γ	9.11−2	2.47−1	5.42−1	7.77−1	9.63−1	1.11+0	1.23+0	1.33+0	1.42+0	1.49+0
	δ	6.51−3	1.08−2	2.17−2	3.48−2	4.91−2	6.39−2	7.89−2	9.40−2	1.09−1	1.24−1
$3d_{3/2}$	σ	2.457+1	9.576+0	2.343+0	8.209−1	3.548−1	1.762−1	9.647−2	5.686−2	3.547−2	2.316−2
E_b =	β	1.162	1.074	0.908	0.780	0.679	0.599	0.533	0.477	0.428	0.385
135.0 eV	γ	4.78−1	6.25−1	8.26−1	9.52−1	1.04+0	1.10+0	1.14+0	1.17+0	1.19+0	1.21+0
	δ	7.45−2	9.51−2	1.38−1	1.80−1	2.20−1	2.58−1	2.94−1	3.28−1	3.61−1	3.91−1
$3d_{5/2}$	σ	3.563+1	1.385+1	3.372+0	1.176+0	5.060−1	2.502−1	1.365−1	8.020−2	4.988−2	3.247−2
E_b =	β	1.146	1.055	0.892	0.770	0.676	0.603	0.543	0.494	0.451	0.413
133.1 eV	γ	4.79−1	6.23−1	8.21−1	9.47−1	1.03+0	1.09+0	1.14+0	1.18+0	1.21+0	1.23+0
	δ	7.57−2	9.71−2	1.41−1	1.84−1	2.24−1	2.62−1	2.98−1	3.31−1	3.63−1	3.93−1
$4s_{1/2}$	σ	3.300+0	1.957+0	9.036−1	5.076−1	3.193−1	2.164−1	1.546−1	1.149−1	8.812−2	6.926−2
E_b =	β	1.994	1.996	1.998	1.997	1.994	1.990	1.984	1.978	1.971	1.964
37.7 eV	γ	−6.83−2	−8.34−2	−9.95−3	1.24−1	2.79−1	4.38−1	5.94−1	7.45−1	8.90−1	1.03+0
	δ	−5.20−5	−5.99−5	−6.82−5	−7.31−5	−7.44−5	−7.52−5	−7.46−5	−7.33−5	−7.12−5	−6.86−5
$4p_{1/2}$	σ	2.965+0	1.593+0	6.113−1	2.932−1	1.611−1	9.709−2	6.255−2	4.239−2	2.990−2	2.177−2
E_b =	β	1.631	1.577	1.471	1.376	1.289	1.210	1.140	1.074	1.015	0.960
20.7 eV	γ	1.29−1	2.77−1	5.49−1	7.69−1	9.44−1	1.09+0	1.20+0	1.30+0	1.38+0	1.45+0
	δ	4.33−3	8.65−3	2.07−2	3.51−2	5.07−2	6.68−2	8.30−2	9.92−2	1.15−1	1.31−1
$4p_{3/2}$	σ	5.705+0	3.026+0	1.141+0	5.404−1	2.940−1	1.757−1	1.123−1	7.565−2	5.304−2	3.842−2
E_b =	β	1.656	1.609	1.509	1.416	1.331	1.253	1.182	1.118	1.059	1.004
19.5 eV	γ	1.35−1	2.88−1	5.70−1	7.96−1	9.76−1	1.12+0	1.24+0	1.34+0	1.42+0	1.49+0
	δ	5.86−3	9.94−3	2.10−2	3.43−2	4.87−2	6.38−2	7.92−2	9.45−2	1.10−1	1.25−1
$5s_{1/2}$	σ	2.259−1	1.334−1	6.130−2	3.436−2	2.159−2	1.461−2	1.043−2	7.751−3	5.940−3	4.667−3
E_b =	β	1.994	1.996	1.998	1.997	1.994	1.989	1.984	1.978	1.971	1.964
5.0 eV	γ	−7.08−2	−8.36−2	−8.58−3	1.26−1	2.82−1	4.42−1	5.99−1	7.49−1	8.93−1	1.03+0
	δ	−5.14−5	−5.94−5	−6.81−5	−7.22−5	−7.38−5	−7.45−5	−7.43−5	−7.25−5	−7.18−5	−6.69−5

Z= 39, Y : [Kr]$4d^1_{3/2}$ $5s^2_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$3s_{1/2}$	σ	2.613+1	1.586+1	7.492+0	4.263+0	2.704+0	1.844+0	1.323+0	9.875−1	7.594−1	5.983−1
E_b =	β	1.991	1.994	1.997	1.997	1.995	1.991	1.987	1.981	1.974	1.967
393.6 eV	γ	−1.84−2	−8.14−2	−5.44−2	6.08−2	2.07−1	3.62−1	5.17−1	6.68−1	8.13−1	9.52−1
	δ	−6.34−5	−7.27−5	−8.30−5	−8.82−5	−9.08−5	−9.17−5	−9.15−5	−9.06−5	−8.90−5	−8.67−5
$3p_{1/2}$	σ	3.202+1	1.745+1	6.783+0	3.276+0	1.809+0	1.094+0	7.065−1	4.799−1	3.391−1	2.473−1
E_b =	β	1.614	1.583	1.492	1.401	1.317	1.239	1.169	1.104	1.045	0.990
312.4 eV	γ	6.07−2	2.05−1	4.89−1	7.21−1	9.07−1	1.06+0	1.18+0	1.29+0	1.37+0	1.45+0
	δ	4.11−3	8.32−3	1.93−2	3.26−2	4.73−2	6.25−2	7.79−2	9.33−2	1.09−1	1.24−1
$3p_{3/2}$	σ	6.225+1	3.342+1	1.274+1	6.070+0	3.316+0	1.987+0	1.274+0	8.593−1	6.035−1	4.378−1
E_b =	β	1.640	1.614	1.531	1.443	1.360	1.284	1.213	1.149	1.090	1.035
300.3 eV	γ	6.73−2	2.17−1	5.10−1	7.50−1	9.42−1	1.10+0	1.22+0	1.33+0	1.42+0	1.49+0
	δ	5.87−3	9.97−3	1.99−2	3.21−2	4.56−2	5.97−2	7.42−2	8.87−2	1.03−1	1.18−1
$3d_{3/2}$	σ	2.933+1	1.155+1	2.866+0	1.012+0	4.401−1	2.194−1	1.206−1	7.130−2	4.460−2	2.919−2
E_b =	β	1.177	1.094	0.934	0.805	0.704	0.623	0.556	0.498	0.449	0.405
159.6 eV	γ	4.60−1	6.11−1	8.22−1	9.56−1	1.05+0	1.11+0	1.16+0	1.19+0	1.22+0	1.24+0
	δ	7.22−2	9.22−2	1.34−1	1.75−1	2.14−1	2.52−1	2.88−1	3.21−1	3.53−1	3.83−1
$3d_{5/2}$	σ	4.246+1	1.667+1	4.115+0	1.446+0	6.261−1	3.109−1	1.703−1	1.003−1	6.255−2	4.081−2
E_b =	β	1.161	1.075	0.917	0.793	0.699	0.624	0.563	0.512	0.469	0.430
157.4 eV	γ	4.61−1	6.09−1	8.16−1	9.50−1	1.04+0	1.11+0	1.16+0	1.20+0	1.23+0	1.25+0
	δ	7.34−2	9.42−2	1.37−1	1.79−1	2.19−1	2.56−1	2.92−1	3.25−1	3.56−1	3.86−1
$4s_{1/2}$	σ	3.783+0	2.247+0	1.042+0	5.878−1	3.709−1	2.520−1	1.804−1	1.344−1	1.032−1	8.121−2
E_b =	β	1.994	1.995	1.997	1.997	1.994	1.990	1.985	1.980	1.973	1.966
45.4 eV	γ	−6.29−2	−8.58−2	−2.70−2	9.71−2	2.45−1	4.00−1	5.53−1	7.02−1	8.46−1	9.83−1
	δ	−5.86−5	−6.76−5	−7.77−5	−8.36−5	−8.56−5	−8.66−5	−8.62−5	−8.52−5	−8.31−5	−8.08−5
$4p_{1/2}$	σ	3.508+0	1.901+0	7.397−1	3.582−1	1.982−1	1.201−1	7.767−2	5.283−2	3.737−2	2.729−2
E_b =	β	1.639	1.588	1.486	1.392	1.307	1.229	1.159	1.094	1.035	0.981
25.1 eV	γ	1.10−1	2.52−1	5.22−1	7.45−1	9.24−1	1.07+0	1.19+0	1.29+0	1.38+0	1.45+0
	δ	3.64−3	7.59−3	1.86−2	3.22−2	4.72−2	6.27−2	7.83−2	9.39−2	1.09−1	1.25−1
$4p_{3/2}$	σ	6.828+0	3.651+0	1.395+0	6.664−1	3.649−1	2.191−1	1.407−1	9.504−2	6.683−2	4.853−2
E_b =	β	1.665	1.621	1.525	1.433	1.350	1.274	1.203	1.140	1.080	1.026
22.8 eV	γ	1.16−1	2.64−1	5.43−1	7.73−1	9.57−1	1.11+0	1.23+0	1.33+0	1.42+0	1.49+0
	δ	5.30−3	9.07−3	1.91−2	3.16−2	4.54−2	5.98−2	7.45−2	8.93−2	1.04−1	1.18−1
$4d_{3/2}$	σ	1.174+0	4.745−1	1.207−1	4.306−2	1.881−2	9.409−3	5.182−3	3.068−3	1.922−3	1.259−3
E_b =	β	1.178	1.082	0.923	0.798	0.697	0.616	0.548	0.490	0.440	0.395
2.4 eV	γ	4.71−1	6.16−1	8.24−1	9.58−1	1.05+0	1.11+0	1.16+0	1.19+0	1.21+0	1.23+0

(*continued on next page*)

Table 1 (*continued*)

	δ	6.84−2	8.96−2	1.33−1	1.75−1	2.15−1	2.52−1	2.88−1	3.21−1	3.53−1	3.83−1
$5s_{1/2}$	σ	2.784−1	1.645−1	7.590−2	4.270−2	2.690−2	1.825−2	1.306−2	9.719−3	7.460−3	5.869−3
E_b =	β	1.994	1.995	1.997	1.997	1.994	1.990	1.985	1.979	1.973	1.966
6.0 eV	γ	−6.55−2	−8.64−2	−2.53−2	9.98−2	2.48−1	4.02−1	5.55−1	7.03−1	8.45−1	9.81−1
	δ	−5.78−5	−6.69−5	−7.75−5	−8.27−5	−8.50−5	−8.62−5	−8.65−5	−8.50−5	−8.41−5	−7.98−5
Z= 40, Zr: [Kr]$4d^2_{3/2}$ $5s^2_{1/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$3s_{1/2}$	σ	2.770+1	1.689+1	8.025+0	4.586+0	2.919+0	1.995+0	1.436+0	1.073+0	8.267−1	6.524−1
E_b =	β	1.990	1.993	1.996	1.997	1.995	1.992	1.988	1.982	1.976	1.969
430.3 eV	γ	7.92−4	−7.61−2	−6.85−2	3.38−2	1.71−1	3.21−1	4.72−1	6.20−1	7.63−1	9.01−1
	δ	−7.13−5	−8.21−5	−9.45−5	−1.00−4	−1.04−4	−1.05−4	−1.06−4	−1.05−4	−1.03−4	−1.01−4
$3p_{1/2}$	σ	3.462+1	1.907+1	7.518+0	3.665+0	2.037+0	1.238+0	8.029−1	5.472−1	3.878−1	2.836−1
E_b =	β	1.616	1.590	1.506	1.418	1.336	1.261	1.191	1.128	1.069	1.015
344.2 eV	γ	4.02−2	1.77−1	4.58−1	6.93−1	8.83−1	1.04+0	1.17+0	1.27+0	1.37+0	1.45+0
	δ	3.44−3	7.32−3	1.76−2	3.02−2	4.42−2	5.87−2	7.36−2	8.86−2	1.04−1	1.18−1
$3p_{3/2}$	σ	6.746+1	3.656+1	1.412+1	6.784+0	3.728+0	2.245+0	1.444+0	9.775−1	6.883−1	5.005−1
E_b =	β	1.642	1.622	1.546	1.462	1.381	1.307	1.238	1.175	1.117	1.063
330.5 eV	γ	4.60−2	1.89−1	4.80−1	7.23−1	9.19−1	1.08+0	1.21+0	1.32+0	1.41+0	1.49+0
	δ	5.32−3	9.19−3	1.86−2	2.99−2	4.27−2	5.61−2	6.99−2	8.40−2	9.81−2	1.12−1
$3d_{3/2}$	σ	3.458+1	1.377+1	3.465+0	1.235+0	5.400−1	2.705−1	1.492−1	8.847−2	5.549−2	3.641−2
E_b =	β	1.190	1.112	0.957	0.830	0.728	0.646	0.578	0.519	0.468	0.423
182.4 eV	γ	4.40−1	5.96−1	8.16−1	9.58−1	1.05+0	1.12+0	1.17+0	1.21+0	1.24+0	1.26+0
	δ	6.99−2	8.92−2	1.29−1	1.70−1	2.08−1	2.45−1	2.81−1	3.14−1	3.45−1	3.75−1
$3d_{5/2}$	σ	4.996+1	1.983+1	4.961+0	1.759+0	7.660−1	3.821−1	2.100−1	1.241−1	7.758−2	5.074−2
E_b =	β	1.174	1.092	0.938	0.816	0.720	0.644	0.583	0.530	0.486	0.446
180.0 eV	γ	4.42−1	5.95−1	8.10−1	9.51−1	1.05+0	1.12+0	1.17+0	1.21+0	1.25+0	1.27+0
	δ	7.09−2	9.12−2	1.33−1	1.74−1	2.13−1	2.50−1	2.85−1	3.18−1	3.49−1	3.79−1
$4s_{1/2}$	σ	4.261+0	2.535+0	1.180+0	6.682−1	4.229−1	2.880−1	2.067−1	1.542−1	1.186−1	9.347−2
E_b =	β	1.993	1.995	1.997	1.997	1.995	1.991	1.986	1.981	1.975	1.968
51.3 eV	γ	−5.68−2	−8.70−2	−4.20−2	7.14−2	2.12−1	3.61−1	5.11−1	6.58−1	8.00−1	9.36−1
	δ	−6.62−5	−7.67−5	−8.80−5	−9.49−5	−9.79−5	−9.94−5	−9.93−5	−9.88−5	−9.68−5	−9.49−5
$4p_{1/2}$	σ	4.054+0	2.215+0	8.732−1	4.268−1	2.377−1	1.448−1	9.405−2	6.419−2	4.555−2	3.335−2
E_b =	β	1.646	1.599	1.500	1.409	1.325	1.249	1.179	1.116	1.057	1.003
29.3 eV	γ	9.19−2	2.29−1	4.96−1	7.20−1	9.03−1	1.05+0	1.18+0	1.28+0	1.37+0	1.45+0
	δ	3.03−3	6.65−3	1.69−2	2.97−2	4.39−2	5.87−2	7.37−2	8.89−2	1.04−1	1.19−1
$4p_{3/2}$	σ	7.955+0	4.286+0	1.657+0	7.986−1	4.400−1	2.655−1	1.711−1	1.160−1	8.179−2	5.955−2
E_b =	β	1.672	1.632	1.540	1.452	1.370	1.295	1.226	1.163	1.104	1.050
25.7 eV	γ	9.84−2	2.41−1	5.17−1	7.49−1	9.37−1	1.09+0	1.22+0	1.33+0	1.42+0	1.49+0
	δ	4.82−3	8.32−3	1.77−2	2.93−2	4.23−2	5.61−2	7.01−2	8.43−2	9.85−2	1.13−1
$4d_{3/2}$	σ	1.739+0	7.130−1	1.848−1	6.673−2	2.938−2	1.477−2	8.171−3	4.855−3	3.050−3	2.004−3
E_b =	β	1.194	1.102	0.944	0.818	0.717	0.635	0.565	0.507	0.455	0.410
3.0 eV	γ	4.56−1	6.03−1	8.17−1	9.58−1	1.05+0	1.12+0	1.17+0	1.21+0	1.23+0	1.25+0
	δ	6.59−2	8.65−2	1.28−1	1.69−1	2.08−1	2.45−1	2.80−1	3.13−1	3.45−1	3.75−1
$5s_{1/2}$	σ	3.188−1	1.885−1	8.726−2	4.926−2	3.112−2	2.117−2	1.517−2	1.131−2	8.697−3	6.853−3
E_b =	β	1.993	1.995	1.997	1.997	1.995	1.991	1.986	1.981	1.974	1.968
7.0 eV	γ	−5.99−2	−8.77−2	−4.01−2	7.43−2	2.15−1	3.64−1	5.13−1	6.58−1	7.99−1	9.34−1
	δ	−6.51−5	−7.53−5	−8.78−5	−9.40−5	−9.72−5	−9.87−5	−9.95−5	−9.83−5	−9.70−5	−9.35−5
Z= 41, Nb: [Kr]$4d^4_{3/2}$ $5s^1_{1/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$3s_{1/2}$	σ	2.931+1	1.795+1	8.573+0	4.919+0	3.141+0	2.153+0	1.553+0	1.163+0	8.973−1	7.091−1
E_b =	β	1.989	1.992	1.996	1.997	1.996	1.993	1.989	1.984	1.978	1.971
468.4 eV	γ	2.34−2	−6.72−2	−7.95−2	8.47−3	1.36−1	2.80−1	4.28−1	5.74−1	7.16−1	8.54−1
	δ	−8.12−5	−9.27−5	−1.06−4	−1.13−4	−1.18−4	−1.19−4	−1.20−4	−1.20−4	−1.18−4	−1.16−4
$3p_{1/2}$	σ	3.738+1	2.080+1	8.307+0	4.086+0	2.286+0	1.396+0	9.090−1	6.215−1	4.417−1	3.238−1
E_b =	β	1.617	1.597	1.520	1.438	1.358	1.284	1.215	1.151	1.092	1.038
378.4 eV	γ	2.16−2	1.49−1	4.24−1	6.63−1	8.59−1	1.02+0	1.15+0	1.26+0	1.36+0	1.44+0
	δ	2.84−3	6.48−3	1.61−2	2.82−2	4.17−2	5.59−2	7.03−2	8.46−2	9.90−2	1.13−1
$3p_{3/2}$	σ	7.302+1	3.994+1	1.560+1	7.557+0	4.178+0	2.527+0	1.632+0	1.107+0	7.817−1	5.697−1
E_b =	β	1.643	1.630	1.561	1.483	1.406	1.332	1.264	1.200	1.142	1.088
363.0 eV	γ	2.63−2	1.60−1	4.46−1	6.93−1	8.96−1	1.06+0	1.20+0	1.31+0	1.41+0	1.49+0
	δ	4.84−3	8.56−3	1.73−2	2.82−2	4.05−2	5.34−2	6.68−2	8.01−2	9.36−2	1.07−1
$3d_{3/2}$	σ	4.074+1	1.637+1	4.171+0	1.498+0	6.589−1	3.313−1	1.834−1	1.091−1	6.858−2	4.509−2
E_b =	β	1.201	1.130	0.982	0.855	0.752	0.666	0.596	0.536	0.485	0.439
207.4 eV	γ	4.21−1	5.81−1	8.10−1	9.59−1	1.06+0	1.13+0	1.19+0	1.23+0	1.26+0	1.28+0
	δ	6.82−2	8.75−2	1.27−1	1.65−1	2.03−1	2.39−1	2.73−1	3.06−1	3.37−1	3.67−1

(*continued on next page*)

Table 1 (*continued*)

$3d_{5/2}$	σ	5.866+1	2.349+1	5.951+0	2.127+0	9.310−1	4.662−1	2.570−1	1.523−1	9.545−2	6.257−2
E_b =	β	1.185	1.110	0.962	0.840	0.742	0.663	0.599	0.545	0.500	0.460
204.6 eV	γ	4.24−1	5.81−1	8.04−1	9.52−1	1.05+0	1.13+0	1.18+0	1.23+0	1.26+0	1.29+0
	δ	6.92−2	8.94−2	1.30−1	1.70−1	2.08−1	2.44−1	2.78−1	3.11−1	3.42−1	3.71−1
$4s_{1/2}$	σ	4.690+0	2.792+0	1.304+0	7.405−1	4.700−1	3.209−1	2.307−1	1.724−1	1.328−1	1.049−1
E_b =	β	1.992	1.994	1.996	1.997	1.995	1.992	1.987	1.982	1.976	1.970
58.1 eV	γ	−4.87−2	−8.56−2	−5.49−2	4.67−2	1.79−1	3.23−1	4.69−1	6.14−1	7.54−1	8.90−1
	δ	−7.45−5	−8.57−5	−9.88−5	−1.07−4	−1.11−4	−1.13−4	−1.13−4	−1.13−4	−1.11−4	−1.10−4
$4p_{1/2}$	σ	4.529+0	2.492+0	9.939−1	4.901−1	2.748−1	1.682−1	1.097−1	7.515−2	5.348−2	3.926−2
E_b =	β	1.653	1.609	1.516	1.428	1.347	1.272	1.204	1.140	1.081	1.027
35.6 eV	γ	7.44−2	2.05−1	4.67−1	6.93−1	8.81−1	1.04+0	1.16+0	1.27+0	1.37+0	1.44+0
	δ	2.50−3	5.85−3	1.53−2	2.75−2	4.12−2	5.56−2	7.03−2	8.50−2	9.95−2	1.14−1
$4p_{3/2}$	σ	8.995+0	4.876+0	1.906+0	9.261−1	5.134−1	3.113−1	2.014−1	1.369−1	9.681−2	7.064−2
E_b =	β	1.680	1.643	1.557	1.473	1.394	1.321	1.253	1.189	1.131	1.077
29.6 eV	γ	8.07−2	2.16−1	4.88−1	7.23−1	9.17−1	1.08+0	1.21+0	1.32+0	1.41+0	1.49+0
	δ	4.42−3	7.70−3	1.63−2	2.73−2	3.97−2	5.30−2	6.66−2	8.03−2	9.40−2	1.08−1
$4d_{3/2}$	σ	2.070+0	8.595−1	2.268−1	8.279−2	3.672−2	1.857−2	1.031−2	6.147−3	3.874−3	2.551−3
E_b =	β	1.212	1.124	0.969	0.844	0.743	0.659	0.588	0.528	0.474	0.428
3.2 eV	γ	4.42−1	5.90−1	8.11−1	9.59−1	1.06+0	1.13+0	1.19+0	1.22+0	1.25+0	1.27+0
	δ	6.42−2	8.39−2	1.24−1	1.64−1	2.03−1	2.39−1	2.74−1	3.06−1	3.37−1	3.67−1
$5s_{1/2}$	σ	2.893−1	1.711−1	7.943−2	4.500−2	2.852−2	1.944−2	1.396−2	1.043−2	8.027−3	6.333−3
E_b =	β	1.992	1.994	1.996	1.997	1.995	1.992	1.987	1.982	1.976	1.969
7.0 eV	γ	−5.29−2	−8.67−2	−5.30−2	5.01−2	1.84−1	3.28−1	4.74−1	6.16−1	7.55−1	8.88−1
	δ	−7.35−5	−8.39−5	−9.82−5	−1.06−4	−1.10−4	−1.12−4	−1.14−4	−1.13−4	−1.12−4	−1.09−4

Z= 42, Mo: [Kr]$4d^4_{3/2}$ $4d^1_{5/2}$ $5s^1_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$3s_{1/2}$	σ	3.087+1	1.898+1	9.121+0	5.255+0	3.367+0	2.314+0	1.673+0	1.255+0	9.702−1	7.679−1
E_b =	β	1.987	1.990	1.995	1.996	1.996	1.993	1.990	1.985	1.979	1.973
504.6 eV	γ	4.75−2	−5.61−2	−8.82−2	−1.37−2	1.05−1	2.41−1	3.85−1	5.28−1	6.69−1	8.05−1
	δ	−8.86−5	−1.03−4	−1.19−4	−1.28−4	−1.33−4	−1.36−4	−1.37−4	−1.37−4	−1.36−4	−1.34−4
$3p_{1/2}$	σ	4.000+1	2.248+1	9.103+0	4.519+0	2.545+0	1.562+0	1.022+0	7.010−1	4.996−1	3.673−1
E_b =	β	1.616	1.602	1.532	1.453	1.376	1.304	1.236	1.173	1.115	1.061
409.7 eV	γ	6.32−3	1.22−1	3.92−1	6.32−1	8.31−1	9.97−1	1.13+0	1.25+0	1.35+0	1.43+0
	δ	2.34−3	5.61−3	1.45−2	2.59−2	3.89−2	5.27−2	6.66−2	8.06−2	9.44−2	1.08−1
$3p_{3/2}$	σ	7.837+1	4.324+1	1.710+1	8.354+0	4.647+0	2.824+0	1.830+0	1.246+0	8.821−1	6.444−1
E_b =	β	1.642	1.636	1.574	1.499	1.426	1.355	1.288	1.225	1.167	1.113
392.3 eV	γ	9.79−3	1.33−1	4.14−1	6.63−1	8.70−1	1.04+0	1.18+0	1.30+0	1.40+0	1.49+0
	δ	4.41−3	7.88−3	1.60−2	2.62−2	3.78−2	5.04−2	6.32−2	7.61−2	8.90−2	1.02−1
$3d_{3/2}$	σ	4.716+1	1.913+1	4.944+0	1.792+0	7.928−1	4.005−1	2.225−1	1.327−1	8.367−2	5.515−2
E_b =	β	1.212	1.148	1.005	0.880	0.776	0.689	0.617	0.556	0.503	0.456
230.3 eV	γ	4.00−1	5.64−1	8.01−1	9.58−1	1.07+0	1.14+0	1.20+0	1.24+0	1.27+0	1.30+0
	δ	6.65−2	8.50−2	1.23−1	1.61−1	1.97−1	2.32−1	2.66−1	2.99−1	3.30−1	3.59−1
$3d_{5/2}$	σ	6.786+1	2.744+1	7.048+0	2.542+0	1.119+0	5.631−1	3.116−1	1.852−1	1.163−1	7.643−2
E_b =	β	1.196	1.127	0.983	0.862	0.763	0.683	0.617	0.562	0.516	0.475
227.0 eV	γ	4.04−1	5.64−1	7.95−1	9.50−1	1.06+0	1.14+0	1.20+0	1.24+0	1.28+0	1.31+0
	δ	6.74−2	8.69−2	1.27−1	1.66−1	2.03−1	2.38−1	2.72−1	3.04−1	3.35−1	3.64−1
$4s_{1/2}$	σ	5.174+0	3.083+0	1.444+0	8.232−1	5.241−1	3.587−1	2.584−1	1.935−1	1.493−1	1.180−1
E_b =	β	1.991	1.993	1.996	1.996	1.995	1.992	1.988	1.983	1.978	1.971
61.8 eV	γ	−4.03−2	−8.39−2	−6.60−2	2.50−2	1.49−1	2.87−1	4.29−1	5.71−1	7.10−1	8.44−1
	δ	−8.22−5	−9.54−5	−1.11−4	−1.20−4	−1.26−4	−1.28−4	−1.29−4	−1.29−4	−1.28−4	−1.26−4
$4p_{1/2}$	σ	5.134+0	2.845+0	1.148+0	5.712−1	3.225−1	1.984−1	1.300−1	8.934−2	6.377−2	4.693−2
E_b =	β	1.660	1.618	1.528	1.443	1.365	1.292	1.224	1.162	1.104	1.050
38.3 eV	γ	5.86−2	1.82−1	4.39−1	6.66−1	8.57−1	1.02+0	1.15+0	1.26+0	1.36+0	1.44+0
	δ	1.99−3	4.98−3	1.37−2	2.51−2	3.82−2	5.22−2	6.64−2	8.07−2	9.49−2	1.09−1
$4p_{3/2}$	σ	1.013+1	5.527+0	2.183+0	1.070+0	5.967−1	3.635−1	2.361−1	1.611−1	1.142−1	8.352−2
E_b =	β	1.686	1.652	1.571	1.490	1.414	1.342	1.276	1.213	1.155	1.101
32.3 eV	γ	6.44−2	1.94−1	4.61−1	6.96−1	8.94−1	1.06+0	1.19+0	1.31+0	1.41+0	1.49+0
	δ	4.02−3	7.02−3	1.49−2	2.51−2	3.70−2	4.98−2	6.29−2	7.61−2	8.93−2	1.02−1
$4d_{3/2}$	σ	2.734+0	1.150+0	3.090−1	1.141−1	5.104−2	2.595−2	1.448−2	8.662−3	5.475−3	3.615−3
E_b =	β	1.227	1.142	0.989	0.866	0.765	0.680	0.608	0.546	0.492	0.444
1.9 eV	γ	4.27−1	5.76−1	8.02−1	9.57−1	1.07+0	1.14+0	1.20+0	1.24+0	1.27+0	1.29+0
	δ	6.17−2	8.07−2	1.20−1	1.59−1	1.97−1	2.33−1	2.67−1	2.99−1	3.29−1	3.59−1
$4d_{5/2}$	σ	3.842+0	1.609+0	4.292−1	1.576−1	7.012−2	3.549−2	1.972−2	1.175−2	7.401−3	4.871−3
E_b =	β	1.207	1.119	0.966	0.848	0.753	0.675	0.610	0.553	0.506	0.463
1.2 eV	γ	4.29−1	5.75−1	7.96−1	9.49−1	1.06+0	1.14+0	1.20+0	1.24+0	1.28+0	1.30+0
	δ	6.27−2	8.27−2	1.23−1	1.64−1	2.03−1	2.39−1	2.73−1	3.04−1	3.34−1	3.63−1
$5s_{1/2}$	σ	3.130−1	1.852−1	8.617−2	4.897−2	3.112−2	2.126−2	1.530−2	1.145−2	8.824−3	6.971−3
E_b =	β	1.991	1.993	1.996	1.996	1.995	1.992	1.988	1.983	1.977	1.971

(*continued on next page*)

Table 1 (*continued*)

7.0 eV	γ	−4.54−2	−8.55−2	−6.41−2	2.83−2	1.54−1	2.92−1	4.34−1	5.74−1	7.10−1	8.43−1
	δ	−8.13−5	−9.36−5	−1.10−4	−1.19−4	−1.24−4	−1.27−4	−1.29−4	−1.29−4	−1.28−4	−1.26−4
Z= 43, Tc: [Kr]$4d^4_{3/2}$ $4d^1_{5/2}$ $5s^2_{1/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$3s_{1/2}$	σ	3.241+1	2.003+1	9.683+0	5.602+0	3.601+0	2.482+0	1.797+0	1.351+0	1.046+0	8.290−1
E_b =	β	1.986	1.989	1.994	1.996	1.996	1.994	1.990	1.986	1.981	1.975
544.0 eV	γ	7.35−2	−4.34−2	−9.47−2	−3.36−2	7.56−2	2.06−1	3.44−1	4.84−1	6.21−1	7.54−1
	δ	−9.72−5	−1.15−4	−1.33−4	−1.43−4	−1.50−4	−1.54−4	−1.56−4	−1.57−4	−1.56−4	−1.55−4
$3p_{1/2}$	σ	4.262+1	2.420+1	9.933+0	4.975+0	2.820+0	1.740+0	1.143+0	7.867−1	5.624−1	4.145−1
E_b =	β	1.614	1.606	1.542	1.466	1.391	1.321	1.254	1.193	1.137	1.085
444.9 eV	γ	−5.96−3	9.84−2	3.62−1	6.02−1	8.05−1	9.73−1	1.11+0	1.23+0	1.34+0	1.42+0
	δ	1.93−3	4.86−3	1.33−2	2.41−2	3.63−2	4.92−2	6.24−2	7.60−2	8.96−2	1.03−1
$3p_{3/2}$	σ	8.374+1	4.663+1	1.866+1	9.192+0	5.143+0	3.140+0	2.043+0	1.395+0	9.904−1	7.252−1
E_b =	β	1.640	1.640	1.586	1.515	1.443	1.373	1.308	1.247	1.191	1.139
425.0 eV	γ	−4.05−3	1.09−1	3.84−1	6.34−1	8.44−1	1.02+0	1.16+0	1.29+0	1.39+0	1.48+0
	δ	4.05−3	7.33−3	1.51−2	2.47−2	3.55−2	4.72−2	5.92−2	7.16−2	8.41−2	9.68−2
$3d_{3/2}$	σ	5.412+1	2.217+1	5.808+0	2.125+0	9.461−1	4.803−1	2.678−1	1.603−1	1.013−1	6.693−2
E_b =	β	1.220	1.161	1.023	0.900	0.796	0.711	0.639	0.578	0.524	0.476
256.4 eV	γ	3.78−1	5.46−1	7.90−1	9.54−1	1.07+0	1.15+0	1.21+0	1.26+0	1.29+0	1.32+0
	δ	6.43−2	8.25−2	1.19−1	1.56−1	1.92−1	2.26−1	2.60−1	2.92−1	3.23−1	3.52−1
$3d_{5/2}$	σ	7.779+1	3.175+1	8.267+0	3.008+0	1.333+0	6.740−1	3.743−1	2.231−1	1.406−1	9.255−2
E_b =	β	1.204	1.140	1.000	0.880	0.782	0.702	0.637	0.581	0.534	0.492
252.9 eV	γ	3.83−1	5.47−1	7.85−1	9.45−1	1.06+0	1.14+0	1.21+0	1.26+0	1.30+0	1.33+0
	δ	6.52−2	8.44−2	1.23−1	1.61−1	1.97−1	2.32−1	2.66−1	2.98−1	3.28−1	3.57−1
$4s_{1/2}$	σ	5.741+0	3.424+0	1.609+0	9.197−1	5.871−1	4.027−1	2.907−1	2.180−1	1.685−1	1.333−1
E_b =	β	1.990	1.992	1.995	1.996	1.995	1.993	1.989	1.984	1.979	1.973
68.8 eV	γ	−3.18−2	−8.12−2	−7.55−2	5.22−3	1.21−1	2.54−1	3.92−1	5.30−1	6.65−1	7.97−1
	δ	−9.23−5	−1.06−4	−1.24−4	−1.35−4	−1.42−4	−1.45−4	−1.47−4	−1.48−4	−1.47−4	−1.46−4
$4p_{1/2}$	σ	5.829+0	3.252+0	1.327+0	6.660−1	3.785−1	2.341−1	1.540−1	1.062−1	7.604−2	5.612−2
E_b =	β	1.666	1.627	1.540	1.457	1.380	1.308	1.242	1.180	1.123	1.071
42.8 eV	γ	4.53−2	1.63−1	4.15−1	6.42−1	8.34−1	9.95−1	1.13+0	1.25+0	1.34+0	1.43+0
	δ	1.54−3	4.30−3	1.25−2	2.33−2	3.57−2	4.88−2	6.24−2	7.59−2	8.97−2	1.03−1
$4p_{3/2}$	σ	1.149+1	6.307+0	2.516+0	1.243+0	6.974−1	4.268−1	2.783−1	1.904−1	1.354−1	9.926−2
E_b =	β	1.692	1.661	1.584	1.506	1.431	1.361	1.295	1.234	1.177	1.125
36.9 eV	γ	5.03−2	1.74−1	4.37−1	6.72−1	8.72−1	1.04+0	1.18+0	1.30+0	1.40+0	1.49+0
	δ	3.69−3	6.53−3	1.40−2	2.36−2	3.47−2	4.66−2	5.90−2	7.16−2	8.41−2	9.69−2
$4d_{3/2}$	σ	3.811+0	1.623+0	4.441−1	1.660−1	7.486−2	3.830−2	2.146−2	1.289−2	8.174−3	5.413−3
E_b =	β	1.241	1.158	1.009	0.885	0.783	0.697	0.625	0.563	0.509	0.462
2.0 eV	γ	4.13−1	5.64−1	7.94−1	9.54−1	1.07+0	1.15+0	1.21+0	1.25+0	1.29+0	1.31+0
	δ	5.95−2	7.83−2	1.17−1	1.54−1	1.91−1	2.26−1	2.59−1	2.91−1	3.22−1	3.51−1
$4d_{5/2}$	σ	5.416+0	2.296+0	6.237−1	2.317−1	1.039−1	5.291−2	2.953−2	1.767−2	1.116−2	7.366−3
E_b =	β	1.220	1.134	0.986	0.866	0.769	0.690	0.624	0.568	0.520	0.478
1.2 eV	γ	4.15−1	5.63−1	7.88−1	9.46−1	1.06+0	1.14+0	1.20+0	1.25+0	1.29+0	1.32+0
	δ	6.05−2	8.03−2	1.20−1	1.59−1	1.97−1	2.32−1	2.66−1	2.98−1	3.28−1	3.57−1
$5s_{1/2}$	σ	4.145−1	2.453−1	1.144−1	6.514−2	4.149−2	2.841−2	2.048−2	1.535−2	1.185−2	9.377−3
E_b =	β	1.990	1.992	1.995	1.996	1.995	1.993	1.989	1.984	1.979	1.973
7.0 eV	γ	−3.86−2	−8.42−2	−7.41−2	8.84−3	1.26−1	2.58−1	3.95−1	5.31−1	6.66−1	7.98−1
	δ	−9.17−5	−1.06−4	−1.24−4	−1.35−4	−1.40−4	−1.44−4	−1.47−4	−1.47−4	−1.46−4	−1.44−4
Z= 44, Ru: [Kr]$4d^4_{3/2}$ $4d^3_{5/2}$ $5s^1_{1/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$3s_{1/2}$	σ	3.404+1	2.111+1	1.026+1	5.959+0	3.841+0	2.653+0	1.926+0	1.451+0	1.125+0	8.930−1
E_b =	β	1.984	1.988	1.993	1.995	1.996	1.994	1.991	1.987	1.982	1.976
585.0 eV	γ	1.05−1	−2.62−2	−9.92−2	−5.20−2	4.70−2	1.69−1	3.02−1	4.38−1	5.74−1	7.07−1
	δ	−1.03−4	−1.25−4	−1.49−4	−1.61−4	−1.69−4	−1.74−4	−1.76−4	−1.77−4	−1.76−4	−1.75−4
$3p_{1/2}$	σ	4.545+1	2.605+1	1.082+1	5.466+0	3.118+0	1.934+0	1.275+0	8.808−1	6.314−1	4.664−1
E_b =	β	1.610	1.610	1.552	1.480	1.409	1.342	1.278	1.217	1.160	1.106
482.8 eV	γ	−1.61−2	7.32−2	3.29−1	5.68−1	7.73−1	9.46−1	1.09+0	1.22+0	1.32+0	1.42+0
	δ	1.61−3	4.08−3	1.17−2	2.16−2	3.32−2	4.61−2	5.95−2	7.29−2	8.61−2	9.92−2
$3p_{3/2}$	σ	8.966+1	5.031+1	2.036+1	1.010+1	5.684+0	3.486+0	2.277+0	1.560+0	1.110+0	8.142−1
E_b =	β	1.636	1.644	1.597	1.530	1.462	1.397	1.334	1.274	1.217	1.164
460.6 eV	γ	−1.63−2	8.29−2	3.51−1	6.00−1	8.13−1	9.94−1	1.15+0	1.27+0	1.38+0	1.48+0
	δ	3.70−3	6.71−3	1.38−2	2.25−2	3.27−2	4.43−2	5.64−2	6.86−2	8.07−2	9.28−2
$3d_{3/2}$	σ	6.228+1	2.570+1	6.808+0	2.511+0	1.125+0	5.732−1	3.206−1	1.924−1	1.219−1	8.069−2
E_b =	β	1.227	1.177	1.046	0.927	0.825	0.736	0.661	0.596	0.540	0.492
283.6 eV	γ	3.53−1	5.24−1	7.78−1	9.51−1	1.07+0	1.16+0	1.22+0	1.27+0	1.31+0	1.34+0
	δ	6.27−2	7.98−2	1.15−1	1.52−1	1.87−1	2.21−1	2.53−1	2.84−1	3.14−1	3.43−1

(*continued on next page*)

Table 1 (*continued*)

$3d_{5/2}$	σ	8.966+1	3.685+1	9.703+0	3.559+0	1.587+0	8.052−1	4.485−1	2.681−1	1.692−1	1.117−1
E_b =	β	1.213	1.155	1.021	0.905	0.807	0.725	0.656	0.597	0.548	0.505
279.4 eV	γ	3.60−1	5.27−1	7.73−1	9.42−1	1.06+0	1.15+0	1.22+0	1.27+0	1.31+0	1.34+0
	δ	6.34−2	8.15−2	1.19−1	1.57−1	1.93−1	2.28−1	2.60−1	2.91−1	3.21−1	3.49−1
$4s_{1/2}$	σ	6.187+0	3.692+0	1.738+0	9.963−1	6.375−1	4.383−1	3.170−1	2.382−1	1.843−1	1.461−1
E_b =	β	1.989	1.991	1.994	1.996	1.995	1.993	1.990	1.985	1.980	1.975
74.9 eV	γ	−2.10−2	−7.75−2	−8.41−2	−1.36−2	9.37−2	2.19−1	3.51−1	4.87−1	6.21−1	7.52−1
	δ	−1.00−4	−1.18−4	−1.39−4	−1.52−4	−1.60−4	−1.64−4	−1.66−4	−1.67−4	−1.66−4	−1.66−4
$4p_{1/2}$	σ	6.406+0	3.595+0	1.482+0	7.494−1	4.286−1	2.665−1	1.760−1	1.218−1	8.747−2	6.471−2
E_b =	β	1.671	1.635	1.552	1.471	1.397	1.329	1.264	1.204	1.147	1.093
47.0 eV	γ	3.10−2	1.42−1	3.88−1	6.12−1	8.06−1	9.72−1	1.11+0	1.23+0	1.33+0	1.42+0
	δ	1.09−3	3.49−3	1.08−2	2.08−2	3.26−2	4.56−2	5.91−2	7.27−2	8.61−2	9.93−2
$4p_{3/2}$	σ	1.255+1	6.920+0	2.786+0	1.386+0	7.822−1	4.811−1	3.149−1	2.161−1	1.540−1	1.132−1
E_b =	β	1.697	1.670	1.597	1.521	1.450	1.383	1.320	1.260	1.203	1.151
41.2 eV	γ	3.53−2	1.52−1	4.09−1	6.44−1	8.45−1	1.02+0	1.16+0	1.29+0	1.39+0	1.48+0
	δ	3.34−3	5.92−3	1.26−2	2.14−2	3.18−2	4.35−2	5.58−2	6.83−2	8.06−2	9.30−2
$4d_{3/2}$	σ	4.293+0	1.846+0	5.130−1	1.939−1	8.808−2	4.532−2	2.551−2	1.537−2	9.771−3	6.486−3
E_b =	β	1.256	1.175	1.028	0.907	0.808	0.723	0.650	0.585	0.529	0.479
2.4 eV	γ	3.95−1	5.48−1	7.83−1	9.49−1	1.07+0	1.16+0	1.22+0	1.27+0	1.31+0	1.33+0
	δ	5.69−2	7.49−2	1.12−1	1.49−1	1.86−1	2.21−1	2.54−1	2.85−1	3.15−1	3.43−1
$4d_{5/2}$	σ	6.075+0	2.600+0	7.170−1	2.693−1	1.217−1	6.231−2	3.492−2	2.096−2	1.327−2	8.780−3
E_b =	β	1.235	1.150	1.002	0.885	0.791	0.713	0.646	0.587	0.538	0.493
1.8 eV	γ	3.99−1	5.49−1	7.77−1	9.41−1	1.06+0	1.15+0	1.22+0	1.27+0	1.31+0	1.34+0
	δ	5.78−2	7.68−2	1.16−1	1.54−1	1.92−1	2.27−1	2.60−1	2.92−1	3.21−1	3.49−1
$5s_{1/2}$	σ	3.529−1	2.089−1	9.754−2	5.571−2	3.559−2	2.443−2	1.765−2	1.324−2	1.024−2	8.109−3
E_b =	β	1.989	1.991	1.994	1.996	1.995	1.993	1.990	1.985	1.980	1.974
7.0 eV	γ	−2.88−2	−8.06−2	−8.21−2	−9.93−3	9.86−2	2.25−1	3.59−1	4.93−1	6.24−1	7.53−1
	δ	−9.95−5	−1.16−4	−1.37−4	−1.49−4	−1.57−4	−1.62−4	−1.65−4	−1.67−4	−1.67−4	−1.66−4

Z= 45, Rh: [Kr]$4d^4_{3/2}$ $4d^4_{5/2}$ $5s^1_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$3s_{1/2}$	σ	3.561+1	2.219+1	1.085+1	6.322+0	4.087+0	2.830+0	2.058+0	1.553+0	1.206+0	9.589−1
E_b =	β	1.983	1.986	1.991	1.994	1.995	1.994	1.992	1.988	1.983	1.978
627.1 eV	γ	1.38−1	−7.42−3	−1.01−1	−6.79−2	2.11−2	1.36−1	2.62−1	3.94−1	5.27−1	6.59−1
	δ	−1.11−4	−1.38−4	−1.65−4	−1.81−4	−1.90−4	−1.96−4	−1.99−4	−2.01−4	−2.00−4	−2.00−4
$3p_{1/2}$	σ	4.816+1	2.788+1	1.173+1	5.975+0	3.430+0	2.138+0	1.415+0	9.809−1	7.052−1	5.223−1
E_b =	β	1.604	1.612	1.562	1.493	1.424	1.359	1.297	1.238	1.182	1.129
521.0 eV	γ	−2.18−2	5.17−2	2.98−1	5.37−1	7.43−1	9.19−1	1.07+0	1.20+0	1.31+0	1.40+0
	δ	1.42−3	3.44−3	1.05−2	1.98−2	3.07−2	4.30−2	5.59−2	6.91−2	8.22−2	9.49−2
$3p_{3/2}$	σ	9.540+1	5.398+1	2.209+1	1.104+1	6.248+0	3.849+0	2.523+0	1.734+0	1.237+0	9.094−1
E_b =	β	1.630	1.647	1.607	1.544	1.479	1.416	1.355	1.297	1.242	1.188
496.2 eV	γ	−2.46−2	6.04−2	3.20−1	5.70−1	7.84−1	9.68−1	1.12+0	1.26+0	1.37+0	1.47+0
	δ	3.46−3	6.24−3	1.30−2	2.10−2	3.06−2	4.14−2	5.30−2	6.50−2	7.69−2	8.85−2
$3d_{3/2}$	σ	7.094+1	2.950+1	7.907+0	2.940+0	1.325+0	6.786−1	3.809−1	2.292−1	1.456−1	9.657−2
E_b =	β	1.232	1.189	1.064	0.948	0.847	0.760	0.684	0.617	0.560	0.510
311.7 eV	γ	3.28−1	5.04−1	7.64−1	9.44−1	1.07+0	1.17+0	1.23+0	1.29+0	1.33+0	1.36+0
	δ	6.09−2	7.76−2	1.12−1	1.47−1	1.82−1	2.16−1	2.48−1	2.78−1	3.07−1	3.35−1
$3d_{5/2}$	σ	1.022+2	4.231+1	1.127+1	4.167+0	1.869+0	9.529−1	5.327−1	3.192−1	2.020−1	1.335−1
E_b =	β	1.219	1.167	1.038	0.923	0.828	0.746	0.676	0.616	0.564	0.520
307.0 eV	γ	3.36−1	5.08−1	7.61−1	9.36−1	1.06+0	1.16+0	1.23+0	1.28+0	1.32+0	1.36+0
	δ	6.14−2	7.91−2	1.15−1	1.52−1	1.88−1	2.23−1	2.55−1	2.85−1	3.14−1	3.42−1
$4s_{1/2}$	σ	6.709+0	4.007+0	1.891+0	1.086+0	6.966−1	4.799−1	3.477−1	2.617−1	2.028−1	1.610−1
E_b =	β	1.988	1.990	1.993	1.995	1.995	1.993	1.990	1.986	1.981	1.976
81.0 eV	γ	−1.03−2	−7.26−2	−9.09−2	−3.05−2	6.89−2	1.87−1	3.15−1	4.46−1	5.77−1	7.07−1
	δ	−1.10−4	−1.30−4	−1.55−4	−1.69−4	−1.79−4	−1.85−4	−1.88−4	−1.89−4	−1.88−4	−1.88−4
$4p_{1/2}$	σ	7.069+0	3.991+0	1.661+0	8.464−1	4.871−1	3.043−1	2.019−1	1.402−1	1.010−1	7.489−2
E_b =	β	1.676	1.643	1.563	1.484	1.412	1.345	1.283	1.224	1.168	1.116
51.9 eV	γ	1.91−2	1.23−1	3.63−1	5.86−1	7.80−1	9.48−1	1.09+0	1.22+0	1.32+0	1.41+0
	δ	7.12−4	2.87−3	9.66−3	1.89−2	3.00−2	4.24−2	5.55−2	6.88−2	8.20−2	9.51−2
$4p_{3/2}$	σ	1.382+1	7.664+0	3.111+0	1.558+0	8.846−1	5.465−1	3.590−1	2.472−1	1.767−1	1.301−1
E_b =	β	1.702	1.678	1.609	1.536	1.467	1.402	1.341	1.283	1.228	1.175
46.3 eV	γ	2.25−2	1.33−1	3.84−1	6.17−1	8.20−1	9.95−1	1.14+0	1.27+0	1.38+0	1.48+0
	δ	3.06−3	5.49−3	1.17−2	1.98−2	2.95−2	4.06−2	5.23−2	6.45−2	7.66−2	8.86−2
$4d_{3/2}$	σ	5.196+0	2.257+0	6.368−1	2.433−1	1.114−1	5.767−2	3.261−2	1.972−2	1.257−2	8.367−3
E_b =	β	1.269	1.192	1.047	0.927	0.828	0.744	0.671	0.606	0.548	0.497
2.8 eV	γ	3.79−1	5.34−1	7.72−1	9.44−1	1.07+0	1.16+0	1.23+0	1.28+0	1.32+0	1.35+0
	δ	5.47−2	7.24−2	1.08−1	1.44−1	1.80−1	2.15−1	2.47−1	2.78−1	3.07−1	3.35−1
$4d_{5/2}$	σ	7.362+0	3.183+0	8.911−1	3.383−1	1.541−1	7.937−2	4.468−2	2.691−2	1.709−2	1.133−2

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Table 1 (*continued*)

E_b =	β	1.248	1.165	1.019	0.902	0.808	0.731	0.664	0.605	0.554	0.509
2.2 eV	γ	3.84−1	5.35−1	7.67−1	9.35−1	1.06+0	1.15+0	1.22+0	1.28+0	1.32+0	1.35+0
	δ	5.56−2	7.42−2	1.12−1	1.50−1	1.86−1	2.22−1	2.55−1	2.85−1	3.14−1	3.42−1
$5s_{1/2}$	σ	3.702−1	2.192−1	1.025−1	5.865−2	3.755−2	2.583−2	1.870−2	1.405−2	1.088−2	8.628−3
E_b =	β	1.988	1.990	1.994	1.995	1.995	1.993	1.990	1.986	1.981	1.976
7.0 eV	γ	−1.95−2	−7.66−2	−8.91−2	−2.65−2	7.36−2	1.94−1	3.23−1	4.54−1	5.83−1	7.09−1
	δ	−1.09−4	−1.28−4	−1.53−4	−1.66−4	−1.75−4	−1.81−4	−1.86−4	−1.88−4	−1.89−4	−1.89−4

Z= 46, Pd: [Kr]$4d^4_{3/2}$ $4d^6_{5/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$3s_{1/2}$	σ	3.721+1	2.331+1	1.144+1	6.696+0	4.343+0	3.014+0	2.195+0	1.659+0	1.290+0	1.027+0
E_b =	β	1.981	1.984	1.990	1.994	1.995	1.994	1.992	1.989	1.984	1.979
669.9 eV	γ	1.74−1	1.51−2	−9.87−2	−8.11−2	−3.18−3	1.05−1	2.26−1	3.52−1	4.80−1	6.08−1
	δ	−1.13−4	−1.48−4	−1.80−4	−1.99−4	−2.12−4	−2.20−4	−2.25−4	−2.27−4	−2.28−4	−2.27−4
$3p_{1/2}$	σ	5.090+1	2.978+1	1.269+1	6.515+0	3.762+0	2.355+0	1.565+0	1.088+0	7.848−1	5.827−1
E_b =	β	1.596	1.613	1.571	1.506	1.438	1.372	1.312	1.256	1.204	1.153
559.1 eV	γ	−2.34−2	3.15−2	2.65−1	5.05−1	7.14−1	8.92−1	1.04+0	1.18+0	1.29+0	1.39+0
	δ	1.40−3	2.90−3	9.46−3	1.85−2	2.89−2	4.00−2	5.18−2	6.45−2	7.78−2	9.09−2
$3p_{3/2}$	σ	1.013+2	5.784+1	2.391+1	1.204+1	6.850+0	4.236+0	2.785+0	1.920+0	1.373+0	1.012+0
E_b =	β	1.622	1.648	1.617	1.559	1.495	1.431	1.372	1.318	1.266	1.216
531.5 eV	γ	−2.96−2	3.88−2	2.87−1	5.38−1	7.57−1	9.43−1	1.10+0	1.24+0	1.36+0	1.46+0
	δ	3.30−3	5.81−3	1.22−2	2.02−2	2.92−2	3.88−2	4.92−2	6.06−2	7.26−2	8.45−2
$3d_{3/2}$	σ	8.068+1	3.379+1	9.151+0	3.426+0	1.553+0	7.988−1	4.501−1	2.716−1	1.729−1	1.149−1
E_b =	β	1.234	1.201	1.084	0.966	0.865	0.780	0.708	0.642	0.583	0.529
340.0 eV	γ	3.04−1	4.83−1	7.52−1	9.37−1	1.07+0	1.17+0	1.24+0	1.30+0	1.34+0	1.38+0
	δ	5.94−2	7.63−2	1.10−1	1.43−1	1.76−1	2.09−1	2.42−1	2.72−1	3.01−1	3.28−1
$3d_{5/2}$	σ	1.164+2	4.853+1	1.306+1	4.861+0	2.192+0	1.123+0	6.299−1	3.786−1	2.401−1	1.590−1
E_b =	β	1.223	1.180	1.057	0.940	0.843	0.764	0.697	0.638	0.585	0.537
334.7 eV	γ	3.13−1	4.89−1	7.50−1	9.29−1	1.06+0	1.16+0	1.23+0	1.29+0	1.34+0	1.37+0
	δ	5.98−2	7.77−2	1.13−1	1.48−1	1.83−1	2.17−1	2.49−1	2.80−1	3.08−1	3.35−1
$4s_{1/2}$	σ	7.197+0	4.300+0	2.032+0	1.170+0	7.523−1	5.192−1	3.767−1	2.839−1	2.203−1	1.751−1
E_b =	β	1.987	1.989	1.993	1.994	1.995	1.993	1.991	1.987	1.983	1.977
86.4 eV	γ	2.16−3	−6.53−2	−9.52−2	−4.58−2	4.54−2	1.58−1	2.80−1	4.06−1	5.33−1	6.59−1
	δ	−1.18−4	−1.40−4	−1.69−4	−1.87−4	−1.99−4	−2.07−4	−2.12−4	−2.15−4	−2.14−4	−2.14−4
$4p_{1/2}$	σ	7.691+0	4.365+0	1.833+0	9.414−1	5.448−1	3.418−1	2.277−1	1.587−1	1.146−1	8.523−2
E_b =	β	1.681	1.650	1.575	1.499	1.426	1.359	1.298	1.242	1.189	1.139
54.4 eV	γ	8.06−3	1.03−1	3.36−1	5.60−1	7.57−1	9.24−1	1.07+0	1.20+0	1.31+0	1.40+0
	δ	3.73−4	2.32−3	8.72−3	1.77−2	2.81−2	3.92−2	5.14−2	6.43−2	7.75−2	9.08−2
$4p_{3/2}$	σ	1.499+1	8.348+0	3.416+0	1.723+0	9.828−1	6.095−1	4.018−1	2.776−1	1.989−1	1.469−1
E_b =	β	1.706	1.686	1.622	1.552	1.483	1.418	1.358	1.303	1.251	1.201
50.0 eV	γ	1.04−2	1.12−1	3.58−1	5.92−1	7.97−1	9.73−1	1.12+0	1.25+0	1.37+0	1.47+0
	δ	2.80−3	5.10−3	1.11−2	1.90−2	2.80−2	3.78−2	4.85−2	6.00−2	7.21−2	8.43−2
$4d_{3/2}$	σ	5.747+0	2.519+0	7.208−1	2.781−1	1.283−1	6.676−2	3.792−2	2.302−2	1.472−2	9.821−3
E_b =	β	1.282	1.210	1.070	0.948	0.845	0.760	0.690	0.627	0.571	0.519
1.7 eV	γ	3.63−1	5.20−1	7.63−1	9.39−1	1.07+0	1.16+0	1.24+0	1.30+0	1.34+0	1.37+0
	δ	5.31−2	7.03−2	1.06−1	1.41−1	1.75−1	2.08−1	2.41−1	2.72−1	3.01−1	3.29−1
$4d_{5/2}$	σ	8.101+0	3.533+0	1.003+0	3.845−1	1.763−1	9.133−2	5.165−2	3.122−2	1.989−2	1.322−2
E_b =	β	1.262	1.183	1.041	0.922	0.824	0.744	0.680	0.623	0.573	0.527
1.3 eV	γ	3.68−1	5.21−1	7.59−1	9.30−1	1.06+0	1.15+0	1.23+0	1.29+0	1.33+0	1.37+0
	δ	5.38−2	7.21−2	1.10−1	1.46−1	1.81−1	2.15−1	2.48−1	2.80−1	3.09−1	3.36−1

Z= 47, Ag: [Kr]$4d^4_{3/2}$ $4d^6_{5/2}$ $5s^1_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$3s_{1/2}$	σ	3.871+1	2.437+1	1.204+1	7.071+0	4.598+0	3.198+0	2.335+0	1.768+0	1.377+0	1.098+0
E_b =	β	1.979	1.983	1.989	1.992	1.994	1.994	1.992	1.989	1.985	1.981
717.5 eV	γ	2.13−1	3.91−2	−9.61−2	−9.28−2	−2.50−2	7.46−2	1.89−1	3.11−1	4.37−1	5.62−1
	δ	−1.18−4	−1.60−4	−2.02−4	−2.23−4	−2.37−4	−2.45−4	−2.51−4	−2.55−4	−2.56−4	−2.55−4
$3p_{1/2}$	σ	5.352+1	3.162+1	1.364+1	7.063+0	4.103+0	2.582+0	1.723+0	1.202+0	8.694−1	6.471−1
E_b =	β	1.586	1.613	1.578	1.517	1.452	1.389	1.331	1.276	1.223	1.172
602.4 eV	γ	−2.01−2	1.49−2	2.36−1	4.73−1	6.82−1	8.62−1	1.02+0	1.15+0	1.27+0	1.38+0
	δ	1.57−3	2.41−3	8.41−3	1.67−2	2.65−2	3.72−2	4.90−2	6.13−2	7.41−2	8.67−2
$3p_{3/2}$	σ	1.070+2	6.159+1	2.574+1	1.305+1	7.467+0	4.639+0	3.062+0	2.117+0	1.518+0	1.121+0
E_b =	β	1.613	1.649	1.625	1.571	1.510	1.450	1.394	1.340	1.288	1.237
571.4 eV	γ	−3.02−2	2.06−2	2.58−1	5.07−1	7.26−1	9.14−1	1.08+0	1.22+0	1.34+0	1.45+0
	δ	3.27−3	5.45−3	1.15−2	1.88−2	2.71−2	3.63−2	4.66−2	5.77−2	6.90−2	8.04−2
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$3d_{3/2}$	σ	9.083+1	3.831+1	1.049+1	3.961+0	1.806+0	9.337−1	5.280−1	3.195−1	2.039−1	1.358−1
E_b =	β	1.235	1.210	1.100	0.987	0.888	0.804	0.729	0.662	0.601	0.548

(*continued on next page*)

Table 1 (*continued*)

372.8 eV	γ	2.75−1	4.60−1	7.36−1	9.27−1	1.07+0	1.17+0	1.25+0	1.31+0	1.36+0	1.39+0
	δ	5.72−2	7.37−2	1.06−1	1.39−1	1.72−1	2.05−1	2.36−1	2.65−1	2.93−1	3.20−1
$3d_{5/2}$	σ	1.309+2	5.497+1	1.495+1	5.613+0	2.547+0	1.310+0	7.377−1	4.446−1	2.827−1	1.876−1
E_b =	β	1.225	1.189	1.071	0.959	0.864	0.785	0.716	0.655	0.600	0.553
366.7 eV	γ	2.85−1	4.67−1	7.34−1	9.20−1	1.06+0	1.16+0	1.24+0	1.30+0	1.35+0	1.39+0
	δ	5.74−2	7.49−2	1.10−1	1.44−1	1.78−1	2.12−1	2.44−1	2.74−1	3.02−1	3.29−1
$4s_{1/2}$	σ	7.791+0	4.663+0	2.207+0	1.273+0	8.202−1	5.672−1	4.124−1	3.113−1	2.419−1	1.925−1
E_b =	β	1.985	1.988	1.991	1.994	1.994	1.993	1.991	1.988	1.983	1.979
95.2 eV	γ	1.39−2	−5.90−2	−9.96−2	−5.95−2	2.37−2	1.29−1	2.46−1	3.68−1	4.92−1	6.17−1
	δ	−1.30−4	−1.56−4	−1.88−4	−2.08−4	−2.23−4	−2.31−4	−2.37−4	−2.40−4	−2.40−4	−2.41−4
$4p_{1/2}$	σ	8.448+0	4.823+0	2.043+0	1.056+0	6.150−1	3.879−1	2.594−1	1.814−1	1.314−1	9.796−2
E_b =	β	1.684	1.657	1.584	1.510	1.440	1.376	1.317	1.261	1.208	1.158
62.6 eV	γ	−8.86−4	8.70−2	3.13−1	5.33−1	7.29−1	8.99−1	1.05+0	1.18+0	1.29+0	1.39+0
	δ	4.86−5	1.79−3	7.62−3	1.58−2	2.56−2	3.65−2	4.84−2	6.11−2	7.38−2	8.65−2
$4p_{3/2}$	σ	1.650+1	9.237+0	3.809+0	1.933+0	1.109+0	6.909−1	4.572−1	3.168−1	2.276−1	1.684−1
E_b =	β	1.709	1.692	1.632	1.565	1.499	1.437	1.379	1.325	1.272	1.222
55.9 eV	γ	6.98−4	9.60−2	3.35−1	5.66−1	7.70−1	9.48−1	1.10+0	1.24+0	1.36+0	1.46+0
	δ	2.57−3	4.78−3	1.03−2	1.74−2	2.58−2	3.53−2	4.58−2	5.71−2	6.86−2	8.01−2
$4d_{3/2}$	σ	7.263+0	3.215+0	9.331−1	3.640−1	1.693−1	8.867−2	5.060−2	3.083−2	1.978−2	1.323−2
E_b =	β	1.294	1.223	1.085	0.966	0.867	0.784	0.712	0.647	0.589	0.536
3.6 eV	γ	3.46−1	5.06−1	7.51−1	9.31−1	1.07+0	1.17+0	1.25+0	1.31+0	1.35+0	1.39+0
	δ	5.09−2	6.79−2	1.02−1	1.36−1	1.69−1	2.03−1	2.35−1	2.65−1	2.94−1	3.21−1
$4d_{5/2}$	σ	1.031+1	4.538+0	1.307+0	5.063−1	2.342−1	1.220−1	6.932−2	4.205−2	2.687−2	1.791−2
E_b =	β	1.273	1.196	1.055	0.938	0.843	0.765	0.699	0.640	0.588	0.541
3.1 eV	γ	3.53−1	5.08−1	7.47−1	9.22−1	1.05+0	1.16+0	1.24+0	1.30+0	1.35+0	1.38+0
	δ	5.15−2	6.96−2	1.06−1	1.41−1	1.76−1	2.10−1	2.43−1	2.74−1	3.02−1	3.29−1
$5s_{1/2}$	σ	4.011−1	2.377−1	1.114−1	6.394−2	4.109−2	2.838−2	2.061−2	1.554−2	1.207−2	9.593−3
E_b =	β	1.986	1.988	1.992	1.994	1.994	1.993	1.991	1.987	1.983	1.978
8.0 eV	γ	1.35−3	−6.55−2	−9.93−2	−5.55−2	2.86−2	1.35−1	2.53−1	3.77−1	5.02−1	6.25−1
	δ	−1.30−4	−1.54−4	−1.87−4	−2.06−4	−2.18−4	−2.26−4	−2.33−4	−2.37−4	−2.38−4	−2.41−4

Z= 48, Cd: [Kr]$4d^4_{3/2}$ $4d^6_{5/2}$ $5s^2_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$3s_{1/2}$	σ	4.022+1	2.547+1	1.265+1	7.454+0	4.860+0	3.388+0	2.479+0	1.880+0	1.467+0	1.171+0
E_b =	β	1.977	1.981	1.987	1.991	1.993	1.994	1.992	1.990	1.986	1.982
770.2 eV	γ	2.55−1	6.69−2	−9.00−2	−1.02−1	−4.49−2	4.61−2	1.55−1	2.72−1	3.94−1	5.18−1
	δ	−1.22−4	−1.72−4	−2.22−4	−2.47−4	−2.62−4	−2.72−4	−2.79−4	−2.84−4	−2.86−4	−2.87−4
$3p_{1/2}$	σ	5.614+1	3.352+1	1.463+1	7.638+0	4.465+0	2.824+0	1.891+0	1.324+0	9.602−1	7.164−1
E_b =	β	1.573	1.612	1.585	1.528	1.466	1.406	1.349	1.294	1.241	1.190
650.7 eV	γ	−1.17−2	2.92−4	2.05−1	4.38−1	6.48−1	8.32−1	9.92−1	1.13+0	1.25+0	1.36+0
	δ	2.02−3	2.02−3	7.29−3	1.50−2	2.43−2	3.49−2	4.64−2	5.84−2	7.05−2	8.24−2
$3p_{3/2}$	σ	1.129+2	6.551+1	2.765+1	1.412+1	8.122+0	5.068+0	3.357+0	2.327+0	1.673+0	1.238+0
E_b =	β	1.600	1.647	1.633	1.583	1.527	1.469	1.414	1.360	1.308	1.258
616.5 eV	γ	−2.69−2	3.65−3	2.27−1	4.72−1	6.92−1	8.85−1	1.05+0	1.20+0	1.32+0	1.43+0
	δ	3.42−3	5.09−3	1.07−2	1.74−2	2.53−2	3.44−2	4.43−2	5.50−2	6.56−2	7.63−2
$3d_{3/2}$	σ	1.022+2	4.339+1	1.200+1	4.565+0	2.093+0	1.086+0	6.164−1	3.741−1	2.393−1	1.598−1
E_b =	β	1.234	1.219	1.118	1.010	0.912	0.826	0.749	0.680	0.620	0.567
410.5 eV	γ	2.48−1	4.34−1	7.18−1	9.18−1	1.06+0	1.17+0	1.26+0	1.32+0	1.37+0	1.41+0
	δ	5.57−2	7.17−2	1.03−1	1.35−1	1.68−1	2.00−1	2.30−1	2.59−1	2.86−1	3.13−1
$3d_{5/2}$	σ	1.472+2	6.220+1	1.708+1	6.460+0	2.947+0	1.522+0	8.600−1	5.198−1	3.312−1	2.203−1
E_b =	β	1.225	1.199	1.089	0.980	0.886	0.804	0.733	0.671	0.616	0.568
403.7 eV	γ	2.60−1	4.43−1	7.18−1	9.11−1	1.05+0	1.16+0	1.24+0	1.31+0	1.36+0	1.40+0
	δ	5.57−2	7.28−2	1.06−1	1.41−1	1.75−1	2.07−1	2.38−1	2.67−1	2.95−1	3.22−1
$4s_{1/2}$	σ	8.440+0	5.055+0	2.396+0	1.385+0	8.938−1	6.193−1	4.511−1	3.410−1	2.654−1	2.114−1
E_b =	β	1.984	1.986	1.990	1.993	1.994	1.993	1.991	1.988	1.984	1.980
107.6 eV	γ	2.75−2	−5.06−2	−1.02−1	−7.13−2	3.28−3	1.02−1	2.13−1	3.32−1	4.53−1	5.75−1
	δ	−1.40−4	−1.70−4	−2.08−4	−2.30−4	−2.47−4	−2.56−4	−2.63−4	−2.68−4	−2.69−4	−2.70−4
$4p_{1/2}$	σ	9.254+0	5.311+0	2.269+0	1.182+0	6.919−1	4.386−1	2.945−1	2.066−1	1.501−1	1.122−1
E_b =	β	1.687	1.663	1.594	1.523	1.455	1.393	1.334	1.279	1.226	1.175
70.8 eV	γ	−8.44−3	7.05−2	2.88−1	5.05−1	7.00−1	8.73−1	1.02+0	1.16+0	1.27+0	1.37+0
	δ	−2.01−4	1.29−3	6.47−3	1.41−2	2.35−2	3.43−2	4.59−2	5.80−2	7.02−2	8.22−2
$4p_{3/2}$	σ	1.817+1	1.021+1	4.240+0	2.165+0	1.248+0	7.812−1	5.189−1	3.606−1	2.597−1	1.926−1
E_b =	β	1.712	1.698	1.643	1.579	1.516	1.456	1.399	1.345	1.292	1.242
65.0 eV	γ	−8.27−3	7.84−2	3.09−1	5.37−1	7.43−1	9.24−1	1.08+0	1.22+0	1.34+0	1.45+0
	δ	2.35−3	4.42−3	9.42−3	1.60−2	2.40−2	3.33−2	4.36−2	5.43−2	6.51−2	7.59−2
$4d_{3/2}$	σ	8.979+0	4.008+0	1.179+0	4.645−1	2.177−1	1.146−1	6.572−2	4.018−2	2.586−2	1.734−2
E_b =	β	1.306	1.240	1.105	0.989	0.891	0.806	0.732	0.665	0.605	0.552
9.7 eV	γ	3.28−1	4.88−1	7.39−1	9.24−1	1.06+0	1.17+0	1.25+0	1.31+0	1.36+0	1.40+0
	δ	4.89−2	6.50−2	9.80−2	1.32−1	1.65−1	1.98−1	2.29−1	2.58−1	2.86−1	3.13−1

(*continued on next page*)

Table 1 (*continued*)

$4d_{5/2}$	σ	1.278+1	5.675+0	1.655+0	6.479−1	3.019−1	1.582−1	9.025−2	5.494−2	3.521−2	2.353−2
E_b =	β	1.285	1.211	1.072	0.958	0.864	0.785	0.716	0.656	0.602	0.555
9.0 eV	γ	3.35−1	4.92−1	7.35−1	9.15−1	1.05+0	1.16+0	1.24+0	1.30+0	1.35+0	1.39+0
	δ	4.94−2	6.66−2	1.02−1	1.37−1	1.72−1	2.06−1	2.37−1	2.67−1	2.95−1	3.22−1
$5s_{1/2}$	σ	5.374−1	3.188−1	1.496−1	8.608−2	5.543−2	3.835−2	2.790−2	2.107−2	1.638−2	1.304−2
E_b =	β	1.985	1.987	1.991	1.993	1.994	1.993	1.991	1.988	1.984	1.979
2.2 eV	γ	1.10−2	−5.86−2	−1.01−1	−6.64−2	9.65−3	1.10−1	2.23−1	3.42−1	4.62−1	5.81−1
	δ	−1.40−4	−1.68−4	−2.04−4	−2.27−4	−2.41−4	−2.52−4	−2.60−4	−2.66−4	−2.68−4	−2.71−4

Z= 49, In: [Kr]$4d^4_{3/2}$ $4d^6_{5/2}$ $5s^2_{1/2}$ $5p^1_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$3s_{1/2}$	σ	4.168+1	2.655+1	1.327+1	7.843+0	5.127+0	3.584+0	2.627+0	1.996+0	1.559+0	1.246+0
E_b =	β	1.975	1.979	1.985	1.990	1.992	1.993	1.992	1.990	1.987	1.983
825.6 eV	γ	3.02−1	9.75−2	−8.04−2	−1.07−1	−6.23−2	1.99−2	1.22−1	2.36−1	3.54−1	4.75−1
	δ	−1.25−4	−1.87−4	−2.41−4	−2.70−4	−2.88−4	−3.01−4	−3.10−4	−3.16−4	−3.20−4	−3.22−4
$3p_{1/2}$	σ	5.867+1	3.543+1	1.566+1	8.239+0	4.845+0	3.078+0	2.069+0	1.453+0	1.057+0	7.903−1
E_b =	β	1.559	1.608	1.591	1.539	1.480	1.421	1.364	1.309	1.257	1.207
702.2 eV	γ	2.90−3	−1.09−2	1.76−1	4.05−1	6.17−1	8.03−1	9.66−1	1.11+0	1.23+0	1.34+0
	δ	2.83−3	1.73−3	6.48−3	1.39−2	2.29−2	3.31−2	4.39−2	5.51−2	6.64−2	7.78−2
$3p_{3/2}$	σ	1.187+2	6.950+1	2.964+1	1.524+1	8.810+0	5.519+0	3.668+0	2.550+0	1.837+0	1.363+0
E_b =	β	1.587	1.644	1.640	1.596	1.542	1.486	1.431	1.378	1.326	1.277
664.3 eV	γ	−1.84−2	−1.02−2	1.97−1	4.39−1	6.62−1	8.58−1	1.03+0	1.18+0	1.30+0	1.42+0
	δ	3.77−3	4.84−3	1.02−2	1.67−2	2.44−2	3.30−2	4.23−2	5.20−2	6.18−2	7.19−2
$3d_{3/2}$	σ	1.143+2	4.887+1	1.365+1	5.229+0	2.410+0	1.257+0	7.155−1	4.356−1	2.794−1	1.870−1
E_b =	β	1.230	1.226	1.135	1.029	0.930	0.843	0.766	0.699	0.640	0.588
450.8 eV	γ	2.19−1	4.11−1	7.03−1	9.09−1	1.06+0	1.17+0	1.26+0	1.33+0	1.38+0	1.42+0
	δ	5.37−2	7.03−2	1.01−1	1.33−1	1.64−1	1.94−1	2.23−1	2.52−1	2.80−1	3.07−1
$3d_{5/2}$	σ	1.646+2	6.999+1	1.940+1	7.391+0	3.389+0	1.758+0	9.968−1	6.042−1	3.861−1	2.574−1
E_b =	β	1.224	1.207	1.105	0.998	0.902	0.819	0.748	0.686	0.633	0.586
443.1 eV	γ	2.31−1	4.21−1	7.04−1	9.03−1	1.05+0	1.16+0	1.25+0	1.31+0	1.37+0	1.41+0
	δ	5.35−2	7.12−2	1.05−1	1.38−1	1.70−1	2.02−1	2.32−1	2.61−1	2.89−1	3.16−1
$4s_{1/2}$	σ	9.111+0	5.464+0	2.594+0	1.501+0	9.708−1	6.739−1	4.917−1	3.722−1	2.900−1	2.313−1
E_b =	β	1.983	1.985	1.989	1.992	1.993	1.993	1.991	1.988	1.985	1.981
121.9 eV	γ	4.14−2	−4.10−2	−1.02−1	−8.13−2	−1.53−2	7.65−2	1.83−1	2.98−1	4.16−1	5.35−1
	δ	−1.53−4	−1.85−4	−2.27−4	−2.52−4	−2.71−4	−2.83−4	−2.92−4	−2.99−4	−3.01−4	−3.04−4
$4p_{1/2}$	σ	1.013+1	5.847+0	2.518+0	1.320+0	7.773−1	4.949−1	3.335−1	2.347−1	1.710−1	1.281−1
E_b =	β	1.690	1.669	1.604	1.535	1.470	1.408	1.349	1.293	1.241	1.191
81.9 eV	γ	−1.47−2	5.54−2	2.64−1	4.78−1	6.75−1	8.50−1	1.00+0	1.14+0	1.25+0	1.36+0
	δ	−4.56−4	8.90−4	5.72−3	1.30−2	2.21−2	3.24−2	4.33−2	5.45−2	6.60−2	7.75−2
$4p_{3/2}$	σ	1.994+1	1.126+1	4.707+0	2.417+0	1.401+0	8.802−1	5.865−1	4.088−1	2.951−1	2.193−1
E_b =	β	1.713	1.704	1.653	1.593	1.532	1.473	1.416	1.362	1.309	1.260
75.1 eV	γ	−1.57−2	6.25−2	2.84−1	5.11−1	7.18−1	9.02−1	1.06+0	1.20+0	1.32+0	1.43+0
	δ	2.16−3	4.17−3	8.96−3	1.53−2	2.31−2	3.19−2	4.13−2	5.12−2	6.12−2	7.15−2
$4d_{3/2}$	σ	1.087+1	4.895+0	1.458+0	5.799−1	2.738−1	1.450−1	8.350−2	5.125−2	3.309−2	2.225−2
E_b =	β	1.316	1.254	1.124	1.009	0.910	0.823	0.748	0.681	0.622	0.571
16.8 eV	γ	3.11−1	4.74−1	7.28−1	9.16−1	1.06+0	1.17+0	1.25+0	1.32+0	1.37+0	1.41+0
	δ	4.74−2	6.34−2	9.59−2	1.29−1	1.61−1	1.92−1	2.22−1	2.51−1	2.79−1	3.06−1
$4d_{5/2}$	σ	1.558+1	6.977+0	2.060+0	8.140−1	3.820−1	2.013−1	1.154−1	7.050−2	4.533−2	3.036−2
E_b =	β	1.296	1.226	1.091	0.977	0.881	0.800	0.730	0.669	0.616	0.569
15.8 eV	γ	3.20−1	4.79−1	7.25−1	9.08−1	1.05+0	1.16+0	1.24+0	1.31+0	1.36+0	1.41+0
	δ	4.78−2	6.50−2	9.96−2	1.34−1	1.68−1	2.00−1	2.31−1	2.60−1	2.88−1	3.16−1
$5s_{1/2}$	σ	7.283−1	4.328−1	2.035−1	1.172−1	7.558−2	5.237−2	3.815−2	2.886−2	2.247−2	1.791−2
E_b =	β	1.983	1.986	1.989	1.992	1.993	1.993	1.991	1.988	1.985	1.980
0.1 eV	γ	2.06−2	−5.28−2	−1.04−1	−7.72−2	−8.12−3	8.53−2	1.92−1	3.05−1	4.22−1	5.40−1
	δ	−1.54−4	−1.87−4	−2.26−4	−2.52−4	−2.69−4	−2.81−4	−2.90−4	−2.96−4	−2.99−4	−3.03−4
$5p_{1/2}$	σ	4.187−1	2.401−1	1.028−1	5.373−2	3.160−2	2.010−2	1.354−2	9.529−3	6.942−3	5.201−3
E_b =	β	1.701	1.675	1.606	1.535	1.468	1.404	1.346	1.291	1.241	1.194
0.8 eV	γ	−1.19−2	6.26−2	2.73−1	4.88−1	6.83−1	8.55−1	1.01+0	1.14+0	1.26+0	1.36+0
	δ	−6.83−4	6.67−4	5.50−3	1.28−2	2.18−2	3.16−2	4.22−2	5.35−2	6.53−2	7.74−2

Z= 50, Sn: [Kr]$4d^4_{3/2}$ $4d^6_{5/2}$ $5s^2_{1/2}$ $5p^2_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$3s_{1/2}$	σ	4.306+1	2.762+1	1.389+1	8.241+0	5.401+0	3.783+0	2.778+0	2.114+0	1.654+0	1.323+0
E_b =	β	1.973	1.976	1.983	1.988	1.991	1.992	1.992	1.990	1.987	1.984
883.8 eV	γ	3.52−1	1.31−1	−6.98−2	−1.12−1	−7.85−2	−4.48−3	9.16−2	2.00−1	3.14−1	4.30−1
	δ	−1.25−4	−1.99−4	−2.66−4	−2.99−4	−3.21−4	−3.36−4	−3.46−4	−3.54−4	−3.59−4	−3.62−4
$3p_{1/2}$	σ	6.115+1	3.732+1	1.671+1	8.859+0	5.240+0	3.344+0	2.257+0	1.590+0	1.159+0	8.692−1

(*continued on next page*)

Table 1 (*continued*)

E_b =	β	1.539	1.604	1.596	1.548	1.491	1.434	1.378	1.324	1.274	1.226
756.4 eV	γ	2.38−2	−1.87−2	1.49−1	3.73−1	5.85−1	7.72−1	9.36−1	1.08+0	1.21+0	1.32+0
	δ	4.13−3	1.57−3	5.62−3	1.25−2	2.09−2	3.05−2	4.06−2	5.13−2	6.22−2	7.34−2
$3p_{3/2}$	σ	1.245+2	7.352+1	3.168+1	1.639+1	9.524+0	5.991+0	3.994+0	2.784+0	2.011+0	1.495+0
E_b =	β	1.569	1.639	1.646	1.606	1.554	1.500	1.447	1.395	1.345	1.298
714.4 eV	γ	−4.84−3	−2.14−2	1.69−1	4.08−1	6.31−1	8.28−1	1.00+0	1.15+0	1.28+0	1.40+0
	δ	4.42−3	4.64−3	9.68−3	1.58−2	2.29−2	3.08−2	3.94−2	4.85−2	5.79−2	6.77−2
$3d_{3/2}$	σ	1.275+2	5.483+1	1.545+1	5.961+0	2.763+0	1.447+0	8.269−1	5.049−1	3.247−1	2.177−1
E_b =	β	1.223	1.231	1.149	1.045	0.949	0.864	0.789	0.722	0.663	0.610
493.3 eV	γ	1.87−1	3.83−1	6.83−1	8.95−1	1.05+0	1.17+0	1.26+0	1.34+0	1.39+0	1.44+0
	δ	5.16−2	6.82−2	9.82−2	1.28−1	1.58−1	1.88−1	2.17−1	2.46−1	2.74−1	3.00−1
$3d_{5/2}$	σ	1.835+2	7.848+1	2.195+1	8.415+0	3.880+0	2.022+0	1.150+0	6.993−1	4.479−1	2.992−1
E_b =	β	1.220	1.213	1.118	1.013	0.918	0.837	0.767	0.706	0.652	0.605
484.8 eV	γ	2.01−1	3.95−1	6.85−1	8.90−1	1.04+0	1.16+0	1.25+0	1.32+0	1.38+0	1.43+0
	δ	5.13−2	6.89−2	1.01−1	1.33−1	1.65−1	1.96−1	2.26−1	2.56−1	2.84−1	3.10−1
$4s_{1/2}$	σ	9.808+0	5.892+0	2.802+0	1.624+0	1.052+0	7.314−1	5.344−1	4.051−1	3.160−1	2.523−1
E_b =	β	1.981	1.984	1.988	1.991	1.992	1.992	1.991	1.989	1.985	1.981
136.5 eV	γ	5.59−2	−3.13−2	−1.03−1	−9.11−2	−3.26−2	5.29−2	1.54−1	2.64−1	3.78−1	4.93−1
	δ	−1.66−4	−2.04−4	−2.51−4	−2.80−4	−3.01−4	−3.15−4	−3.25−4	−3.34−4	−3.38−4	−3.41−4
$4p_{1/2}$	σ	1.106+1	6.419+0	2.786+0	1.470+0	8.698−1	5.563−1	3.763−1	2.657−1	1.941−1	1.458−1
E_b =	β	1.691	1.674	1.612	1.545	1.481	1.420	1.362	1.308	1.257	1.210
93.9 eV	γ	−1.94−2	4.18−2	2.42−1	4.54−1	6.49−1	8.23−1	9.77−1	1.11+0	1.23+0	1.34+0
	δ	−6.80−4	4.72−4	4.84−3	1.16−2	2.01−2	2.97−2	3.99−2	5.07−2	6.18−2	7.31−2
$4p_{3/2}$	σ	2.181+1	1.237+1	5.207+0	2.688+0	1.565+0	9.873−1	6.601−1	4.613−1	3.339−1	2.487−1
E_b =	β	1.714	1.709	1.662	1.604	1.545	1.487	1.431	1.379	1.329	1.281
86.0 eV	γ	−2.19−2	4.81−2	2.63−1	4.87−1	6.93−1	8.76−1	1.04+0	1.18+0	1.30+0	1.42+0
	δ	1.98−3	3.92−3	8.42−3	1.43−2	2.14−2	2.96−2	3.83−2	4.76−2	5.72−2	6.71−2
$4d_{3/2}$	σ	1.293+1	5.871+0	1.769+0	7.104−1	3.378−1	1.800−1	1.041−1	6.418−2	4.156−2	2.803−2
E_b =	β	1.325	1.267	1.139	1.025	0.926	0.841	0.767	0.702	0.645	0.593
24.6 eV	γ	2.93−1	4.57−1	7.15−1	9.06−1	1.05+0	1.17+0	1.26+0	1.33+0	1.38+0	1.43+0
	δ	4.53−2	6.09−2	9.22−2	1.24−1	1.55−1	1.86−1	2.16−1	2.45−1	2.73−1	3.00−1
$4d_{5/2}$	σ	1.863+1	8.409+0	2.512+0	1.001+0	4.734−1	2.509−1	1.445−1	8.862−2	5.715−2	3.839−2
E_b =	β	1.305	1.238	1.104	0.990	0.895	0.815	0.746	0.687	0.634	0.588
23.4 eV	γ	3.02−1	4.63−1	7.13−1	8.98−1	1.04+0	1.15+0	1.24+0	1.31+0	1.37+0	1.42+0
	δ	4.57−2	6.23−2	9.59−2	1.29−1	1.62−1	1.94−1	2.25−1	2.55−1	2.83−1	3.10−1
$5s_{1/2}$	σ	9.174−1	5.457−1	2.567−1	1.481−1	9.561−2	6.636−2	4.842−2	3.668−2	2.860−2	2.282−2
E_b =	β	1.982	1.984	1.988	1.991	1.992	1.992	1.991	1.989	1.985	1.981
0.9 eV	γ	3.13−2	−4.45−2	−1.03−1	−8.56−2	−2.46−2	6.16−2	1.63−1	2.72−1	3.86−1	5.01−1
	δ	−1.68−4	−2.03−4	−2.47−4	−2.76−4	−2.96−4	−3.09−4	−3.19−4	−3.27−4	−3.31−4	−3.36−4
$5p_{1/2}$	σ	6.047−1	3.484−1	1.502−1	7.902−2	4.672−2	2.986−2	2.020−2	1.426−2	1.042−2	7.825−3
E_b =	β	1.705	1.681	1.615	1.546	1.481	1.420	1.364	1.311	1.260	1.212
1.1 eV	γ	−1.68−2	4.96−2	2.51−1	4.61−1	6.54−1	8.27−1	9.81−1	1.12+0	1.24+0	1.34+0
	δ	−9.05−4	2.16−4	4.45−3	1.11−2	1.94−2	2.91−2	3.97−2	5.09−2	6.26−2	7.42−2

Z= 51, Sb: [Kr]$4d^4_{3/2}$ $4d^6_{5/2}$ $5s^2_{1/2}$ $5p^2_{1/2}$ $5p^1_{3/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$3s_{1/2}$	σ	4.438+1	2.866+1	1.451+1	8.640+0	5.677+0	3.984+0	2.931+0	2.234+0	1.750+0	1.402+0
E_b =	β	1.970	1.974	1.981	1.987	1.990	1.992	1.991	1.990	1.988	1.984
943.7 eV	γ	4.03−1	1.68−1	−5.59−2	−1.14−1	−9.19−2	−2.69−2	6.19−2	1.64−1	2.73−1	3.85−1
	δ	−1.20−4	−2.11−4	−2.91−4	−3.30−4	−3.54−4	−3.72−4	−3.85−4	−3.93−4	−4.00−4	−4.03−4
$3p_{1/2}$	σ	6.348+1	3.920+1	1.777+1	9.494+0	5.648+0	3.621+0	2.453+0	1.734+0	1.268+0	9.530−1
E_b =	β	1.516	1.597	1.601	1.557	1.503	1.447	1.394	1.342	1.293	1.247
811.9 eV	γ	5.14−2	−2.25−2	1.22−1	3.40−1	5.49−1	7.37−1	9.04−1	1.05+0	1.18+0	1.29+0
	δ	6.08−3	1.57−3	4.82−3	1.11−2	1.89−2	2.79−2	3.77−2	4.81−2	5.89−2	7.00−2
$3p_{3/2}$	σ	1.302+2	7.757+1	3.376+1	1.758+1	1.027+1	6.483+0	4.337+0	3.032+0	2.195+0	1.635+0
E_b =	β	1.547	1.633	1.651	1.616	1.568	1.516	1.465	1.415	1.367	1.322
765.6 eV	γ	1.39−2	−2.93−2	1.41−1	3.74−1	5.96−1	7.94−1	9.69−1	1.12+0	1.26+0	1.38+0
	δ	5.47−3	4.51−3	9.17−3	1.48−2	2.13−2	2.87−2	3.69−2	4.56−2	5.49−2	6.45−2
$3d_{3/2}$	σ	1.416+2	6.125+1	1.741+1	6.764+0	3.153+0	1.658+0	9.511−1	5.824−1	3.754−1	2.523−1
E_b =	β	1.213	1.235	1.163	1.065	0.972	0.888	0.813	0.746	0.686	0.631
536.9 eV	γ	1.56−1	3.54−1	6.61−1	8.81−1	1.04+0	1.17+0	1.27+0	1.34+0	1.40+0	1.45+0
	δ	4.95−2	6.62−2	9.53−2	1.24−1	1.54−1	1.84−1	2.13−1	2.41−1	2.68−1	2.94−1
$3d_{5/2}$	σ	2.036+2	8.760+1	2.471+1	9.537+0	4.421+0	2.314+0	1.321+0	8.054−1	5.170−1	3.461−1
E_b =	β	1.214	1.218	1.132	1.031	0.939	0.858	0.788	0.726	0.672	0.622
527.5 eV	γ	1.71−1	3.68−1	6.66−1	8.77−1	1.03+0	1.16+0	1.25+0	1.33+0	1.39+0	1.44+0
	δ	4.90−2	6.67−2	9.82−2	1.30−1	1.61−1	1.92−1	2.22−1	2.51−1	2.78−1	3.05−1
$4s_{1/2}$	σ	1.053+1	6.338+0	3.019+0	1.752+0	1.137+0	7.913−1	5.790−1	4.395−1	3.433−1	2.744−1
E_b =	β	1.979	1.982	1.986	1.990	1.991	1.992	1.991	1.989	1.986	1.982
152.0 eV	γ	7.12−2	−2.04−2	−1.02−1	−9.90−2	−4.83−2	3.03−2	1.25−1	2.30−1	3.39−1	4.50−1

(*continued on next page*)

Table 1 (*continued*)

	δ	−1.79−4	−2.22−4	−2.76−4	−3.10−4	−3.32−4	−3.48−4	−3.60−4	−3.71−4	−3.77−4	−3.80−4
$4p_{1/2}$	σ	1.199+1	7.000+0	3.062+0	1.625+0	9.666−1	6.209−1	4.216−1	2.987−1	2.189−1	1.648−1
E_b =	β	1.693	1.678	1.620	1.556	1.493	1.434	1.379	1.327	1.277	1.230
104.3 eV	γ	−2.24−2	2.94−2	2.20−1	4.27−1	6.20−1	7.95−1	9.50−1	1.09+0	1.21+0	1.32+0
	δ	−8.60−4	1.09−4	3.99−3	1.01−2	1.80−2	2.71−2	3.70−2	4.76−2	5.85−2	6.97−2
$4p_{3/2}$	σ	2.378+1	1.355+1	5.739+0	2.978+0	1.741+0	1.103+0	7.399−1	5.186−1	3.764−1	2.810−1
E_b =	β	1.715	1.713	1.671	1.616	1.559	1.503	1.450	1.399	1.351	1.305
95.4 eV	γ	−2.65−2	3.46−2	2.40−1	4.60−1	6.65−1	8.48−1	1.01+0	1.16+0	1.29+0	1.40+0
	δ	1.82−3	3.69−3	7.86−3	1.32−2	1.98−2	2.73−2	3.57−2	4.47−2	5.41−2	6.39−2
$4d_{3/2}$	σ	1.520+1	6.961+0	2.122+0	8.598−1	4.119−1	2.207−1	1.283−1	7.937−2	5.156−2	3.486−2
E_b =	β	1.334	1.280	1.157	1.045	0.949	0.865	0.791	0.726	0.666	0.613
32.2 eV	γ	2.73−1	4.39−1	7.01−1	8.97−1	1.05+0	1.17+0	1.26+0	1.34+0	1.40+0	1.44+0
	δ	4.35−2	5.86−2	8.87−2	1.20−1	1.51−1	1.81−1	2.11−1	2.39−1	2.67−1	2.93−1
$4d_{5/2}$	σ	2.188+1	9.955+0	3.008+0	1.210+0	5.759−1	3.070−1	1.776−1	1.093−1	7.073−2	4.763−2
E_b =	β	1.315	1.251	1.120	1.008	0.915	0.835	0.766	0.707	0.653	0.605
30.8 eV	γ	2.83−1	4.46−1	7.00−1	8.89−1	1.04+0	1.15+0	1.25+0	1.32+0	1.38+0	1.43+0
	δ	4.37−2	5.99−2	9.24−2	1.25−1	1.58−1	1.90−1	2.20−1	2.50−1	2.78−1	3.04−1
$5s_{1/2}$	σ	1.111+0	6.617−1	3.115−1	1.798−1	1.162−1	8.076−2	5.901−2	4.475−2	3.493−2	2.790−2
E_b =	β	1.980	1.983	1.987	1.990	1.992	1.992	1.991	1.989	1.986	1.982
6.7 eV	γ	4.34−2	−3.61−2	−1.03−1	−9.38−2	−4.02−2	3.97−2	1.36−1	2.41−1	3.51−1	4.64−1
	δ	−1.83−4	−2.20−4	−2.72−4	−3.03−4	−3.25−4	−3.40−4	−3.53−4	−3.63−4	−3.67−4	−3.74−4
$5p_{1/2}$	σ	8.142−1	4.715−1	2.047−1	1.083−1	6.435−2	4.131−2	2.804−2	1.986−2	1.455−2	1.095−2
E_b =	β	1.708	1.687	1.624	1.558	1.495	1.435	1.379	1.326	1.275	1.226
2.2 eV	γ	−2.06−2	3.70−2	2.29−1	4.36−1	6.29−1	8.03−1	9.58−1	1.10+0	1.22+0	1.33+0
	δ	−1.11−3	−1.32−4	3.73−3	1.00−2	1.81−2	2.75−2	3.77−2	4.84−2	5.93−2	7.02−2
$5p_{3/2}$	σ	1.555+0	8.797−1	3.701−1	1.916−1	1.119−1	7.082−2	4.750−2	3.329−2	2.415−2	1.803−2
E_b =	β	1.729	1.722	1.675	1.618	1.561	1.505	1.451	1.399	1.349	1.302
2.0 eV	γ	−2.37−2	4.21−2	2.48−1	4.68−1	6.72−1	8.56−1	1.02+0	1.17+0	1.29+0	1.41+0
	δ	1.65−3	3.44−3	7.49−3	1.30−2	1.97−2	2.76−2	3.63−2	4.55−2	5.49−2	6.46−2

Z= 52, Te: [Kr]$4d^4_{3/2}$ $4d^6_{5/2}$ $5s^2_{1/2}$ $5p^2_{1/2}$ $5p^2_{3/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$3s_{1/2}$	σ	4.562+1	2.969+1	1.514+1	9.043+0	5.957+0	4.189+0	3.087+0	2.356+0	1.849+0	1.483+0
E_b =	β	1.968	1.972	1.979	1.985	1.989	1.991	1.991	1.990	1.988	1.985
1006.0 eV	γ	4.65−1	2.09−1	−3.91−2	−1.13−1	−1.03−1	−4.72−2	3.40−2	1.30−1	2.34−1	3.43−1
	δ	−1.10−4	−2.21−4	−3.16−4	−3.62−4	−3.90−4	−4.09−4	−4.23−4	−4.33−4	−4.41−4	−4.46−4
$3p_{1/2}$	σ	6.567+1	4.105+1	1.885+1	1.015+1	6.072+0	3.911+0	2.660+0	1.886+0	1.383+0	1.042+0
E_b =	β	1.487	1.588	1.604	1.565	1.514	1.461	1.410	1.360	1.312	1.265
869.7 eV	γ	8.63−2	−2.17−2	9.64−2	3.07−1	5.14−1	7.04−1	8.72−1	1.02+0	1.16+0	1.27+0
	δ	8.96−3	1.75−3	4.12−3	9.88−3	1.73−2	2.59−2	3.56−2	4.58−2	5.64−2	6.71−2
$3p_{3/2}$	σ	1.358+2	8.167+1	3.590+1	1.882+1	1.104+1	6.999+0	4.697+0	3.293+0	2.390+0	1.784+0
E_b =	β	1.521	1.625	1.655	1.625	1.581	1.532	1.483	1.435	1.388	1.343
818.7 eV	γ	3.85−2	−3.36−2	1.14−1	3.41−1	5.61−1	7.61−1	9.40−1	1.10+0	1.24+0	1.36+0
	δ	7.07−3	4.48−3	8.74−3	1.40−2	2.01−2	2.72−2	3.52−2	4.37−2	5.27−2	6.19−2
$3d_{3/2}$	σ	1.567+2	6.820+1	1.956+1	7.646+0	3.583+0	1.892+0	1.089+0	6.688−1	4.321−1	2.910−1
E_b =	β	1.201	1.237	1.176	1.083	0.993	0.909	0.834	0.766	0.704	0.648
582.5 eV	γ	1.24−1	3.24−1	6.40−1	8.66−1	1.04+0	1.17+0	1.27+0	1.35+0	1.41+0	1.46+0
	δ	4.73−2	6.44−2	9.29−2	1.21−1	1.51−1	1.80−1	2.08−1	2.35−1	2.61−1	2.87−1
$3d_{5/2}$	σ	2.253+2	9.747+1	2.771+1	1.077+1	5.016+0	2.636+0	1.510+0	9.232−1	5.941−1	3.984−1
E_b =	β	1.205	1.222	1.145	1.048	0.958	0.878	0.807	0.743	0.687	0.637
572.1 eV	γ	1.39−1	3.39−1	6.46−1	8.63−1	1.03+0	1.15+0	1.25+0	1.33+0	1.39+0	1.45+0
	δ	4.67−2	6.47−2	9.57−2	1.26−1	1.58−1	1.88−1	2.18−1	2.46−1	2.72−1	2.98−1
$4s_{1/2}$	σ	1.128+1	6.800+0	3.245+0	1.886+0	1.225+0	8.539−1	6.257−1	4.756−1	3.719−1	2.976−1
E_b =	β	1.978	1.980	1.985	1.988	1.990	1.991	1.990	1.989	1.986	1.983
168.3 eV	γ	8.71−2	−8.51−3	−9.94−2	−1.05−1	−6.22−2	9.20−3	9.80−2	1.97−1	3.03−1	4.11−1
	δ	−1.92−4	−2.41−4	−3.02−4	−3.39−4	−3.64−4	−3.82−4	−3.97−4	−4.08−4	−4.16−4	−4.20−4
$4p_{1/2}$	σ	1.296+1	7.607+0	3.353+0	1.789+0	1.070+0	6.903−1	4.705−1	3.344−1	2.457−1	1.855−1
E_b =	β	1.693	1.682	1.628	1.567	1.506	1.449	1.395	1.344	1.295	1.249
116.8 eV	γ	−2.39−2	1.80−2	1.98−1	4.00−1	5.92−1	7.67−1	9.24−1	1.06+0	1.19+0	1.30+0
	δ	−1.01−3	−2.16−4	3.23−3	8.92−3	1.64−2	2.52−2	3.48−2	4.52−2	5.59−2	6.68−2
$4p_{3/2}$	σ	2.570+1	1.472+1	6.281+0	3.277+0	1.925+0	1.224+0	8.243−1	5.796−1	4.218−1	3.156−1
E_b =	β	1.715	1.717	1.679	1.627	1.573	1.520	1.468	1.419	1.371	1.326
96.9 eV	γ	−2.92−2	2.34−2	2.19−1	4.34−1	6.37−1	8.22−1	9.88−1	1.14+0	1.27+0	1.38+0
	δ	1.69−3	3.50−3	7.42−3	1.24−2	1.86−2	2.59−2	3.40−2	4.27−2	5.19−2	6.13−2
$4d_{3/2}$	σ	1.767+1	8.155+0	2.514+0	1.027+0	4.955−1	2.670−1	1.559−1	9.682−2	6.309−2	4.277−2
E_b =	β	1.342	1.293	1.174	1.065	0.970	0.886	0.811	0.745	0.684	0.629
40.8 eV	γ	2.54−1	4.21−1	6.87−1	8.87−1	1.04+0	1.17+0	1.26+0	1.34+0	1.40+0	1.45+0
	δ	4.18−2	5.65−2	8.58−2	1.16−1	1.47−1	1.77−1	2.06−1	2.33−1	2.60−1	2.86−1

(*continued on next page*)

Table 1 (*continued*)

$4d_{5/2}$	σ	2.539+1	1.165+1	3.557+0	1.443+0	6.915−1	3.706−1	2.154−1	1.331−1	8.635−2	5.829−2
E_b =	β	1.323	1.263	1.135	1.026	0.934	0.854	0.784	0.723	0.668	0.619
39.2 eV	γ	2.65−1	4.30−1	6.87−1	8.80−1	1.03+0	1.15+0	1.25+0	1.32+0	1.39+0	1.44+0
	δ	4.18−2	5.77−2	8.94−2	1.22−1	1.54−1	1.86−1	2.16−1	2.44−1	2.71−1	2.97−1
$5s_{1/2}$	σ	1.308+0	7.804−1	3.678−1	2.124−1	1.375−1	9.562−2	6.995−2	5.311−2	4.150−2	3.318−2
E_b =	β	1.979	1.981	1.986	1.989	1.990	1.991	1.990	1.988	1.986	1.982
11.6 eV	γ	5.56−2	−2.72−2	−1.03−1	−1.01−1	−5.48−2	1.91−2	1.10−1	2.10−1	3.16−1	4.25−1
	δ	−1.97−4	−2.41−4	−2.99−4	−3.34−4	−3.60−4	−3.77−4	−3.92−4	−4.03−4	−4.10−4	−4.18−4
$5p_{1/2}$	σ	1.033+0	6.012−1	2.629−1	1.398−1	8.346−2	5.380−2	3.665−2	2.604−2	1.913−2	1.443−2
E_b =	β	1.710	1.692	1.632	1.568	1.506	1.447	1.391	1.339	1.289	1.242
2.6 eV	γ	−2.33−2	2.61−2	2.10−1	4.13−1	6.05−1	7.79−1	9.34−1	1.07+0	1.20+0	1.30+0
	δ	−1.30−3	−4.71−4	3.04−3	8.95−3	1.66−2	2.54−2	3.49−2	4.49−2	5.53−2	6.58−2
$5p_{3/2}$	σ	1.973+0	1.121+0	4.744−1	2.466−1	1.446−1	9.188−2	6.182−2	4.344−2	3.160−2	2.364−2
E_b =	β	1.731	1.726	1.684	1.630	1.573	1.518	1.465	1.414	1.365	1.319
2.0 eV	γ	−2.77−2	3.01−2	2.28−1	4.45−1	6.49−1	8.33−1	9.97−1	1.14+0	1.27+0	1.39+0
	δ	1.48−3	3.24−3	7.13−3	1.23−2	1.87−2	2.60−2	3.39−2	4.24−2	5.12−2	6.05−2

Z= 53, I : [Kr]$4d^4_{3/2}$ $4d^6_{5/2}$ $5s^2_{1/2}$ $5p^2_{1/2}$ $5p^3_{3/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$3s_{1/2}$	σ	4.677+1	3.070+1	1.577+1	9.455+0	6.243+0	4.399+0	3.248+0	2.483+0	1.951+0	1.567+0
E_b =	β	1.965	1.969	1.977	1.983	1.987	1.990	1.990	1.990	1.988	1.985
1072.1 eV	γ	5.31−1	2.53−1	−1.90−2	−1.10−1	−1.12−1	−6.55−2	8.04−3	9.80−2	1.98−1	3.03−1
	δ	−9.31−5	−2.31−4	−3.41−4	−3.95−4	−4.27−4	−4.49−4	−4.65−4	−4.78−4	−4.86−4	−4.93−4
$3p_{1/2}$	σ	6.771+1	4.287+1	1.995+1	1.082+1	6.512+0	4.213+0	2.876+0	2.046+0	1.504+0	1.136+0
E_b =	β	1.457	1.578	1.606	1.572	1.525	1.474	1.424	1.375	1.327	1.281
930.5 eV	γ	1.29−1	−1.59−2	7.25−2	2.75−1	4.80−1	6.70−1	8.41−1	9.94−1	1.13+0	1.25+0
	δ	1.30−2	2.19−3	3.49−3	8.79−3	1.58−2	2.41−2	3.34−2	4.34−2	5.36−2	6.40−2
$3p_{3/2}$	σ	1.414+2	8.581+1	3.811+1	2.010+1	1.185+1	7.539+0	5.076+0	3.568+0	2.596+0	1.942+0
E_b =	β	1.489	1.614	1.657	1.634	1.593	1.547	1.500	1.453	1.407	1.362
874.6 eV	γ	6.95−2	−3.39−2	8.84−2	3.08−1	5.27−1	7.28−1	9.10−1	1.07+0	1.21+0	1.34+0
	δ	9.50−3	4.57−3	8.37−3	1.34−2	1.91−2	2.59−2	3.36−2	4.18−2	5.04−2	5.92−2
$3d_{3/2}$	σ	1.732+2	7.579+1	2.190+1	8.616+0	4.057+0	2.151+0	1.242+0	7.650−1	4.955−1	3.343−1
E_b =	β	1.184	1.236	1.188	1.100	1.012	0.929	0.853	0.784	0.722	0.665
631.3 eV	γ	9.02−2	2.93−1	6.17−1	8.50−1	1.03+0	1.16+0	1.27+0	1.35+0	1.42+0	1.47+0
	δ	4.48−2	6.25−2	9.07−2	1.18−1	1.47−1	1.75−1	2.03−1	2.29−1	2.55−1	2.79−1
$3d_{5/2}$	σ	2.488+2	1.082+2	3.100+1	1.211+1	5.671+0	2.992+0	1.719+0	1.054+0	6.799−1	4.569−1
E_b =	β	1.193	1.224	1.157	1.063	0.975	0.895	0.823	0.759	0.702	0.651
619.4 eV	γ	1.07−1	3.09−1	6.24−1	8.49−1	1.02+0	1.15+0	1.25+0	1.33+0	1.40+0	1.45+0
	δ	4.41−2	6.25−2	9.32−2	1.23−1	1.54−1	1.84−1	2.13−1	2.40−1	2.66−1	2.91−1
$4s_{1/2}$	σ	1.204+1	7.280+0	3.480+0	2.025+0	1.317+0	9.193−1	6.745−1	5.134−1	4.020−1	3.220−1
E_b =	β	1.976	1.978	1.983	1.987	1.989	1.990	1.990	1.989	1.986	1.983
186.4 eV	γ	1.04−1	4.53−3	−9.58−2	−1.10−1	−7.49−2	−1.03−2	7.26−2	1.67−1	2.69−1	3.74−1
	δ	−2.06−4	−2.60−4	−3.30−4	−3.71−4	−3.98−4	−4.19−4	−4.36−4	−4.49−4	−4.58−4	−4.64−4
$4p_{1/2}$	σ	1.395+1	8.235+0	3.658+0	1.963+0	1.179+0	7.640−1	5.226−1	3.726−1	2.746−1	2.078−1
E_b =	β	1.693	1.686	1.636	1.577	1.519	1.463	1.410	1.359	1.310	1.264
130.1 eV	γ	−2.37−2	7.84−3	1.77−1	3.75−1	5.65−1	7.40−1	8.98−1	1.04+0	1.17+0	1.28+0
	δ	−1.13−3	−5.01−4	2.56−3	7.82−3	1.50−2	2.35−2	3.28−2	4.28−2	5.31−2	6.36−2
$4p_{3/2}$	σ	2.800+1	1.610+1	6.905+0	3.617+0	2.133+0	1.361+0	9.188−1	6.477−1	4.724−1	3.542−1
E_b =	β	1.713	1.720	1.688	1.639	1.587	1.536	1.485	1.436	1.390	1.344
119.0 eV	γ	−3.17−2	1.04−2	1.96−1	4.07−1	6.10−1	7.96−1	9.64−1	1.11+0	1.25+0	1.37+0
	δ	1.53−3	3.30−3	7.02−3	1.16−2	1.76−2	2.46−2	3.23−2	4.07−2	4.94−2	5.84−2
$4d_{3/2}$	σ	2.032+1	9.458+0	2.947+0	1.214+0	5.894−1	3.193−1	1.873−1	1.167−1	7.629−2	5.185−2
E_b =	β	1.349	1.305	1.190	1.084	0.989	0.905	0.829	0.762	0.701	0.645
50.7 eV	γ	2.34−1	4.03−1	6.72−1	8.77−1	1.04+0	1.16+0	1.26+0	1.34+0	1.41+0	1.46+0
	δ	4.00−2	5.46−2	8.30−2	1.13−1	1.43−1	1.72−1	2.00−1	2.27−1	2.53−1	2.78−1
$4d_{5/2}$	σ	2.919+1	1.350+1	4.164+0	1.702+0	8.212−1	4.424−1	2.582−1	1.601−1	1.042−1	7.053−2
E_b =	β	1.331	1.275	1.151	1.043	0.950	0.870	0.799	0.737	0.681	0.632
48.9 eV	γ	2.46−1	4.12−1	6.74−1	8.71−1	1.02+0	1.15+0	1.25+0	1.33+0	1.39+0	1.44+0
	δ	4.00−2	5.56−2	8.65−2	1.19−1	1.51−1	1.81−1	2.10−1	2.38−1	2.65−1	2.90−1
$5s_{1/2}$	σ	1.508+0	9.015−1	4.255−1	2.460−1	1.593−1	1.110−1	8.126−2	6.176−2	4.831−2	3.867−2
E_b =	β	1.977	1.980	1.984	1.987	1.989	1.990	1.990	1.988	1.986	1.983
13.6 eV	γ	6.73−2	−1.77−2	−1.01−1	−1.07−1	−6.75−2	8.08−6	8.48−2	1.80−1	2.81−1	3.87−1
	δ	−2.12−4	−2.60−4	−3.27−4	−3.67−4	−3.95−4	−4.16−4	−4.33−4	−4.45−4	−4.53−4	−4.63−4
$5p_{1/2}$	σ	1.260+0	7.377−1	3.248−1	1.736−1	1.041−1	6.737−2	4.606−2	3.283−2	2.418−2	1.829−2
E_b =	β	1.712	1.697	1.640	1.578	1.517	1.459	1.405	1.354	1.306	1.260
3.8 eV	γ	−2.47−2	1.60−2	1.90−1	3.90−1	5.79−1	7.52−1	9.07−1	1.05+0	1.17+0	1.28+0
	δ	−1.48−3	−7.83−4	2.33−3	7.72−3	1.47−2	2.29−2	3.20−2	4.16−2	5.17−2	6.21−2
$5p_{3/2}$	σ	2.412+0	1.376+0	5.858−1	3.058−1	1.800−1	1.148−1	7.744−2	5.457−2	3.979−2	2.983−2
E_b =	β	1.732	1.731	1.692	1.640	1.586	1.532	1.481	1.432	1.384	1.339

(*continued on next page*)

Table 1 (*continued*)

2.9 eV	γ	−3.06−2	1.90−2	2.09−1	4.22−1	6.24−1	8.07−1	9.72−1	1.12+0	1.25+0	1.37+0
	δ	1.33−3	3.05−3	6.74−3	1.15−2	1.73−2	2.41−2	3.14−2	3.94−2	4.79−2	5.68−2
Z= 54, Xe: [Kr]$4d^4_{3/2}$ $4d^6_{5/2}$ $5s^2_{1/2}$ $5p^2_{1/2}$ $5p^4_{3/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$3s_{1/2}$	σ	4.787+1	3.175+1	1.643+1	9.886+0	6.542+0	4.619+0	3.415+0	2.615+0	2.057+0	1.654+0
E_b =	β	1.962	1.966	1.974	1.981	1.985	1.988	1.989	1.989	1.988	1.986
1148.4 eV	γ	6.13−1	3.07−1	5.43−3	−1.04−1	−1.19−1	−8.24−2	−1.66−2	6.73−2	1.62−1	2.64−1
	δ	−6.17−5	−2.35−4	−3.68−4	−4.32−4	−4.68−4	−4.92−4	−5.12−4	−5.26−4	−5.37−4	−5.46−4
$3p_{1/2}$	σ	6.968+1	4.473+1	2.110+1	1.153+1	6.976+0	4.533+0	3.106+0	2.216+0	1.634+0	1.237+0
E_b =	β	1.409	1.563	1.608	1.579	1.535	1.486	1.438	1.389	1.342	1.297
999.0 eV	γ	1.83−1	−3.72−3	4.97−2	2.43−1	4.45−1	6.35−1	8.09−1	9.64−1	1.10+0	1.22+0
	δ	1.97−2	3.01−3	2.93−3	7.77−3	1.43−2	2.23−2	3.13−2	4.08−2	5.06−2	6.05−2
$3p_{3/2}$	σ	1.470+2	9.012+1	4.044+1	2.145+1	1.270+1	8.111+0	5.478+0	3.861+0	2.815+0	2.110+0
E_b =	β	1.454	1.601	1.659	1.641	1.604	1.561	1.515	1.469	1.424	1.379
937.0 eV	γ	1.09−1	−2.96−2	6.34−2	2.75−1	4.92−1	6.95−1	8.79−1	1.04+0	1.19+0	1.32+0
	δ	1.31−2	4.85−3	8.01−3	1.28−2	1.82−2	2.46−2	3.19−2	3.98−2	4.78−2	5.61−2
$3d_{3/2}$	σ	1.927+2	8.467+1	2.461+1	9.722+0	4.596+0	2.446+0	1.416+0	8.741−1	5.674−1	3.835−1
E_b =	β	1.161	1.233	1.200	1.117	1.031	0.949	0.872	0.803	0.741	0.685
690.6 eV	γ	5.31−2	2.56−1	5.91−1	8.32−1	1.02+0	1.16+0	1.27+0	1.35+0	1.42+0	1.48+0
	δ	4.18−2	6.03−2	8.88−2	1.15−1	1.43−1	1.71−1	1.97−1	2.23−1	2.48−1	2.72−1
$3d_{5/2}$	σ	2.760+2	1.205+2	3.472+1	1.363+1	6.407+0	3.392+0	1.955+0	1.201+0	7.765−1	5.228−1
E_b =	β	1.176	1.224	1.169	1.079	0.993	0.913	0.840	0.775	0.718	0.667
674.7 eV	γ	7.12−2	2.75−1	6.02−1	8.33−1	1.01+0	1.14+0	1.25+0	1.33+0	1.40+0	1.46+0
	δ	4.11−2	6.01−2	9.11−2	1.20−1	1.50−1	1.80−1	2.08−1	2.34−1	2.60−1	2.85−1
$4s_{1/2}$	σ	1.291+1	7.811+0	3.738+0	2.176+0	1.416+0	9.893−1	7.266−1	5.535−1	4.339−1	3.479−1
E_b =	β	1.974	1.976	1.981	1.985	1.988	1.989	1.989	1.988	1.986	1.984
217.7 eV	γ	1.25−1	2.07−2	−9.06−2	−1.14−1	−8.70−2	−2.94−2	4.78−2	1.38−1	2.35−1	3.38−1
	δ	−2.18−4	−2.79−4	−3.59−4	−4.06−4	−4.36−4	−4.60−4	−4.79−4	−4.94−4	−5.07−4	−5.15−4
$4p_{1/2}$	σ	1.510+1	8.959+0	4.004+0	2.158+0	1.301+0	8.460−1	5.805−1	4.150−1	3.065−1	2.324−1
E_b =	β	1.692	1.689	1.644	1.587	1.531	1.476	1.424	1.373	1.325	1.279
163.9 eV	γ	−2.13−2	−2.99−3	1.54−1	3.48−1	5.36−1	7.12−1	8.72−1	1.02+0	1.14+0	1.26+0
	δ	−1.24−3	−7.89−4	1.88−3	6.70−3	1.34−2	2.16−2	3.06−2	4.01−2	4.99−2	5.99−2
$4p_{3/2}$	σ	3.064+1	1.768+1	7.608+0	3.996+0	2.363+0	1.512+0	1.023+0	7.228−1	5.282−1	3.967−1
E_b =	β	1.710	1.722	1.696	1.651	1.601	1.551	1.502	1.454	1.407	1.362
156.5 eV	γ	−3.22−2	−3.02−3	1.71−1	3.79−1	5.81−1	7.68−1	9.38−1	1.09+0	1.23+0	1.35+0
	δ	1.34−3	3.08−3	6.65−3	1.10−2	1.65−2	2.32−2	3.05−2	3.84−2	4.66−2	5.50−2
$4d_{3/2}$	σ	2.336+1	1.095+1	3.441+0	1.427+0	6.967−1	3.793−1	2.233−1	1.396−1	9.154−2	6.238−2
E_b =	β	1.355	1.317	1.207	1.102	1.009	0.924	0.848	0.779	0.719	0.664
69.5 eV	γ	2.11−1	3.82−1	6.57−1	8.65−1	1.03+0	1.16+0	1.26+0	1.35+0	1.41+0	1.47+0
	δ	3.82−2	5.27−2	8.03−2	1.09−1	1.39−1	1.67−1	1.94−1	2.20−1	2.46−1	2.71−1
$4d_{5/2}$	σ	3.354+1	1.561+1	4.857+0	1.998+0	9.693−1	5.246−1	3.073−1	1.912−1	1.248−1	8.467−2
E_b =	β	1.339	1.288	1.166	1.059	0.967	0.886	0.815	0.752	0.696	0.647
67.6 eV	γ	2.24−1	3.93−1	6.60−1	8.60−1	1.02+0	1.14+0	1.24+0	1.33+0	1.39+0	1.45+0
	δ	3.81−2	5.35−2	8.37−2	1.15−1	1.46−1	1.76−1	2.05−1	2.32−1	2.59−1	2.84−1
$5s_{1/2}$	σ	1.719+0	1.029+0	4.863−1	2.812−1	1.822−1	1.270−1	9.310−2	7.084−2	5.547−2	4.444−2
E_b =	β	1.975	1.978	1.982	1.986	1.988	1.989	1.989	1.988	1.986	1.983
23.4 eV	γ	8.12−2	−6.68−3	−9.81−2	−1.12−1	−7.94−2	−1.83−2	6.06−2	1.51−1	2.48−1	3.50−1
	δ	−2.26−4	−2.82−4	−3.56−4	−4.01−4	−4.33−4	−4.55−4	−4.74−4	−4.87−4	−4.99−4	−5.08−4
$5p_{1/2}$	σ	1.503+0	8.842−1	3.918−1	2.104−1	1.266−1	8.223−2	5.640−2	4.032−2	2.978−2	2.258−2
E_b =	β	1.714	1.702	1.649	1.588	1.529	1.473	1.420	1.371	1.324	1.279
13.4 eV	γ	−2.51−2	6.15−3	1.70−1	3.65−1	5.52−1	7.24−1	8.80−1	1.02+0	1.15+0	1.26+0
	δ	−1.65−3	−1.08−3	1.64−3	6.55−3	1.31−2	2.08−2	2.96−2	3.90−2	4.89−2	5.92−2
$5p_{3/2}$	σ	2.885+0	1.653+0	7.066−1	3.702−1	2.186−1	1.398−1	9.458−2	6.682−2	4.884−2	3.668−2
E_b =	β	1.733	1.735	1.701	1.651	1.599	1.548	1.498	1.450	1.405	1.361
12.1 eV	γ	−3.28−2	7.79−3	1.88−1	3.97−1	5.97−1	7.80−1	9.46−1	1.10+0	1.23+0	1.35+0
	δ	1.16−3	2.86−3	6.36−3	1.08−2	1.61−2	2.24−2	2.94−2	3.71−2	4.54−2	5.41−2
Z= 55, Cs: [Xe]$6s^1_{1/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$3s_{1/2}$	σ	4.865+1	3.263+1	1.702+1	1.029+1	6.830+0	4.833+0	3.580+0	2.744+0	2.161+0	1.740+0
E_b =	β	1.959	1.963	1.972	1.979	1.984	1.987	1.988	1.988	1.987	1.985
1217.1 eV	γ	6.87−1	3.55−1	3.00−2	−9.48−2	−1.23−1	−9.69−2	−3.85−2	3.96−2	1.30−1	2.27−1
	δ	−2.11−5	−2.38−4	−3.95−4	−4.65−4	−5.10−4	−5.41−4	−5.65−4	−5.83−4	−5.95−4	−6.06−4
$3p_{1/2}$	σ	7.121+1	4.636+1	2.217+1	1.222+1	7.439+0	4.855+0	3.338+0	2.389+0	1.765+0	1.340+0
E_b =	β	1.363	1.549	1.608	1.585	1.544	1.497	1.448	1.401	1.356	1.312
1065.0 eV	γ	2.35−1	1.33−2	3.07−2	2.12−1	4.13−1	6.05−1	7.77−1	9.32−1	1.07+0	1.19+0
	δ	2.77−2	4.14−3	2.47−3	6.92−3	1.33−2	2.08−2	2.89−2	3.76−2	4.67−2	5.62−2

(*continued on next page*)

Table 1 (*continued*)

$3p_{3/2}$	σ	1.519+2	9.404+1	4.265+1	2.278+1	1.355+1	8.688+0	5.884+0	4.157+0	3.038+0	2.281+0
E_b =	β	1.409	1.587	1.660	1.648	1.614	1.573	1.528	1.483	1.439	1.397
997.6 eV	γ	1.49−1	−2.10−2	4.14−2	2.43−1	4.61−1	6.65−1	8.48−1	1.01+0	1.16+0	1.29+0
	δ	1.81−2	5.31−3	7.70−3	1.24−2	1.78−2	2.37−2	3.01−2	3.71−2	4.44−2	5.22−2
$3d_{3/2}$	σ	2.094+2	9.267+1	2.720+1	1.082+1	5.142+0	2.748+0	1.597+0	9.890−1	6.438−1	4.362−1
E_b =	β	1.139	1.229	1.210	1.132	1.045	0.964	0.890	0.824	0.764	0.709
739.5 eV	γ	2.24−2	2.24−1	5.65−1	8.16−1	1.00+0	1.15+0	1.26+0	1.35+0	1.43+0	1.49+0
	δ	3.88−2	5.81−2	8.68−2	1.13−1	1.40−1	1.65−1	1.91−1	2.17−1	2.42−1	2.67−1
$3d_{5/2}$	σ	3.011+2	1.322+2	3.843+1	1.518+1	7.170+0	3.810+0	2.204+0	1.358+0	8.804−1	5.941−1
E_b =	β	1.158	1.222	1.180	1.093	1.005	0.925	0.855	0.793	0.737	0.687
725.5 eV	γ	3.95−2	2.44−1	5.78−1	8.18−1	9.96−1	1.13+0	1.24+0	1.33+0	1.41+0	1.47+0
	δ	3.80−2	5.77−2	8.89−2	1.18−1	1.47−1	1.74−1	2.02−1	2.29−1	2.55−1	2.80−1
$4s_{1/2}$	σ	1.364+1	8.282+0	3.977+0	2.321+0	1.513+0	1.058+0	7.783−1	5.937−1	4.658−1	3.738−1
E_b =	β	1.972	1.975	1.980	1.984	1.987	1.988	1.988	1.988	1.986	1.984
230.8 eV	γ	1.40−1	3.32−2	−8.39−2	−1.16−1	−9.70−2	−4.56−2	2.64−2	1.11−1	2.05−1	3.03−1
	δ	−2.33−4	−3.00−4	−3.86−4	−4.40−4	−4.78−4	−5.08−4	−5.30−4	−5.46−4	−5.62−4	−5.72−4
$4p_{1/2}$	σ	1.604+1	9.579+0	4.319+0	2.343+0	1.420+0	9.265−1	6.379−1	4.574−1	3.388−1	2.575−1
E_b =	β	1.690	1.691	1.650	1.596	1.540	1.486	1.434	1.385	1.339	1.294
172.3 eV	γ	−1.83−2	−8.97−3	1.35−1	3.25−1	5.13−1	6.87−1	8.45−1	9.88−1	1.12+0	1.23+0
	δ	−1.33−3	−9.84−4	1.40−3	6.02−3	1.23−2	1.97−2	2.79−2	3.67−2	4.60−2	5.56−2
$4p_{3/2}$	σ	3.269+1	1.896+1	8.223+0	4.343+0	2.579+0	1.656+0	1.124+0	7.962−1	5.832−1	4.390−1
E_b =	β	1.708	1.724	1.703	1.660	1.612	1.563	1.514	1.467	1.422	1.379
161.6 eV	γ	−3.13−2	−1.03−2	1.52−1	3.57−1	5.58−1	7.44−1	9.13−1	1.06+0	1.20+0	1.33+0
	δ	1.25−3	2.95−3	6.41−3	1.07−2	1.59−2	2.18−2	2.84−2	3.55−2	4.32−2	5.11−2
$4d_{3/2}$	σ	2.621+1	1.241+1	3.948+0	1.650+0	8.107−1	4.437−1	2.625−1	1.648−1	1.084−1	7.410−2
E_b =	β	1.359	1.326	1.223	1.117	1.022	0.939	0.866	0.801	0.741	0.687
78.8 eV	γ	1.92−1	3.62−1	6.43−1	8.55−1	1.02+0	1.15+0	1.26+0	1.35+0	1.42+0	1.48+0
	δ	3.66−2	5.08−2	7.86−2	1.06−1	1.34−1	1.61−1	1.88−1	2.15−1	2.40−1	2.66−1
$4d_{5/2}$	σ	3.765+1	1.769+1	5.571+0	2.310+0	1.127+0	6.133−1	3.609−1	2.255−1	1.477−1	1.005−1
E_b =	β	1.344	1.298	1.181	1.073	0.979	0.898	0.830	0.769	0.715	0.666
76.5 eV	γ	2.06−1	3.74−1	6.47−1	8.50−1	1.01+0	1.14+0	1.24+0	1.33+0	1.40+0	1.46+0
	δ	3.63−2	5.15−2	8.18−2	1.12−1	1.42−1	1.71−1	1.99−1	2.27−1	2.54−1	2.79−1
$5s_{1/2}$	σ	2.026+0	1.216+0	5.760−1	3.336−1	2.165−1	1.511−1	1.109−1	8.448−2	6.622−2	5.311−2
E_b =	β	1.974	1.976	1.981	1.985	1.987	1.988	1.988	1.988	1.986	1.983
22.7 eV	γ	9.14−2	2.53−3	−9.35−2	−1.14−1	−8.87−2	−3.41−2	3.95−2	1.25−1	2.19−1	3.18−1
	δ	−2.43−4	−3.04−4	−3.84−4	−4.33−4	−4.70−4	−4.96−4	−5.18−4	−5.34−4	−5.47−4	−5.59−4
$5p_{1/2}$	σ	1.888+0	1.116+0	4.982−1	2.690−1	1.627−1	1.061−1	7.302−2	5.235−2	3.877−2	2.947−2
E_b =	β	1.715	1.705	1.656	1.598	1.541	1.486	1.434	1.384	1.337	1.292
13.1 eV	γ	−2.42−2	−8.06−4	1.52−1	3.40−1	5.26−1	6.99−1	8.57−1	9.99−1	1.13+0	1.24+0
	δ	−1.79−3	−1.32−3	1.02−3	5.61−3	1.20−2	1.97−2	2.82−2	3.73−2	4.68−2	5.64−2
$5p_{3/2}$	σ	3.690+0	2.122+0	9.129−1	4.805−1	2.849−1	1.828−1	1.241−1	8.789−2	6.439−2	4.847−2
E_b =	β	1.733	1.738	1.708	1.662	1.613	1.563	1.515	1.467	1.422	1.378
11.4 eV	γ	−3.36−2	−3.88−4	1.69−1	3.72−1	5.70−1	7.56−1	9.24−1	1.08+0	1.21+0	1.33+0
	δ	1.04−3	2.72−3	5.98−3	1.01−2	1.54−2	2.16−2	2.86−2	3.60−2	4.39−2	5.20−2
$6s_{1/2}$	σ	1.083−1	6.478−2	3.059−2	1.769−2	1.146−2	7.993−3	5.862−3	4.463−3	3.497−3	2.804−3
E_b =	β	1.973	1.976	1.981	1.984	1.987	1.988	1.988	1.988	1.986	1.983
4.0 eV	γ	9.06−2	1.20−3	−9.43−2	−1.15−1	−8.94−2	−3.41−2	3.98−2	1.26−1	2.19−1	3.17−1
	δ	−2.44−4	−3.08−4	−3.85−4	−4.35−4	−4.73−4	−5.01−4	−5.19−4	−5.37−4	−5.48−4	−5.62−4

Z= 56, Ba: [Xe]$6s^2_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$3s_{1/2}$	σ	4.926+1	3.348+1	1.762+1	1.070+1	7.122+0	5.049+0	3.746+0	2.876+0	2.268+0	1.828+0
E_b =	β	1.956	1.960	1.969	1.976	1.981	1.985	1.987	1.988	1.987	1.986
1292.8 eV	γ	7.75−1	4.08−1	5.82−2	−8.46−2	−1.25−1	−1.09−1	−5.83−2	1.28−2	9.68−2	1.89−1
	δ	3.85−5	−2.35−4	−4.22−4	−5.08−4	−5.59−4	−5.92−4	−6.17−4	−6.37−4	−6.51−4	−6.64−4
$3p_{1/2}$	σ	7.254+1	4.800+1	2.327+1	1.293+1	7.915+0	5.188+0	3.580+0	2.571+0	1.905+0	1.449+0
E_b =	β	1.300	1.528	1.607	1.590	1.552	1.508	1.462	1.417	1.373	1.330
1136.7 eV	γ	2.93−1	3.72−2	1.40−2	1.82−1	3.78−1	5.67−1	7.40−1	8.97−1	1.04+0	1.17+0
	δ	4.03−2	5.90−3	2.09−3	5.93−3	1.17−2	1.87−2	2.66−2	3.52−2	4.44−2	5.40−2
$3p_{3/2}$	σ	1.566+2	9.808+1	4.493+1	2.415+1	1.443+1	9.284+0	6.307+0	4.468+0	3.273+0	2.463+0
E_b =	β	1.360	1.568	1.659	1.654	1.624	1.585	1.544	1.501	1.459	1.418
1062.2 eV	γ	1.94−1	−7.83−3	2.16−2	2.13−1	4.25−1	6.27−1	8.12−1	9.80−1	1.13+0	1.27+0
	δ	2.48−2	6.10−3	7.44−3	1.18−2	1.67−2	2.22−2	2.85−2	3.53−2	4.26−2	5.04−2
$3d_{3/2}$	σ	2.284+2	1.017+2	3.009+1	1.204+1	5.751+0	3.086+0	1.800+0	1.118+0	7.292−1	4.951−1
E_b =	β	1.111	1.221	1.218	1.146	1.065	0.987	0.914	0.847	0.785	0.728
796.1 eV	γ	−1.05−2	1.89−1	5.34−1	7.92−1	9.87−1	1.14+0	1.26+0	1.36+0	1.43+0	1.50+0
	δ	3.50−2	5.58−2	8.39−2	1.10−1	1.36−1	1.62−1	1.88−1	2.13−1	2.38−1	2.61−1
$3d_{5/2}$	σ	3.284+2	1.450+2	4.246+1	1.687+1	8.006+0	4.272+0	2.479+0	1.533+0	9.955−1	6.731−1

(*continued on next page*)

Table 1 (*continued*)

E_b =	β	1.135	1.218	1.189	1.107	1.023	0.946	0.876	0.812	0.755	0.703
780.7 eV	γ	6.39−3	2.10−1	5.50−1	7.97−1	9.82−1	1.13+0	1.24+0	1.33+0	1.41+0	1.47+0
	δ	3.42−2	5.52−2	8.56−2	1.14−1	1.43−1	1.71−1	1.99−1	2.25−1	2.51−1	2.75−1
$4s_{1/2}$	σ	1.443+1	8.789+0	4.234+0	2.474+0	1.614+0	1.131+0	8.323−1	6.356−1	4.992−1	4.011−1
E_b =	β	1.970	1.973	1.978	1.982	1.985	1.987	1.988	1.987	1.986	1.984
253.0 eV	γ	1.57−1	4.79−2	−7.77−2	−1.18−1	−1.05−1	−6.05−2	5.24−3	8.45−2	1.73−1	2.67−1
	δ	−2.46−4	−3.23−4	−4.22−4	−4.82−4	−5.23−4	−5.55−4	−5.78−4	−5.96−4	−6.13−4	−6.25−4
$4p_{1/2}$	σ	1.707+1	1.025+1	4.660+0	2.541+0	1.546+0	1.013+0	6.999−1	5.035−1	3.739−1	2.849−1
E_b =	β	1.689	1.693	1.656	1.605	1.551	1.499	1.449	1.402	1.357	1.313
191.8 eV	γ	−1.29−2	−1.45−2	1.17−1	3.00−1	4.84−1	6.56−1	8.15−1	9.60−1	1.09+0	1.21+0
	δ	−1.34−3	−1.18−3	8.08−4	4.88−3	1.06−2	1.77−2	2.58−2	3.46−2	4.38−2	5.35−2
$4p_{3/2}$	σ	3.500+1	2.039+1	8.900+0	4.721+0	2.813+0	1.811+0	1.233+0	8.760−1	6.432−1	4.852−1
E_b =	β	1.705	1.725	1.709	1.670	1.624	1.578	1.532	1.487	1.443	1.401
179.7 eV	γ	−2.85−2	−1.78−2	1.33−1	3.31−1	5.29−1	7.14−1	8.84−1	1.04+0	1.18+0	1.31+0
	δ	1.16−3	2.81−3	6.10−3	9.95−3	1.47−2	2.03−2	2.67−2	3.38−2	4.14−2	4.93−2
$4d_{3/2}$	σ	2.934+1	1.400+1	4.505+0	1.898+0	9.384−1	5.164−1	3.069−1	1.934−1	1.276−1	8.744−2
E_b =	β	1.362	1.335	1.237	1.136	1.044	0.963	0.889	0.822	0.761	0.706
92.5 eV	γ	1.72−1	3.39−1	6.23−1	8.40−1	1.01+0	1.15+0	1.26+0	1.35+0	1.43+0	1.49+0
	δ	3.48−2	4.85−2	7.51−2	1.02−1	1.30−1	1.57−1	1.84−1	2.10−1	2.35−1	2.59−1
$4d_{5/2}$	σ	4.216+1	1.997+1	6.357+0	2.655+0	1.304+0	7.132−1	4.216−1	2.643−1	1.736−1	1.184−1
E_b =	β	1.349	1.307	1.195	1.089	0.998	0.919	0.849	0.787	0.731	0.681
89.9 eV	γ	1.86−1	3.53−1	6.29−1	8.37−1	1.00+0	1.13+0	1.24+0	1.33+0	1.40+0	1.46+0
	δ	3.45−2	4.90−2	7.82−2	1.08−1	1.38−1	1.67−1	1.96−1	2.23−1	2.49−1	2.74−1
$5s_{1/2}$	σ	2.359+0	1.419+0	6.739−1	3.907−1	2.537−1	1.772−1	1.302−1	9.925−2	7.787−2	6.250−2
E_b =	β	1.972	1.974	1.979	1.983	1.985	1.987	1.987	1.987	1.985	1.983
29.1 eV	γ	1.03−1	1.29−2	−9.02−2	−1.18−1	−9.84−2	−4.94−2	1.89−2	9.97−2	1.89−1	2.83−1
	δ	−2.60−4	−3.30−4	−4.22−4	−4.76−4	−5.17−4	−5.46−4	−5.71−4	−5.88−4	−6.04−4	−6.18−4
$5p_{1/2}$	σ	2.283+0	1.358+0	6.104−1	3.312−1	2.011−1	1.316−1	9.085−2	6.533−2	4.850−2	3.696−2
E_b =	β	1.717	1.709	1.663	1.606	1.550	1.497	1.445	1.397	1.351	1.307
16.6 eV	γ	−2.22−2	−7.10−3	1.36−1	3.20−1	5.03−1	6.73−1	8.29−1	9.71−1	1.10+0	1.22+0
	δ	−1.90−3	−1.56−3	4.35−4	4.57−3	1.04−2	1.74−2	2.53−2	3.39−2	4.30−2	5.23−2
$5p_{3/2}$	σ	4.518+0	2.611+0	1.130+0	5.969−1	3.550−1	2.285−1	1.555−1	1.104−1	8.107−2	6.115−2
E_b =	β	1.733	1.741	1.715	1.671	1.623	1.575	1.528	1.481	1.437	1.395
14.6 eV	γ	−3.33−2	−8.10−3	1.52−1	3.51−1	5.47−1	7.30−1	8.97−1	1.05+0	1.19+0	1.31+0
	δ	9.14−4	2.59−3	5.73−3	9.56−3	1.43−2	2.00−2	2.62−2	3.31−2	4.05−2	4.81−2
$6s_{1/2}$	σ	1.865−1	1.118−1	5.288−2	3.058−2	1.983−2	1.384−2	1.016−2	7.744−3	6.074−3	4.875−3
E_b =	β	1.972	1.974	1.979	1.983	1.986	1.987	1.988	1.987	1.986	1.983
5.0 eV	γ	1.01−1	1.09−2	−9.13−2	−1.18−1	−9.76−2	−4.86−2	1.94−2	1.00−1	1.90−1	2.85−1
	δ	−2.62−4	−3.31−4	−4.22−4	−4.78−4	−5.15−4	−5.40−4	−5.60−4	−5.85−4	−6.02−4	−6.14−4

Z= 57, La: [Xe]$5d^1_{3/2}$ $6s^2_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$3s_{1/2}$	σ	4.952+1	3.424+1	1.819+1	1.109+1	7.407+0	5.262+0	3.911+0	3.008+0	2.376+0	1.917+0
E_b =	β	1.952	1.957	1.966	1.973	1.979	1.983	1.986	1.987	1.986	1.985
1361.3 eV	γ	8.71−1	4.63−1	8.75−2	−7.12−2	−1.24−1	−1.18−1	−7.56−2	−1.14−2	6.71−2	1.55−1
	δ	1.25−4	−2.31−4	−4.50−4	−5.47−4	−6.04−4	−6.44−4	−6.72−4	−6.95−4	−7.12−4	−7.28−4
$3p_{1/2}$	σ	7.350+1	4.948+1	2.435+1	1.364+1	8.396+0	5.529+0	3.830+0	2.758+0	2.050+0	1.563+0
E_b =	β	1.221	1.505	1.605	1.595	1.560	1.518	1.474	1.430	1.387	1.345
1204.4 eV	γ	3.40−1	6.67−2	7.07−4	1.54−1	3.44−1	5.32−1	7.06−1	8.66−1	1.01+0	1.14+0
	δ	5.69−2	8.26−3	1.83−3	5.15−3	1.05−2	1.72−2	2.49−2	3.34−2	4.23−2	5.14−2
$3p_{3/2}$	σ	1.609+2	1.019+2	4.720+1	2.553+1	1.533+1	9.897+0	6.745+0	4.791+0	3.517+0	2.652+0
E_b =	β	1.297	1.547	1.657	1.659	1.633	1.597	1.558	1.517	1.476	1.435
1123.4 eV	γ	2.38−1	9.98−3	4.46−3	1.83−1	3.91−1	5.93−1	7.79−1	9.50−1	1.10+0	1.24+0
	δ	3.45−2	7.21−3	7.24−3	1.14−2	1.61−2	2.14−2	2.74−2	3.41−2	4.11−2	4.84−2
$3d_{3/2}$	σ	2.475+2	1.110+2	3.311+1	1.334+1	6.401+0	3.448+0	2.018+0	1.257+0	8.221−1	5.593−1
E_b =	β	1.079	1.212	1.225	1.161	1.082	1.005	0.932	0.864	0.802	0.745
848.5 eV	γ	−4.03−2	1.53−1	5.05−1	7.71−1	9.72−1	1.13+0	1.25+0	1.35+0	1.43+0	1.50+0
	δ	3.12−2	5.32−2	8.18−2	1.07−1	1.33−1	1.59−1	1.84−1	2.08−1	2.32−1	2.54−1
$3d_{5/2}$	σ	3.558+2	1.581+2	4.668+1	1.866+1	8.897+0	4.767+0	2.775+0	1.720+0	1.120+0	7.589−1
E_b =	β	1.110	1.212	1.197	1.121	1.039	0.962	0.891	0.827	0.769	0.717
831.7 eV	γ	−2.39−2	1.76−1	5.23−1	7.78−1	9.69−1	1.12+0	1.24+0	1.33+0	1.41+0	1.48+0
	δ	3.06−2	5.25−2	8.33−2	1.12−1	1.40−1	1.68−1	1.94−1	2.20−1	2.45−1	2.69−1
$4s_{1/2}$	σ	1.521+1	9.289+0	4.490+0	2.628+0	1.717+0	1.204+0	8.875−1	6.785−1	5.335−1	4.291−1
E_b =	β	1.968	1.970	1.976	1.980	1.983	1.986	1.987	1.986	1.985	1.984
270.4 eV	γ	1.73−1	6.25−2	−6.96−2	−1.17−1	−1.12−1	−7.39−2	−1.41−2	6.02−2	1.44−1	2.35−1
	δ	−2.62−4	−3.47−4	−4.55−4	−5.22−4	−5.68−4	−6.03−4	−6.31−4	−6.50−4	−6.70−4	−6.85−4
$4p_{1/2}$	σ	1.807+1	1.092+1	5.005+0	2.744+0	1.678+0	1.103+0	7.649−1	5.519−1	4.109−1	3.139−1
E_b =	β	1.686	1.694	1.662	1.613	1.561	1.511	1.462	1.415	1.370	1.327
205.8 eV	γ	−6.60−3	−1.84−2	1.00−1	2.76−1	4.57−1	6.29−1	7.89−1	9.35−1	1.07+0	1.19+0

(*continued on next page*)

Table 1 (*continued*)

	δ	−1.35−3	−1.34−3	3.55−4	4.08−3	9.53−3	1.64−2	2.42−2	3.27−2	4.16−2	5.08−2
$4p_{3/2}$	σ	3.727+1	2.182+1	9.585+0	5.107+0	3.055+0	1.974+0	1.348+0	9.597−1	7.062−1	5.338−1
E_b =	β	1.702	1.725	1.714	1.679	1.636	1.591	1.546	1.502	1.459	1.417
191.4 eV	γ	−2.51−2	−2.36−2	1.15−1	3.07−1	5.02−1	6.87−1	8.59−1	1.02+0	1.16+0	1.29+0
	δ	1.09−3	2.70−3	5.90−3	9.54−3	1.40−2	1.95−2	2.57−2	3.25−2	3.97−2	4.71−2
$4d_{3/2}$	σ	3.256+1	1.569+1	5.107+0	2.168+0	1.079+0	5.966−1	3.561−1	2.252−1	1.491−1	1.024−1
E_b =	β	1.365	1.343	1.251	1.153	1.062	0.981	0.906	0.838	0.777	0.721
100.7 eV	γ	1.53−1	3.19−1	6.06−1	8.28−1	1.00+0	1.14+0	1.26+0	1.35+0	1.43+0	1.49+0
	δ	3.32−2	4.68−2	7.29−2	9.96−2	1.27−1	1.53−1	1.79−1	2.04−1	2.29−1	2.52−1
$4d_{5/2}$	σ	4.673+1	2.234+1	7.192+0	3.028+0	1.496+0	8.222−1	4.880−1	3.071−1	2.023−1	1.384−1
E_b =	β	1.353	1.315	1.208	1.104	1.014	0.934	0.864	0.801	0.744	0.693
97.7 eV	γ	1.68−1	3.34−1	6.14−1	8.26−1	9.92−1	1.13+0	1.24+0	1.33+0	1.40+0	1.47+0
	δ	3.27−2	4.71−2	7.58−2	1.05−1	1.35−1	1.63−1	1.91−1	2.17−1	2.43−1	2.67−1
$5s_{1/2}$	σ	2.653+0	1.599+0	7.613−1	4.419−1	2.872−1	2.008−1	1.476−1	1.127−1	8.847−2	7.108−2
E_b =	β	1.970	1.972	1.977	1.981	1.984	1.986	1.987	1.986	1.985	1.983
32.3 eV	γ	1.15−1	2.38−2	−8.46−2	−1.19−1	−1.06−1	−6.30−2	−4.11−4	7.53−2	1.60−1	2.50−1
	δ	−2.78−4	−3.55−4	−4.56−4	−5.16−4	−5.61−4	−5.94−4	−6.21−4	−6.40−4	−6.59−4	−6.74−4
$5p_{1/2}$	σ	2.599+0	1.554+0	7.036−1	3.837−1	2.339−1	1.536−1	1.064−1	7.674−2	5.713−2	4.363−2
E_b =	β	1.717	1.712	1.669	1.615	1.561	1.509	1.459	1.413	1.368	1.325
16.6 eV	γ	−1.94−2	−1.23−2	1.19−1	2.97−1	4.76−1	6.45−1	8.02−1	9.45−1	1.08+0	1.20+0
	δ	−2.01−3	−1.76−3	−5.84−5	3.65−3	9.07−3	1.58−2	2.34−2	3.18−2	4.08−2	4.99−2
$5p_{3/2}$	σ	5.251+0	3.047+0	1.326+0	7.037−1	4.200−1	2.711−1	1.850−1	1.317−1	9.692−2	7.326−2
E_b =	β	1.732	1.743	1.722	1.681	1.635	1.589	1.544	1.499	1.456	1.415
13.3 eV	γ	−3.24−2	−1.47−2	1.34−1	3.27−1	5.21−1	7.03−1	8.71−1	1.02+0	1.16+0	1.29+0
	δ	7.96−4	2.47−3	5.48−3	9.02−3	1.35−2	1.87−2	2.48−2	3.14−2	3.85−2	4.60−2
$5d_{3/2}$	σ	2.041+0	9.857−1	3.215−1	1.366−1	6.805−2	3.768−2	2.251−2	1.425−2	9.443−3	6.492−3
E_b =	β	1.385	1.354	1.253	1.150	1.057	0.975	0.902	0.836	0.777	0.722
6.0 eV	γ	1.67−1	3.34−1	6.19−1	8.36−1	1.01+0	1.14+0	1.26+0	1.35+0	1.43+0	1.49+0
	δ	3.21−2	4.56−2	7.19−2	9.84−2	1.25−1	1.51−1	1.77−1	2.03−1	2.28−1	2.52−1
$6s_{1/2}$	σ	2.261−1	1.358−1	6.434−2	3.725−2	2.418−2	1.689−2	1.241−2	9.466−3	7.431−3	5.968−3
E_b =	β	1.970	1.972	1.977	1.981	1.984	1.986	1.987	1.986	1.985	1.983
5.0 eV	γ	1.12−1	2.15−2	−8.58−2	−1.19−1	−1.05−1	−6.25−2	2.99−4	7.68−2	1.62−1	2.54−1
	δ	−2.80−4	−3.56−4	−4.55−4	−5.17−4	−5.59−4	−5.90−4	−6.14−4	−6.42−4	−6.62−4	−6.76−4
Z= 58, Ce: [Xe]$4f^2_{5/2}$ $6s^2_{1/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$3s_{1/2}$	σ	4.933+1	3.515+1	1.885+1	1.155+1	7.728+0	5.500+0	4.094+0	3.152+0	2.492+0	2.012+0
E_b =	β	1.947	1.953	1.962	1.970	1.976	1.981	1.984	1.985	1.985	1.985
1434.6 eV	γ	1.01+0	5.38−1	1.25−1	−5.46−2	−1.22−1	−1.27−1	−9.32−2	−3.54−2	3.76−2	1.20−1
	δ	3.81−4	−2.14−4	−4.79−4	−5.95−4	−6.62−4	−7.08−4	−7.40−4	−7.66−4	−7.85−4	−8.02−4
$3p_{1/2}$	σ	7.425+1	5.111+1	2.555+1	1.443+1	8.929+0	5.903+0	4.102+0	2.962+0	2.207+0	1.686+0
E_b =	β	1.105	1.477	1.601	1.598	1.567	1.527	1.485	1.442	1.400	1.360
1272.8 eV	γ	3.75−1	1.10−1	−1.06−2	1.26−1	3.12−1	4.98−1	6.71−1	8.30−1	9.75−1	1.11+0
	δ	8.54−2	1.20−2	1.62−3	4.36−3	9.36−3	1.56−2	2.27−2	3.05−2	3.89−2	4.77−2
$3p_{3/2}$	σ	1.658+2	1.065+2	4.983+1	2.711+1	1.634+1	1.058+1	7.228+0	5.145+0	3.784+0	2.859+0
E_b =	β	1.213	1.520	1.653	1.663	1.641	1.608	1.570	1.531	1.491	1.452
1185.4 eV	γ	2.91−1	3.79−2	−1.21−2	1.53−1	3.58−1	5.59−1	7.45−1	9.15−1	1.07+0	1.21+0
	δ	5.05−2	9.07−3	7.04−3	1.11−2	1.56−2	2.05−2	2.59−2	3.18−2	3.83−2	4.53−2
$3d_{3/2}$	σ	2.719+2	1.226+2	3.678+1	1.487+1	7.160+0	3.869+0	2.270+0	1.417+0	9.288−1	6.332−1
E_b =	β	1.036	1.198	1.231	1.172	1.097	1.022	0.951	0.886	0.825	0.769
901.3 eV	γ	−7.18−2	1.14−1	4.73−1	7.47−1	9.54−1	1.12+0	1.25+0	1.35+0	1.44+0	1.51+0
	δ	2.65−2	5.05−2	7.96−2	1.04−1	1.29−1	1.53−1	1.78−1	2.03−1	2.26−1	2.49−1
$3d_{5/2}$	σ	3.926+2	1.751+2	5.191+1	2.082+1	9.958+0	5.349+0	3.122+0	1.939+0	1.265+0	8.589−1
E_b =	β	1.075	1.203	1.204	1.132	1.052	0.977	0.908	0.846	0.789	0.737
883.3 eV	γ	−5.77−2	1.38−1	4.93−1	7.56−1	9.53−1	1.11+0	1.23+0	1.33+0	1.41+0	1.48+0
	δ	2.58−2	4.96−2	8.07−2	1.08−1	1.35−1	1.62−1	1.89−1	2.15−1	2.40−1	2.64−1
$4s_{1/2}$	σ	1.585+1	9.712+0	4.707+0	2.758+0	1.804+0	1.266+0	9.335−1	7.141−1	5.620−1	4.522−1
E_b =	β	1.965	1.968	1.973	1.978	1.981	1.984	1.985	1.985	1.985	1.983
289.6 eV	γ	1.96−1	8.17−2	−6.05−2	−1.17−1	−1.20−1	−8.81−2	−3.37−2	3.57−2	1.15−1	2.01−1
	δ	−2.79−4	−3.74−4	−4.96−4	−5.71−4	−6.24−4	−6.62−4	−6.93−4	−7.15−4	−7.37−4	−7.54−4
$4p_{1/2}$	σ	1.885+1	1.147+1	5.296+0	2.918+0	1.790+0	1.181+0	8.210−1	5.938−1	4.431−1	3.392−1
E_b =	β	1.682	1.695	1.667	1.621	1.571	1.521	1.474	1.428	1.385	1.343
223.3 eV	γ	3.66−3	−2.18−2	8.23−2	2.53−1	4.31−1	6.01−1	7.59−1	9.05−1	1.04+0	1.16+0
	δ	−1.38−3	−1.56−3	−1.63−4	3.22−3	8.23−3	1.45−2	2.17−2	2.97−2	3.82−2	4.71−2
$4p_{3/2}$	σ	3.915+1	2.303+1	1.017+1	5.437+0	3.261+0	2.112+0	1.445+0	1.031+0	7.601−1	5.755−1
E_b =	β	1.696	1.724	1.720	1.687	1.646	1.603	1.559	1.517	1.476	1.435
207.2 eV	γ	−1.87−2	−2.98−2	9.52−2	2.82−1	4.76−1	6.59−1	8.30−1	9.86−1	1.13+0	1.26+0
	δ	9.38−4	2.50−3	5.68−3	9.16−3	1.33−2	1.82−2	2.38−2	3.00−2	3.68−2	4.39−2

(*continued on next page*)

Table 1 (*continued*)

$4d_{3/2}$	σ	3.530+1	1.713+1	5.623+0	2.400+0	1.199+0	6.659−1	3.988−1	2.530−1	1.680−1	1.157−1
E_b =	β	1.365	1.350	1.264	1.168	1.078	0.999	0.927	0.861	0.800	0.745
113.6 eV	γ	1.30−1	2.95−1	5.87−1	8.12−1	9.90−1	1.13+0	1.25+0	1.35+0	1.43+0	1.50+0
	δ	3.15−2	4.49−2	7.04−2	9.59−2	1.22−1	1.48−1	1.74−1	1.99−1	2.23−1	2.47−1
$4d_{5/2}$	σ	5.060+1	2.436+1	7.905+0	3.345+0	1.660+0	9.158−1	5.454−1	3.443−1	2.274−1	1.559−1
E_b =	β	1.356	1.323	1.220	1.117	1.027	0.949	0.880	0.819	0.764	0.713
107.6 eV	γ	1.45−1	3.12−1	5.96−1	8.12−1	9.81−1	1.12+0	1.23+0	1.33+0	1.41+0	1.47+0
	δ	3.09−2	4.50−2	7.31−2	1.01−1	1.30−1	1.58−1	1.86−1	2.12−1	2.38−1	2.62−1
$4f_{5/2}$	σ	4.446+0	1.504+0	3.078−1	9.568−2	3.752−2	1.708−2	8.634−3	4.724−3	2.750−3	1.684−3
E_b =	β	1.013	0.925	0.780	0.678	0.600	0.534	0.476	0.423	0.375	0.330
0.1 eV	γ	5.22−1	6.44−1	8.04−1	9.15−1	1.00+0	1.07+0	1.13+0	1.17+0	1.20+0	1.23+0
	δ	1.20−1	1.50−1	2.08−1	2.62−1	3.13−1	3.59−1	4.01−1	4.40−1	4.76−1	5.09−1
$5s_{1/2}$	σ	2.611+0	1.578+0	7.536−1	4.379−1	2.848−1	1.993−1	1.466−1	1.120−1	8.800−2	7.075−2
E_b =	β	1.967	1.969	1.974	1.979	1.982	1.984	1.985	1.985	1.984	1.983
37.8 eV	γ	1.32−1	3.80−2	−7.82−2	−1.20−1	−1.15−1	−7.76−2	−2.01−2	5.13−2	1.32−1	2.19−1
	δ	−2.99−4	−3.84−4	−4.96−4	−5.63−4	−6.14−4	−6.52−4	−6.83−4	−7.04−4	−7.26−4	−7.42−4
$5p_{1/2}$	σ	2.558+0	1.538+0	7.020−1	3.847−1	2.354−1	1.551−1	1.077−1	7.786−2	5.809−2	4.446−2
E_b =	β	1.716	1.714	1.675	1.624	1.571	1.520	1.471	1.424	1.379	1.337
21.8 eV	γ	−1.43−2	−1.79−2	1.01−1	2.74−1	4.52−1	6.21−1	7.77−1	9.20−1	1.05+0	1.17+0
	δ	−2.17−3	−2.02−3	−5.48−4	2.90−3	8.02−3	1.43−2	2.15−2	2.93−2	3.77−2	4.64−2
$5p_{3/2}$	σ	5.008+0	2.919+0	1.278+0	6.803−1	4.072−1	2.635−1	1.802−1	1.286−1	9.478−2	7.176−2
E_b =	β	1.729	1.744	1.727	1.690	1.647	1.601	1.557	1.513	1.470	1.429
18.8 eV	γ	−3.00−2	−2.25−2	1.15−1	3.04−1	4.96−1	6.78−1	8.47−1	1.00+0	1.14+0	1.27+0
	δ	5.90−4	2.29−3	5.31−3	8.75−3	1.30−2	1.80−2	2.36−2	2.97−2	3.63−2	4.32−2
$6s_{1/2}$	σ	1.946−1	1.173−1	5.578−2	3.234−2	2.101−2	1.468−2	1.080−2	8.244−3	6.477−3	5.207−3
E_b =	β	1.967	1.969	1.975	1.979	1.982	1.984	1.985	1.985	1.985	1.983
6.0 eV	γ	1.28−1	3.50−2	−7.99−2	−1.21−1	−1.14−1	−7.64−2	−1.90−2	5.21−2	1.33−1	2.20−1
	δ	−3.02−4	−3.85−4	−4.96−4	−5.67−4	−6.14−4	−6.46−4	−6.71−4	−7.00−4	−7.22−4	−7.37−4

Z= 59, Pr: [Xe]$4f^3_{5/2}$ $6s^2_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$3p_{1/2}$	σ	7.420+1	5.243+1	2.663+1	1.517+1	9.441+0	6.269+0	4.371+0	3.167+0	2.365+0	1.811+0
E_b =	β	0.959	1.446	1.596	1.601	1.574	1.537	1.496	1.454	1.413	1.373
1337.4 eV	γ	3.48−1	1.55−1	−1.72−2	1.00−1	2.80−1	4.64−1	6.37−1	7.97−1	9.42−1	1.07+0
	δ	1.21−1	1.67−2	1.58−3	3.69−3	8.34−3	1.42−2	2.10−2	2.84−2	3.63−2	4.47−2
$3p_{3/2}$	σ	1.695+2	1.104+2	5.223+1	2.860+1	1.731+1	1.125+1	7.706+0	5.498+0	4.053+0	3.067+0
E_b =	β	1.121	1.492	1.649	1.666	1.649	1.618	1.582	1.545	1.506	1.468
1242.2 eV	γ	3.18−1	6.77−2	−2.43−2	1.25−1	3.25−1	5.25−1	7.12−1	8.83−1	1.04+0	1.18+0
	δ	6.93−2	1.14−2	6.91−3	1.08−2	1.51−2	1.98−2	2.49−2	3.04−2	3.65−2	4.29−2
$3d_{3/2}$	σ	2.939+2	1.336+2	4.040+1	1.642+1	7.941+0	4.305+0	2.533+0	1.586+0	1.042+0	7.117−1
E_b =	β	0.990	1.182	1.235	1.184	1.112	1.038	0.969	0.904	0.844	0.788
951.1 eV	γ	−9.71−2	7.83−2	4.40−1	7.22−1	9.36−1	1.10+0	1.24+0	1.35+0	1.44+0	1.51+0
	δ	2.17−2	4.77−2	7.76−2	1.02−1	1.26−1	1.49−1	1.73−1	1.97−1	2.21−1	2.44−1
$3d_{5/2}$	σ	4.254+2	1.910+2	5.700+1	2.298+1	1.104+1	5.947+0	3.481+0	2.168+0	1.418+0	9.643−1
E_b =	β	1.038	1.192	1.210	1.144	1.066	0.991	0.923	0.861	0.804	0.753
931.0 eV	γ	−8.49−2	1.02−1	4.63−1	7.34−1	9.37−1	1.09+0	1.22+0	1.33+0	1.41+0	1.48+0
	δ	2.11−2	4.65−2	7.85−2	1.06−1	1.32−1	1.58−1	1.84−1	2.10−1	2.35−1	2.59−1
$4s_{1/2}$	σ	1.651+1	1.015+1	4.936+0	2.898+0	1.897+0	1.333+0	9.841−1	7.535−1	5.935−1	4.780−1
E_b =	β	1.962	1.965	1.971	1.976	1.979	1.982	1.984	1.984	1.984	1.983
304.5 eV	γ	2.16−1	9.91−2	−5.02−2	−1.15−1	−1.25−1	−9.98−2	−5.11−2	1.33−2	8.84−2	1.71−1
	δ	−2.96−4	−4.01−4	−5.36−4	−6.19−4	−6.78−4	−7.22−4	−7.56−4	−7.82−4	−8.06−4	−8.26−4
$4p_{1/2}$	σ	1.967+1	1.205+1	5.611+0	3.108+0	1.915+0	1.267+0	8.836−1	6.408−1	4.793−1	3.677−1
E_b =	β	1.678	1.694	1.672	1.628	1.580	1.532	1.485	1.440	1.397	1.357
236.3 eV	γ	1.43−2	−2.28−2	6.64−2	2.30−1	4.05−1	5.74−1	7.32−1	8.77−1	1.01+0	1.13+0
	δ	−1.35−3	−1.72−3	−5.84−4	2.50−3	7.19−3	1.30−2	1.98−2	2.74−2	3.55−2	4.41−2
$4p_{3/2}$	σ	4.110+1	2.430+1	1.080+1	5.797+0	3.488+0	2.265+0	1.554+0	1.111+0	8.207−1	6.225−1
E_b =	β	1.690	1.723	1.724	1.695	1.656	1.615	1.573	1.531	1.491	1.452
217.6 eV	γ	−1.18−2	−3.35−2	7.79−2	2.59−1	4.50−1	6.33−1	8.03−1	9.60−1	1.10+0	1.24+0
	δ	8.50−4	2.35−3	5.51−3	8.86−3	1.28−2	1.74−2	2.26−2	2.84−2	3.47−2	4.15−2
$4d_{3/2}$	σ	3.817+1	1.870+1	6.206+0	2.668+0	1.340+0	7.476−1	4.495−1	2.862−1	1.905−1	1.316−1
E_b =	β	1.364	1.356	1.276	1.183	1.095	1.015	0.944	0.879	0.819	0.764
117.9 eV	γ	1.11−1	2.74−1	5.68−1	7.97−1	9.78−1	1.13+0	1.25+0	1.35+0	1.43+0	1.50+0
	δ	2.99−2	4.33−2	6.83−2	9.32−2	1.18−1	1.43−1	1.69−1	1.93−1	2.17−1	2.41−1
$4d_{5/2}$	σ	5.460+1	2.652+1	8.700+0	3.707+0	1.849+0	1.025+0	6.127−1	3.880−1	2.571−1	1.767−1
E_b =	β	1.357	1.330	1.231	1.130	1.041	0.963	0.895	0.834	0.778	0.728
110.1 eV	γ	1.27−1	2.92−1	5.79−1	7.99−1	9.71−1	1.11+0	1.23+0	1.32+0	1.41+0	1.48+0
	δ	2.92−2	4.32−2	7.08−2	9.86−2	1.26−1	1.54−1	1.81−1	2.07−1	2.33−1	2.57−1
$4f_{5/2}$	σ	5.602+0	1.908+0	3.933−1	1.229−1	4.845−2	2.217−2	1.126−2	6.187−3	3.615−3	2.220−3
E_b =	β	1.022	0.938	0.793	0.689	0.611	0.545	0.487	0.434	0.386	0.341

(*continued on next page*)

Table 1 (*continued*)

2.0 eV	γ	5.12−1	6.39−1	8.05−1	9.19−1	1.01+0	1.08+0	1.14+0	1.18+0	1.22+0	1.24+0
	δ	1.18−1	1.47−1	2.04−1	2.57−1	3.08−1	3.53−1	3.96−1	4.34−1	4.70−1	5.04−1
$5s_{1/2}$	σ	2.712+0	1.644+0	7.877−1	4.585−1	2.986−1	2.091−1	1.540−1	1.177−1	9.257−2	7.449−2
$E_b =$	β	1.965	1.967	1.972	1.977	1.980	1.983	1.984	1.984	1.984	1.982
37.4 eV	γ	1.46−1	5.07−2	−7.10−2	−1.20−1	−1.21−1	−8.97−2	−3.76−2	2.90−2	1.06−1	1.89−1
	δ	−3.21−4	−4.13−4	−5.36−4	−6.11−4	−6.67−4	−7.09−4	−7.44−4	−7.68−4	−7.93−4	−8.12−4
$5p_{1/2}$	σ	2.672+0	1.616+0	7.431−1	4.092−1	2.513−1	1.661−1	1.157−1	8.387−2	6.272−2	4.811−2
$E_b =$	β	1.715	1.715	1.681	1.632	1.581	1.531	1.483	1.437	1.393	1.351
24.6 eV	γ	−8.29−3	−2.15−2	8.50−2	2.51−1	4.26−1	5.94−1	7.50−1	8.94−1	1.03+0	1.15+0
	δ	−2.30−3	−2.23−3	−9.90−4	2.15−3	6.92−3	1.30−2	1.98−2	2.74−2	3.54−2	4.37−2
$5p_{3/2}$	σ	5.206+0	3.048+0	1.342+0	7.171−1	4.305−1	2.793−1	1.915−1	1.369−1	1.011−1	7.670−2
$E_b =$	β	1.725	1.744	1.733	1.699	1.658	1.614	1.571	1.528	1.486	1.446
21.2 eV	γ	−2.67−2	−2.81−2	9.74−2	2.80−1	4.70−1	6.52−1	8.21−1	9.76−1	1.12+0	1.25+0
	δ	4.18−4	2.13−3	5.13−3	8.41−3	1.24−2	1.71−2	2.24−2	2.83−2	3.45−2	4.11−2
$6s_{1/2}$	σ	1.972−1	1.192−1	5.686−2	3.302−2	2.147−2	1.502−2	1.105−2	8.444−3	6.640−3	5.342−3
$E_b =$	β	1.965	1.967	1.972	1.977	1.980	1.983	1.984	1.984	1.984	1.982
6.0 eV	γ	1.43−1	4.78−2	−7.26−2	−1.21−1	−1.20−1	−8.88−2	−3.65−2	2.98−2	1.06−1	1.89−1
	δ	−3.23−4	−4.14−4	−5.36−4	−6.15−4	−6.69−4	−7.05−4	−7.33−4	−7.64−4	−7.89−4	−8.06−4

Z= 60, Nd: [Xe]$4f^4_{5/2}$ $6s^2_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$3p_{1/2}$	σ	7.314+1	5.361+1	2.769+1	1.591+1	9.960+0	6.643+0	4.649+0	3.377+0	2.529+0	1.941+0
$E_b =$	β	0.738	1.408	1.589	1.603	1.580	1.545	1.506	1.466	1.425	1.386
1402.8 eV	γ	2.03−1	2.05−1	−1.97−2	7.68−2	2.48−1	4.29−1	6.03−1	7.63−1	9.09−1	1.04+0
	δ	1.69−1	2.29−2	1.69−3	3.08−3	7.35−3	1.29−2	1.94−2	2.65−2	3.41−2	4.21−2
$3p_{3/2}$	σ	1.723+2	1.141+2	5.460+1	3.009+1	1.829+1	1.193+1	8.195+0	5.862+0	4.329+0	3.282+0
$E_b =$	β	1.004	1.462	1.642	1.669	1.656	1.628	1.594	1.558	1.521	1.484
1297.4 eV	γ	3.17−1	1.01−1	−3.34−2	9.93−2	2.92−1	4.90−1	6.78−1	8.50−1	1.01+0	1.15+0
	δ	9.46−2	1.45−2	6.83−3	1.05−2	1.47−2	1.92−2	2.41−2	2.93−2	3.49−2	4.10−2
$3d_{3/2}$	σ	3.158+2	1.450+2	4.420+1	1.807+1	8.774+0	4.774+0	2.818+0	1.768+0	1.164+0	7.971−1
$E_b =$	β	0.938	1.164	1.237	1.194	1.126	1.055	0.986	0.922	0.862	0.807
999.9 eV	γ	−1.18−1	4.32−2	4.07−1	6.96−1	9.17−1	1.09+0	1.23+0	1.34+0	1.44+0	1.51+0
	δ	1.65−2	4.46−2	7.57−2	1.00−1	1.23−1	1.46−1	1.69−1	1.92−1	2.15−1	2.37−1
$3d_{5/2}$	σ	4.587+2	2.074+2	6.236+1	2.527+1	1.219+1	6.590+0	3.868+0	2.415+0	1.583+0	1.079+0
$E_b =$	β	0.996	1.179	1.214	1.154	1.079	1.005	0.937	0.876	0.819	0.768
977.7 eV	γ	−1.08−1	6.74−2	4.33−1	7.11−1	9.20−1	1.08+0	1.21+0	1.32+0	1.41+0	1.48+0
	δ	1.61−2	4.34−2	7.62−2	1.03−1	1.29−1	1.55−1	1.80−1	2.05−1	2.30−1	2.53−1
$4s_{1/2}$	σ	1.711+1	1.056+1	5.159+0	3.036+0	1.990+0	1.400+0	1.035+0	7.929−1	6.250−1	5.039−1
$E_b =$	β	1.959	1.962	1.968	1.973	1.977	1.980	1.982	1.983	1.983	1.982
315.2 eV	γ	2.34−1	1.16−1	−3.93−2	−1.11−1	−1.29−1	−1.10−1	−6.70−2	−7.59−3	6.31−2	1.41−1
	δ	−3.14−4	−4.29−4	−5.77−4	−6.70−4	−7.36−4	−7.85−4	−8.24−4	−8.53−4	−8.80−4	−9.02−4
$4p_{1/2}$	σ	2.041+1	1.259+1	5.914+0	3.295+0	2.039+0	1.354+0	9.471−1	6.886−1	5.164−1	3.970−1
$E_b =$	β	1.674	1.694	1.676	1.635	1.589	1.542	1.496	1.452	1.410	1.370
243.3 eV	γ	2.54−2	−2.22−2	5.23−2	2.08−1	3.80−1	5.47−1	7.04−1	8.50−1	9.84−1	1.11+0
	δ	−1.30−3	−1.86−3	−9.61−4	1.83−3	6.20−3	1.18−2	1.82−2	2.53−2	3.31−2	4.12−2
$4p_{3/2}$	σ	4.296+1	2.553+1	1.142+1	6.157+0	3.717+0	2.420+0	1.664+0	1.193+0	8.828−1	6.708−1
$E_b =$	β	1.684	1.721	1.728	1.702	1.666	1.627	1.586	1.545	1.506	1.467
224.6 eV	γ	−4.03−3	−3.57−2	6.18−2	2.36−1	4.24−1	6.06−1	7.76−1	9.33−1	1.08+0	1.21+0
	δ	7.79−4	2.21−3	5.36−3	8.59−3	1.24−2	1.67−2	2.16−2	2.70−2	3.29−2	3.92−2
$4d_{3/2}$	σ	4.114+1	2.034+1	6.824+0	2.954+0	1.492+0	8.357−1	5.044−1	3.222−1	2.151−1	1.490−1
$E_b =$	β	1.363	1.361	1.288	1.198	1.111	1.033	0.961	0.897	0.837	0.783
123.4 eV	γ	9.28−2	2.53−1	5.48−1	7.82−1	9.66−1	1.12+0	1.24+0	1.35+0	1.43+0	1.51+0
	δ	2.84−2	4.18−2	6.63−2	9.06−2	1.15−1	1.39−1	1.64−1	1.88−1	2.12−1	2.35−1
$4d_{5/2}$	σ	5.870+1	2.877+1	9.536+0	4.091+0	2.051+0	1.141+0	6.849−1	4.352−1	2.891−1	1.993−1
$E_b =$	β	1.358	1.336	1.243	1.144	1.055	0.977	0.909	0.848	0.793	0.743
113.5 eV	γ	1.09−1	2.72−1	5.61−1	7.85−1	9.60−1	1.10+0	1.22+0	1.32+0	1.41+0	1.48+0
	δ	2.76−2	4.15−2	6.86−2	9.59−2	1.23−1	1.50−1	1.76−1	2.02−1	2.27−1	2.51−1
$4f_{5/2}$	σ	6.861+0	2.356+0	4.895−1	1.538−1	6.095−2	2.803−2	1.430−2	7.891−3	4.628−3	2.851−3
$E_b =$	β	1.030	0.949	0.805	0.701	0.621	0.556	0.498	0.446	0.397	0.352
1.5 eV	γ	5.00−1	6.32−1	8.06−1	9.22−1	1.01+0	1.09+0	1.14+0	1.19+0	1.23+0	1.25+0
	δ	1.16−1	1.44−1	2.00−1	2.53−1	3.02−1	3.48−1	3.90−1	4.29−1	4.65−1	4.98−1
$5s_{1/2}$	σ	2.806+0	1.706+0	8.203−1	4.784−1	3.119−1	2.186−1	1.611−1	1.232−1	9.702−2	7.813−2
$E_b =$	β	1.962	1.964	1.970	1.975	1.978	1.981	1.982	1.983	1.983	1.982
37.5 eV	γ	1.60−1	6.40−2	−6.28−2	−1.18−1	−1.25−1	−1.01−1	−5.40−2	7.75−3	8.01−2	1.60−1
	δ	−3.44−4	−4.44−4	−5.79−4	−6.60−4	−7.24−4	−7.71−4	−8.10−4	−8.37−4	−8.65−4	−8.86−4
$5p_{1/2}$	σ	2.771+0	1.686+0	7.816−1	4.326−1	2.668−1	1.769−1	1.236−1	8.982−2	6.733−2	5.175−2
$E_b =$	β	1.713	1.717	1.686	1.639	1.590	1.542	1.495	1.450	1.406	1.365
23.6 eV	γ	−1.45−3	−2.35−2	7.01−2	2.29−1	4.01−1	5.67−1	7.23−1	8.67−1	1.00+0	1.12+0

(*continued on next page*)

Table 1 (*continued*)

	δ	−2.43−3	−2.42−3	−1.39−3	1.43−3	5.90−3	1.16−2	1.82−2	2.54−2	3.31−2	4.11−2
$5p_{3/2}$	σ	5.376+0	3.162+0	1.401+0	7.516−1	4.527−1	2.944−1	2.024−1	1.450−1	1.073−1	8.153−2
E_b =	β	1.722	1.744	1.737	1.707	1.668	1.627	1.585	1.543	1.502	1.463
19.8 eV	γ	−2.25−2	−3.23−2	8.10−2	2.57−1	4.44−1	6.25−1	7.94−1	9.50−1	1.09+0	1.22+0
	δ	2.59−4	1.98−3	4.97−3	8.11−3	1.19−2	1.64−2	2.15−2	2.70−2	3.29−2	3.91−2
$6s_{1/2}$	σ	1.993−1	1.208−1	5.783−2	3.365−2	2.190−2	1.533−2	1.129−2	8.634−3	6.795−3	5.471−3
E_b =	β	1.962	1.965	1.970	1.975	1.978	1.981	1.983	1.983	1.983	1.982
5.0 eV	γ	1.57−1	6.09−2	−6.45−2	−1.19−1	−1.26−1	−1.00−1	−5.29−2	8.72−3	8.05−2	1.60−1
	δ	−3.46−4	−4.45−4	−5.78−4	−6.67−4	−7.27−4	−7.69−4	−8.00−4	−8.34−4	−8.61−4	−8.80−4

Z= 61, Pm: [Xe]$4f^5_{5/2}$ $6s^2_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$3p_{1/2}$	σ	6.997+1	5.468+1	2.874+1	1.666+1	1.049+1	7.027+0	4.935+0	3.596+0	2.700+0	2.077+0
E_b =	β	0.267	1.359	1.581	1.603	1.585	1.553	1.516	1.477	1.438	1.399
1471.4 eV	γ	−2.38−1	2.61−1	−1.79−2	5.49−2	2.16−1	3.94−1	5.67−1	7.28−1	8.76−1	1.01+0
	δ	1.65−1	3.19−2	1.99−3	2.53−3	6.41−3	1.17−2	1.79−2	2.47−2	3.19−2	3.96−2
$3p_{3/2}$	σ	1.738+2	1.178+2	5.704+1	3.163+1	1.931+1	1.264+1	8.706+0	6.242+0	4.619+0	3.509+0
E_b =	β	0.832	1.426	1.635	1.670	1.662	1.637	1.606	1.571	1.535	1.499
1356.9 eV	γ	2.57−1	1.41−1	−3.95−2	7.42−2	2.59−1	4.55−1	6.43−1	8.17−1	9.76−1	1.12+0
	δ	1.31−1	1.88−2	6.81−3	1.03−2	1.43−2	1.87−2	2.33−2	2.83−2	3.36−2	3.92−2
$3d_{3/2}$	σ	3.385+2	1.571+2	4.829+1	1.985+1	9.677+0	5.283+0	3.127+0	1.967+0	1.298+0	8.905−1
E_b =	β	0.882	1.142	1.238	1.204	1.140	1.071	1.003	0.939	0.880	0.825
1051.5 eV	γ	−1.35−1	8.39−3	3.73−1	6.69−1	8.96−1	1.07+0	1.22+0	1.33+0	1.43+0	1.51+0
	δ	1.06−2	4.13−2	7.37−2	9.81−2	1.21−1	1.43−1	1.65−1	1.87−1	2.09−1	2.32−1
$3d_{5/2}$	σ	4.941+2	2.251+2	6.815+1	2.775+1	1.343+1	7.287+0	4.289+0	2.685+0	1.763+0	1.204+0
E_b =	β	0.946	1.163	1.217	1.165	1.093	1.020	0.952	0.890	0.834	0.783
1026.9 eV	γ	−1.29−1	3.23−2	4.01−1	6.87−1	9.02−1	1.07+0	1.20+0	1.31+0	1.41+0	1.48+0
	δ	1.04−2	3.99−2	7.39−2	1.01−1	1.27−1	1.52−1	1.76−1	2.00−1	2.24−1	2.48−1
$4s_{1/2}$	σ	1.772+1	1.098+1	5.387+0	3.176+0	2.085+0	1.468+0	1.086+0	8.332−1	6.574−1	5.303−1
E_b =	β	1.956	1.959	1.965	1.971	1.975	1.978	1.980	1.981	1.982	1.981
331.4 eV	γ	2.55−1	1.35−1	−2.68−2	−1.06−1	−1.31−1	−1.19−1	−8.19−2	−2.76−2	3.86−2	1.13−1
	δ	−3.32−4	−4.59−4	−6.21−4	−7.23−4	−7.96−4	−8.51−4	−8.95−4	−9.29−4	−9.59−4	−9.84−4
$4p_{1/2}$	σ	2.115+1	1.314+1	6.226+0	3.488+0	2.167+0	1.445+0	1.013+0	7.386−1	5.551−1	4.277−1
E_b =	β	1.668	1.692	1.680	1.642	1.597	1.552	1.507	1.464	1.423	1.383
254.7 eV	γ	3.88−2	−2.01−2	3.87−2	1.86−1	3.54−1	5.20−1	6.76−1	8.22−1	9.57−1	1.08+0
	δ	−1.21−3	−1.99−3	−1.32−3	1.18−3	5.27−3	1.05−2	1.66−2	2.35−2	3.08−2	3.86−2
$4p_{3/2}$	σ	4.487+1	2.680+1	1.206+1	6.531+0	3.955+0	2.582+0	1.780+0	1.278+0	9.477−1	7.214−1
E_b =	β	1.676	1.718	1.731	1.709	1.676	1.638	1.599	1.559	1.521	1.483
236.2 eV	γ	5.67−3	−3.67−2	4.60−2	2.12−1	3.97−1	5.78−1	7.48−1	9.07−1	1.05+0	1.19+0
	δ	7.27−4	2.05−3	5.20−3	8.34−3	1.20−2	1.61−2	2.07−2	2.58−2	3.12−2	3.72−2
$4d_{3/2}$	σ	4.411+1	2.201+1	7.468+0	3.255+0	1.653+0	9.298−1	5.633−1	3.609−1	2.417−1	1.678−1
E_b =	β	1.360	1.365	1.299	1.213	1.128	1.049	0.979	0.914	0.855	0.801
127.6 eV	γ	7.57−2	2.32−1	5.28−1	7.65−1	9.54−1	1.11+0	1.23+0	1.34+0	1.43+0	1.51+0
	δ	2.69−2	4.03−2	6.45−2	8.81−2	1.12−1	1.35−1	1.59−1	1.82−1	2.06−1	2.28−1
$4d_{5/2}$	σ	6.277+1	3.104+1	1.040+1	4.492+0	2.264+0	1.265+0	7.618−1	4.855−1	3.235−1	2.235−1
E_b =	β	1.358	1.341	1.253	1.157	1.069	0.991	0.923	0.862	0.807	0.757
115.6 eV	γ	9.22−2	2.52−1	5.43−1	7.70−1	9.49−1	1.09+0	1.21+0	1.32+0	1.40+0	1.48+0
	δ	2.61−2	3.98−2	6.65−2	9.32−2	1.20−1	1.46−1	1.72−1	1.97−1	2.22−1	2.46−1
$4f_{5/2}$	σ	8.293+0	2.869+0	6.005−1	1.896−1	7.547−2	3.486−2	1.786−2	9.893−3	5.822−3	3.597−3
E_b =	β	1.037	0.960	0.819	0.713	0.632	0.566	0.508	0.456	0.408	0.363
3.5 eV	γ	4.88−1	6.25−1	8.06−1	9.25−1	1.02+0	1.09+0	1.15+0	1.20+0	1.24+0	1.26+0
	δ	1.14−1	1.42−1	1.97−1	2.49−1	2.97−1	3.43−1	3.85−1	4.24−1	4.59−1	4.92−1
$5s_{1/2}$	σ	2.891+0	1.764+0	8.514−1	4.975−1	3.248−1	2.278−1	1.681−1	1.287−1	1.014−1	8.171−2
E_b =	β	1.959	1.962	1.967	1.972	1.976	1.979	1.981	1.982	1.982	1.981
36.0 eV	γ	1.74−1	7.75−2	−5.39−2	−1.15−1	−1.29−1	−1.10−1	−6.91−2	−1.22−2	5.58−2	1.31−1
	δ	−3.68−4	−4.76−4	−6.23−4	−7.14−4	−7.84−4	−8.35−4	−8.79−4	−9.10−4	−9.41−4	−9.65−4
$5p_{1/2}$	σ	2.865+0	1.754+0	8.194−1	4.559−1	2.822−1	1.878−1	1.315−1	9.584−2	7.200−2	5.546−2
E_b =	β	1.711	1.717	1.690	1.646	1.599	1.552	1.506	1.462	1.420	1.379
24.5 eV	γ	6.81−3	−2.43−2	5.59−2	2.08−1	3.75−1	5.40−1	6.96−1	8.40−1	9.73−1	1.10+0
	δ	−2.55−3	−2.61−3	−1.76−3	7.54−4	4.89−3	1.03−2	1.66−2	2.35−2	3.10−2	3.87−2
$5p_{3/2}$	σ	5.537+0	3.272+0	1.458+0	7.855−1	4.745−1	3.094−1	2.131−1	1.530−1	1.135−1	8.636−2
E_b =	β	1.717	1.743	1.742	1.714	1.678	1.638	1.598	1.558	1.518	1.479
20.1 eV	γ	−1.72−2	−3.55−2	6.52−2	2.34−1	4.18−1	5.98−1	7.67−1	9.24−1	1.07+0	1.20+0
	δ	8.84−5	1.82−3	4.82−3	7.83−3	1.14−2	1.57−2	2.05−2	2.58−2	3.14−2	3.73−2
$6s_{1/2}$	σ	2.012−1	1.223−1	5.876−2	3.426−2	2.232−2	1.564−2	1.153−2	8.821−3	6.947−3	5.597−3
E_b =	β	1.959	1.962	1.967	1.972	1.976	1.979	1.981	1.982	1.982	1.981
5.0 eV	γ	1.71−1	7.47−2	−5.56−2	−1.17−1	−1.30−1	−1.10−1	−6.83−2	−1.13−2	5.62−2	1.31−1
	δ	−3.70−4	−4.77−4	−6.23−4	−7.20−4	−7.89−4	−8.37−4	−8.73−4	−9.09−4	−9.39−4	−9.60−4

(*continued on next page*)

Table 1 (*continued*)

Z= 62, Sm: [Xe]$4f^6_{5/2}$ $6s^2_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$3p_{3/2}$	σ	1.728+2	1.215+2	5.953+1	3.321+1	2.037+1	1.337+1	9.237+0	6.637+0	4.922+0	3.745+0
E_b =	β	0.561	1.381	1.625	1.670	1.667	1.646	1.617	1.584	1.549	1.514
1419.8 eV	γ	6.60−2	1.86−1	−4.22−2	5.03−2	2.26−1	4.19−1	6.07−1	7.82−1	9.44−1	1.09+0
	δ	1.77−1	2.48−2	6.88−3	1.00−2	1.39−2	1.81−2	2.26−2	2.74−2	3.24−2	3.77−2
$3d_{3/2}$	σ	3.617+2	1.701+2	5.271+1	2.177+1	1.066+1	5.836+0	3.464+0	2.184+0	1.444+0	9.926−1
E_b =	β	0.812	1.115	1.238	1.213	1.154	1.087	1.020	0.957	0.898	0.843
1106.0 eV	γ	−1.46−1	−2.60−2	3.37−1	6.40−1	8.74−1	1.06+0	1.21+0	1.33+0	1.43+0	1.51+0
	δ	4.15−3	3.76−2	7.18−2	9.61−2	1.18−1	1.40−1	1.61−1	1.83−1	2.04−1	2.26−1
$3d_{5/2}$	σ	5.318+2	2.444+2	7.445+1	3.045+1	1.479+1	8.048+0	4.749+0	2.979+0	1.960+0	1.341+0
E_b =	β	0.890	1.144	1.220	1.174	1.106	1.035	0.967	0.905	0.849	0.797
1080.2 eV	γ	−1.43−1	−3.43−3	3.67−1	6.60−1	8.83−1	1.06+0	1.19+0	1.31+0	1.40+0	1.48+0
	δ	4.17−3	3.61−2	7.15−2	9.88−2	1.24−1	1.49−1	1.73−1	1.96−1	2.19−1	2.42−1
$4s_{1/2}$	σ	1.830+1	1.139+1	5.611+0	3.316+0	2.180+0	1.537+0	1.138+0	8.737−1	6.899−1	5.571−1
E_b =	β	1.953	1.956	1.962	1.968	1.973	1.976	1.978	1.980	1.980	1.980
345.7 eV	γ	2.75−1	1.54−1	−1.36−2	−9.99−2	−1.32−1	−1.26−1	−9.52−2	−4.63−2	1.53−2	8.58−2
	δ	−3.51−4	−4.88−4	−6.66−4	−7.78−4	−8.60−4	−9.21−4	−9.71−4	−1.01−3	−1.04−3	−1.07−3
$4p_{1/2}$	σ	2.185+1	1.368+1	6.536+0	3.682+0	2.297+0	1.537+0	1.081+0	7.901−1	5.952−1	4.595−1
E_b =	β	1.662	1.690	1.683	1.648	1.606	1.562	1.518	1.476	1.435	1.396
265.6 eV	γ	5.35−2	−1.62−2	2.65−2	1.65−1	3.28−1	4.92−1	6.48−1	7.94−1	9.29−1	1.05+0
	δ	−1.09−3	−2.09−3	−1.65−3	5.76−4	4.35−3	9.36−3	1.52−2	2.17−2	2.87−2	3.62−2
$4p_{3/2}$	σ	4.675+1	2.807+1	1.271+1	6.911+0	4.198+0	2.748+0	1.898+0	1.366+0	1.015+0	7.736−1
E_b =	β	1.667	1.715	1.734	1.716	1.685	1.649	1.611	1.573	1.535	1.498
247.4 eV	γ	1.66−2	−3.62−2	3.14−2	1.89−1	3.70−1	5.50−1	7.21−1	8.79−1	1.03+0	1.16+0
	δ	6.99−4	1.89−3	5.06−3	8.13−3	1.16−2	1.55−2	1.99−2	2.47−2	2.99−2	3.54−2
$4d_{3/2}$	σ	4.735+1	2.384+1	8.172+0	3.585+0	1.829+0	1.033+0	6.278−1	4.035−1	2.709−1	1.885−1
E_b =	β	1.356	1.368	1.310	1.227	1.144	1.067	0.996	0.932	0.872	0.819
137.5 eV	γ	5.81−2	2.09−1	5.06−1	7.47−1	9.40−1	1.10+0	1.23+0	1.34+0	1.43+0	1.51+0
	δ	2.54−2	3.88−2	6.26−2	8.59−2	1.09−1	1.32−1	1.55−1	1.77−1	2.00−1	2.22−1
$4d_{5/2}$	σ	6.720+1	3.351+1	1.134+1	4.928+0	2.495+0	1.399+0	8.455−1	5.404−1	3.610−1	2.500−1
E_b =	β	1.358	1.346	1.264	1.171	1.084	1.006	0.937	0.876	0.821	0.771
123.3 eV	γ	7.46−2	2.30−1	5.23−1	7.55−1	9.38−1	1.09+0	1.21+0	1.31+0	1.40+0	1.48+0
	δ	2.45−2	3.81−2	6.44−2	9.08−2	1.17−1	1.42−1	1.67−1	1.92−1	2.16−1	2.40−1
$4f_{5/2}$	σ	9.888+0	3.447+0	7.269−1	2.306−1	9.216−2	4.274−2	2.199−2	1.222−2	7.217−3	4.473−3
E_b =	β	1.044	0.970	0.832	0.725	0.643	0.576	0.518	0.466	0.419	0.374
5.5 eV	γ	4.75−1	6.16−1	8.05−1	9.28−1	1.02+0	1.10+0	1.16+0	1.21+0	1.25+0	1.28+0
	δ	1.12−1	1.40−1	1.94−1	2.45−1	2.93−1	3.37−1	3.79−1	4.18−1	4.54−1	4.87−1
$5s_{1/2}$	σ	2.975+0	1.821+0	8.822−1	5.166−1	3.376−1	2.370−1	1.750−1	1.341−1	1.057−1	8.527−2
E_b =	β	1.956	1.959	1.965	1.970	1.974	1.977	1.979	1.980	1.980	1.980
37.4 eV	γ	1.89−1	9.20−2	−4.39−2	−1.12−1	−1.31−1	−1.19−1	−8.30−2	−3.12−2	3.23−2	1.04−1
	δ	−3.93−4	−5.10−4	−6.70−4	−7.70−4	−8.47−4	−9.05−4	−9.53−4	−9.87−4	−1.02−3	−1.05−3
$5p_{1/2}$	σ	2.950+0	1.817+0	8.558−1	4.787−1	2.975−1	1.986−1	1.395−1	1.019−1	7.673−2	5.922−2
E_b =	β	1.708	1.718	1.694	1.653	1.608	1.562	1.518	1.475	1.433	1.393
23.6 eV	γ	1.60−2	−2.38−2	4.29−2	1.87−1	3.50−1	5.13−1	6.68−1	8.12−1	9.46−1	1.07+0
	δ	−2.66−3	−2.78−3	−2.11−3	1.18−4	3.93−3	9.01−3	1.50−2	2.17−2	2.89−2	3.64−2
$5p_{3/2}$	σ	5.683+0	3.374+0	1.513+0	8.183−1	4.958−1	3.241−1	2.238−1	1.610−1	1.196−1	9.118−2
E_b =	β	1.712	1.742	1.745	1.721	1.687	1.650	1.611	1.572	1.534	1.496
18.9 eV	γ	−1.11−2	−3.74−2	5.05−2	2.12−1	3.92−1	5.70−1	7.39−1	8.97−1	1.04+0	1.18+0
	δ	−7.66−5	1.66−3	4.69−3	7.59−3	1.10−2	1.50−2	1.96−2	2.46−2	3.00−2	3.57−2
$6s_{1/2}$	σ	2.028−1	1.236−1	5.964−2	3.484−2	2.273−2	1.594−2	1.176−2	9.005−3	7.096−3	5.721−3
E_b =	β	1.956	1.959	1.965	1.970	1.974	1.977	1.979	1.980	1.980	1.980
5.0 eV	γ	1.86−1	8.89−2	−4.57−2	−1.13−1	−1.33−1	−1.19−1	−8.26−2	−3.03−2	3.30−2	1.04−1
	δ	−3.95−4	−5.11−4	−6.69−4	−7.77−4	−8.54−4	−9.09−4	−9.50−4	−9.90−4	−1.02−3	−1.05−3

Z= 63, Eu: [Xe]$4f^6_{5/2}$ $4f^1_{7/2}$ $6s^2_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$3p_{3/2}$	σ	1.679+2	1.243+2	6.165+1	3.462+1	2.134+1	1.406+1	9.741+0	7.018+0	5.216+0	3.977+0
E_b =	β	0.123	1.337	1.616	1.669	1.671	1.653	1.627	1.597	1.564	1.531
1480.6 eV	γ	−2.67−1	2.23−1	−4.11−2	3.05−2	1.98−1	3.86−1	5.71−1	7.46−1	9.09−1	1.06+0
	δ	1.26−1	3.16−2	7.02−3	9.79−3	1.37−2	1.77−2	2.20−2	2.66−2	3.16−2	3.69−2
$3d_{3/2}$	σ	3.788+2	1.811+2	5.676+1	2.359+1	1.161+1	6.386+0	3.804+0	2.406+0	1.595+0	1.098+0
E_b =	β	0.747	1.090	1.236	1.220	1.166	1.102	1.038	0.976	0.917	0.861
1160.6 eV	γ	−1.50−1	−5.40−2	3.03−1	6.06−1	8.49−1	1.04+0	1.19+0	1.32+0	1.42+0	1.51+0
	δ	−1.76−3	3.41−2	6.98−2	9.31−2	1.15−1	1.37−1	1.59−1	1.80−1	2.01−1	2.22−1
$3d_{5/2}$	σ	5.594+2	2.601+2	8.008+1	3.295+1	1.609+1	8.792+0	5.206+0	3.275+0	2.161+0	1.481+0
E_b =	β	0.838	1.124	1.220	1.182	1.117	1.049	0.983	0.922	0.865	0.812

(*continued on next page*)

Table 1 (*continued*)

1130.9 eV	γ	−1.50−1	−3.17−2	3.36−1	6.30−1	8.61−1	1.04+0	1.18+0	1.30+0	1.40+0	1.48+0
	δ	−1.12−3	3.27−2	6.93−2	9.53−2	1.21−1	1.46−1	1.70−1	1.94−1	2.17−1	2.39−1
$4s_{1/2}$	σ	1.885+1	1.179+1	5.836+0	3.461+0	2.280+0	1.609+0	1.193+0	9.168−1	7.247−1	5.857−1
E_b =	β	1.949	1.953	1.960	1.965	1.970	1.974	1.977	1.978	1.979	1.979
360.2 eV	γ	2.91−1	1.70−1	−1.15−3	−9.40−2	−1.31−1	−1.31−1	−1.06−1	−6.21−2	−5.61−3	6.03−2
	δ	−3.69−4	−5.19−4	−7.11−4	−8.42−4	−9.26−4	−9.90−4	−1.04−3	−1.09−3	−1.12−3	−1.16−3
$4p_{1/2}$	σ	2.261+1	1.424+1	6.866+0	3.892+0	2.439+0	1.637+0	1.155+0	8.467−1	6.394−1	4.947−1
E_b =	β	1.654	1.688	1.685	1.653	1.613	1.571	1.530	1.489	1.449	1.411
283.9 eV	γ	6.77−2	−1.12−2	1.65−2	1.46−1	3.03−1	4.64−1	6.18−1	7.64−1	9.01−1	1.03+0
	δ	−9.52−4	−2.15−3	−1.92−3	−1.19−5	3.51−3	8.24−3	1.39−2	2.03−2	2.73−2	3.47−2
$4p_{3/2}$	σ	4.856+1	2.931+1	1.337+1	7.306+0	4.453+0	2.923+0	2.025+0	1.460+0	1.087+0	8.306−1
E_b =	β	1.659	1.711	1.735	1.721	1.693	1.660	1.624	1.588	1.552	1.516
256.6 eV	γ	2.50−2	−3.46−2	1.99−2	1.70−1	3.45−1	5.21−1	6.91−1	8.51−1	9.99−1	1.14+0
	δ	7.22−4	1.80−3	4.94−3	7.96−3	1.13−2	1.50−2	1.92−2	2.40−2	2.92−2	3.47−2
$4d_{3/2}$	σ	5.033+1	2.561+1	8.892+0	3.934+0	2.020+0	1.147+0	6.998−1	4.514−1	3.040−1	2.121−1
E_b =	β	1.354	1.370	1.319	1.240	1.160	1.085	1.015	0.950	0.890	0.835
141.4 eV	γ	4.61−2	1.92−1	4.82−1	7.29−1	9.26−1	1.09+0	1.22+0	1.33+0	1.43+0	1.51+0
	δ	2.42−2	3.75−2	6.02−2	8.30−2	1.06−1	1.29−1	1.52−1	1.74−1	1.96−1	2.17−1
$4d_{5/2}$	σ	7.130+1	3.592+1	1.230+1	5.391+0	2.745+0	1.548+0	9.388−1	6.021−1	4.034−1	2.801−1
E_b =	β	1.357	1.350	1.273	1.182	1.098	1.023	0.954	0.892	0.836	0.784
127.7 eV	γ	6.20−2	2.13−1	5.01−1	7.38−1	9.25−1	1.08+0	1.20+0	1.31+0	1.40+0	1.48+0
	δ	2.32−2	3.67−2	6.17−2	8.79−2	1.14−1	1.40−1	1.65−1	1.89−1	2.13−1	2.36−1
$4f_{5/2}$	σ	1.229+1	4.352+0	9.326−1	2.985−1	1.201−1	5.604−2	2.898−2	1.618−2	9.591−3	5.966−3
E_b =	β	1.048	0.979	0.846	0.736	0.653	0.585	0.526	0.473	0.425	0.380
1.5 eV	γ	4.62−1	6.07−1	8.03−1	9.29−1	1.02+0	1.10+0	1.16+0	1.21+0	1.25+0	1.28+0
	δ	1.10−1	1.38−1	1.91−1	2.41−1	2.88−1	3.32−1	3.73−1	4.11−1	4.46−1	4.79−1
$4f_{7/2}$	σ	7.493−3	2.600−3	5.443−4	1.718−4	6.852−5	3.171−5	1.630−5	9.053−6	5.349−6	3.316−6
E_b =	β	1.040	0.973	0.841	0.740	0.659	0.594	0.537	0.491	0.442	0.402
1.2 eV	γ	4.67−1	6.13−1	8.10−1	9.40−1	1.03+0	1.10+0	1.16+0	1.21+0	1.25+0	1.28+0
	δ	1.12−1	1.39−1	1.94−1	2.44−1	2.93−1	3.38−1	3.79−1	4.15−1	4.50−1	4.88−1
$5s_{1/2}$	σ	3.246+0	1.994+0	9.709−1	5.703−1	3.733−1	2.624−1	1.939−1	1.488−1	1.174−1	9.475−2
E_b =	β	1.954	1.956	1.962	1.967	1.972	1.975	1.977	1.979	1.979	1.979
31.8 eV	γ	1.96−1	1.02−1	−3.57−2	−1.08−1	−1.32−1	−1.25−1	−9.40−2	−4.71−2	1.15−2	7.87−2
	δ	−4.18−4	−5.44−4	−7.22−4	−8.33−4	−9.13−4	−9.75−4	−1.03−3	−1.07−3	−1.10−3	−1.14−3
$5p_{1/2}$	σ	3.297+0	2.042+0	9.698−1	5.456−1	3.404−1	2.279−1	1.606−1	1.176−1	8.875−2	6.865−2
E_b =	β	1.707	1.718	1.698	1.659	1.616	1.572	1.529	1.487	1.447	1.408
25.2 eV	γ	2.41−2	−2.21−2	3.27−2	1.69−1	3.27−1	4.86−1	6.38−1	7.82−1	9.16−1	1.04+0
	δ	−2.72−3	−2.90−3	−2.44−3	−4.60−4	3.02−3	7.67−3	1.33−2	1.97−2	2.65−2	3.39−2
$5p_{3/2}$	σ	6.482+0	3.865+0	1.744+0	9.477−1	5.759−1	3.774−1	2.612−1	1.883−1	1.401−1	1.070−1
E_b =	β	1.709	1.741	1.748	1.727	1.696	1.660	1.623	1.586	1.549	1.513
20.4 eV	γ	−5.47−3	−3.79−2	3.85−2	1.94−1	3.68−1	5.42−1	7.10−1	8.66−1	1.01+0	1.15+0
	δ	−1.84−4	1.54−3	4.59−3	7.43−3	1.06−2	1.42−2	1.84−2	2.30−2	2.80−2	3.35−2
$6s_{1/2}$	σ	3.573−1	2.182−1	1.056−1	6.183−2	4.039−2	2.836−2	2.094−2	1.604−2	1.265−2	1.021−2
E_b =	β	1.953	1.956	1.962	1.967	1.971	1.975	1.977	1.978	1.979	1.979
6.0 eV	γ	1.96−1	1.01−1	−3.71−2	−1.10−1	−1.34−1	−1.26−1	−9.48−2	−4.73−2	1.20−2	8.00−2
	δ	−4.20−4	−5.49−4	−7.22−4	−8.39−4	−9.20−4	−9.82−4	−1.03−3	−1.07−3	−1.11−3	−1.14−3

Z= 64, Gd: [Xe]$4f^6_{5/2}$ $4f^1_{7/2}$ $5d^1_{3/2}$ $6s^2_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$3d_{3/2}$	σ	4.036+2	1.965+2	6.200+1	2.588+1	1.277+1	7.043+0	4.205+0	2.665+0	1.770+0	1.221+0
E_b =	β	0.652	1.053	1.231	1.227	1.178	1.117	1.054	0.993	0.935	0.881
1217.2 eV	γ	−1.45−1	−8.77−2	2.62−1	5.76−1	8.23−1	1.02+0	1.18+0	1.31+0	1.42+0	1.51+0
	δ	−8.74−3	2.91−2	6.73−2	9.16−2	1.13−1	1.34−1	1.54−1	1.75−1	1.95−1	2.16−1
$3d_{5/2}$	σ	5.990+2	2.822+2	8.734+1	3.608+1	1.767+1	9.674+0	5.740+0	3.618+0	2.391+0	1.642+0
E_b =	β	0.754	1.098	1.220	1.190	1.129	1.061	0.996	0.935	0.880	0.828
1185.2 eV	γ	−1.51−1	−6.66−2	2.97−1	6.03−1	8.38−1	1.02+0	1.17+0	1.29+0	1.39+0	1.48+0
	δ	−7.63−3	2.79−2	6.65−2	9.35−2	1.18−1	1.42−1	1.65−1	1.88−1	2.11−1	2.33−1
$4s_{1/2}$	σ	1.944+1	1.221+1	6.072+0	3.607+0	2.380+0	1.682+0	1.248+0	9.596−1	7.590−1	6.138−1
E_b =	β	1.946	1.949	1.956	1.962	1.967	1.971	1.974	1.976	1.977	1.977
375.8 eV	γ	3.13−1	1.92−1	1.45−2	−8.52−2	−1.30−1	−1.37−1	−1.18−1	−7.91−2	−2.68−2	3.52−2
	δ	−3.77−4	−5.46−4	−7.65−4	−9.04−4	−1.00−3	−1.08−3	−1.14−3	−1.19−3	−1.23−3	−1.26−3
$4p_{1/2}$	σ	2.325+1	1.476+1	7.182+0	4.093+0	2.576+0	1.735+0	1.227+0	9.017−1	6.824−1	5.291−1
E_b =	β	1.648	1.685	1.687	1.658	1.620	1.580	1.539	1.498	1.460	1.422
288.5 eV	γ	8.49−2	−4.18−3	6.97−3	1.26−1	2.79−1	4.38−1	5.91−1	7.36−1	8.71−1	9.97−1
	δ	−7.33−4	−2.22−3	−2.23−3	−5.30−4	2.62−3	6.96−3	1.22−2	1.81−2	2.46−2	3.15−2
$4p_{3/2}$	σ	5.061+1	3.070+1	1.409+1	7.725+0	4.722+0	3.107+0	2.156+0	1.557+0	1.161+0	8.883−1
E_b =	β	1.649	1.706	1.737	1.726	1.701	1.669	1.635	1.599	1.564	1.529
270.9 eV	γ	4.01−2	−3.11−2	6.77−3	1.48−1	3.19−1	4.94−1	6.63−1	8.22−1	9.70−1	1.11+0
	δ	7.60−4	1.62−3	4.82−3	7.79−3	1.09−2	1.44−2	1.83−2	2.26−2	2.72−2	3.22−2

(*continued on next page*)

Table 1 (*continued*)

$4d_{3/2}$	σ	5.391+1	2.766+1	9.699+0	4.315+0	2.224+0	1.267+0	7.756−1	5.016−1	3.387−1	2.368−1
E_b =	β	1.347	1.371	1.329	1.254	1.175	1.100	1.032	0.969	0.910	0.856
149.5 eV	γ	2.93−2	1.68−1	4.61−1	7.09−1	9.09−1	1.07+0	1.21+0	1.33+0	1.43+0	1.51+0
	δ	2.26−2	3.58−2	5.88−2	8.08−2	1.03−1	1.25−1	1.46−1	1.68−1	1.90−1	2.11−1
$4d_{5/2}$	σ	7.630+1	3.874+1	1.340+1	5.901+0	3.017+0	1.706+0	1.038+0	6.675−1	4.483−1	3.119−1
E_b =	β	1.355	1.353	1.283	1.195	1.111	1.035	0.967	0.906	0.851	0.801
134.5 eV	γ	4.52−2	1.91−1	4.82−1	7.21−1	9.10−1	1.06+0	1.19+0	1.30+0	1.40+0	1.48+0
	δ	2.17−2	3.49−2	6.01−2	8.53−2	1.10−1	1.35−1	1.59−1	1.83−1	2.07−1	2.30−1
$4f_{5/2}$	σ	1.435+1	5.105+0	1.100+0	3.531−1	1.426−1	6.671−2	3.461−2	1.938−2	1.152−2	7.185−3
E_b =	β	1.053	0.989	0.856	0.749	0.666	0.598	0.540	0.487	0.439	0.393
2.0 eV	γ	4.48−1	5.96−1	7.99−1	9.31−1	1.03+0	1.11+0	1.17+0	1.22+0	1.26+0	1.30+0
	δ	1.08−1	1.35−1	1.87−1	2.37−1	2.84−1	3.28−1	3.69−1	4.07−1	4.42−1	4.75−1
$4f_{7/2}$	σ	1.829+1	6.453+0	1.376+0	4.387−1	1.761−1	8.205−2	4.241−2	2.368−2	1.404−2	8.733−3
E_b =	β	1.044	0.979	0.849	0.746	0.667	0.604	0.549	0.500	0.456	0.414
1.3 eV	γ	4.52−1	6.01−1	8.06−1	9.37−1	1.03+0	1.11+0	1.17+0	1.22+0	1.26+0	1.29+0
	δ	1.08−1	1.35−1	1.89−1	2.39−1	2.87−1	3.32−1	3.73−1	4.11−1	4.47−1	4.80−1
$5s_{1/2}$	σ	3.296+0	2.030+0	9.915−1	5.833−1	3.823−1	2.690−1	1.989−1	1.527−1	1.205−1	9.735−2
E_b =	β	1.950	1.953	1.959	1.964	1.969	1.972	1.975	1.976	1.977	1.977
36.1 eV	γ	2.16−1	1.19−1	−2.34−2	−1.02−1	−1.34−1	−1.33−1	−1.07−1	−6.49−2	−1.01−2	5.37−2
	δ	−4.37−4	−5.78−4	−7.73−4	−8.97−4	−9.93−4	−1.06−3	−1.12−3	−1.17−3	−1.21−3	−1.24−3
$5p_{1/2}$	σ	3.268+0	2.037+0	9.749−1	5.512−1	3.453−1	2.319−1	1.638−1	1.202−1	9.092−2	7.046−2
E_b =	β	1.702	1.717	1.702	1.665	1.624	1.581	1.538	1.497	1.457	1.419
24.3 eV	γ	3.66−2	−1.91−2	2.11−2	1.49−1	3.04−1	4.61−1	6.14−1	7.57−1	8.91−1	1.02+0
	δ	−2.86−3	−3.09−3	−2.74−3	−1.03−3	2.15−3	6.58−3	1.19−2	1.80−2	2.45−2	3.15−2
$5p_{3/2}$	σ	6.527+0	3.907+0	1.774+0	9.673−1	5.896−1	3.873−1	2.685−1	1.939−1	1.446−1	1.106−1
E_b =	β	1.702	1.738	1.751	1.733	1.704	1.670	1.635	1.598	1.562	1.526
18.3 eV	γ	2.85−3	−3.81−2	2.50−2	1.72−1	3.44−1	5.18−1	6.85−1	8.43−1	9.89−1	1.12+0
	δ	−3.81−4	1.35−3	4.48−3	7.27−3	1.03−2	1.39−2	1.79−2	2.22−2	2.70−2	3.21−2
$5d_{3/2}$	σ	2.780+0	1.430+0	5.033−1	2.244−1	1.159−1	6.610−2	4.052−2	2.623−2	1.773−2	1.240−2
E_b =	β	1.386	1.393	1.338	1.258	1.178	1.102	1.031	0.966	0.905	0.849
6.0 eV	γ	4.92−2	1.88−1	4.76−1	7.21−1	9.21−1	1.08+0	1.22+0	1.33+0	1.43+0	1.51+0
	δ	2.21−2	3.46−2	5.70−2	7.92−2	1.02−1	1.25−1	1.47−1	1.69−1	1.90−1	2.11−1
$6s_{1/2}$	σ	2.444−1	1.497−1	7.273−2	4.266−2	2.790−2	1.960−2	1.448−2	1.110−2	8.763−3	7.074−3
E_b =	β	1.950	1.953	1.958	1.964	1.968	1.972	1.975	1.977	1.977	1.978
6.0 eV	γ	2.14−1	1.17−1	−2.52−2	−1.04−1	−1.36−1	−1.33−1	−1.07−1	−6.40−2	−9.46−3	5.40−2
	δ	−4.40−4	−5.83−4	−7.75−4	−9.05−4	−9.99−4	−1.06−3	−1.12−3	−1.16−3	−1.20−3	−1.23−3

Z= 65, Tb: [Xe]$4f^6_{5/2}\,4f^3_{7/2}\,6s^2_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$3d_{3/2}$	σ	4.281+2	2.132+2	6.773+1	2.838+1	1.405+1	7.765+0	4.645+0	2.950+0	1.963+0	1.356+0
E_b =	β	0.550	1.009	1.225	1.232	1.190	1.132	1.071	1.010	0.952	0.897
1275.0 eV	γ	−1.26−1	−1.18−1	2.21−1	5.40−1	7.95−1	9.98−1	1.16+0	1.30+0	1.41+0	1.50+0
	δ	−1.28−2	2.37−2	6.51−2	8.98−2	1.11−1	1.32−1	1.52−1	1.72−1	1.91−1	2.10−1
$3d_{5/2}$	σ	6.371+2	3.058+2	9.521+1	3.947+1	1.937+1	1.064+1	6.325+0	3.994+0	2.643+0	1.817+0
E_b =	β	0.666	1.064	1.218	1.197	1.141	1.077	1.012	0.951	0.894	0.841
1241.2 eV	γ	−1.38−1	−9.86−2	2.59−1	5.71−1	8.14−1	1.00+0	1.16+0	1.28+0	1.39+0	1.47+0
	δ	−1.21−2	2.30−2	6.40−2	9.12−2	1.16−1	1.40−1	1.63−1	1.85−1	2.07−1	2.28−1
$4s_{1/2}$	σ	1.998+1	1.260+1	6.291+0	3.745+0	2.473+0	1.750+0	1.299+0	1.000+0	7.915−1	6.405−1
E_b =	β	1.941	1.945	1.952	1.959	1.964	1.968	1.972	1.974	1.975	1.976
397.9 eV	γ	3.41−1	2.17−1	3.27−2	−7.43−2	−1.26−1	−1.40−1	−1.27−1	−9.44−2	−4.72−2	1.05−2
	δ	−3.70−4	−5.65−4	−8.09−4	−9.64−4	−1.07−3	−1.16−3	−1.23−3	−1.28−3	−1.33−3	−1.37−3
$4p_{1/2}$	σ	2.386+1	1.527+1	7.493+0	4.292+0	2.711+0	1.831+0	1.299+0	9.566−1	7.255−1	5.634−1
E_b =	β	1.638	1.681	1.689	1.664	1.628	1.589	1.550	1.510	1.472	1.434
310.2 eV	γ	1.10−1	6.63−3	−2.59−3	1.05−1	2.52−1	4.08−1	5.61−1	7.07−1	8.43−1	9.70−1
	δ	−3.84−4	−2.28−3	−2.51−3	−1.07−3	1.81−3	5.94−3	1.10−2	1.68−2	2.31−2	2.97−2
$4p_{3/2}$	σ	5.235+1	3.192+1	1.474+1	8.109+0	4.970+0	3.278+0	2.279+0	1.649+0	1.232+0	9.437−1
E_b =	β	1.637	1.700	1.737	1.731	1.709	1.679	1.647	1.613	1.578	1.544
285.0 eV	γ	5.70−2	−2.57−2	−5.29−3	1.25−1	2.91−1	4.64−1	6.33−1	7.94−1	9.43−1	1.08+0
	δ	8.52−4	1.43−3	4.64−3	7.61−3	1.06−2	1.41−2	1.79−2	2.21−2	2.66−2	3.12−2
$4d_{3/2}$	σ	5.674+1	2.938+1	1.040+1	4.657+0	2.411+0	1.378+0	8.463−1	5.487−1	3.713−1	2.602−1
E_b =	β	1.339	1.371	1.338	1.268	1.192	1.118	1.049	0.985	0.925	0.871
154.5 eV	γ	1.41−2	1.46−1	4.36−1	6.88−1	8.94−1	1.06+0	1.20+0	1.32+0	1.42+0	1.51+0
	δ	2.09−2	3.43−2	5.71−2	7.89−2	1.01−1	1.22−1	1.43−1	1.64−1	1.85−1	2.05−1
$4d_{5/2}$	σ	8.072+1	4.133+1	1.443+1	6.389+0	3.281+0	1.861+0	1.135+0	7.319−1	4.926−1	3.434−1
E_b =	β	1.351	1.356	1.293	1.209	1.127	1.051	0.982	0.919	0.863	0.812
142.0 eV	γ	2.91−2	1.69−1	4.59−1	7.02−1	8.97−1	1.05+0	1.19+0	1.30+0	1.39+0	1.47+0
	δ	2.01−2	3.33−2	5.82−2	8.31−2	1.08−1	1.33−1	1.57−1	1.80−1	2.02−1	2.24−1
$4f_{5/2}$	σ	1.570+1	5.608+0	1.213+0	3.905−1	1.580−1	7.409−2	3.853−2	2.164−2	1.290−2	8.061−3

(*continued on next page*)

Table 1 (*continued*)

E_b =	β	1.056	0.997	0.870	0.763	0.677	0.607	0.547	0.495	0.448	0.403
4.0 eV	γ	4.33−1	5.86−1	7.97−1	9.34−1	1.03+0	1.11+0	1.17+0	1.23+0	1.27+0	1.31+0
	δ	1.07−1	1.34−1	1.86−1	2.34−1	2.80−1	3.22−1	3.63−1	4.01−1	4.36−1	4.70−1
$4f_{7/2}$	σ	1.964+1	6.972+0	1.495+0	4.781−1	1.924−1	8.986−2	4.657−2	2.607−2	1.550−2	9.663−3
E_b =	β	1.047	0.988	0.862	0.759	0.678	0.612	0.556	0.507	0.464	0.423
1.6 eV	γ	4.39−1	5.92−1	8.04−1	9.40−1	1.04+0	1.11+0	1.17+0	1.22+0	1.27+0	1.30+0
	δ	1.06−1	1.34−1	1.87−1	2.37−1	2.83−1	3.26−1	3.67−1	4.05−1	4.41−1	4.75−1
$5s_{1/2}$	σ	3.221+0	1.991+0	9.760−1	5.755−1	3.777−1	2.660−1	1.969−1	1.512−1	1.195−1	9.656−2
E_b =	β	1.946	1.949	1.955	1.961	1.966	1.970	1.973	1.974	1.976	1.976
39.0 eV	γ	2.34−1	1.37−1	−1.00−2	−9.49−2	−1.33−1	−1.37−1	−1.17−1	−8.03−2	−3.04−2	2.90−2
	δ	−4.48−4	−6.05−4	−8.19−4	−9.58−4	−1.06−3	−1.14−3	−1.21−3	−1.25−3	−1.30−3	−1.34−3
$5p_{1/2}$	σ	3.134+0	1.966+0	9.487−1	5.392−1	3.391−1	2.284−1	1.618−1	1.190−1	9.022−2	7.005−2
E_b =	β	1.697	1.716	1.704	1.671	1.631	1.590	1.550	1.510	1.471	1.433
26.3 eV	γ	5.13−2	−1.43−2	1.05−2	1.29−1	2.77−1	4.32−1	5.83−1	7.27−1	8.62−1	9.87−1
	δ	−2.97−3	−3.26−3	−3.02−3	−1.57−3	1.29−3	5.40−3	1.05−2	1.65−2	2.29−2	2.98−2
$5p_{3/2}$	σ	6.218+0	3.740+0	1.707+0	9.347−1	5.713−1	3.761−1	2.613−1	1.890−1	1.412−1	1.082−1
E_b =	β	1.694	1.735	1.753	1.738	1.712	1.681	1.647	1.612	1.577	1.543
21.3 eV	γ	1.33−2	−3.66−2	1.19−2	1.50−1	3.16−1	4.87−1	6.54−1	8.12−1	9.60−1	1.10+0
	δ	−5.69−4	1.13−3	4.34−3	7.07−3	9.97−3	1.33−2	1.71−2	2.14−2	2.61−2	3.11−2
$6s_{1/2}$	σ	2.075−1	1.276−1	6.227−2	3.663−2	2.400−2	1.688−2	1.248−2	9.579−3	7.563−3	6.109−3
E_b =	β	1.946	1.949	1.955	1.961	1.966	1.969	1.972	1.974	1.975	1.976
6.0 eV	γ	2.31−1	1.34−1	−1.21−2	−9.65−2	−1.34−1	−1.39−1	−1.18−1	−8.04−2	−2.99−2	2.98−2
	δ	−4.50−4	−6.08−4	−8.21−4	−9.64−4	−1.07−3	−1.15−3	−1.21−3	−1.27−3	−1.31−3	−1.34−3
Z= 66, Dy: [Xe]$4f^6_{5/2}$ $4f^4_{7/2}$ $6s^2_{1/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$3d_{3/2}$	σ	4.443+2	2.284+2	7.328+1	3.085+1	1.532+1	8.498+0	5.097+0	3.244+0	2.163+0	1.497+0
E_b =	β	0.450	0.963	1.216	1.236	1.200	1.146	1.087	1.027	0.970	0.915
1332.5 eV	γ	−9.87−2	−1.42−1	1.82−1	5.04−1	7.65−1	9.75−1	1.15+0	1.28+0	1.40+0	1.50+0
	δ	−1.22−2	1.80−2	6.26−2	8.76−2	1.09−1	1.29−1	1.49−1	1.68−1	1.87−1	2.06−1
$3d_{5/2}$	σ	6.657+2	3.273+2	1.028+2	4.280+1	2.109+1	1.161+1	6.921+0	4.380+0	2.905+0	2.000+0
E_b =	β	0.575	1.030	1.214	1.203	1.151	1.090	1.027	0.966	0.909	0.856
1294.9 eV	γ	−1.17−1	−1.25−1	2.22−1	5.39−1	7.88−1	9.85−1	1.14+0	1.27+0	1.38+0	1.47+0
	δ	−1.34−2	1.80−2	6.12−2	8.87−2	1.13−1	1.37−1	1.60−1	1.82−1	2.03−1	2.24−1
$4s_{1/2}$	σ	2.049+1	1.298+1	6.514+0	3.888+0	2.572+0	1.822+0	1.354+0	1.043+0	8.262−1	6.691−1
E_b =	β	1.937	1.941	1.949	1.955	1.961	1.965	1.969	1.971	1.973	1.974
416.3 eV	γ	3.63−1	2.40−1	5.00−2	−6.35−2	−1.22−1	−1.42−1	−1.35−1	−1.08−1	−6.54−2	−1.21−2
	δ	−3.67−4	−5.86−4	−8.59−4	−1.03−3	−1.16−3	−1.25−3	−1.32−3	−1.38−3	−1.44−3	−1.48−3
$4p_{1/2}$	σ	2.449+1	1.579+1	7.820+0	4.504+0	2.856+0	1.935+0	1.377+0	1.016+0	7.723−1	6.010−1
E_b =	β	1.627	1.676	1.690	1.668	1.635	1.598	1.560	1.521	1.484	1.447
331.8 eV	γ	1.35−1	1.89−2	−9.58−3	8.71−2	2.27−1	3.79−1	5.31−1	6.76−1	8.13−1	9.41−1
	δ	3.60−5	−2.29−3	−2.76−3	−1.56−3	1.03−3	4.85−3	9.67−3	1.52−2	2.13−2	2.77−2
$4p_{3/2}$	σ	5.405+1	3.313+1	1.540+1	8.510+0	5.232+0	3.459+0	2.411+0	1.748+0	1.308+0	1.003+0
E_b =	β	1.626	1.694	1.737	1.735	1.715	1.688	1.658	1.625	1.592	1.558
292.9 eV	γ	7.11−2	−1.97−2	−1.45−2	1.06−1	2.66−1	4.36−1	6.04−1	7.64−1	9.14−1	1.05+0
	δ	9.84−4	1.29−3	4.51−3	7.48−3	1.04−2	1.37−2	1.73−2	2.13−2	2.56−2	3.01−2
$4d_{3/2}$	σ	5.994+1	3.133+1	1.121+1	5.053+0	2.629+0	1.508+0	9.291−1	6.041−1	4.098−1	2.878−1
E_b =	β	1.331	1.371	1.345	1.280	1.207	1.135	1.067	1.003	0.944	0.889
161.4 eV	γ	1.49−3	1.26−1	4.12−1	6.66−1	8.75−1	1.05+0	1.19+0	1.31+0	1.42+0	1.51+0
	δ	1.95−2	3.28−2	5.53−2	7.66−2	9.79−2	1.19−1	1.40−1	1.60−1	1.80−1	2.00−1
$4d_{5/2}$	σ	8.537+1	4.410+1	1.555+1	6.931+0	3.575+0	2.035+0	1.246+0	8.050−1	5.431−1	3.794−1
E_b =	β	1.347	1.358	1.301	1.221	1.141	1.065	0.997	0.935	0.878	0.826
149.4 eV	γ	1.57−2	1.49−1	4.37−1	6.82−1	8.81−1	1.04+0	1.18+0	1.29+0	1.39+0	1.47+0
	δ	1.87−2	3.18−2	5.61−2	8.05−2	1.05−1	1.29−1	1.53−1	1.76−1	1.98−1	2.20−1
$4f_{5/2}$	σ	1.807+1	6.504+0	1.418+0	4.586−1	1.862−1	8.759−2	4.569−2	2.573−2	1.538−2	9.638−3
E_b =	β	1.058	1.005	0.882	0.776	0.689	0.618	0.558	0.504	0.457	0.413
5.5 eV	γ	4.19−1	5.74−1	7.93−1	9.35−1	1.04+0	1.12+0	1.18+0	1.23+0	1.28+0	1.31+0
	δ	1.05−1	1.32−1	1.83−1	2.31−1	2.76−1	3.18−1	3.58−1	3.95−1	4.30−1	4.64−1
$4f_{7/2}$	σ	2.266+1	8.105+0	1.753+0	5.630−1	2.274−1	1.065−1	5.536−2	3.108−2	1.852−2	1.158−2
E_b =	β	1.050	0.996	0.874	0.771	0.689	0.622	0.566	0.516	0.472	0.432
3.3 eV	γ	4.25−1	5.81−1	8.00−1	9.41−1	1.04+0	1.12+0	1.18+0	1.23+0	1.27+0	1.31+0
	δ	1.05−1	1.32−1	1.84−1	2.33−1	2.79−1	3.22−1	3.62−1	4.00−1	4.35−1	4.69−1
$5s_{1/2}$	σ	3.327+0	2.060+0	1.012+0	5.975−1	3.925−1	2.765−1	2.048−1	1.573−1	1.244−1	1.006−1
E_b =	β	1.941	1.945	1.952	1.957	1.963	1.967	1.970	1.972	1.974	1.974
62.9 eV	γ	2.58−1	1.59−1	5.49−3	−8.65−2	−1.31−1	−1.42−1	−1.27−1	−9.55−2	−5.02−2	4.98−3
	δ	−4.61−4	−6.36−4	−8.73−4	−1.03−3	−1.15−3	−1.23−3	−1.30−3	−1.36−3	−1.41−3	−1.45−3
$5p_{1/2}$	σ	3.184+0	2.010+0	9.780−1	5.589−1	3.528−1	2.384−1	1.693−1	1.249−1	9.484−2	7.378−2
E_b =	β	1.692	1.715	1.707	1.676	1.639	1.599	1.560	1.521	1.483	1.446
28.2 eV	γ	6.56−2	−8.30−3	2.08−3	1.11−1	2.54−1	4.05−1	5.54−1	6.97−1	8.32−1	9.59−1

(*continued on next page*)

Table 1 (*continued*)

	δ	−3.06−3	−3.41−3	−3.29−3	−2.06−3	5.14−4	4.30−3	9.13−3	1.48−2	2.10−2	2.76−2
$5p_{3/2}$	σ	6.382+0	3.855+0	1.770+0	9.730−1	5.964−1	3.936−1	2.740−1	1.985−1	1.485−1	1.139−1
E_b =	β	1.686	1.731	1.754	1.743	1.719	1.690	1.658	1.625	1.591	1.557
22.9 eV	γ	2.33−2	−3.41−2	1.08−3	1.30−1	2.92−1	4.60−1	6.25−1	7.82−1	9.31−1	1.07+0
	δ	−7.26−4	9.33−4	4.22−3	6.96−3	9.74−3	1.28−2	1.64−2	2.05−2	2.50−2	2.97−2
$6s_{1/2}$	σ	2.085−1	1.286−1	6.303−2	3.716−2	2.439−2	1.718−2	1.271−2	9.761−3	7.713−3	6.233−3
E_b =	β	1.942	1.946	1.952	1.958	1.963	1.967	1.970	1.972	1.973	1.974
6.0 eV	γ	2.46−1	1.49−1	5.56−4	−8.91−2	−1.33−1	−1.42−1	−1.28−1	−9.48−2	−4.87−2	7.14−3
	δ	−4.66−4	−6.39−4	−8.76−4	−1.03−3	−1.15−3	−1.24−3	−1.31−3	−1.37−3	−1.42−3	−1.46−3
Z= 67, Ho: [Xe]$4f^6_{5/2}$ $4f^5_{7/2}$ $6s^2_{1/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$3d_{3/2}$	σ	4.520+2	2.441+2	7.914+1	3.347+1	1.669+1	9.281+0	5.582+0	3.560+0	2.378+0	1.649+0
E_b =	β	0.375	0.914	1.206	1.238	1.209	1.159	1.103	1.045	0.988	0.933
1391.5 eV	γ	−6.50−2	−1.62−1	1.41−1	4.66−1	7.33−1	9.49−1	1.13+0	1.27+0	1.39+0	1.49+0
	δ	−6.44−3	1.17−2	5.99−2	8.55−2	1.06−1	1.26−1	1.46−1	1.65−1	1.84−1	2.02−1
$3d_{5/2}$	σ	6.876+2	3.498+2	1.109+2	4.637+1	2.292+1	1.266+1	7.562+0	4.796+0	3.187+0	2.198+0
E_b =	β	0.478	0.991	1.209	1.208	1.161	1.102	1.041	0.981	0.925	0.871
1351.4 eV	γ	−8.70−2	−1.48−1	1.84−1	5.05−1	7.60−1	9.63−1	1.13+0	1.26+0	1.37+0	1.47+0
	δ	−1.07−2	1.24−2	5.83−2	8.61−2	1.10−1	1.33−1	1.56−1	1.78−1	1.99−1	2.20−1
$4s_{1/2}$	σ	2.098+1	1.335+1	6.735+0	4.032+0	2.672+0	1.894+0	1.409+0	1.087+0	8.614−1	6.981−1
E_b =	β	1.932	1.936	1.945	1.951	1.957	1.962	1.966	1.969	1.971	1.972
435.7 eV	γ	3.87−1	2.63−1	6.85−2	−5.15−2	−1.17−1	−1.43−1	−1.42−1	−1.19−1	−8.22−2	−3.34−2
	δ	−3.61−4	−6.06−4	−9.11−4	−1.10−3	−1.24−3	−1.34−3	−1.42−3	−1.49−3	−1.55−3	−1.60−3
$4p_{1/2}$	σ	2.499+1	1.625+1	8.122+0	4.706+0	2.997+0	2.038+0	1.454+0	1.076+0	8.193−1	6.388−1
E_b =	β	1.616	1.671	1.691	1.672	1.641	1.605	1.569	1.532	1.495	1.459
343.5 eV	γ	1.57−1	3.16−2	−1.43−2	7.12−2	2.04−1	3.52−1	5.01−1	6.45−1	7.82−1	9.11−1
	δ	4.51−4	−2.29−3	−2.99−3	−2.00−3	3.22−4	3.85−3	8.39−3	1.37−2	1.96−2	2.58−2
$4p_{3/2}$	σ	5.584+1	3.440+1	1.610+1	8.931+0	5.507+0	3.650+0	2.548+0	1.851+0	1.387+0	1.066+0
E_b =	β	1.612	1.686	1.737	1.738	1.722	1.697	1.668	1.637	1.605	1.573
306.6 eV	γ	8.78−2	−1.19−2	−2.29−2	8.70−2	2.41−1	4.07−1	5.73−1	7.34−1	8.84−1	1.03+0
	δ	1.19−3	1.15−3	4.36−3	7.37−3	1.02−2	1.33−2	1.68−2	2.06−2	2.47−2	2.90−2
$4d_{3/2}$	σ	6.310+1	3.329+1	1.205+1	5.465+0	2.857+0	1.645+0	1.017+0	6.630−1	4.509−1	3.173−1
E_b =	β	1.322	1.369	1.352	1.291	1.222	1.152	1.085	1.021	0.962	0.907
167.8 eV	γ	−9.72−3	1.06−1	3.87−1	6.43−1	8.56−1	1.03+0	1.18+0	1.31+0	1.41+0	1.50+0
	δ	1.80−2	3.13−2	5.36−2	7.44−2	9.52−2	1.16−1	1.37−1	1.56−1	1.76−1	1.95−1
$4d_{5/2}$	σ	9.002+1	4.691+1	1.671+1	7.497+0	3.884+0	2.220+0	1.362+0	8.828−1	5.970−1	4.179−1
E_b =	β	1.342	1.359	1.309	1.232	1.153	1.080	1.012	0.950	0.893	0.841
156.5 eV	γ	3.43−3	1.30−1	4.14−1	6.61−1	8.64−1	1.03+0	1.17+0	1.28+0	1.38+0	1.47+0
	δ	1.73−2	3.02−2	5.41−2	7.79−2	1.02−1	1.26−1	1.50−1	1.72−1	1.94−1	2.15−1
$4f_{5/2}$	σ	2.059+1	7.470+0	1.644+0	5.341−1	2.176−1	1.027−1	5.375−2	3.036−2	1.819−2	1.143−2
E_b =	β	1.060	1.012	0.894	0.788	0.702	0.630	0.568	0.514	0.466	0.422
4.8 eV	γ	4.04−1	5.61−1	7.87−1	9.34−1	1.04+0	1.12+0	1.19+0	1.24+0	1.29+0	1.32+0
	δ	1.03−1	1.30−1	1.80−1	2.28−1	2.73−1	3.14−1	3.53−1	3.90−1	4.25−1	4.58−1
$4f_{7/2}$	σ	2.584+1	9.326+0	2.036+0	6.572−1	2.664−1	1.252−1	6.526−2	3.674−2	2.195−2	1.376−2
E_b =	β	1.053	1.003	0.885	0.783	0.701	0.633	0.575	0.525	0.481	0.440
2.8 eV	γ	4.11−1	5.69−1	7.94−1	9.41−1	1.04+0	1.12+0	1.19+0	1.24+0	1.28+0	1.32+0
	δ	1.03−1	1.30−1	1.82−1	2.30−1	2.76−1	3.18−1	3.57−1	3.95−1	4.30−1	4.63−1
$5s_{1/2}$	σ	3.380+0	2.101+0	1.038+0	6.149−1	4.047−1	2.856−1	2.117−1	1.628−1	1.288−1	1.042−1
E_b =	β	1.937	1.941	1.948	1.954	1.959	1.964	1.967	1.970	1.971	1.972
51.2 eV	γ	2.69−1	1.71−1	1.75−2	−7.87−2	−1.28−1	−1.44−1	−1.35−1	−1.08−1	−6.67−2	−1.57−2
	δ	−4.76−4	−6.68−4	−9.29−4	−1.10−3	−1.23−3	−1.33−3	−1.41−3	−1.47−3	−1.52−3	−1.57−3
$5p_{1/2}$	σ	3.224+0	2.048+0	1.005+0	5.777−1	3.662−1	2.483−1	1.768−1	1.307−1	9.945−2	7.752−2
E_b =	β	1.687	1.713	1.709	1.681	1.645	1.607	1.569	1.531	1.494	1.458
24.9 eV	γ	7.94−2	−1.51−3	−4.73−3	9.49−2	2.32−1	3.80−1	5.26−1	6.68−1	8.03−1	9.29−1
	δ	−3.15−3	−3.56−3	−3.54−3	−2.51−3	−2.02−4	3.29−3	7.80−3	1.32−2	1.91−2	2.55−2
$5p_{3/2}$	σ	6.524+0	3.958+0	1.829+0	1.010+0	6.208−1	4.107−1	2.864−1	2.080−1	1.558−1	1.197−1
E_b =	β	1.679	1.727	1.755	1.747	1.726	1.699	1.668	1.636	1.604	1.572
19.5 eV	γ	3.29−2	−3.08−2	−8.20−3	1.13−1	2.69−1	4.34−1	5.97−1	7.54−1	9.02−1	1.04+0
	δ	−8.63−4	7.42−4	4.11−3	6.88−3	9.57−3	1.25−2	1.59−2	1.97−2	2.39−2	2.84−2
$6s_{1/2}$	σ	2.093−1	1.295−1	6.374−2	3.768−2	2.477−2	1.746−2	1.294−2	9.941−3	7.860−3	6.357−3
E_b =	β	1.938	1.942	1.948	1.954	1.959	1.964	1.967	1.969	1.971	1.972
6.0 eV	γ	2.62−1	1.65−1	1.38−2	−8.07−2	−1.30−1	−1.45−1	−1.36−1	−1.08−1	−6.63−2	−1.44−2
	δ	−4.81−4	−6.72−4	−9.33−4	−1.11−3	−1.23−3	−1.33−3	−1.41−3	−1.48−3	−1.54−3	−1.58−3
Z= 68, Er: [Xe]$4f^6_{5/2}$ $4f^6_{7/2}$ $6s^2_{1/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$3d_{3/2}$	σ	4.115+2	2.603+2	8.540+1	3.629+1	1.815+1	1.012+1	6.103+0	3.901+0	2.611+0	1.813+0

(*continued on next page*)

Table 1 (*continued*)

E_b =	β	0.492	0.856	1.193	1.239	1.216	1.171	1.117	1.061	1.006	0.952
1453.3 eV	γ	−1.93−2	−1.76−1	1.01−1	4.27−1	7.00−1	9.22−1	1.10+0	1.26+0	1.38+0	1.49+0
	δ	−1.80−3	4.95−3	5.70−2	8.34−2	1.04−1	1.24−1	1.43−1	1.62−1	1.80−1	1.98−1
$3d_{5/2}$	σ	6.884+2	3.729+2	1.194+2	5.014+1	2.487+1	1.377+1	8.247+0	5.241+0	3.489+0	2.410+0
E_b =	β	0.411	0.947	1.202	1.212	1.170	1.113	1.054	0.996	0.940	0.887
1409.3 eV	γ	−5.21−2	−1.67−1	1.45−1	4.70−1	7.31−1	9.39−1	1.11+0	1.25+0	1.36+0	1.46+0
	δ	−4.91−3	6.44−3	5.53−2	8.34−2	1.07−1	1.30−1	1.53−1	1.75−1	1.96−1	2.16−1
$4s_{1/2}$	σ	2.140+1	1.369+1	6.943+0	4.169+0	2.769+0	1.966+0	1.464+0	1.130+0	8.963−1	7.269−1
E_b =	β	1.927	1.932	1.941	1.947	1.953	1.959	1.963	1.966	1.968	1.970
449.1 eV	γ	4.07−1	2.84−1	8.66−2	−3.89−2	−1.11−1	−1.43−1	−1.47−1	−1.30−1	−9.72−2	−5.29−2
	δ	−3.52−4	−6.25−4	−9.63−4	−1.18−3	−1.33−3	−1.45−3	−1.53−3	−1.61−3	−1.67−3	−1.73−3
$4p_{1/2}$	σ	2.552+1	1.673+1	8.444+0	4.921+0	3.146+0	2.146+0	1.535+0	1.138+0	8.689−1	6.787−1
E_b =	β	1.603	1.665	1.691	1.676	1.647	1.613	1.578	1.542	1.507	1.472
366.2 eV	γ	1.85−1	4.81−2	−1.78−2	5.55−2	1.81−1	3.25−1	4.71−1	6.14−1	7.51−1	8.80−1
	δ	1.07−3	−2.24−3	−3.22−3	−2.43−3	−3.68−4	2.86−3	7.12−3	1.21−2	1.78−2	2.39−2
$4p_{3/2}$	σ	5.758+1	3.567+1	1.679+1	9.357+0	5.787+0	3.844+0	2.689+0	1.957+0	1.469+0	1.130+0
E_b =	β	1.598	1.679	1.736	1.741	1.727	1.705	1.678	1.649	1.618	1.587
320.0 eV	γ	1.05−1	−2.83−3	−3.00−2	6.94−2	2.17−1	3.79−1	5.43−1	7.02−1	8.54−1	9.96−1
	δ	1.47−3	1.02−3	4.21−3	7.28−3	1.01−2	1.30−2	1.63−2	1.99−2	2.39−2	2.80−2
$4d_{3/2}$	σ	6.636+1	3.534+1	1.293+1	5.903+0	3.100+0	1.792+0	1.111+0	7.262−1	4.951−1	3.491−1
E_b =	β	1.312	1.366	1.358	1.302	1.235	1.167	1.102	1.039	0.981	0.925
176.7 eV	γ	−1.99−2	8.66−2	3.62−1	6.19−1	8.36−1	1.02+0	1.17+0	1.30+0	1.41+0	1.50+0
	δ	1.65−2	2.98−2	5.19−2	7.22−2	9.25−2	1.13−1	1.33−1	1.53−1	1.72−1	1.91−1
$4d_{5/2}$	σ	9.493+1	4.991+1	1.796+1	8.103+0	4.216+0	2.418+0	1.488+0	9.667−1	6.551−1	4.595−1
E_b =	β	1.337	1.360	1.316	1.242	1.166	1.094	1.027	0.965	0.908	0.855
167.6 eV	γ	−8.34−3	1.10−1	3.91−1	6.40−1	8.46−1	1.02+0	1.16+0	1.28+0	1.38+0	1.47+0
	δ	1.59−2	2.86−2	5.21−2	7.53−2	9.90−2	1.23−1	1.46−1	1.68−1	1.90−1	2.11−1
$4f_{5/2}$	σ	2.335+1	8.541+0	1.896+0	6.190−1	2.531−1	1.198−1	6.287−2	3.560−2	2.139−2	1.347−2
E_b =	β	1.061	1.019	0.905	0.801	0.714	0.641	0.579	0.524	0.476	0.431
5.3 eV	γ	3.90−1	5.48−1	7.80−1	9.33−1	1.04+0	1.13+0	1.19+0	1.25+0	1.29+0	1.33+0
	δ	1.02−1	1.28−1	1.78−1	2.25−1	2.69−1	3.10−1	3.48−1	3.85−1	4.19−1	4.52−1
$4f_{7/2}$	σ	2.934+1	1.068+1	2.352+0	7.631−1	3.104−1	1.463−1	7.647−2	4.317−2	2.586−2	1.624−2
E_b =	β	1.054	1.009	0.896	0.795	0.712	0.644	0.585	0.535	0.490	0.449
3.6 eV	γ	3.97−1	5.56−1	7.88−1	9.40−1	1.05+0	1.13+0	1.19+0	1.25+0	1.29+0	1.33+0
	δ	1.02−1	1.28−1	1.79−1	2.27−1	2.72−1	3.14−1	3.53−1	3.90−1	4.24−1	4.57−1
$5s_{1/2}$	σ	3.458+0	2.155+0	1.069+0	6.347−1	4.184−1	2.955−1	2.192−1	1.687−1	1.335−1	1.081−1
E_b =	β	1.933	1.937	1.944	1.950	1.956	1.960	1.964	1.967	1.969	1.970
59.8 eV	γ	2.88−1	1.90−1	3.27−2	−6.90−2	−1.25−1	−1.46−1	−1.42−1	−1.20−1	−8.31−2	−3.62−2
	δ	−4.86−4	−6.97−4	−9.87−4	−1.18−3	−1.33−3	−1.43−3	−1.52−3	−1.58−3	−1.65−3	−1.69−3
$5p_{1/2}$	σ	3.266+0	2.087+0	1.033+0	5.971−1	3.800−1	2.584−1	1.845−1	1.367−1	1.042−1	8.140−2
E_b =	β	1.681	1.711	1.711	1.685	1.651	1.615	1.578	1.541	1.505	1.470
27.9 eV	γ	9.59−2	7.11−3	−1.07−2	7.92−2	2.10−1	3.54−1	4.99−1	6.39−1	7.73−1	8.99−1
	δ	−3.24−3	−3.73−3	−3.80−3	−2.95−3	−8.88−4	2.31−3	6.52−3	1.16−2	1.73−2	2.34−2
$5p_{3/2}$	σ	6.678+0	4.068+0	1.891+0	1.048+0	6.462−1	4.284−1	2.994−1	2.177−1	1.633−1	1.257−1
E_b =	β	1.670	1.723	1.755	1.751	1.733	1.707	1.678	1.648	1.617	1.585
22.3 eV	γ	4.46−2	−2.61−2	−1.70−2	9.47−2	2.45−1	4.07−1	5.69−1	7.24−1	8.73−1	1.01+0
	δ	−1.00−3	5.25−4	3.99−3	6.81−3	9.44−3	1.22−2	1.54−2	1.90−2	2.29−2	2.71−2
$6s_{1/2}$	σ	2.100−1	1.303−1	6.441−2	3.818−2	2.514−2	1.774−2	1.316−2	1.012−2	8.006−3	6.479−3
E_b =	β	1.933	1.938	1.944	1.950	1.956	1.960	1.964	1.966	1.968	1.970
6.0 eV	γ	2.77−1	1.82−1	2.78−2	−7.15−2	−1.26−1	−1.47−1	−1.43−1	−1.20−1	−8.26−2	−3.49−2
	δ	−4.95−4	−7.03−4	−9.92−4	−1.18−3	−1.32−3	−1.43−3	−1.52−3	−1.60−3	−1.66−3	−1.71−3
Z= 69, Tm: [Xe]$4f^6_{5/2}\,4f^7_{7/2}\,6s^2_{1/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$3d_{5/2}$	σ	5.454+2	3.961+2	1.283+2	5.411+1	2.692+1	1.495+1	8.973+0	5.714+0	3.810+0	2.637+0
E_b =	β	0.625	0.898	1.193	1.215	1.178	1.124	1.067	1.009	0.955	0.902
1467.7 eV	γ	−3.84−3	−1.79−1	1.07−1	4.34−1	7.01−1	9.15−1	1.09+0	1.23+0	1.35+0	1.45+0
	δ	−2.54−3	4.08−4	5.21−2	8.08−2	1.05−1	1.27−1	1.49−1	1.71−1	1.92−1	2.12−1
$4s_{1/2}$	σ	2.185+1	1.404+1	7.162+0	4.313+0	2.870+0	2.040+0	1.521+0	1.175+0	9.325−1	7.567−1
E_b =	β	1.921	1.927	1.936	1.943	1.949	1.955	1.959	1.963	1.965	1.967
471.7 eV	γ	4.32−1	3.09−1	1.07−1	−2.44−2	−1.03−1	−1.41−1	−1.51−1	−1.39−1	−1.11−1	−7.16−2
	δ	−3.34−4	−6.41−4	−1.02−3	−1.26−3	−1.43−3	−1.55−3	−1.65−3	−1.73−3	−1.80−3	−1.86−3
$4p_{1/2}$	σ	2.597+1	1.717+1	8.753+0	5.131+0	3.295+0	2.255+0	1.617+0	1.202+0	9.194−1	7.195−1
E_b =	β	1.589	1.658	1.691	1.679	1.652	1.620	1.586	1.552	1.517	1.483
385.9 eV	γ	2.12−1	6.60−2	−1.94−2	4.14−2	1.60−1	2.99−1	4.42−1	5.83−1	7.19−1	8.48−1
	δ	1.78−3	−2.16−3	−3.44−3	−2.83−3	−1.01−3	1.95−3	5.92−3	1.07−2	1.61−2	2.19−2
$4p_{3/2}$	σ	5.935+1	3.696+1	1.751+1	9.797+0	6.077+0	4.046+0	2.836+0	2.067+0	1.554+0	1.197+0
E_b =	β	1.583	1.669	1.733	1.743	1.732	1.712	1.687	1.659	1.630	1.600
336.6 eV	γ	1.25−1	8.08−3	−3.58−2	5.25−2	1.93−1	3.52−1	5.13−1	6.71−1	8.23−1	9.65−1

(*continued on next page*)

Table 1 (*continued*)

	δ	1.86−3	8.97−4	4.04−3	7.18−3	9.99−3	1.28−2	1.59−2	1.93−2	2.31−2	2.70−2
$4d_{3/2}$	σ	6.960+1	3.742+1	1.384+1	6.359+0	3.355+0	1.946+0	1.210+0	7.933−1	5.421−1	3.831−1
E_b =	β	1.300	1.363	1.364	1.313	1.249	1.183	1.119	1.057	0.999	0.944
185.5 eV	γ	−2.85−2	6.81−2	3.37−1	5.95−1	8.15−1	1.00+0	1.16+0	1.29+0	1.40+0	1.50+0
	δ	1.50−2	2.83−2	5.02−2	7.02−2	8.99−2	1.10−1	1.30−1	1.49−1	1.68−1	1.86−1
$4d_{5/2}$	σ	9.964+1	5.286+1	1.922+1	8.726+0	4.560+0	2.624+0	1.620+0	1.055+0	7.165−1	5.035−1
E_b =	β	1.331	1.360	1.323	1.252	1.178	1.107	1.041	0.980	0.923	0.870
175.7 eV	γ	−1.82−2	9.17−2	3.67−1	6.19−1	8.28−1	1.00+0	1.15+0	1.27+0	1.37+0	1.46+0
	δ	1.46−2	2.71−2	5.02−2	7.30−2	9.62−2	1.19−1	1.42−1	1.65−1	1.86−1	2.07−1
$4f_{5/2}$	σ	2.635+1	9.717+0	2.176+0	7.137−1	2.928−1	1.390−1	7.314−2	4.152−2	2.501−2	1.579−2
E_b =	β	1.061	1.024	0.916	0.813	0.726	0.653	0.590	0.535	0.485	0.440
6.2 eV	γ	3.75−1	5.34−1	7.72−1	9.31−1	1.04+0	1.13+0	1.20+0	1.26+0	1.30+0	1.34+0
	δ	1.01−1	1.27−1	1.75−1	2.22−1	2.65−1	3.06−1	3.44−1	3.80−1	4.14−1	4.46−1
$4f_{7/2}$	σ	3.313+1	1.216+1	2.703+0	8.813−1	3.597−1	1.700−1	8.910−2	5.042−2	3.027−2	1.906−2
E_b =	β	1.055	1.015	0.906	0.806	0.724	0.655	0.596	0.544	0.499	0.457
4.7 eV	γ	3.82−1	5.43−1	7.80−1	9.39−1	1.05+0	1.13+0	1.20+0	1.25+0	1.30+0	1.34+0
	δ	1.00−1	1.27−1	1.76−1	2.24−1	2.68−1	3.10−1	3.49−1	3.85−1	4.19−1	4.52−1
$5s_{1/2}$	σ	3.511+0	2.197+0	1.095+0	6.523−1	4.309−1	3.048−1	2.263−1	1.743−1	1.381−1	1.119−1
E_b =	β	1.928	1.933	1.940	1.946	1.952	1.957	1.961	1.964	1.966	1.968
53.2 eV	γ	3.01−1	2.05−1	4.65−2	−5.91−2	−1.20−1	−1.46−1	−1.47−1	−1.30−1	−9.76−2	−5.48−2
	δ	−4.97−4	−7.29−4	−1.05−3	−1.26−3	−1.42−3	−1.54−3	−1.63−3	−1.71−3	−1.78−3	−1.83−3
$5p_{1/2}$	σ	3.309+0	2.127+0	1.062+0	6.170−1	3.942−1	2.689−1	1.925−1	1.429−1	1.092−1	8.542−2
E_b =	β	1.674	1.708	1.712	1.689	1.658	1.623	1.587	1.551	1.516	1.481
36.2 eV	γ	1.15−1	1.78−2	−1.55−2	6.39−2	1.89−1	3.29−1	4.71−1	6.09−1	7.42−1	8.69−1
	δ	−3.32−3	−3.90−3	−4.06−3	−3.37−3	−1.54−3	1.41−3	5.34−3	1.01−2	1.55−2	2.14−2
$5p_{3/2}$	σ	6.841+0	4.183+0	1.956+0	1.088+0	6.725−1	4.468−1	3.127−1	2.278−1	1.711−1	1.319−1
E_b =	β	1.659	1.717	1.755	1.754	1.739	1.715	1.688	1.659	1.629	1.599
30.4 eV	γ	5.83−2	−2.00−2	−2.50−2	7.71−2	2.22−1	3.81−1	5.40−1	6.95−1	8.43−1	9.83−1
	δ	−1.14−3	2.78−4	3.84−3	6.74−3	9.35−3	1.20−2	1.50−2	1.83−2	2.20−2	2.60−2
$6s_{1/2}$	σ	2.105−1	1.310−1	6.503−2	3.865−2	2.550−2	1.802−2	1.337−2	1.030−2	8.151−3	6.600−3
E_b =	β	1.928	1.933	1.940	1.946	1.952	1.957	1.961	1.964	1.966	1.967
6.0 eV	γ	2.93−1	1.98−1	4.25−2	−6.14−2	−1.21−1	−1.47−1	−1.48−1	−1.30−1	−9.78−2	−5.42−2
	δ	−5.06−4	−7.35−4	−1.05−3	−1.26−3	−1.42−3	−1.54−3	−1.63−3	−1.72−3	−1.79−3	−1.84−3
Z= 70, Yb: [Xe]$4f^6_{5/2}$ $4f^8_{7/2}$ $6s^2_{1/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$4s_{1/2}$	σ	2.221+1	1.435+1	7.364+0	4.450+0	2.967+0	2.112+0	1.576+0	1.219+0	9.683−1	7.863−1
E_b =	β	1.915	1.921	1.931	1.938	1.945	1.951	1.956	1.959	1.962	1.964
487.2 eV	γ	4.54−1	3.32−1	1.27−1	−9.51−3	−9.36−2	−1.38−1	−1.53−1	−1.47−1	−1.24−1	−8.85−2
	δ	−3.10−4	−6.52−4	−1.07−3	−1.34−3	−1.53−3	−1.67−3	−1.78−3	−1.87−3	−1.94−3	−2.01−3
$4p_{1/2}$	σ	2.631+1	1.754+1	9.035+0	5.330+0	3.438+0	2.361+0	1.698+0	1.265+0	9.698−1	7.605−1
E_b =	β	1.577	1.651	1.690	1.681	1.657	1.627	1.594	1.561	1.528	1.495
396.7 eV	γ	2.37−1	8.34−2	−1.90−2	2.95−2	1.40−1	2.74−1	4.14−1	5.53−1	6.88−1	8.17−1
	δ	2.45−3	−2.07−3	−3.63−3	−3.20−3	−1.57−3	1.12−3	4.81−3	9.27−3	1.44−2	2.01−2
$4p_{3/2}$	σ	6.087+1	3.810+1	1.818+1	1.022+1	6.358+0	4.243+0	2.980+0	2.176+0	1.638+0	1.265+0
E_b =	β	1.569	1.661	1.731	1.745	1.737	1.719	1.696	1.670	1.642	1.613
343.5 eV	γ	1.40−1	1.86−2	−3.98−2	3.77−2	1.71−1	3.26−1	4.84−1	6.41−1	7.91−1	9.34−1
	δ	2.24−3	8.08−4	3.87−3	7.11−3	9.93−3	1.27−2	1.56−2	1.88−2	2.24−2	2.61−2
$4d_{3/2}$	σ	7.298+1	3.961+1	1.481+1	6.846+0	3.628+0	2.112+0	1.317+0	8.654−1	5.926−1	4.197−1
E_b =	β	1.287	1.358	1.368	1.322	1.261	1.198	1.135	1.075	1.018	0.963
198.1 eV	γ	−3.59−2	4.97−2	3.11−1	5.69−1	7.93−1	9.81−1	1.14+0	1.28+0	1.39+0	1.49+0
	δ	1.35−2	2.67−2	4.87−2	6.82−2	8.74−2	1.07−1	1.26−1	1.45−1	1.64−1	1.82−1
$4d_{5/2}$	σ	1.044+2	5.588+1	2.053+1	9.380+0	4.923+0	2.842+0	1.760+0	1.149+0	7.819−1	5.506−1
E_b =	β	1.324	1.359	1.329	1.262	1.189	1.120	1.055	0.994	0.938	0.885
184.9 eV	γ	−2.69−2	7.39−2	3.44−1	5.97−1	8.09−1	9.85−1	1.13+0	1.26+0	1.37+0	1.46+0
	δ	1.33−2	2.56−2	4.83−2	7.06−2	9.33−2	1.16−1	1.39−1	1.61−1	1.82−1	2.03−1
$4f_{5/2}$	σ	2.959+1	1.100+1	2.484+0	8.188−1	3.370−1	1.605−1	8.466−2	4.818−2	2.908−2	1.840−2
E_b =	β	1.061	1.029	0.926	0.825	0.738	0.665	0.601	0.546	0.495	0.450
7.0 eV	γ	3.60−1	5.20−1	7.63−1	9.28−1	1.05+0	1.13+0	1.20+0	1.26+0	1.31+0	1.35+0
	δ	9.91−2	1.25−1	1.73−1	2.18−1	2.62−1	3.02−1	3.40−1	3.75−1	4.08−1	4.40−1
$4f_{7/2}$	σ	3.719+1	1.377+1	3.089+0	1.012+0	4.146−1	1.965−1	1.033−1	5.856−2	3.524−2	2.223−2
E_b =	β	1.056	1.020	0.915	0.817	0.735	0.666	0.606	0.554	0.508	0.466
5.8 eV	γ	3.68−1	5.29−1	7.72−1	9.36−1	1.05+0	1.14+0	1.21+0	1.26+0	1.31+0	1.34+0
	δ	9.90−2	1.25−1	1.74−1	2.20−1	2.65−1	3.06−1	3.44−1	3.80−1	4.14−1	4.46−1
$5s_{1/2}$	σ	3.571+0	2.242+0	1.123+0	6.707−1	4.439−1	3.144−1	2.337−1	1.801−1	1.428−1	1.158−1
E_b =	β	1.923	1.928	1.935	1.942	1.948	1.953	1.957	1.961	1.963	1.965
54.1 eV	γ	3.16−1	2.21−1	6.21−2	−4.80−2	−1.14−1	−1.46−1	−1.52−1	−1.39−1	−1.11−1	−7.25−2
	δ	−5.04−4	−7.58−4	−1.11−3	−1.35−3	−1.52−3	−1.66−3	−1.76−3	−1.84−3	−1.91−3	−1.97−3

(*continued on next page*)

Table 1 (*continued*)

$5p_{1/2}$	σ	3.329+0	2.154+0	1.085+0	6.343−1	4.070−1	2.786−1	1.999−1	1.488−1	1.139−1	8.931−2
E_b =	β	1.668	1.705	1.713	1.693	1.663	1.630	1.595	1.560	1.526	1.492
27.4 eV	γ	1.30−1	2.74−2	−1.83−2	5.14−2	1.70−1	3.05−1	4.45−1	5.81−1	7.13−1	8.39−1
	δ	−3.41−3	−4.06−3	−4.30−3	−3.74−3	−2.11−3	5.94−4	4.24−3	8.69−3	1.38−2	1.94−2
$5p_{3/2}$	σ	6.948+0	4.268+0	2.008+0	1.122+0	6.961−1	4.636−1	3.252−1	2.373−1	1.785−1	1.378−1
E_b =	β	1.651	1.712	1.754	1.757	1.744	1.722	1.697	1.669	1.640	1.611
21.4 eV	γ	6.81−2	−1.43−2	−3.07−2	6.24−2	2.01−1	3.56−1	5.13−1	6.67−1	8.14−1	9.54−1
	δ	−1.24−3	8.26−5	3.71−3	6.70−3	9.31−3	1.19−2	1.47−2	1.78−2	2.13−2	2.50−2
$6s_{1/2}$	σ	2.108−1	1.316−1	6.562−2	3.911−2	2.585−2	1.829−2	1.359−2	1.047−2	8.295−3	6.721−3
E_b =	β	1.923	1.928	1.935	1.942	1.948	1.953	1.957	1.960	1.963	1.964
6.0 eV	γ	3.08−1	2.15−1	5.79−2	−5.05−2	−1.15−1	−1.46−1	−1.52−1	−1.39−1	−1.12−1	−7.23−2
	δ	−5.15−4	−7.66−4	−1.12−3	−1.35−3	−1.52−3	−1.65−3	−1.75−3	−1.85−3	−1.93−3	−1.99−3

Z= 71, Lu: [Xe]$4f^6_{5/2}$ $4f^8_{7/2}$ $5d^1_{3/2}$ $6s^2_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$4s_{1/2}$	σ	2.258+1	1.466+1	7.572+0	4.592+0	3.069+0	2.189+0	1.635+0	1.266+0	1.007+0	8.180−1
E_b =	β	1.908	1.916	1.926	1.934	1.941	1.947	1.952	1.956	1.959	1.961
506.2 eV	γ	4.74−1	3.53−1	1.47−1	6.37−3	−8.30−2	−1.33−1	−1.54−1	−1.53−1	−1.35−1	−1.04−1
	δ	−2.89−4	−6.67−4	−1.13−3	−1.42−3	−1.63−3	−1.78−3	−1.90−3	−2.01−3	−2.09−3	−2.17−3
$4p_{1/2}$	σ	2.667+1	1.792+1	9.326+0	5.538+0	3.589+0	2.473+0	1.784+0	1.333+0	1.024+0	8.044−1
E_b =	β	1.564	1.644	1.689	1.683	1.661	1.633	1.602	1.569	1.537	1.504
410.1 eV	γ	2.58−1	1.00−1	−1.73−2	1.92−2	1.22−1	2.51−1	3.88−1	5.26−1	6.60−1	7.88−1
	δ	3.15−3	−1.96−3	−3.82−3	−3.49−3	−2.03−3	4.94−4	3.96−3	8.19−3	1.30−2	1.83−2
$4p_{3/2}$	σ	6.261+1	3.939+1	1.893+1	1.068+1	6.669+0	4.462+0	3.140+0	2.297+0	1.732+0	1.339+0
E_b =	β	1.553	1.651	1.728	1.746	1.741	1.725	1.704	1.679	1.652	1.624
359.3 eV	γ	1.57−1	3.01−2	−4.26−2	2.39−2	1.50−1	3.00−1	4.57−1	6.13−1	7.63−1	9.06−1
	δ	2.74−3	7.49−4	3.70−3	7.03−3	9.92−3	1.27−2	1.56−2	1.86−2	2.19−2	2.54−2
$4d_{3/2}$	σ	7.615+1	4.174+1	1.580+1	7.358+0	3.919+0	2.291+0	1.433+0	9.443−1	6.482−1	4.601−1
E_b =	β	1.275	1.353	1.372	1.331	1.273	1.211	1.149	1.089	1.033	0.979
204.8 eV	γ	−4.02−2	3.58−2	2.90−1	5.48−1	7.73−1	9.64−1	1.13+0	1.26+0	1.38+0	1.48+0
	δ	1.23−2	2.54−2	4.75−2	6.69−2	8.58−2	1.05−1	1.23−1	1.41−1	1.59−1	1.77−1
$4d_{5/2}$	σ	1.093+2	5.902+1	2.193+1	1.009+1	5.320+0	3.082+0	1.914+0	1.253+0	8.545−1	6.029−1
E_b =	β	1.317	1.358	1.334	1.271	1.200	1.131	1.066	1.005	0.949	0.898
195.0 eV	γ	−3.33−2	5.88−2	3.24−1	5.77−1	7.92−1	9.71−1	1.12+0	1.25+0	1.36+0	1.45+0
	δ	1.22−2	2.42−2	4.69−2	6.91−2	9.14−2	1.14−1	1.36−1	1.57−1	1.78−1	1.98−1
$4f_{5/2}$	σ	3.420+1	1.285+1	2.941+0	9.762−1	4.036−1	1.929−1	1.021−1	5.826−2	3.526−2	2.236−2
E_b =	β	1.061	1.033	0.934	0.834	0.747	0.673	0.610	0.555	0.505	0.460
7.8 eV	γ	3.45−1	5.06−1	7.53−1	9.23−1	1.04+0	1.13+0	1.21+0	1.27+0	1.32+0	1.36+0
	δ	9.72−2	1.23−1	1.70−1	2.15−1	2.57−1	2.97−1	3.34−1	3.70−1	4.04−1	4.35−1
$4f_{7/2}$	σ	4.331+1	1.621+1	3.685+0	1.216+0	5.003−1	2.380−1	1.254−1	7.134−2	4.304−2	2.722−2
E_b =	β	1.056	1.024	0.923	0.825	0.742	0.673	0.614	0.562	0.517	0.475
6.2 eV	γ	3.54−1	5.15−1	7.63−1	9.31−1	1.05+0	1.14+0	1.21+0	1.27+0	1.31+0	1.35+0
	δ	9.71−2	1.23−1	1.71−1	2.17−1	2.60−1	3.01−1	3.39−1	3.75−1	4.09−1	4.42−1
$5s_{1/2}$	σ	3.789+0	2.385+0	1.200+0	7.186−1	4.765−1	3.380−1	2.515−1	1.941−1	1.539−1	1.249−1
E_b =	β	1.917	1.923	1.931	1.938	1.944	1.949	1.954	1.957	1.960	1.962
56.8 eV	γ	3.30−1	2.38−1	7.73−2	−3.58−2	−1.06−1	−1.43−1	−1.55−1	−1.47−1	−1.24−1	−8.90−2
	δ	−5.18−4	−7.94−4	−1.17−3	−1.43−3	−1.62−3	−1.77−3	−1.88−3	−1.98−3	−2.06−3	−2.13−3
$5p_{1/2}$	σ	3.559+0	2.315+0	1.176+0	6.912−1	4.454−1	3.058−1	2.201−1	1.642−1	1.260−1	9.890−2
E_b =	β	1.661	1.702	1.714	1.696	1.668	1.637	1.603	1.569	1.536	1.503
33.0 eV	γ	1.47−1	3.89−2	−2.02−2	3.89−2	1.50−1	2.81−1	4.18−1	5.54−1	6.85−1	8.11−1
	δ	−3.49−3	−4.25−3	−4.52−3	−4.05−3	−2.58−3	−6.52−5	3.40−3	7.67−3	1.25−2	1.79−2
$5p_{3/2}$	σ	7.631+0	4.703+0	2.225+0	1.248+0	7.765−1	5.184−1	3.643−1	2.663−1	2.007−1	1.550−1
E_b =	β	1.642	1.705	1.753	1.759	1.749	1.730	1.706	1.680	1.652	1.624
25.8 eV	γ	7.98−2	−7.61−3	−3.57−2	4.74−2	1.80−1	3.30−1	4.86−1	6.39−1	7.86−1	9.27−1
	δ	−1.35−3	−1.50−4	3.56−3	6.64−3	9.29−3	1.19−2	1.47−2	1.77−2	2.10−2	2.46−2
$5d_{3/2}$	σ	2.533+0	1.388+0	5.282−1	2.470−1	1.319−1	7.724−2	4.840−2	3.194−2	2.196−2	1.561−2
E_b =	β	1.343	1.392	1.387	1.337	1.274	1.210	1.148	1.089	1.033	0.981
4.6 eV	γ	−2.47−2	6.06−2	3.16−1	5.69−1	7.89−1	9.76−1	1.13+0	1.27+0	1.39+0	1.49+0
	δ	1.26−2	2.48−2	4.58−2	6.46−2	8.30−2	1.01−1	1.20−1	1.39−1	1.58−1	1.77−1
$6s_{1/2}$	σ	2.607−1	1.632−1	8.164−2	4.878−2	3.230−2	2.288−2	1.701−2	1.311−2	1.040−2	8.428−3
E_b =	β	1.918	1.923	1.931	1.938	1.944	1.949	1.953	1.957	1.959	1.961
7.0 eV	γ	3.23−1	2.32−1	7.30−2	−3.89−2	−1.09−1	−1.46−1	−1.57−1	−1.48−1	−1.24−1	−8.86−2
	δ	−5.32−4	−8.03−4	−1.18−3	−1.44−3	−1.63−3	−1.78−3	−1.89−3	−1.99−3	−2.08−3	−2.14−3

Z= 72, Hf: [Xe]$4f^6_{5/2}$ $4f^8_{7/2}$ $5d^2_{3/2}$ $6s^2_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$4s_{1/2}$	σ	2.302+1	1.502+1	7.801+0	4.746+0	3.179+0	2.270+0	1.698+0	1.316+0	1.047+0	8.514−1
E_b =	β	1.900	1.909	1.920	1.929	1.936	1.942	1.947	1.951	1.955	1.957

(*continued on next page*)

Table 1 (*continued*)

538.1 eV	γ	5.01−1	3.79−1	1.71−1	2.44−2	−7.11−2	−1.27−1	−1.54−1	−1.59−1	−1.46−1	−1.19−1
	δ	−2.50−4	−6.75−4	−1.19−3	−1.51−3	−1.74−3	−1.91−3	−2.05−3	−2.16−3	−2.26−3	−2.34−3
$4p_{1/2}$	σ	2.708+1	1.835+1	9.645+0	5.764+0	3.753+0	2.595+0	1.877+0	1.405+0	1.082+0	8.514−1
E_b =	β	1.545	1.635	1.687	1.685	1.665	1.639	1.609	1.578	1.546	1.514
437.0 eV	γ	2.87−1	1.23−1	−1.36−2	9.52−3	1.04−1	2.27−1	3.62−1	4.98−1	6.30−1	7.57−1
	δ	4.24−3	−1.75−3	−3.99−3	−3.83−3	−2.54−3	−2.22−4	2.99−3	6.95−3	1.15−2	1.65−2
$4p_{3/2}$	σ	6.450+1	4.077+1	1.972+1	1.118+1	6.999+0	4.694+0	3.309+0	2.425+0	1.831+0	1.417+0
E_b =	β	1.534	1.640	1.724	1.746	1.744	1.731	1.711	1.688	1.663	1.636
380.4 eV	γ	1.76−1	4.35−2	−4.41−2	1.09−2	1.30−1	2.76−1	4.30−1	5.84−1	7.33−1	8.76−1
	δ	3.41−3	7.22−4	3.51−3	6.95−3	9.91−3	1.27−2	1.55−2	1.84−2	2.15−2	2.46−2
$4d_{3/2}$	σ	8.002+1	4.427+1	1.694+1	7.944+0	4.251+0	2.493+0	1.564+0	1.033+0	7.107−1	5.054−1
E_b =	β	1.260	1.347	1.375	1.339	1.284	1.224	1.164	1.105	1.049	0.997
223.8 eV	γ	−4.41−2	2.03−2	2.66−1	5.23−1	7.51−1	9.45−1	1.11+0	1.25+0	1.37+0	1.48+0
	δ	1.10−2	2.39−2	4.60−2	6.53−2	8.37−2	1.02−1	1.20−1	1.37−1	1.55−1	1.72−1
$4d_{5/2}$	σ	1.149+2	6.260+1	2.350+1	1.088+1	5.761+0	3.349+0	2.085+0	1.368+0	9.349−1	6.608−1
E_b =	β	1.309	1.357	1.340	1.280	1.211	1.143	1.078	1.018	0.962	0.911
213.7 eV	γ	−3.94−2	4.25−2	3.01−1	5.55−1	7.73−1	9.54−1	1.11+0	1.24+0	1.35+0	1.44+0
	δ	1.10−2	2.28−2	4.52−2	6.71−2	8.90−2	1.11−1	1.32−1	1.53−1	1.73−1	1.93−1
$4f_{5/2}$	σ	3.973+1	1.506+1	3.480+0	1.161+0	4.817−1	2.308−1	1.224−1	7.006−2	4.250−2	2.701−2
E_b =	β	1.060	1.038	0.943	0.844	0.757	0.684	0.621	0.565	0.516	0.472
18.2 eV	γ	3.31−1	4.91−1	7.43−1	9.17−1	1.04+0	1.14+0	1.21+0	1.27+0	1.32+0	1.37+0
	δ	9.58−2	1.21−1	1.68−1	2.11−1	2.53−1	2.92−1	3.30−1	3.65−1	3.99−1	4.31−1
$4f_{7/2}$	σ	5.055+1	1.908+1	4.381+0	1.453+0	5.998−1	2.861−1	1.512−1	8.617−2	5.210−2	3.302−2
E_b =	β	1.056	1.029	0.932	0.835	0.752	0.682	0.623	0.572	0.526	0.485
16.3 eV	γ	3.40−1	5.01−1	7.53−1	9.27−1	1.05+0	1.14+0	1.21+0	1.27+0	1.32+0	1.36+0
	δ	9.57−2	1.21−1	1.68−1	2.13−1	2.56−1	2.96−1	3.35−1	3.71−1	4.05−1	4.37−1
$5s_{1/2}$	σ	4.022+0	2.536+0	1.280+0	7.691−1	5.110−1	3.629−1	2.703−1	2.087−1	1.657−1	1.345−1
E_b =	β	1.911	1.917	1.926	1.933	1.939	1.945	1.949	1.953	1.956	1.958
64.9 eV	γ	3.46−1	2.55−1	9.39−2	−2.28−2	−9.82−2	−1.40−1	−1.57−1	−1.54−1	−1.35−1	−1.05−1
	δ	−5.29−4	−8.28−4	−1.24−3	−1.52−3	−1.73−3	−1.89−3	−2.02−3	−2.13−3	−2.22−3	−2.30−3
$5p_{1/2}$	σ	3.784+0	2.474+0	1.266+0	7.489−1	4.846−1	3.339−1	2.409−1	1.801−1	1.384−1	1.089−1
E_b =	β	1.655	1.698	1.714	1.699	1.674	1.643	1.611	1.578	1.545	1.513
38.2 eV	γ	1.65−1	5.14−2	−2.07−2	2.80−2	1.32−1	2.59−1	3.93−1	5.28−1	6.58−1	7.83−1
	δ	−3.59−3	−4.44−3	−4.76−3	−4.38−3	−3.07−3	−7.53−4	2.49−3	6.50−3	1.11−2	1.62−2
$5p_{3/2}$	σ	8.322+0	5.144+0	2.447+0	1.378+0	8.597−1	5.753−1	4.050−1	2.965−1	2.238−1	1.731−1
E_b =	β	1.632	1.699	1.751	1.761	1.753	1.736	1.714	1.689	1.663	1.635
29.0 eV	γ	9.14−2	−1.84−4	−3.97−2	3.40−2	1.60−1	3.07−1	4.60−1	6.12−1	7.59−1	9.00−1
	δ	−1.44−3	−3.77−4	3.40−3	6.59−3	9.30−3	1.19−2	1.46−2	1.75−2	2.07−2	2.40−2
$5d_{3/2}$	σ	3.459+0	1.912+0	7.356−1	3.465−1	1.860−1	1.093−1	6.872−2	4.548−2	3.134−2	2.231−2
E_b =	β	1.337	1.390	1.392	1.347	1.288	1.226	1.165	1.106	1.051	0.997
6.6 eV	γ	−2.95−2	4.70−2	2.92−1	5.45−1	7.67−1	9.58−1	1.12+0	1.26+0	1.38+0	1.49+0
	δ	1.14−2	2.36−2	4.42−2	6.27−2	8.09−2	9.93−2	1.18−1	1.36−1	1.55−1	1.73−1
$6s_{1/2}$	σ	2.979−1	1.867−1	9.374−2	5.616−2	3.725−2	2.642−2	1.966−2	1.517−2	1.203−2	9.759−3
E_b =	β	1.912	1.918	1.926	1.933	1.939	1.944	1.949	1.953	1.956	1.958
7.0 eV	γ	3.37−1	2.47−1	8.83−2	−2.70−2	−1.02−1	−1.43−1	−1.59−1	−1.55−1	−1.35−1	−1.03−1
	δ	−5.49−4	−8.41−4	−1.25−3	−1.54−3	−1.75−3	−1.91−3	−2.04−3	−2.14−3	−2.23−3	−2.30−3

Z= 73, Ta: [Xe]$4f^6_{5/2}$ $4f^8_{7/2}$ $5d^3_{3/2}$ $6s^2_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$4s_{1/2}$	σ	2.341+1	1.535+1	8.018+0	4.896+0	3.287+0	2.351+0	1.761+0	1.365+0	1.088+0	8.850−1
E_b =	β	1.892	1.903	1.915	1.923	1.931	1.937	1.943	1.947	1.951	1.954
565.5 eV	γ	5.25−1	4.03−1	1.94−1	4.29−2	−5.81−2	−1.20−1	−1.53−1	−1.62−1	−1.54−1	−1.32−1
	δ	−2.06−4	−6.81−4	−1.24−3	−1.60−3	−1.85−3	−2.04−3	−2.20−3	−2.32−3	−2.43−3	−2.52−3
$4p_{1/2}$	σ	2.744+1	1.876+1	9.962+0	5.992+0	3.919+0	2.719+0	1.972+0	1.480+0	1.142+0	9.003−1
E_b =	β	1.526	1.626	1.684	1.686	1.669	1.645	1.616	1.586	1.555	1.524
464.8 eV	γ	3.16−1	1.46−1	−7.93−3	1.40−3	8.63−2	2.04−1	3.35−1	4.69−1	6.00−1	7.25−1
	δ	5.47−3	−1.48−3	−4.16−3	−4.14−3	−3.02−3	−9.18−4	2.05−3	5.76−3	9.99−3	1.47−2
$4p_{3/2}$	σ	6.648+1	4.221+1	2.054+1	1.169+1	7.343+0	4.936+0	3.487+0	2.559+0	1.935+0	1.499+0
E_b =	β	1.513	1.628	1.719	1.746	1.747	1.736	1.719	1.697	1.673	1.647
404.5 eV	γ	1.95−1	5.85−2	−4.43−2	−1.29−3	1.10−1	2.51−1	4.02−1	5.54−1	7.02−1	8.44−1
	δ	4.21−3	7.30−4	3.30−3	6.85−3	9.89−3	1.26−2	1.54−2	1.81−2	2.10−2	2.40−2
$4d_{3/2}$	σ	8.387+1	4.684+1	1.812+1	8.557+0	4.600+0	2.708+0	1.703+0	1.128+0	7.778−1	5.542−1
E_b =	β	1.245	1.340	1.377	1.347	1.296	1.237	1.178	1.121	1.066	1.014
241.3 eV	γ	−4.61−2	6.40−3	2.41−1	4.98−1	7.27−1	9.24−1	1.09+0	1.23+0	1.36+0	1.47+0
	δ	9.74−3	2.25−2	4.46−2	6.36−2	8.17−2	9.93−2	1.17−1	1.34−1	1.51−1	1.67−1
$4d_{5/2}$	σ	1.204+2	6.615+1	2.510+1	1.169+1	6.221+0	3.629+0	2.265+0	1.489+0	1.020+0	7.227−1
E_b =	β	1.300	1.355	1.344	1.288	1.221	1.154	1.090	1.031	0.976	0.925
229.3 eV	γ	−4.35−2	2.79−2	2.78−1	5.32−1	7.53−1	9.37−1	1.09+0	1.22+0	1.34+0	1.44+0
	δ	9.93−3	2.14−2	4.35−2	6.50−2	8.65−2	1.08−1	1.29−1	1.49−1	1.69−1	1.89−1

(*continued on next page*)

Table 1 (*continued*)

$4f_{5/2}$	σ	4.565+1	1.745+1	4.076+0	1.368+0	5.696−1	2.737−1	1.456−1	8.349−2	5.076−2	3.233−2
E_b =	β	1.059	1.042	0.952	0.855	0.768	0.695	0.631	0.577	0.527	0.482
27.5 eV	γ	3.16−1	4.75−1	7.32−1	9.12−1	1.04+0	1.14+0	1.22+0	1.28+0	1.33+0	1.38+0
	δ	9.40−2	1.19−1	1.65−1	2.08−1	2.49−1	2.88−1	3.25−1	3.61−1	3.94−1	4.26−1
$4f_{7/2}$	σ	5.829+1	2.220+1	5.149+0	1.718+0	7.116−1	3.404−1	1.803−1	1.030−1	6.241−2	3.963−2
E_b =	β	1.055	1.033	0.940	0.845	0.762	0.692	0.633	0.582	0.536	0.495
25.6 eV	γ	3.25−1	4.86−1	7.43−1	9.22−1	1.05+0	1.14+0	1.22+0	1.28+0	1.33+0	1.37+0
	δ	9.39−2	1.19−1	1.66−1	2.10−1	2.53−1	2.92−1	3.30−1	3.67−1	4.01−1	4.32−1
$5s_{1/2}$	σ	4.255+0	2.688+0	1.362+0	8.205−1	5.462−1	3.885−1	2.897−1	2.239−1	1.778−1	1.444−1
E_b =	β	1.905	1.912	1.921	1.928	1.934	1.940	1.945	1.949	1.952	1.955
71.1 eV	γ	3.60−1	2.72−1	1.11−1	−9.22−3	−8.92−2	−1.36−1	−1.58−1	−1.59−1	−1.45−1	−1.19−1
	δ	−5.40−4	−8.62−4	−1.31−3	−1.62−3	−1.85−3	−2.03−3	−2.17−3	−2.29−3	−2.40−3	−2.48−3
$5p_{1/2}$	σ	4.009+0	2.633+0	1.359+0	8.080−1	5.251−1	3.629−1	2.625−1	1.967−1	1.515−1	1.194−1
E_b =	β	1.648	1.695	1.715	1.702	1.678	1.649	1.618	1.587	1.555	1.523
43.7 eV	γ	1.83−1	6.49−2	−1.99−2	1.82−2	1.15−1	2.37−1	3.68−1	5.00−1	6.30−1	7.54−1
	δ	−3.68−3	−4.61−3	−4.98−3	−4.71−3	−3.56−3	−1.45−3	1.55−3	5.31−3	9.62−3	1.44−2
$5p_{3/2}$	σ	9.034+0	5.598+0	2.676+0	1.513+0	9.466−1	6.348−1	4.477−1	3.282−1	2.480−1	1.921−1
E_b =	β	1.622	1.692	1.749	1.762	1.757	1.742	1.722	1.698	1.673	1.646
34.7 eV	γ	1.04−1	8.25−3	−4.27−2	2.14−2	1.40−1	2.83−1	4.34−1	5.85−1	7.31−1	8.71−1
	δ	−1.54−3	−6.15−4	3.22−3	6.53−3	9.30−3	1.19−2	1.45−2	1.73−2	2.02−2	2.33−2
$5d_{3/2}$	σ	4.317+0	2.406+0	9.363−1	4.443−1	2.397−1	1.415−1	8.922−2	5.919−2	4.088−2	2.917−2
E_b =	β	1.330	1.388	1.397	1.356	1.300	1.240	1.180	1.122	1.066	1.013
5.7 eV	γ	−3.31−2	3.49−2	2.71−1	5.22−1	7.46−1	9.40−1	1.11+0	1.25+0	1.37+0	1.48+0
	δ	1.03−2	2.24−2	4.29−2	6.12−2	7.92−2	9.72−2	1.15−1	1.33−1	1.51−1	1.68−1
$6s_{1/2}$	σ	3.302−1	2.072−1	1.043−1	6.267−2	4.164−2	2.957−2	2.203−2	1.701−2	1.350−2	1.096−2
E_b =	β	1.906	1.912	1.920	1.928	1.934	1.940	1.945	1.949	1.952	1.955
8.0 eV	γ	3.51−1	2.63−1	1.04−1	−1.42−2	−9.33−2	−1.40−1	−1.60−1	−1.60−1	−1.44−1	−1.17−1
	δ	−5.66−4	−8.79−4	−1.33−3	−1.64−3	−1.87−3	−2.04−3	−2.18−3	−2.29−3	−2.39−3	−2.46−3

Z= 74, W : [Xe]$4f^6_{5/2}$ $4f^8_{7/2}$ $5d^4_{3/2}$ $6s^2_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$4s_{1/2}$	σ	2.379+1	1.568+1	8.236+0	5.047+0	3.396+0	2.434+0	1.825+0	1.416+0	1.129+0	9.195−1
E_b =	β	1.884	1.896	1.909	1.918	1.925	1.932	1.938	1.942	1.946	1.950
595.0 eV	γ	5.50−1	4.28−1	2.17−1	6.26−2	−4.36−2	−1.12−1	−1.50−1	−1.65−1	−1.61−1	−1.44−1
	δ	−1.50−4	−6.82−4	−1.30−3	−1.69−3	−1.97−3	−2.18−3	−2.35−3	−2.49−3	−2.61−3	−2.71−3
$4p_{1/2}$	σ	2.777+1	1.914+1	1.027+1	6.219+0	4.086+0	2.845+0	2.070+0	1.557+0	1.203+0	9.506−1
E_b =	β	1.507	1.617	1.681	1.687	1.673	1.650	1.623	1.594	1.564	1.534
491.6 eV	γ	3.44−1	1.70−1	−4.96−4	−5.01−3	7.03−2	1.82−1	3.09−1	4.40−1	5.69−1	6.94−1
	δ	6.82−3	−1.17−3	−4.31−3	−4.44−3	−3.48−3	−1.57−3	1.17−3	4.61−3	8.65−3	1.31−2
$4p_{3/2}$	σ	6.838+1	4.361+1	2.136+1	1.221+1	7.692+0	5.182+0	3.668+0	2.696+0	2.042+0	1.584+0
E_b =	β	1.494	1.617	1.714	1.745	1.750	1.741	1.726	1.705	1.683	1.658
425.3 eV	γ	2.13−1	7.33−2	−4.31−2	−1.18−2	9.10−2	2.26−1	3.74−1	5.24−1	6.71−1	8.12−1
	δ	5.05−3	7.77−4	3.09−3	6.74−3	9.86−3	1.27−2	1.53−2	1.80−2	2.07−2	2.35−2
$4d_{3/2}$	σ	8.775+1	4.946+1	1.936+1	9.201+0	4.970+0	2.936+0	1.853+0	1.230+0	8.498−1	6.068−1
E_b =	β	1.229	1.333	1.379	1.354	1.306	1.251	1.193	1.137	1.083	1.032
258.8 eV	γ	−4.63−2	−6.06−3	2.17−1	4.72−1	7.03−1	9.03−1	1.07+0	1.22+0	1.35+0	1.46+0
	δ	8.61−3	2.10−2	4.31−2	6.20−2	7.98−2	9.70−2	1.14−1	1.30−1	1.47−1	1.63−1
$4d_{5/2}$	σ	1.259+2	6.980+1	2.677+1	1.255+1	6.708+0	3.926+0	2.458+0	1.620+0	1.112+0	7.891−1
E_b =	β	1.292	1.352	1.349	1.296	1.232	1.166	1.103	1.044	0.989	0.939
245.4 eV	γ	−4.62−2	1.44−2	2.56−1	5.09−1	7.32−1	9.19−1	1.08+0	1.21+0	1.33+0	1.43+0
	δ	8.95−3	2.00−2	4.18−2	6.30−2	8.42−2	1.05−1	1.25−1	1.45−1	1.65−1	1.84−1
$4f_{5/2}$	σ	5.206+1	2.008+1	4.740+0	1.600+0	6.687−1	3.223−1	1.718−1	9.876−2	6.017−2	3.840−2
E_b =	β	1.058	1.045	0.961	0.866	0.779	0.706	0.642	0.587	0.538	0.492
37.4 eV	γ	3.00−1	4.59−1	7.20−1	9.06−1	1.04+0	1.14+0	1.22+0	1.28+0	1.34+0	1.38+0
	δ	9.20−2	1.17−1	1.63−1	2.06−1	2.46−1	2.84−1	3.21−1	3.56−1	3.90−1	4.21−1
$4f_{7/2}$	σ	6.659+1	2.559+1	5.999+0	2.013+0	8.370−1	4.015−1	2.131−1	1.220−1	7.410−2	4.714−2
E_b =	β	1.055	1.037	0.949	0.855	0.772	0.702	0.643	0.591	0.546	0.504
35.1 eV	γ	3.09−1	4.70−1	7.32−1	9.16−1	1.05+0	1.15+0	1.22+0	1.28+0	1.34+0	1.38+0
	δ	9.20−2	1.17−1	1.63−1	2.07−1	2.49−1	2.88−1	3.26−1	3.62−1	3.96−1	4.28−1
$5s_{1/2}$	σ	4.491+0	2.842+0	1.445+0	8.728−1	5.822−1	4.147−1	3.096−1	2.394−1	1.903−1	1.547−1
E_b =	β	1.899	1.906	1.915	1.923	1.929	1.935	1.940	1.945	1.948	1.951
77.1 eV	γ	3.75−1	2.88−1	1.28−1	5.15−3	−7.90−2	−1.31−1	−1.58−1	−1.64−1	−1.54−1	−1.32−1
	δ	−5.50−4	−8.97−4	−1.38−3	−1.72−3	−1.97−3	−2.17−3	−2.33−3	−2.46−3	−2.58−3	−2.67−3
$5p_{1/2}$	σ	4.230+0	2.791+0	1.451+0	8.677−1	5.663−1	3.928−1	2.849−1	2.139−1	1.651−1	1.303−1
E_b =	β	1.642	1.691	1.715	1.705	1.683	1.655	1.626	1.595	1.564	1.533
46.7 eV	γ	2.00−1	7.86−2	−1.79−2	9.85−3	9.86−2	2.15−1	3.44−1	4.74−1	6.01−1	7.24−1
	δ	−3.78−3	−4.80−3	−5.21−3	−5.02−3	−4.02−3	−2.11−3	6.61−4	4.17−3	8.21−3	1.27−2

(*continued on next page*)

Table 1 (*continued*)

$5p_{3/2}$	σ	9.743+0	6.052+0	2.908+0	1.650+0	1.035+0	6.960−1	4.918−1	3.611−1	2.733−1	2.119−1
E_b =	β	1.613	1.686	1.747	1.763	1.760	1.748	1.729	1.707	1.683	1.658
36.5 eV	γ	1.15−1	1.66−2	−4.46−2	1.00−2	1.22−1	2.60−1	4.08−1	5.57−1	7.02−1	8.41−1
	δ	−1.61−3	−8.46−4	3.04−3	6.47−3	9.31−3	1.19−2	1.44−2	1.71−2	1.99−2	2.27−2
$5d_{3/2}$	σ	5.161+0	2.899+0	1.141+0	5.453−1	2.957−1	1.752−1	1.108−1	7.372−2	5.103−2	3.649−2
E_b =	β	1.323	1.385	1.401	1.365	1.311	1.253	1.195	1.137	1.082	1.029
6.1 eV	γ	−3.57−2	2.35−2	2.50−1	4.99−1	7.24−1	9.21−1	1.09+0	1.23+0	1.36+0	1.47+0
	δ	9.27−3	2.12−2	4.16−2	5.97−2	7.73−2	9.49−2	1.12−1	1.30−1	1.47−1	1.63−1
$6s_{1/2}$	σ	3.593−1	2.257−1	1.139−1	6.861−2	4.567−2	3.248−2	2.422−2	1.871−2	1.486−2	1.207−2
E_b =	β	1.899	1.906	1.915	1.922	1.929	1.935	1.940	1.945	1.949	1.952
8.0 eV	γ	3.65−1	2.79−1	1.21−1	−5.43−4	−8.37−2	−1.34−1	−1.59−1	−1.63−1	−1.52−1	−1.29−1
	δ	−5.80−4	−9.17−4	−1.40−3	−1.74−3	−1.99−3	−2.18−3	−2.33−3	−2.45−3	−2.56−3	−2.64−3

Z= 75, Re: [Xe]$4f^6_{5/2}\,4f^8_{7/2}\,5d^4_{3/2}\,5d^1_{5/2}\,6s^2_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$4s_{1/2}$	σ	2.414+1	1.599+1	8.450+0	5.196+0	3.505+0	2.516+0	1.890+0	1.468+0	1.171+0	9.544−1
E_b =	β	1.874	1.888	1.902	1.912	1.920	1.926	1.932	1.937	1.942	1.945
625.0 eV	γ	5.74−1	4.53−1	2.42−1	8.33−2	−2.80−2	−1.01−1	−1.45−1	−1.65−1	−1.67−1	−1.54−1
	δ	−7.97−5	−6.75−4	−1.36−3	−1.78−3	−2.09−3	−2.32−3	−2.51−3	−2.66−3	−2.80−3	−2.90−3
$4p_{1/2}$	σ	2.803+1	1.949+1	1.057+1	6.441+0	4.252+0	2.972+0	2.168+0	1.635+0	1.266+0	1.002+0
E_b =	β	1.487	1.606	1.678	1.687	1.675	1.655	1.629	1.602	1.573	1.544
517.9 eV	γ	3.71−1	1.96−1	8.57−3	−9.70−3	5.58−2	1.61−1	2.83−1	4.11−1	5.38−1	6.62−1
	δ	8.30−3	−7.97−4	−4.46−3	−4.72−3	−3.90−3	−2.18−3	3.64−4	3.57−3	7.34−3	1.16−2
$4p_{3/2}$	σ	7.025+1	4.500+1	2.217+1	1.273+1	8.046+0	5.434+0	3.854+0	2.837+0	2.152+0	1.671+0
E_b =	β	1.476	1.604	1.708	1.743	1.751	1.745	1.732	1.713	1.692	1.669
444.4 eV	γ	2.30−1	8.82−2	−4.07−2	−2.09−2	7.34−2	2.03−1	3.47−1	4.95−1	6.40−1	7.80−1
	δ	5.97−3	8.70−4	2.87−3	6.62−3	9.84−3	1.27−2	1.53−2	1.79−2	2.04−2	2.31−2
$4d_{3/2}$	σ	9.141+1	5.200+1	2.058+1	9.855+0	5.350+0	3.172+0	2.008+0	1.336+0	9.254−1	6.621−1
E_b =	β	1.213	1.324	1.380	1.361	1.316	1.263	1.207	1.152	1.100	1.050
273.7 eV	γ	−4.50−2	−1.65−2	1.94−1	4.45−1	6.78−1	8.81−1	1.05+0	1.20+0	1.33+0	1.45+0
	δ	7.65−3	1.97−2	4.17−2	6.04−2	7.80−2	9.47−2	1.11−1	1.27−1	1.43−1	1.60−1
$4d_{5/2}$	σ	1.315+2	7.349+1	2.848+1	1.344+1	7.219+0	4.240+0	2.662+0	1.759+0	1.210+0	8.601−1
E_b =	β	1.282	1.349	1.353	1.304	1.242	1.177	1.115	1.057	1.003	0.953
260.2 eV	γ	−4.74−2	2.45−3	2.34−1	4.86−1	7.11−1	9.01−1	1.06+0	1.20+0	1.32+0	1.42+0
	δ	8.10−3	1.87−2	4.01−2	6.10−2	8.19−2	1.02−1	1.22−1	1.42−1	1.61−1	1.81−1
$4f_{5/2}$	σ	5.910+1	2.299+1	5.486+0	1.863+0	7.817−1	3.778−1	2.019−1	1.163−1	7.100−2	4.540−2
E_b =	β	1.056	1.048	0.970	0.876	0.791	0.716	0.653	0.597	0.548	0.502
48.1 eV	γ	2.84−1	4.43−1	7.08−1	8.98−1	1.04+0	1.14+0	1.22+0	1.29+0	1.34+0	1.39+0
	δ	9.00−2	1.14−1	1.60−1	2.03−1	2.42−1	2.80−1	3.17−1	3.52−1	3.85−1	4.16−1
$4f_{7/2}$	σ	7.545+1	2.924+1	6.930+0	2.339+0	9.763−1	4.696−1	2.499−1	1.434−1	8.722−2	5.559−2
E_b =	β	1.053	1.040	0.957	0.865	0.782	0.712	0.652	0.601	0.555	0.513
45.7 eV	γ	2.94−1	4.54−1	7.20−1	9.10−1	1.05+0	1.15+0	1.23+0	1.29+0	1.34+0	1.39+0
	δ	8.99−2	1.14−1	1.61−1	2.04−1	2.46−1	2.84−1	3.22−1	3.57−1	3.91−1	4.23−1
$5s_{1/2}$	σ	4.732+0	2.999+0	1.530+0	9.266−1	6.193−1	4.418−1	3.302−1	2.556−1	2.033−1	1.653−1
E_b =	β	1.892	1.899	1.909	1.917	1.924	1.930	1.935	1.940	1.944	1.947
82.8 eV	γ	3.89−1	3.05−1	1.45−1	2.02−2	−6.80−2	−1.25−1	−1.56−1	−1.67−1	−1.61−1	−1.43−1
	δ	−5.56−4	−9.30−4	−1.46−3	−1.82−3	−2.10−3	−2.31−3	−2.49−3	−2.64−3	−2.76−3	−2.86−3
$5p_{1/2}$	σ	4.493+0	2.977+0	1.559+0	9.380−1	6.148−1	4.278−1	3.112−1	2.342−1	1.811−1	1.432−1
E_b =	β	1.635	1.687	1.714	1.707	1.687	1.661	1.633	1.603	1.573	1.543
48.4 eV	γ	2.17−1	9.28−2	−1.47−2	2.77−3	8.36−2	1.95−1	3.19−1	4.47−1	5.73−1	6.94−1
	δ	−3.90−3	−5.02−3	−5.45−3	−5.31−3	−4.45−3	−2.73−3	−1.78−4	3.07−3	6.86−3	1.12−2
$5p_{3/2}$	σ	1.043+1	6.493+0	3.134+0	1.785+0	1.124+0	7.571−1	5.360−1	3.942−1	2.987−1	2.320−1
E_b =	β	1.603	1.678	1.744	1.764	1.763	1.753	1.736	1.715	1.693	1.668
36.8 eV	γ	1.26−1	2.51−2	−4.55−2	−1.78−4	1.05−1	2.38−1	3.83−1	5.29−1	6.73−1	8.12−1
	δ	−1.67−3	−1.08−3	2.84−3	6.40−3	9.32−3	1.19−2	1.44−2	1.70−2	1.96−2	2.23−2
$5d_{3/2}$	σ	6.037+0	3.416+0	1.359+0	6.545−1	3.568−1	2.123−1	1.347−1	8.984−2	6.233−2	4.466−2
E_b =	β	1.315	1.382	1.405	1.372	1.322	1.266	1.208	1.152	1.097	1.045
3.8 eV	γ	−3.73−2	1.36−2	2.31−1	4.75−1	7.02−1	9.01−1	1.07+0	1.22+0	1.35+0	1.46+0
	δ	8.30−3	2.01−2	4.03−2	5.81−2	7.55−2	9.27−2	1.10−1	1.26−1	1.43−1	1.59−1
$5d_{5/2}$	σ	8.076+0	4.499+0	1.754+0	8.328−1	4.490−1	2.646−1	1.665−1	1.102−1	7.597−2	5.409−2
E_b =	β	1.363	1.392	1.367	1.309	1.243	1.177	1.114	1.055	1.000	0.948
2.5 eV	γ	−3.44−2	3.42−2	2.68−1	5.12−1	7.30−1	9.17−1	1.08+0	1.21+0	1.33+0	1.43+0
	δ	8.54−3	1.89−2	3.90−2	5.92−2	7.98−2	1.01−1	1.22−1	1.42−1	1.62−1	1.80−1
$6s_{1/2}$	σ	3.909−1	2.457−1	1.244−1	7.506−2	5.006−2	3.565−2	2.661−2	2.058−2	1.636−2	1.329−2
E_b =	β	1.892	1.899	1.909	1.917	1.923	1.930	1.935	1.940	1.944	1.948
8.0 eV	γ	3.79−1	2.95−1	1.37−1	1.39−2	−7.31−2	−1.28−1	−1.57−1	−1.66−1	−1.59−1	−1.41−1
	δ	−5.90−4	−9.53−4	−1.48−3	−1.84−3	−2.12−3	−2.33−3	−2.49−3	−2.62−3	−2.74−3	−2.83−3

(*continued on next page*)

Table 1 (*continued*)

Z= 76, Os: [Xe]$4f^6_{5/2}$ $4f^8_{7/2}$ $5d^4_{3/2}$ $5d^2_{5/2}$ $6s^2_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$4s_{1/2}$	σ	2.447+1	1.629+1	8.657+0	5.343+0	3.613+0	2.599+0	1.954+0	1.520+0	1.214+0	9.898−1
E_b =	β	1.864	1.880	1.895	1.905	1.913	1.921	1.927	1.932	1.937	1.941
654.3 eV	γ	5.97−1	4.78−1	2.67−1	1.05−1	−1.12−2	−8.98−2	−1.39−1	−1.64−1	−1.71−1	−1.63−1
	δ	4.10−6	−6.60−4	−1.42−3	−1.88−3	−2.21−3	−2.47−3	−2.68−3	−2.85−3	−2.99−3	−3.11−3
$4p_{1/2}$	σ	2.825+1	1.982+1	1.086+1	6.663+0	4.420+0	3.101+0	2.269+0	1.715+0	1.331+0	1.055+0
E_b =	β	1.465	1.593	1.674	1.687	1.678	1.659	1.635	1.609	1.581	1.553
546.5 eV	γ	3.99−1	2.23−1	1.96−2	−1.28−2	4.24−2	1.40−1	2.58−1	3.83−1	5.08−1	6.30−1
	δ	1.01−2	−3.24−4	−4.62−3	−5.00−3	−4.31−3	−2.76−3	−4.26−4	2.60−3	6.16−3	1.02−2
$4p_{3/2}$	σ	7.221+1	4.646+1	2.303+1	1.327+1	8.416+0	5.698+0	4.049+0	2.985+0	2.267+0	1.763+0
E_b =	β	1.455	1.589	1.701	1.741	1.752	1.749	1.737	1.721	1.701	1.679
468.2 eV	γ	2.48−1	1.05−1	−3.71−2	−2.91−2	5.63−2	1.80−1	3.20−1	4.66−1	6.09−1	7.49−1
	δ	7.18−3	1.04−3	2.63−3	6.47−3	9.81−3	1.27−2	1.53−2	1.79−2	2.04−2	2.29−2
$4d_{3/2}$	σ	9.510+1	5.459+1	2.185+1	1.054+1	5.749+0	3.422+0	2.172+0	1.449+0	1.006+0	7.212−1
E_b =	β	1.195	1.314	1.380	1.367	1.326	1.275	1.221	1.168	1.116	1.067
289.4 eV	γ	−4.24−2	−2.57−2	1.72−1	4.19−1	6.53−1	8.58−1	1.03+0	1.19+0	1.32+0	1.44+0
	δ	6.79−3	1.84−2	4.03−2	5.89−2	7.62−2	9.27−2	1.09−1	1.24−1	1.40−1	1.56−1
$4d_{5/2}$	σ	1.369+2	7.716+1	3.022+1	1.436+1	7.749+0	4.569+0	2.876+0	1.905+0	1.313+0	9.353−1
E_b =	β	1.273	1.345	1.356	1.311	1.251	1.189	1.127	1.069	1.016	0.966
272.8 eV	γ	−4.74−2	−7.87−3	2.14−1	4.63−1	6.89−1	8.82−1	1.05+0	1.18+0	1.31+0	1.41+0
	δ	7.39−3	1.76−2	3.85−2	5.90−2	7.96−2	9.99−2	1.20−1	1.39−1	1.58−1	1.77−1
$4f_{5/2}$	σ	6.612+1	2.598+1	6.276+0	2.147+0	9.049−1	4.388−1	2.351−1	1.358−1	8.305−2	5.321−2
E_b =	β	1.053	1.050	0.977	0.887	0.802	0.727	0.663	0.608	0.558	0.512
53.8 eV	γ	2.69−1	4.27−1	6.94−1	8.90−1	1.03+0	1.14+0	1.22+0	1.29+0	1.35+0	1.40+0
	δ	8.80−2	1.12−1	1.58−1	2.00−1	2.39−1	2.77−1	3.13−1	3.47−1	3.80−1	4.11−1
$4f_{7/2}$	σ	8.427+1	3.298+1	7.913+0	2.690+0	1.128+0	5.443−1	2.904−1	1.670−1	1.018−1	6.501−2
E_b =	β	1.052	1.042	0.965	0.875	0.792	0.722	0.662	0.610	0.564	0.521
51.0 eV	γ	2.80−1	4.39−1	7.07−1	9.02−1	1.04+0	1.15+0	1.23+0	1.29+0	1.35+0	1.39+0
	δ	8.80−2	1.12−1	1.58−1	2.02−1	2.42−1	2.81−1	3.18−1	3.53−1	3.87−1	4.18−1
$5s_{1/2}$	σ	4.964+0	3.151+0	1.613+0	9.797−1	6.563−1	4.690−1	3.510−1	2.719−1	2.165−1	1.761−1
E_b =	β	1.884	1.892	1.903	1.911	1.918	1.925	1.930	1.935	1.939	1.942
83.7 eV	γ	4.03−1	3.21−1	1.62−1	3.53−2	−5.61−2	−1.17−1	−1.53−1	−1.68−1	−1.67−1	−1.53−1
	δ	−5.61−4	−9.63−4	−1.53−3	−1.93−3	−2.23−3	−2.46−3	−2.66−3	−2.82−3	−2.96−3	−3.07−3
$5p_{1/2}$	σ	4.763+0	3.169+0	1.671+0	1.011+0	6.653−1	4.645−1	3.388−1	2.555−1	1.980−1	1.568−1
E_b =	β	1.625	1.681	1.713	1.709	1.691	1.666	1.639	1.611	1.581	1.552
58.0 eV	γ	2.39−1	1.10−1	−1.01−2	−3.50−3	6.90−2	1.74−1	2.95−1	4.20−1	5.44−1	6.64−1
	δ	−3.99−3	−5.28−3	−5.73−3	−5.62−3	−4.89−3	−3.33−3	−9.98−4	2.03−3	5.61−3	9.69−3
$5p_{3/2}$	σ	1.116+1	6.961+0	3.373+0	1.928+0	1.217+0	8.215−1	5.827−1	4.291−1	3.256−1	2.531−1
E_b =	β	1.589	1.669	1.740	1.763	1.766	1.757	1.743	1.724	1.702	1.679
45.4 eV	γ	1.40−1	3.55−2	−4.56−2	−1.00−2	8.73−2	2.15−1	3.56−1	5.01−1	6.43−1	7.81−1
	δ	−1.69−3	−1.34−3	2.60−3	6.31−3	9.32−3	1.20−2	1.44−2	1.69−2	1.94−2	2.19−2
$5d_{3/2}$	σ	6.910+0	3.938+0	1.584+0	7.681−1	4.210−1	2.515−1	1.601−1	1.071−1	7.446−2	5.346−2
E_b =	β	1.306	1.379	1.408	1.380	1.332	1.278	1.222	1.167	1.113	1.062
0.4 eV	γ	−3.80−2	4.73−3	2.12−1	4.53−1	6.80−1	8.80−1	1.05+0	1.20+0	1.33+0	1.45+0
	δ	7.40−3	1.90−2	3.91−2	5.66−2	7.37−2	9.05−2	1.07−1	1.23−1	1.39−1	1.55−1
$5d_{5/2}$	σ	9.315+0	5.224+0	2.057+0	9.834−1	5.328−1	3.152−1	1.990−1	1.320−1	9.119−2	6.506−2
E_b =	β	1.361	1.393	1.373	1.317	1.252	1.188	1.126	1.067	1.012	0.960
0.9 eV	γ	−3.69−2	2.42−2	2.50−1	4.92−1	7.11−1	9.00−1	1.06+0	1.20+0	1.32+0	1.42+0
	δ	7.75−3	1.79−2	3.76−2	5.73−2	7.76−2	9.82−2	1.19−1	1.39−1	1.58−1	1.76−1
$6s_{1/2}$	σ	4.203−1	2.643−1	1.341−1	8.114−2	5.421−2	3.866−2	2.889−2	2.236−2	1.779−2	1.447−2
E_b =	β	1.885	1.893	1.903	1.911	1.918	1.924	1.930	1.935	1.940	1.943
8.0 eV	γ	3.92−1	3.10−1	1.54−1	2.90−2	−6.16−2	−1.21−1	−1.55−1	−1.68−1	−1.65−1	−1.51−1
	δ	−6.00−4	−9.87−4	−1.55−3	−1.95−3	−2.25−3	−2.48−3	−2.66−3	−2.80−3	−2.93−3	−3.03−3

Z= 77, Ir: [Xe]$4f^6_{5/2}$ $4f^8_{7/2}$ $5d^4_{3/2}$ $5d^3_{5/2}$ $6s^2_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$4s_{1/2}$	σ	2.480+1	1.659+1	8.871+0	5.494+0	3.724+0	2.684+0	2.021+0	1.573+0	1.257+0	1.026+0
E_b =	β	1.853	1.871	1.887	1.898	1.907	1.914	1.921	1.927	1.931	1.935
690.1 eV	γ	6.24−1	5.08−1	2.95−1	1.28−1	7.20−3	−7.64−2	−1.31−1	−1.61−1	−1.73−1	−1.70−1
	δ	1.16−4	−6.31−4	−1.47−3	−1.98−3	−2.34−3	−2.62−3	−2.85−3	−3.04−3	−3.20−3	−3.33−3
$4p_{1/2}$	σ	2.843+1	2.012+1	1.115+1	6.885+0	4.589+0	3.231+0	2.371+0	1.797+0	1.398+0	1.110+0
E_b =	β	1.440	1.579	1.669	1.686	1.680	1.663	1.641	1.616	1.589	1.562
577.1 eV	γ	4.27−1	2.52−1	3.26−2	−1.42−2	3.05−2	1.21−1	2.34−1	3.55−1	4.78−1	5.99−1
	δ	1.22−2	2.67−4	−4.78−3	−5.29−3	−4.71−3	−3.32−3	−1.15−3	1.66−3	5.04−3	8.83−3
$4p_{3/2}$	σ	7.423+1	4.797+1	2.391+1	1.384+1	8.798+0	5.970+0	4.250+0	3.139+0	2.387+0	1.859+0
E_b =	β	1.430	1.572	1.693	1.738	1.753	1.752	1.743	1.728	1.709	1.689

(*continued on next page*)

Table 1 (*continued*)

494.3 eV	γ	2.67−1	1.23−1	−3.21−2	−3.61−2	4.02−2	1.57−1	2.93−1	4.36−1	5.79−1	7.17−1
	δ	8.66−3	1.30−3	2.36−3	6.31−3	9.76−3	1.27−2	1.54−2	1.79−2	2.03−2	2.27−2
$4d_{3/2}$	σ	9.908+1	5.740+1	2.322+1	1.127+1	6.180+0	3.692+0	2.350+0	1.572+0	1.093+0	7.851−1
E_b =	β	1.173	1.303	1.380	1.372	1.335	1.287	1.235	1.183	1.132	1.083
311.4 eV	γ	−3.78−2	−3.42−2	1.50−1	3.92−1	6.26−1	8.34−1	1.01+0	1.17+0	1.30+0	1.42+0
	δ	5.98−3	1.71−2	3.90−2	5.73−2	7.45−2	9.08−2	1.06−1	1.22−1	1.37−1	1.52−1
$4d_{5/2}$	σ	1.431+2	8.131+1	3.215+1	1.537+1	8.332+0	4.929+0	3.111+0	2.065+0	1.426+0	1.018+0
E_b =	β	1.260	1.341	1.359	1.318	1.261	1.200	1.140	1.082	1.029	0.979
294.9 eV	γ	−4.59−2	−1.85−2	1.92−1	4.38−1	6.65−1	8.62−1	1.03+0	1.17+0	1.29+0	1.40+0
	δ	6.68−3	1.64−2	3.70−2	5.70−2	7.73−2	9.74−2	1.17−1	1.36−1	1.54−1	1.73−1
$4f_{5/2}$	σ	7.397+1	2.931+1	7.161+0	2.466+0	1.044+0	5.076−1	2.726−1	1.578−1	9.671−2	6.208−2
E_b =	β	1.051	1.052	0.985	0.897	0.813	0.738	0.673	0.617	0.567	0.521
63.8 eV	γ	2.55−1	4.11−1	6.80−1	8.81−1	1.03+0	1.14+0	1.23+0	1.30+0	1.35+0	1.40+0
	δ	8.62−2	1.10−1	1.55−1	1.97−1	2.36−1	2.73−1	3.08−1	3.42−1	3.75−1	4.06−1
$4f_{7/2}$	σ	9.416+1	3.716+1	9.016+0	3.086+0	1.299+0	6.286−1	3.361−1	1.937−1	1.183−1	7.569−2
E_b =	β	1.050	1.044	0.972	0.885	0.803	0.732	0.671	0.619	0.572	0.530
60.8 eV	γ	2.66−1	4.24−1	6.93−1	8.94−1	1.04+0	1.15+0	1.23+0	1.30+0	1.36+0	1.40+0
	δ	8.63−2	1.10−1	1.55−1	1.99−1	2.39−1	2.77−1	3.13−1	3.48−1	3.82−1	4.13−1
$5s_{1/2}$	σ	5.215+0	3.314+0	1.700+0	1.035+0	6.948−1	4.972−1	3.725−1	2.889−1	2.301−1	1.874−1
E_b =	β	1.875	1.884	1.896	1.905	1.912	1.919	1.925	1.930	1.934	1.937
95.2 eV	γ	4.21−1	3.42−1	1.82−1	5.25−2	−4.27−2	−1.08−1	−1.48−1	−1.68−1	−1.72−1	−1.62−1
	δ	−5.54−4	−9.89−4	−1.61−3	−2.04−3	−2.36−3	−2.62−3	−2.83−3	−3.01−3	−3.17−3	−3.29−3
$5p_{1/2}$	σ	5.023+0	3.355+0	1.781+0	1.083+0	7.161−1	5.017−1	3.669−1	2.774−1	2.154−1	1.709−1
E_b =	β	1.615	1.675	1.712	1.710	1.694	1.671	1.646	1.618	1.590	1.562
63.0 eV	γ	2.59−1	1.27−1	−4.45−3	−8.28−3	5.59−2	1.55−1	2.71−1	3.93−1	5.16−1	6.35−1
	δ	−4.10−3	−5.56−3	−6.03−3	−5.93−3	−5.29−3	−3.90−3	−1.75−3	1.08−3	4.46−3	8.30−3
$5p_{3/2}$	σ	1.189+1	7.427+0	3.612+0	2.072+0	1.311+0	8.873−1	6.305−1	4.651−1	3.533−1	2.750−1
E_b =	β	1.575	1.658	1.735	1.762	1.768	1.762	1.748	1.731	1.711	1.689
49.6 eV	γ	1.53−1	4.57−2	−4.49−2	−1.85−2	7.12−2	1.94−1	3.31−1	4.73−1	6.14−1	7.51−1
	δ	−1.68−3	−1.60−3	2.35−3	6.21−3	9.33−3	1.20−2	1.45−2	1.69−2	1.93−2	2.17−2
$5d_{3/2}$	σ	7.818+0	4.486+0	1.822+0	8.897−1	4.901−1	2.938−1	1.876−1	1.258−1	8.766−2	6.306−2
E_b =	β	1.296	1.374	1.410	1.387	1.343	1.291	1.237	1.182	1.129	1.079
4.2 eV	γ	−3.81−2	−4.29−3	1.92−1	4.29−1	6.55−1	8.58−1	1.04+0	1.19+0	1.32+0	1.44+0
	δ	6.39−3	1.79−2	3.79−2	5.52−2	7.18−2	8.83−2	1.05−1	1.20−1	1.35−1	1.51−1
$5d_{5/2}$	σ	1.059+1	5.973+0	2.374+0	1.142+0	6.219−1	3.692−1	2.338−1	1.555−1	1.076−1	7.691−2
E_b =	β	1.358	1.394	1.378	1.324	1.262	1.199	1.138	1.079	1.024	0.973
3.2 eV	γ	−3.88−2	1.44−2	2.32−1	4.71−1	6.90−1	8.81−1	1.05+0	1.19+0	1.31+0	1.41+0
	δ	6.93−3	1.68−2	3.62−2	5.54−2	7.53−2	9.55−2	1.16−1	1.35−1	1.54−1	1.72−1
$6s_{1/2}$	σ	4.483−1	2.821−1	1.434−1	8.695−2	5.820−2	4.157−2	3.109−2	2.409−2	1.918−2	1.561−2
E_b =	β	1.877	1.886	1.896	1.904	1.912	1.918	1.925	1.930	1.935	1.939
9.0 eV	γ	4.06−1	3.27−1	1.72−1	4.50−2	−4.90−2	−1.13−1	−1.51−1	−1.68−1	−1.70−1	−1.60−1
	δ	−6.05−4	−1.02−3	−1.63−3	−2.06−3	−2.39−3	−2.64−3	−2.83−3	−2.99−3	−3.13−3	−3.25−3

Z= 78, Pt: [Xe]$4f^6_{5/2}$ $4f^8_{7/2}$ $5d^4_{3/2}$ $5d^5_{5/2}$ $6s^1_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$4s_{1/2}$	σ	2.510+1	1.688+1	9.081+0	5.644+0	3.834+0	2.767+0	2.086+0	1.626+0	1.301+0	1.063+0
E_b =	β	1.841	1.860	1.878	1.890	1.899	1.908	1.915	1.921	1.926	1.930
722.8 eV	γ	6.49−1	5.39−1	3.24−1	1.53−1	2.64−2	−6.22−2	−1.21−1	−1.56−1	−1.73−1	−1.75−1
	δ	2.51−4	−5.77−4	−1.51−3	−2.09−3	−2.49−3	−2.78−3	−3.02−3	−3.22−3	−3.40−3	−3.55−3
$4p_{1/2}$	σ	2.854+1	2.041+1	1.144+1	7.109+0	4.759+0	3.363+0	2.475+0	1.881+0	1.466+0	1.167+0
E_b =	β	1.413	1.560	1.662	1.685	1.681	1.667	1.646	1.623	1.597	1.571
608.4 eV	γ	4.56−1	2.85−1	4.81−2	−1.41−2	2.02−2	1.02−1	2.08−1	3.26−1	4.48−1	5.68−1
	δ	1.49−2	1.02−3	−4.97−3	−5.67−3	−5.17−3	−3.88−3	−1.88−3	8.28−4	4.08−3	7.74−3
$4p_{3/2}$	σ	7.629+1	4.952+1	2.483+1	1.442+1	9.191+0	6.251+0	4.458+0	3.299+0	2.512+0	1.959+0
E_b =	β	1.404	1.552	1.684	1.734	1.753	1.755	1.747	1.734	1.718	1.698
519.0 eV	γ	2.87−1	1.42−1	−2.58−2	−4.21−2	2.55−2	1.35−1	2.65−1	4.05−1	5.47−1	6.86−1
	δ	1.05−2	1.64−3	2.08−3	6.13−3	9.73−3	1.27−2	1.54−2	1.80−2	2.04−2	2.28−2
$4d_{3/2}$	σ	1.031+2	6.026+1	2.464+1	1.204+1	6.628+0	3.975+0	2.538+0	1.702+0	1.186+0	8.531−1
E_b =	β	1.147	1.289	1.378	1.376	1.344	1.299	1.250	1.198	1.147	1.098
330.7 eV	γ	−3.16−2	−4.13−2	1.31−1	3.67−1	5.97−1	8.06−1	9.91−1	1.15+0	1.29+0	1.41+0
	δ	5.33−3	1.58−2	3.80−2	5.60−2	7.23−2	8.86−2	1.05−1	1.20−1	1.34−1	1.49−1
$4d_{5/2}$	σ	1.494+2	8.559+1	3.418+1	1.643+1	8.943+0	5.309+0	3.361+0	2.236+0	1.547+0	1.106+0
E_b =	β	1.245	1.336	1.362	1.324	1.270	1.212	1.153	1.096	1.042	0.991
313.4 eV	γ	−4.29−2	−2.78−2	1.73−1	4.16−1	6.40−1	8.39−1	1.01+0	1.16+0	1.28+0	1.39+0
	δ	6.10−3	1.52−2	3.58−2	5.52−2	7.44−2	9.45−2	1.14−1	1.34−1	1.52−1	1.70−1
$4f_{5/2}$	σ	8.276+1	3.304+1	8.150+0	2.824+0	1.201+0	5.855−1	3.151−1	1.826−1	1.121−1	7.212−2
E_b =	β	1.047	1.053	0.990	0.906	0.826	0.751	0.684	0.626	0.575	0.529
74.3 eV	γ	2.43−1	3.98−1	6.66−1	8.70−1	1.02+0	1.14+0	1.23+0	1.30+0	1.36+0	1.41+0
	δ	8.51−2	1.09−1	1.52−1	1.93−1	2.34−1	2.71−1	3.05−1	3.37−1	3.69−1	4.00−1

(*continued on next page*)

Table 1 (*continued*)

$4f_{7/2}$	σ	1.051+2	4.180+1	1.024+1	3.524+0	1.490+0	7.232−1	3.875−1	2.237−1	1.368−1	8.769−2
E_b =	β	1.048	1.046	0.977	0.893	0.815	0.744	0.681	0.626	0.579	0.537
70.9 eV	γ	2.54−1	4.11−1	6.80−1	8.84−1	1.04+0	1.15+0	1.23+0	1.30+0	1.36+0	1.41+0
	δ	8.52−2	1.09−1	1.52−1	1.95−1	2.36−1	2.75−1	3.10−1	3.44−1	3.76−1	4.08−1
$5s_{1/2}$	σ	5.416+0	3.446+0	1.773+0	1.082+0	7.271−1	5.210−1	3.908−1	3.034−1	2.419−1	1.971−1
E_b =	β	1.866	1.876	1.888	1.897	1.905	1.913	1.919	1.924	1.929	1.933
101.7 eV	γ	4.40−1	3.61−1	2.02−1	7.00−2	−2.90−2	−9.77−2	−1.42−1	−1.66−1	−1.74−1	−1.69−1
	δ	−5.33−4	−1.01−3	−1.69−3	−2.17−3	−2.51−3	−2.78−3	−3.00−3	−3.19−3	−3.37−3	−3.51−3
$5p_{1/2}$	σ	5.246+0	3.518+0	1.880+0	1.149+0	7.628−1	5.362−1	3.932−1	2.981−1	2.319−1	1.843−1
E_b =	β	1.601	1.668	1.710	1.711	1.697	1.676	1.652	1.626	1.599	1.571
65.3 eV	γ	2.80−1	1.45−1	2.21−3	−1.20−2	4.43−2	1.36−1	2.47−1	3.66−1	4.87−1	6.06−1
	δ	−4.24−3	−5.87−3	−6.40−3	−6.32−3	−5.73−3	−4.46−3	−2.45−3	2.49−4	3.51−3	7.17−3
$5p_{3/2}$	σ	1.247+1	7.805+0	3.810+0	2.192+0	1.391+0	9.431−1	6.714−1	4.960−1	3.774−1	2.941−1
E_b =	β	1.559	1.648	1.730	1.761	1.769	1.765	1.754	1.738	1.720	1.699
51.6 eV	γ	1.66−1	5.67−2	−4.34−2	−2.61−2	5.63−2	1.72−1	3.04−1	4.44−1	5.85−1	7.22−1
	δ	−1.65−3	−1.85−3	2.07−3	6.10−3	9.33−3	1.20−2	1.45−2	1.69−2	1.94−2	2.18−2
$5d_{3/2}$	σ	8.263+0	4.772+0	1.957+0	9.620−1	5.324−1	3.204−1	2.053−1	1.380−1	9.640−2	6.948−2
E_b =	β	1.285	1.369	1.412	1.393	1.352	1.303	1.251	1.199	1.147	1.096
2.8 eV	γ	−3.70−2	−1.22−2	1.75−1	4.08−1	6.31−1	8.33−1	1.01+0	1.17+0	1.31+0	1.43+0
	δ	5.45−3	1.68−2	3.70−2	5.40−2	6.97−2	8.55−2	1.02−1	1.18−1	1.33−1	1.48−1
$5d_{5/2}$	σ	1.111+1	6.307+0	2.530+0	1.225+0	6.698−1	3.991−1	2.535−1	1.690−1	1.172−1	8.395−2
E_b =	β	1.355	1.394	1.382	1.331	1.270	1.209	1.150	1.093	1.039	0.987
1.4 eV	γ	−3.98−2	5.23−3	2.15−1	4.53−1	6.70−1	8.61−1	1.03+0	1.17+0	1.30+0	1.40+0
	δ	6.17−3	1.58−2	3.51−2	5.40−2	7.27−2	9.21−2	1.12−1	1.32−1	1.51−1	1.69−1
$6s_{1/2}$	σ	4.176−1	2.629−1	1.339−1	8.140−2	5.462−2	3.907−2	2.926−2	2.269−2	1.807−2	1.471−2
E_b =	β	1.868	1.877	1.889	1.898	1.906	1.912	1.918	1.924	1.929	1.933
9.0 eV	γ	4.22−1	3.45−1	1.90−1	6.19−2	−3.46−2	−1.03−1	−1.46−1	−1.69−1	−1.74−1	−1.67−1
	δ	−6.06−4	−1.05−3	−1.70−3	−2.16−3	−2.51−3	−2.80−3	−3.03−3	−3.22−3	−3.36−3	−3.48−3
Z= 79, Au: [Xe]$4f^6_{5/2}$ $4f^8_{7/2}$ $5d^4_{3/2}$ $5d^6_{5/2}$ $6s^1_{1/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$4s_{1/2}$	σ	2.536+1	1.715+1	9.284+0	5.791+0	3.944+0	2.851+0	2.153+0	1.680+0	1.345+0	1.100+0
E_b =	β	1.827	1.849	1.870	1.882	1.891	1.900	1.908	1.915	1.920	1.925
758.8 eV	γ	6.76−1	5.67−1	3.52−1	1.79−1	4.74−2	−4.64−2	−1.10−1	−1.50−1	−1.72−1	−1.79−1
	δ	4.14−4	−5.16−4	−1.55−3	−2.18−3	−2.63−3	−2.95−3	−3.21−3	−3.43−3	−3.62−3	−3.79−3
$4p_{1/2}$	σ	2.860+1	2.066+1	1.171+1	7.329+0	4.930+0	3.496+0	2.581+0	1.966+0	1.536+0	1.225+0
E_b =	β	1.380	1.543	1.656	1.683	1.683	1.670	1.651	1.629	1.605	1.580
643.7 eV	γ	4.84−1	3.18−1	6.59−2	−1.19−2	1.11−2	8.55−2	1.86−1	2.99−1	4.18−1	5.37−1
	δ	1.81−2	1.88−3	−5.08−3	−5.98−3	−5.58−3	−4.43−3	−2.58−3	−4.96−5	3.04−3	6.55−3
$4p_{3/2}$	σ	7.831+1	5.105+1	2.573+1	1.500+1	9.591+0	6.536+0	4.671+0	3.461+0	2.640+0	2.061+0
E_b =	β	1.376	1.534	1.675	1.730	1.752	1.756	1.751	1.740	1.725	1.707
545.4 eV	γ	3.05−1	1.61−1	−1.79−2	−4.65−2	1.19−2	1.15−1	2.40−1	3.76−1	5.16−1	6.54−1
	δ	1.25−2	2.06−3	1.81−3	5.91−3	9.68−3	1.28−2	1.55−2	1.80−2	2.05−2	2.29−2
$4d_{3/2}$	σ	1.069+2	6.310+1	2.609+1	1.283+1	7.095+0	4.270+0	2.735+0	1.838+0	1.284+0	9.250−1
E_b =	β	1.123	1.276	1.375	1.380	1.351	1.310	1.263	1.213	1.163	1.115
352.0 eV	γ	−2.36−2	−4.67−2	1.10−1	3.42−1	5.70−1	7.80−1	9.67−1	1.13+0	1.27+0	1.40+0
	δ	4.89−3	1.45−2	3.67−2	5.48−2	7.07−2	8.64−2	1.02−1	1.17−1	1.32−1	1.46−1
$4d_{5/2}$	σ	1.555+2	8.980+1	3.621+1	1.752+1	9.575+0	5.703+0	3.621+0	2.414+0	1.673+0	1.198+0
E_b =	β	1.231	1.330	1.364	1.331	1.279	1.222	1.165	1.109	1.055	1.004
333.9 eV	γ	−3.81−2	−3.58−2	1.53−1	3.94−1	6.18−1	8.17−1	9.91−1	1.14+0	1.27+0	1.38+0
	δ	5.68−3	1.41−2	3.44−2	5.37−2	7.23−2	9.17−2	1.11−1	1.31−1	1.49−1	1.66−1
$4f_{5/2}$	σ	9.199+1	3.701+1	9.221+0	3.214+0	1.372+0	6.713−1	3.621−1	2.103−1	1.293−1	8.332−2
E_b =	β	1.043	1.054	0.997	0.915	0.836	0.763	0.695	0.636	0.585	0.539
87.3 eV	γ	2.28−1	3.82−1	6.52−1	8.59−1	1.02+0	1.14+0	1.23+0	1.30+0	1.36+0	1.41+0
	δ	8.34−2	1.07−1	1.50−1	1.90−1	2.30−1	2.67−1	3.01−1	3.33−1	3.65−1	3.95−1
$4f_{7/2}$	σ	1.168+2	4.678+1	1.157+1	4.008+0	1.702+0	8.283−1	4.448−1	2.572−1	1.576−1	1.012−1
E_b =	β	1.045	1.048	0.984	0.901	0.824	0.754	0.691	0.636	0.588	0.545
83.7 eV	γ	2.39−1	3.96−1	6.67−1	8.74−1	1.03+0	1.15+0	1.24+0	1.31+0	1.36+0	1.41+0
	δ	8.35−2	1.07−1	1.50−1	1.92−1	2.33−1	2.71−1	3.06−1	3.39−1	3.72−1	4.03−1
$5s_{1/2}$	σ	5.655+0	3.602+0	1.858+0	1.136+0	7.652−1	5.492−1	4.124−1	3.205−1	2.558−1	2.085−1
E_b =	β	1.856	1.867	1.880	1.890	1.898	1.906	1.913	1.918	1.923	1.927
107.8 eV	γ	4.54−1	3.78−1	2.22−1	8.82−2	−1.42−2	−8.69−2	−1.35−1	−1.64−1	−1.76−1	−1.75−1
	δ	−5.16−4	−1.03−3	−1.77−3	−2.28−3	−2.67−3	−2.96−3	−3.20−3	−3.40−3	−3.59−3	−3.75−3
$5p_{1/2}$	σ	5.494+0	3.698+0	1.990+0	1.223+0	8.148−1	5.746−1	4.226−1	3.211−1	2.503−1	1.993−1
E_b =	β	1.590	1.662	1.708	1.712	1.700	1.681	1.658	1.633	1.607	1.580
71.7 eV	γ	3.01−1	1.64−1	1.05−2	−1.45−2	3.35−2	1.19−1	2.25−1	3.40−1	4.59−1	5.76−1
	δ	−4.39−3	−6.15−3	−6.70−3	−6.66−3	−6.14−3	−4.99−3	−3.15−3	−6.33−4	2.44−3	5.92−3
$5p_{3/2}$	σ	1.323+1	8.286+0	4.058+0	2.342+0	1.490+0	1.012+0	7.220−1	5.343−1	4.071−1	3.176−1

(*continued on next page*)

Table 1 (*continued*)

E_b =	β	1.545	1.638	1.724	1.759	1.770	1.768	1.759	1.745	1.728	1.708
56.9 eV	γ	1.78−1	6.80−2	−4.07−2	−3.28−2	4.21−2	1.52−1	2.80−1	4.16−1	5.55−1	6.91−1
	δ	−1.61−3	−2.09−3	1.78−3	5.96−3	9.34−3	1.21−2	1.46−2	1.70−2	1.94−2	2.17−2
$5d_{3/2}$	σ	9.174+0	5.331+0	2.207+0	1.092+0	6.076−1	3.671−1	2.359−1	1.590−1	1.113−1	8.039−2
E_b =	β	1.275	1.364	1.413	1.399	1.361	1.314	1.264	1.213	1.162	1.112
3.3 eV	γ	−3.50−2	−1.91−2	1.57−1	3.86−1	6.08−1	8.10−1	9.92−1	1.15+0	1.29+0	1.41+0
	δ	4.56−3	1.57−2	3.59−2	5.29−2	6.82−2	8.36−2	9.93−2	1.15−1	1.30−1	1.44−1
$5d_{5/2}$	σ	1.239+1	7.073+0	2.863+0	1.395+0	7.664−1	4.583−1	2.919−1	1.952−1	1.356−1	9.729−2
E_b =	β	1.352	1.394	1.387	1.339	1.279	1.220	1.161	1.105	1.051	1.000
1.8 eV	γ	−3.99−2	−3.04−3	1.97−1	4.33−1	6.50−1	8.42−1	1.01+0	1.16+0	1.28+0	1.39+0
	δ	5.45−3	1.48−2	3.38−2	5.24−2	7.08−2	8.97−2	1.09−1	1.29−1	1.48−1	1.66−1
$6s_{1/2}$	σ	4.389−1	2.765−1	1.410−1	8.590−2	5.774−2	4.138−2	3.103−2	2.407−2	1.919−2	1.564−2
E_b =	β	1.858	1.868	1.882	1.891	1.899	1.906	1.912	1.918	1.923	1.928
9.0 eV	γ	4.37−1	3.62−1	2.09−1	7.89−2	−2.02−2	−9.21−2	−1.40−1	−1.67−1	−1.76−1	−1.73−1
	δ	−6.01−4	−1.08−3	−1.79−3	−2.28−3	−2.66−3	−2.97−3	−3.23−3	−3.43−3	−3.59−3	−3.72−3

Z= 80, Hg: [Xe]$4f^6_{5/2}$ $4f^8_{7/2}$ $5d^4_{3/2}$ $5d^6_{5/2}$ $6s^2_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$4s_{1/2}$	σ	2.560+1	1.742+1	9.486+0	5.938+0	4.054+0	2.937+0	2.221+0	1.735+0	1.391+0	1.138+0
E_b =	β	1.813	1.837	1.860	1.873	1.884	1.893	1.901	1.908	1.913	1.918
803.0 eV	γ	7.03−1	5.98−1	3.83−1	2.06−1	7.03−2	−2.83−2	−9.74−2	−1.43−1	−1.70−1	−1.81−1
	δ	6.01−4	−4.42−4	−1.59−3	−2.28−3	−2.76−3	−3.12−3	−3.41−3	−3.66−3	−3.87−3	−4.06−3
$4p_{1/2}$	σ	2.860+1	2.086+1	1.195+1	7.534+0	5.094+0	3.627+0	2.686+0	2.051+0	1.606+0	1.283+0
E_b =	β	1.343	1.526	1.648	1.680	1.683	1.673	1.656	1.635	1.612	1.588
676.9 eV	γ	5.05−1	3.49−1	8.45−2	−7.76−3	3.87−3	6.98−2	1.64−1	2.74−1	3.90−1	5.06−1
	δ	2.15−2	2.89−3	−5.23−3	−6.27−3	−5.93−3	−4.89−3	−3.19−3	−8.67−4	1.99−3	5.26−3
$4p_{3/2}$	σ	8.020+1	5.248+1	2.660+1	1.557+1	9.985+0	6.823+0	4.885+0	3.626+0	2.769+0	2.164+0
E_b =	β	1.350	1.515	1.664	1.725	1.750	1.758	1.755	1.745	1.732	1.715
571.0 eV	γ	3.18−1	1.79−1	−9.65−3	−4.93−2	−3.50−4	9.54−2	2.16−1	3.49−1	4.87−1	6.23−1
	δ	1.44−2	2.60−3	1.54−3	5.67−3	9.58−3	1.28−2	1.56−2	1.82−2	2.06−2	2.28−2
$4d_{3/2}$	σ	1.108+2	6.599+1	2.757+1	1.365+1	7.587+0	4.582+0	2.943+0	1.982+0	1.387+0	1.002+0
E_b =	β	1.098	1.260	1.372	1.383	1.359	1.320	1.274	1.226	1.178	1.131
378.3 eV	γ	−1.40−2	−5.07−2	8.98−2	3.14−1	5.42−1	7.55−1	9.45−1	1.11+0	1.25+0	1.38+0
	δ	4.69−3	1.33−2	3.53−2	5.34−2	6.94−2	8.51−2	1.00−1	1.15−1	1.28−1	1.42−1
$4d_{5/2}$	σ	1.616+2	9.408+1	3.830+1	1.864+1	1.024+1	6.117+0	3.893+0	2.601+0	1.807+0	1.295+0
E_b =	β	1.216	1.323	1.366	1.337	1.288	1.232	1.176	1.120	1.067	1.017
359.8 eV	γ	−3.16−2	−4.26−2	1.33−1	3.68−1	5.94−1	7.96−1	9.73−1	1.12+0	1.25+0	1.37+0
	δ	5.43−3	1.30−2	3.29−2	5.17−2	7.05−2	8.98−2	1.09−1	1.27−1	1.45−1	1.62−1
$4f_{5/2}$	σ	1.016+2	4.119+1	1.037+1	3.640+0	1.561+0	7.655−1	4.139−1	2.409−1	1.485−1	9.578−2
E_b =	β	1.039	1.055	1.003	0.925	0.846	0.772	0.705	0.647	0.596	0.550
103.3 eV	γ	2.14−1	3.66−1	6.36−1	8.49−1	1.01+0	1.13+0	1.23+0	1.30+0	1.37+0	1.42+0
	δ	8.14−2	1.05−1	1.47−1	1.88−1	2.27−1	2.63−1	2.97−1	3.29−1	3.60−1	3.91−1
$4f_{7/2}$	σ	1.290+2	5.206+1	1.301+1	4.537+0	1.934+0	9.442−1	5.082−1	2.945−1	1.808−1	1.162−1
E_b =	β	1.041	1.050	0.990	0.911	0.834	0.763	0.699	0.645	0.597	0.555
99.4 eV	γ	2.25−1	3.80−1	6.52−1	8.64−1	1.02+0	1.14+0	1.24+0	1.31+0	1.37+0	1.42+0
	δ	8.17−2	1.05−1	1.48−1	1.89−1	2.30−1	2.67−1	3.02−1	3.35−1	3.67−1	3.98−1
$5s_{1/2}$	σ	5.946+0	3.791+0	1.959+0	1.201+0	8.103−1	5.825−1	4.381−1	3.408−1	2.721−1	2.220−1
E_b =	β	1.845	1.857	1.872	1.882	1.891	1.899	1.906	1.912	1.917	1.921
120.3 eV	γ	4.72−1	3.98−1	2.42−1	1.07−1	2.35−3	−7.42−2	−1.27−1	−1.60−1	−1.77−1	−1.80−1
	δ	−4.93−4	−1.05−3	−1.85−3	−2.40−3	−2.81−3	−3.13−3	−3.40−3	−3.64−3	−3.85−3	−4.01−3
$5p_{1/2}$	σ	5.769+0	3.898+0	2.110+0	1.304+0	8.725−1	6.176−1	4.555−1	3.468−1	2.709−1	2.161−1
E_b =	β	1.577	1.654	1.706	1.712	1.702	1.685	1.663	1.639	1.614	1.588
80.5 eV	γ	3.22−1	1.83−1	2.00−2	−1.53−2	2.36−2	1.03−1	2.04−1	3.16−1	4.32−1	5.47−1
	δ	−4.46−3	−6.49−3	−7.06−3	−6.96−3	−6.48−3	−5.46−3	−3.79−3	−1.48−3	1.35−3	4.60−3
$5p_{3/2}$	σ	1.414+1	8.873+0	4.359+0	2.524+0	1.610+0	1.097+0	7.835−1	5.806−1	4.429−1	3.459−1
E_b =	β	1.529	1.626	1.718	1.756	1.770	1.771	1.763	1.751	1.735	1.717
61.8 eV	γ	1.90−1	7.88−2	−3.74−2	−3.81−2	2.90−2	1.33−1	2.57−1	3.91−1	5.27−1	6.62−1
	δ	−1.52−3	−2.33−3	1.47−3	5.79−3	9.31−3	1.22−2	1.48−2	1.72−2	1.94−2	2.16−2
$5d_{3/2}$	σ	1.059+1	6.188+0	2.585+0	1.288+0	7.202−1	4.369−1	2.816−1	1.903−1	1.335−1	9.657−2
E_b =	β	1.263	1.357	1.414	1.404	1.370	1.325	1.277	1.227	1.177	1.128
7.5 eV	γ	−3.23−2	−2.49−2	1.39−1	3.61−1	5.83−1	7.88−1	9.72−1	1.13+0	1.28+0	1.40+0
	δ	3.70−3	1.47−2	3.47−2	5.14−2	6.68−2	8.22−2	9.75−2	1.12−1	1.27−1	1.40−1
$5d_{5/2}$	σ	1.448+1	8.308+0	3.390+0	1.663+0	9.179−1	5.510−1	3.519−1	2.358−1	1.642−1	1.180−1
E_b =	β	1.348	1.394	1.391	1.346	1.289	1.231	1.173	1.116	1.062	1.012
5.7 eV	γ	−3.94−2	−1.02−2	1.81−1	4.11−1	6.28−1	8.23−1	9.94−1	1.14+0	1.27+0	1.38+0
	δ	4.78−3	1.39−2	3.24−2	5.05−2	6.87−2	8.78−2	1.07−1	1.26−1	1.44−1	1.62−1
$6s_{1/2}$	σ	5.248−1	3.307−1	1.689−1	1.031−1	6.939−2	4.978−2	3.737−2	2.903−2	2.316−2	1.889−2
E_b =	β	1.849	1.860	1.874	1.884	1.892	1.899	1.906	1.912	1.918	1.922
9.0 eV	γ	4.48−1	3.77−1	2.26−1	9.63−2	−5.77−3	−8.12−2	−1.32−1	−1.63−1	−1.77−1	−1.78−1

(*continued on next page*)

Table 1 (*continued*)

	δ	−5.98−4	−1.12−3	−1.87−3	−2.40−3	−2.83−3	−3.16−3	−3.43−3	−3.64−3	−3.82−3	−3.97−3
Z= 81, Tl: [Xe]$4f^6_{5/2}$ $4f^8_{7/2}$ $5d^4_{3/2}$ $5d^6_{5/2}$ $6s^2_{1/2}$ $6p^1_{1/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$4s_{1/2}$	σ	2.579+1	1.766+1	9.671+0	6.078+0	4.161+0	3.021+0	2.288+0	1.790+0	1.436+0	1.175+0
E_b =	β	1.796	1.825	1.851	1.865	1.876	1.885	1.893	1.900	1.906	1.911
845.5 eV	γ	7.27−1	6.23−1	4.11−1	2.32−1	9.40−2	−9.29−3	−8.40−2	−1.35−1	−1.67−1	−1.82−1
	δ	8.31−4	−3.56−4	−1.62−3	−2.37−3	−2.89−3	−3.30−3	−3.63−3	−3.91−3	−4.14−3	−4.33−3
$4p_{1/2}$	σ	2.853+1	2.104+1	1.220+1	7.745+0	5.264+0	3.763+0	2.795+0	2.140+0	1.678+0	1.343+0
E_b =	β	1.303	1.509	1.641	1.678	1.683	1.675	1.660	1.640	1.619	1.596
721.3 eV	γ	5.30−1	3.84−1	1.06−1	−1.19−3	−2.16−3	5.52−2	1.44−1	2.50−1	3.61−1	4.74−1
	δ	2.66−2	4.01−3	−5.27−3	−6.49−3	−6.29−3	−5.40−3	−3.87−3	−1.75−3	8.68−4	3.96−3
$4p_{3/2}$	σ	8.230+1	5.406+1	2.754+1	1.618+1	1.041+1	7.130+0	5.113+0	3.800+0	2.905+0	2.273+0
E_b =	β	1.307	1.498	1.655	1.720	1.748	1.758	1.757	1.750	1.738	1.723
609.0 eV	γ	3.35−1	2.00−1	1.19−3	−5.07−2	−1.20−2	7.69−2	1.93−1	3.22−1	4.56−1	5.88−1
	δ	1.76−2	3.26−3	1.26−3	5.37−3	9.44−3	1.29−2	1.58−2	1.83−2	2.06−2	2.28−2
$4d_{3/2}$	σ	1.147+2	6.886+1	2.908+1	1.450+1	8.098+0	4.907+0	3.160+0	2.134+0	1.496+0	1.082+0
E_b =	β	1.073	1.246	1.368	1.385	1.365	1.329	1.285	1.239	1.193	1.148
406.6 eV	γ	−2.51−3	−5.29−2	6.96−2	2.88−1	5.17−1	7.31−1	9.20−1	1.09+0	1.23+0	1.36+0
	δ	4.77−3	1.20−2	3.38−2	5.22−2	6.85−2	8.37−2	9.79−2	1.11−1	1.25−1	1.39−1
$4d_{5/2}$	σ	1.675+2	9.829+1	4.040+1	1.980+1	1.092+1	6.545+0	4.176+0	2.796+0	1.946+0	1.398+0
E_b =	β	1.203	1.316	1.367	1.343	1.296	1.241	1.185	1.131	1.080	1.032
386.2 eV	γ	−2.35−2	−4.78−2	1.13−1	3.44−1	5.72−1	7.77−1	9.53−1	1.11+0	1.24+0	1.36+0
	δ	5.41−3	1.20−2	3.12−2	5.01−2	6.91−2	8.79−2	1.06−1	1.24−1	1.41−1	1.59−1
$4f_{5/2}$	σ	1.120+2	4.573+1	1.163+1	4.108+0	1.768+0	8.699−1	4.716−1	2.750−1	1.698−1	1.097−1
E_b =	β	1.034	1.055	1.010	0.934	0.854	0.780	0.716	0.659	0.608	0.560
123.0 eV	γ	1.97−1	3.47−1	6.22−1	8.39−1	1.00+0	1.13+0	1.23+0	1.31+0	1.37+0	1.43+0
	δ	7.89−2	1.03−1	1.46−1	1.86−1	2.24−1	2.59−1	2.92−1	3.25−1	3.57−1	3.87−1
$4f_{7/2}$	σ	1.421+2	5.778+1	1.459+1	5.119+0	2.191+0	1.072+0	5.787−1	3.360−1	2.066−1	1.330−1
E_b =	β	1.038	1.051	0.998	0.919	0.841	0.770	0.709	0.656	0.608	0.565
118.7 eV	γ	2.08−1	3.62−1	6.38−1	8.55−1	1.02+0	1.14+0	1.24+0	1.31+0	1.38+0	1.43+0
	δ	7.92−2	1.03−1	1.46−1	1.88−1	2.26−1	2.62−1	2.97−1	3.31−1	3.64−1	3.94−1
$5s_{1/2}$	σ	6.235+0	3.978+0	2.060+0	1.265+0	8.556−1	6.161−1	4.638−1	3.611−1	2.886−1	2.356−1
E_b =	β	1.835	1.848	1.864	1.875	1.884	1.891	1.898	1.904	1.910	1.915
136.3 eV	γ	4.87−1	4.17−1	2.62−1	1.27−1	2.00−2	−6.08−2	−1.18−1	−1.56−1	−1.77−1	−1.83−1
	δ	−4.71−4	−1.07−3	−1.92−3	−2.51−3	−2.96−3	−3.33−3	−3.63−3	−3.89−3	−4.10−3	−4.28−3
$5p_{1/2}$	σ	6.068+0	4.115+0	2.242+0	1.392+0	9.357−1	6.645−1	4.913−1	3.749−1	2.934−1	2.344−1
E_b =	β	1.567	1.647	1.704	1.713	1.705	1.689	1.668	1.646	1.622	1.597
99.6 eV	γ	3.47−1	2.06−1	3.17−2	−1.50−2	1.44−2	8.72−2	1.84−1	2.92−1	4.04−1	5.16−1
	δ	−4.63−3	−6.81−3	−7.36−3	−7.25−3	−6.87−3	−5.99−3	−4.49−3	−2.41−3	1.85−4	3.28−3
$5p_{3/2}$	σ	1.516+1	9.519+0	4.689+0	2.723+0	1.742+0	1.189+0	8.508−1	6.313−1	4.821−1	3.769−1
E_b =	β	1.518	1.616	1.713	1.754	1.770	1.773	1.767	1.756	1.742	1.725
74.5 eV	γ	2.04−1	9.12−2	−3.26−2	−4.25−2	1.65−2	1.15−1	2.36−1	3.66−1	4.98−1	6.29−1
	δ	−1.43−3	−2.56−3	1.14−3	5.58−3	9.28−3	1.23−2	1.50−2	1.73−2	1.94−2	2.15−2
$5d_{3/2}$	σ	1.205+1	7.085+0	2.986+0	1.498+0	8.419−1	5.126−1	3.313−1	2.244−1	1.577−1	1.144−1
E_b =	β	1.253	1.351	1.414	1.409	1.378	1.336	1.288	1.239	1.191	1.145
15.3 eV	γ	−2.84−2	−3.01−2	1.20−1	3.37−1	5.60−1	7.67−1	9.51−1	1.11+0	1.26+0	1.38+0
	δ	2.87−3	1.35−2	3.34−2	5.03−2	6.59−2	8.09−2	9.52−2	1.09−1	1.23−1	1.37−1
$5d_{5/2}$	σ	1.681+1	9.698+0	3.990+0	1.969+0	1.092+0	6.580−1	4.214−1	2.830−1	1.975−1	1.422−1
E_b =	β	1.345	1.394	1.395	1.353	1.299	1.241	1.182	1.126	1.073	1.024
13.1 eV	γ	−3.79−2	−1.72−2	1.62−1	3.89−1	6.08−1	8.06−1	9.78−1	1.13+0	1.25+0	1.37+0
	δ	4.13−3	1.29−2	3.09−2	4.89−2	6.74−2	8.62−2	1.05−1	1.22−1	1.40−1	1.57−1
$6s_{1/2}$	σ	6.470−1	4.080−1	2.087−1	1.275−1	8.598−2	6.179−2	4.645−2	3.613−2	2.885−2	2.355−2
E_b =	β	1.838	1.850	1.865	1.875	1.884	1.892	1.899	1.906	1.911	1.916
8.0 eV	γ	4.63−1	3.94−1	2.45−1	1.14−1	9.29−3	−6.84−2	−1.23−1	−1.57−1	−1.76−1	−1.82−1
	δ	−5.84−4	−1.14−3	−1.96−3	−2.55−3	−2.99−3	−3.34−3	−3.62−3	−3.85−3	−4.06−3	−4.25−3
$6p_{1/2}$	σ	3.308−1	2.220−1	1.198−1	7.415−2	4.974−2	3.526−2	2.605−2	1.987−2	1.555−2	1.242−2
E_b =	β	1.588	1.662	1.711	1.717	1.707	1.691	1.670	1.647	1.623	1.598
6.0 eV	γ	3.28−1	1.91−1	2.56−2	−1.61−2	1.70−2	9.17−2	1.88−1	2.95−1	4.07−1	5.20−1
	δ	−6.23−3	−7.44−3	−7.51−3	−7.44−3	−7.08−3	−6.19−3	−4.68−3	−2.54−3	2.28−4	3.48−3
Z= 82, Pb: [Xe]$4f^6_{5/2}$ $4f^8_{7/2}$ $5d^4_{3/2}$ $5d^6_{5/2}$ $6s^2_{1/2}$ $6p^2_{1/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$4s_{1/2}$	σ	2.595+1	1.789+1	9.863+0	6.221+0	4.270+0	3.106+0	2.355+0	1.844+0	1.481+0	1.213+0
E_b =	β	1.777	1.810	1.840	1.855	1.866	1.876	1.884	1.892	1.898	1.905
893.6 eV	γ	7.59−1	6.57−1	4.42−1	2.62−1	1.20−1	1.11−2	−6.90−2	−1.25−1	−1.61−1	−1.80−1
	δ	1.13−3	−2.20−4	−1.64−3	−2.46−3	−3.05−3	−3.50−3	−3.87−3	−4.16−3	−4.40−3	−4.59−3

(*continued on next page*)

Table 1 (*continued*)

$4p_{1/2}$	σ	2.838+1	2.117+1	1.243+1	7.949+0	5.431+0	3.896+0	2.903+0	2.227+0	1.751+0	1.404+0
E_b =	β	1.264	1.484	1.633	1.674	1.683	1.677	1.664	1.646	1.625	1.603
763.9 eV	γ	5.50−1	4.19−1	1.30−1	7.06−3	−6.25−3	4.25−2	1.25−1	2.25−1	3.32−1	4.42−1
	δ	3.13−2	5.44−3	−5.35−3	−6.82−3	−6.74−3	−5.95−3	−4.54−3	−2.58−3	−9.23−5	2.88−3
$4p_{3/2}$	σ	8.429+1	5.562+1	2.849+1	1.680+1	1.084+1	7.437+0	5.342+0	3.976+0	3.044+0	2.384+0
E_b =	β	1.273	1.474	1.643	1.713	1.745	1.758	1.760	1.754	1.744	1.730
644.5 eV	γ	3.50−1	2.21−1	1.29−2	−5.10−2	−2.22−2	5.97−2	1.70−1	2.94−1	4.24−1	5.55−1
	δ	2.08−2	4.09−3	9.99−4	5.06−3	9.32−3	1.29−2	1.59−2	1.85−2	2.07−2	2.29−2
$4d_{3/2}$	σ	1.184+2	7.176+1	3.063+1	1.537+1	8.626+0	5.245+0	3.387+0	2.293+0	1.611+0	1.168+0
E_b =	β	1.041	1.230	1.363	1.387	1.371	1.338	1.297	1.253	1.209	1.165
435.2 eV	γ	1.01−2	−5.35−2	5.19−2	2.64−1	4.92−1	7.03−1	8.93−1	1.06+0	1.21+0	1.35+0
	δ	5.18−3	1.09−2	3.25−2	5.12−2	6.74−2	8.17−2	9.55−2	1.09−1	1.23−1	1.37−1
$4d_{5/2}$	σ	1.735+2	1.026+2	4.257+1	2.099+1	1.162+1	6.989+0	4.471+0	3.001+0	2.093+0	1.506+0
E_b =	β	1.185	1.309	1.368	1.348	1.303	1.250	1.196	1.143	1.093	1.046
412.9 eV	γ	−1.41−2	−5.16−2	9.46−2	3.23−1	5.50−1	7.53−1	9.31−1	1.09+0	1.22+0	1.34+0
	δ	5.59−3	1.10−2	2.99−2	4.88−2	6.73−2	8.52−2	1.03−1	1.20−1	1.38−1	1.56−1
$4f_{5/2}$	σ	1.228+2	5.051+1	1.298+1	4.611+0	1.994+0	9.842−1	5.350−1	3.126−1	1.933−1	1.251−1
E_b =	β	1.028	1.055	1.016	0.941	0.863	0.791	0.728	0.671	0.618	0.569
141.8 eV	γ	1.83−1	3.32−1	6.08−1	8.26−1	9.93−1	1.12+0	1.23+0	1.31+0	1.38+0	1.43+0
	δ	7.71−2	1.01−1	1.44−1	1.83−1	2.20−1	2.55−1	2.89−1	3.22−1	3.53−1	3.82−1
$4f_{7/2}$	σ	1.558+2	6.380+1	1.627+1	5.744+0	2.469+0	1.213+0	6.561−1	3.818−1	2.351−1	1.516−1
E_b =	β	1.033	1.051	1.003	0.926	0.849	0.780	0.720	0.667	0.618	0.573
136.9 eV	γ	1.94−1	3.47−1	6.26−1	8.44−1	1.01+0	1.14+0	1.24+0	1.32+0	1.38+0	1.43+0
	δ	7.74−2	1.01−1	1.44−1	1.84−1	2.22−1	2.58−1	2.94−1	3.28−1	3.60−1	3.90−1
$5s_{1/2}$	σ	6.519+0	4.166+0	2.161+0	1.330+0	9.014−1	6.500−1	4.899−1	3.818−1	3.054−1	2.495−1
E_b =	β	1.822	1.838	1.855	1.866	1.875	1.883	1.890	1.897	1.903	1.908
147.3 eV	γ	5.02−1	4.34−1	2.83−1	1.47−1	3.75−2	−4.71−2	−1.09−1	−1.50−1	−1.74−1	−1.84−1
	δ	−4.32−4	−1.08−3	−1.99−3	−2.64−3	−3.14−3	−3.54−3	−3.87−3	−4.13−3	−4.36−3	−4.54−3
$5p_{1/2}$	σ	6.358+0	4.327+0	2.372+0	1.480+0	9.994−1	7.120−1	5.279−1	4.038−1	3.167−1	2.535−1
E_b =	β	1.554	1.641	1.701	1.712	1.706	1.692	1.673	1.652	1.629	1.605
104.8 eV	γ	3.66−1	2.25−1	4.30−2	−1.36−2	7.54−3	7.39−2	1.65−1	2.68−1	3.76−1	4.86−1
	δ	−4.85−3	−7.18−3	−7.72−3	−7.64−3	−7.31−3	−6.52−3	−5.15−3	−3.22−3	−7.44−4	2.24−3
$5p_{3/2}$	σ	1.622+1	1.019+1	5.034+0	2.931+0	1.879+0	1.285+0	9.213−1	6.846−1	5.234−1	4.097−1
E_b =	β	1.502	1.605	1.706	1.750	1.769	1.774	1.771	1.761	1.749	1.733
84.5 eV	γ	2.16−1	1.03−1	−2.73−2	−4.62−2	5.44−3	9.83−2	2.13−1	3.39−1	4.68−1	5.97−1
	δ	−1.32−3	−2.79−3	7.90−4	5.36−3	9.25−3	1.24−2	1.51−2	1.74−2	1.95−2	2.16−2
$5d_{3/2}$	σ	1.353+1	7.996+0	3.399+0	1.716+0	9.690−1	5.921−1	3.839−1	2.606−1	1.837−1	1.334−1
E_b =	β	1.241	1.345	1.414	1.413	1.385	1.345	1.300	1.254	1.208	1.162
21.8 eV	γ	−2.37−2	−3.42−2	1.04−1	3.17−1	5.38−1	7.43−1	9.27−1	1.09+0	1.24+0	1.37+0
	δ	2.12−3	1.24−2	3.23−2	4.94−2	6.47−2	7.88−2	9.25−2	1.06−1	1.20−1	1.34−1
$5d_{5/2}$	σ	1.916+1	1.111+1	4.606+0	2.286+0	1.274+0	7.700−1	4.945−1	3.329−1	2.328−1	1.679−1
E_b =	β	1.342	1.394	1.399	1.360	1.307	1.249	1.192	1.138	1.087	1.039
19.2 eV	γ	−3.57−2	−2.31−2	1.47−1	3.71−1	5.90−1	7.86−1	9.58−1	1.11+0	1.24+0	1.36+0
	δ	3.56−3	1.20−2	2.98−2	4.77−2	6.57−2	8.35−2	1.01−1	1.19−1	1.36−1	1.54−1
$6s_{1/2}$	σ	7.619−1	4.807−1	2.463−1	1.508−1	1.019−1	7.333−2	5.521−2	4.299−2	3.437−2	2.806−2
E_b =	β	1.828	1.841	1.856	1.867	1.877	1.885	1.892	1.898	1.904	1.909
3.1 eV	γ	4.72−1	4.07−1	2.62−1	1.31−1	2.56−2	−5.46−2	−1.13−1	−1.52−1	−1.75−1	−1.85−1
	δ	−5.88−4	−1.19−3	−2.05−3	−2.67−3	−3.14−3	−3.51−3	−3.83−3	−4.11−3	−4.35−3	−4.55−3
$6p_{1/2}$	σ	4.376−1	2.944−1	1.597−1	9.923−2	6.683−2	4.756−2	3.524−2	2.695−2	2.113−2	1.691−2
E_b =	β	1.575	1.653	1.708	1.717	1.710	1.694	1.675	1.653	1.629	1.605
0.7 eV	γ	3.45−1	2.08−1	3.51−2	−1.49−2	1.02−2	7.76−2	1.68−1	2.73−1	3.83−1	4.95−1
	δ	−6.54−3	−7.94−3	−8.01−3	−7.81−3	−7.41−3	−6.58−3	−5.18−3	−3.19−3	−6.62−4	2.32−3

Z= 83, Bi: [Xe]$4f^6_{5/2}$ $4f^8_{7/2}$ $5d^4_{3/2}$ $5d^6_{5/2}$ $6s^2_{1/2}$ $6p^2_{1/2}$ $6p^1_{3/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$4s_{1/2}$	σ	2.605+1	1.808+1	1.004+1	6.354+0	4.373+0	3.186+0	2.420+0	1.897+0	1.525+0	1.251+0
E_b =	β	1.759	1.795	1.828	1.844	1.856	1.866	1.875	1.884	1.891	1.898
938.2 eV	γ	7.81−1	6.88−1	4.74−1	2.92−1	1.46−1	3.25−2	−5.19−2	−1.12−1	−1.52−1	−1.76−1
	δ	1.42−3	−6.88−5	−1.65−3	−2.56−3	−3.21−3	−3.70−3	−4.08−3	−4.39−3	−4.64−3	−4.86−3
$4p_{1/2}$	σ	2.818+1	2.126+1	1.263+1	8.140+0	5.588+0	4.025+0	3.008+0	2.315+0	1.824+0	1.466+0
E_b =	β	1.216	1.458	1.622	1.669	1.682	1.678	1.667	1.650	1.631	1.610
805.3 eV	γ	5.62−1	4.53−1	1.56−1	1.71−2	−8.25−3	3.14−2	1.06−1	2.00−1	3.04−1	4.12−1
	δ	3.67−2	7.21−3	−5.45−3	−7.23−3	−7.20−3	−6.45−3	−5.12−3	−3.27−3	−9.01−4	1.99−3
$4p_{3/2}$	σ	8.621+1	5.714+1	2.942+1	1.742+1	1.126+1	7.745+0	5.574+0	4.155+0	3.185+0	2.499+0
E_b =	β	1.240	1.449	1.629	1.705	1.741	1.757	1.761	1.758	1.749	1.737
678.9 eV	γ	3.62−1	2.40−1	2.52−2	−5.03−2	−3.10−2	4.32−2	1.47−1	2.66−1	3.93−1	5.23−1
	δ	2.42−2	5.14−3	7.43−4	4.74−3	9.16−3	1.29−2	1.60−2	1.86−2	2.10−2	2.32−2
$4d_{3/2}$	σ	1.220+2	7.464+1	3.220+1	1.626+1	9.166+0	5.594+0	3.624+0	2.459+0	1.732+0	1.258+0
E_b =	β	1.009	1.211	1.357	1.388	1.376	1.346	1.308	1.266	1.223	1.179

(*continued on next page*)

Table 1 (*continued*)

463.6 eV	γ	2.35−2	−5.26−2	3.58−2	2.41−1	4.63−1	6.73−1	8.64−1	1.04+0	1.19+0	1.33+0
	δ	5.95−3	9.94−3	3.13−2	5.01−2	6.57−2	7.99−2	9.37−2	1.08−1	1.21−1	1.35−1
$4d_{5/2}$	σ	1.793+2	1.069+2	4.477+1	2.220+1	1.234+1	7.449+0	4.779+0	3.216+0	2.247+0	1.620+0
E_b =	β	1.166	1.300	1.368	1.352	1.310	1.260	1.208	1.156	1.107	1.059
440.0 eV	γ	−3.39−3	−5.40−2	7.82−2	3.01−1	5.25−1	7.28−1	9.08−1	1.07+0	1.21+0	1.33+0
	δ	6.01−3	1.02−2	2.87−2	4.73−2	6.51−2	8.25−2	1.00−1	1.18−1	1.36−1	1.54−1
$4f_{5/2}$	σ	1.343+2	5.562+1	1.443+1	5.159+0	2.241+0	1.110+0	6.049−1	3.541−1	2.193−1	1.421−1
E_b =	β	1.022	1.054	1.020	0.949	0.874	0.804	0.740	0.681	0.626	0.577
162.3 eV	γ	1.69−1	3.17−1	5.93−1	8.12−1	9.83−1	1.12+0	1.23+0	1.31+0	1.38+0	1.43+0
	δ	7.53−2	9.94−2	1.42−1	1.80−1	2.16−1	2.52−1	2.87−1	3.18−1	3.48−1	3.76−1
$4f_{7/2}$	σ	1.704+2	7.025+1	1.808+1	6.424+0	2.775+0	1.367+0	7.415−1	4.322−1	2.666−1	1.721−1
E_b =	β	1.029	1.051	1.008	0.933	0.859	0.792	0.731	0.676	0.625	0.579
157.2 eV	γ	1.80−1	3.33−1	6.11−1	8.30−1	1.00+0	1.13+0	1.24+0	1.32+0	1.38+0	1.44+0
	δ	7.57−2	9.94−2	1.42−1	1.81−1	2.19−1	2.56−1	2.91−1	3.25−1	3.55−1	3.84−1
$5s_{1/2}$	σ	6.804+0	4.354+0	2.264+0	1.396+0	9.476−1	6.843−1	5.165−1	4.029−1	3.226−1	2.638−1
E_b =	β	1.809	1.826	1.844	1.856	1.866	1.874	1.882	1.890	1.896	1.902
159.3 eV	γ	5.19−1	4.53−1	3.05−1	1.69−1	5.59−2	−3.17−2	−9.63−2	−1.41−1	−1.69−1	−1.83−1
	δ	−3.82−4	−1.08−3	−2.07−3	−2.78−3	−3.32−3	−3.74−3	−4.09−3	−4.37−3	−4.60−3	−4.82−3
$5p_{1/2}$	σ	6.639+0	4.535+0	2.501+0	1.569+0	1.063+0	7.599−1	5.651−1	4.333−1	3.406−1	2.732−1
E_b =	β	1.536	1.630	1.696	1.711	1.708	1.695	1.678	1.657	1.636	1.613
116.8 eV	γ	3.89−1	2.47−1	5.62−2	−1.09−2	1.82−3	6.08−2	1.46−1	2.44−1	3.49−1	4.57−1
	δ	−4.95−3	−7.60−3	−8.22−3	−8.10−3	−7.75−3	−6.98−3	−5.71−3	−3.89−3	−1.51−3	1.34−3
$5p_{3/2}$	σ	1.732+1	1.090+1	5.396+0	3.150+0	2.024+0	1.387+0	9.959−1	7.412−1	5.675−1	4.448−1
E_b =	β	1.483	1.591	1.697	1.745	1.767	1.775	1.773	1.766	1.755	1.741
92.9 eV	γ	2.27−1	1.15−1	−2.20−2	−4.90−2	−4.66−3	8.14−2	1.91−1	3.12−1	4.39−1	5.68−1
	δ	−1.13−3	−3.01−3	4.09−4	5.13−3	9.19−3	1.25−2	1.52−2	1.75−2	1.98−2	2.19−2
$5d_{3/2}$	σ	1.512+1	8.986+0	3.851+0	1.956+0	1.110+0	6.807−1	4.428−1	3.015−1	2.130−1	1.550−1
E_b =	β	1.228	1.337	1.413	1.417	1.392	1.355	1.313	1.268	1.223	1.178
26.5 eV	γ	−1.86−2	−3.72−2	9.04−2	2.96−1	5.12−1	7.15−1	9.01−1	1.07+0	1.22+0	1.35+0
	δ	1.45−3	1.15−2	3.15−2	4.83−2	6.30−2	7.68−2	9.05−2	1.04−1	1.18−1	1.32−1
$5d_{5/2}$	σ	2.149+1	1.252+1	5.229+0	2.611+0	1.461+0	8.863−1	5.710−1	3.854−1	2.701−1	1.952−1
E_b =	β	1.338	1.394	1.403	1.366	1.314	1.259	1.204	1.151	1.101	1.053
24.4 eV	γ	−3.29−2	−2.80−2	1.33−1	3.52−1	5.68−1	7.63−1	9.37−1	1.09+0	1.23+0	1.35+0
	δ	3.04−3	1.12−2	2.88−2	4.62−2	6.34−2	8.06−2	9.83−2	1.16−1	1.34−1	1.52−1
$6s_{1/2}$	σ	8.813−1	5.563−1	2.853−1	1.749−1	1.183−1	8.529−2	6.428−2	5.010−2	4.007−2	3.274−2
E_b =	β	1.815	1.830	1.847	1.859	1.868	1.876	1.883	1.890	1.896	1.901
7.5 eV	γ	4.85−1	4.23−1	2.80−1	1.50−1	4.32−2	−4.06−2	−1.03−1	−1.46−1	−1.73−1	−1.86−1
	δ	−5.66−4	−1.20−3	−2.13−3	−2.80−3	−3.31−3	−3.74−3	−4.09−3	−4.39−3	−4.65−3	−4.85−3
$6p_{1/2}$	σ	5.638−1	3.803−1	2.073−1	1.294−1	8.750−2	6.248−2	4.643−2	3.558−2	2.795−2	2.241−2
E_b =	β	1.568	1.649	1.707	1.718	1.712	1.698	1.679	1.659	1.636	1.613
1.2 eV	γ	3.63−1	2.26−1	4.64−2	−1.25−2	3.82−3	6.45−2	1.51−1	2.52−1	3.59−1	4.67−1
	δ	−6.99−3	−8.41−3	−8.37−3	−8.09−3	−7.75−3	−7.03−3	−5.79−3	−4.01−3	−1.71−3	1.05−3
$6p_{3/2}$	σ	1.203+0	7.512−1	3.693−1	2.150−1	1.380−1	9.448−2	6.782−2	5.046−2	3.862−2	3.026−2
E_b =	β	1.504	1.604	1.705	1.751	1.771	1.777	1.775	1.767	1.755	1.741
0.2 eV	γ	2.13−1	1.04−1	−2.60−2	−4.78−2	−1.36−3	8.56−2	1.96−1	3.20−1	4.49−1	5.78−1
	δ	−2.49−3	−3.50−3	4.05−4	5.14−3	9.10−3	1.23−2	1.51−2	1.75−2	1.97−2	2.17−2

Z= 84, Po: [Xe]$4f^6_{5/2}$ $4f^8_{7/2}$ $5d^4_{3/2}$ $5d^6_{5/2}$ $6s^2_{1/2}$ $6p^2_{1/2}$ $6p^2_{3/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$4s_{1/2}$	σ	2.612+1	1.825+1	1.020+1	6.484+0	4.474+0	3.267+0	2.485+0	1.951+0	1.570+0	1.289+0
E_b =	β	1.736	1.778	1.814	1.833	1.846	1.857	1.867	1.876	1.883	1.890
987.5 eV	γ	8.07−1	7.20−1	5.09−1	3.24−1	1.74−1	5.62−2	−3.23−2	−9.69−2	−1.42−1	−1.71−1
	δ	1.83−3	1.16−4	−1.64−3	−2.65−3	−3.36−3	−3.88−3	−4.29−3	−4.63−3	−4.92−3	−5.17−3
$4p_{1/2}$	σ	2.789+1	2.130+1	1.283+1	8.324+0	5.744+0	4.154+0	3.114+0	2.403+0	1.899+0	1.529+0
E_b =	β	1.157	1.430	1.610	1.664	1.680	1.679	1.670	1.655	1.637	1.617
850.9 eV	γ	5.70−1	4.89−1	1.84−1	2.97−2	−8.31−3	2.13−2	8.87−2	1.77−1	2.77−1	3.84−1
	δ	4.40−2	9.35−3	−5.50−3	−7.61−3	−7.61−3	−6.90−3	−5.66−3	−3.92−3	−1.66−3	1.06−3
$4p_{3/2}$	σ	8.813+1	5.867+1	3.037+1	1.804+1	1.170+1	8.060+0	5.812+0	4.340+0	3.332+0	2.617+0
E_b =	β	1.203	1.423	1.614	1.696	1.736	1.756	1.762	1.760	1.754	1.743
715.2 eV	γ	3.73−1	2.60−1	3.87−2	−4.81−2	−3.85−2	2.75−2	1.25−1	2.40−1	3.65−1	4.94−1
	δ	2.80−2	6.38−3	5.05−4	4.38−3	8.94−3	1.28−2	1.61−2	1.88−2	2.13−2	2.36−2
$4d_{3/2}$	σ	1.257+2	7.760+1	3.383+1	1.719+1	9.735+0	5.964+0	3.875+0	2.636+0	1.860+0	1.353+0
E_b =	β	0.974	1.190	1.349	1.387	1.381	1.354	1.319	1.279	1.236	1.193
495.7 eV	γ	3.90−2	−5.00−2	1.99−2	2.15−1	4.33−1	6.43−1	8.38−1	1.01+0	1.17+0	1.31+0
	δ	7.21−3	9.00−3	3.01−2	4.88−2	6.43−2	7.87−2	9.27−2	1.06−1	1.20−1	1.33−1
$4d_{5/2}$	σ	1.852+2	1.113+2	4.705+1	2.346+1	1.310+1	7.934+0	5.105+0	3.442+0	2.410+0	1.740+0
E_b =	β	1.145	1.291	1.368	1.357	1.318	1.270	1.219	1.168	1.118	1.069
469.9 eV	γ	9.29−3	−5.51−2	6.15−2	2.78−1	4.99−1	7.04−1	8.87−1	1.05+0	1.19+0	1.32+0
	δ	6.73−3	9.43−3	2.74−2	4.56−2	6.30−2	8.05−2	9.84−2	1.16−1	1.34−1	1.51−1

(*continued on next page*)

Table 1 (*continued*)

$4f_{5/2}$	σ	1.466+2	6.111+1	1.600+1	5.757+0	2.512+0	1.249+0	6.818−1	3.999−1	2.481−1	1.610−1
E_b =	β	1.015	1.053	1.025	0.957	0.885	0.815	0.749	0.689	0.635	0.585
184.6 eV	γ	1.54−1	3.01−1	5.76−1	7.98−1	9.75−1	1.11+0	1.22+0	1.31+0	1.38+0	1.44+0
	δ	7.33−2	9.75−2	1.39−1	1.77−1	2.14−1	2.50−1	2.83−1	3.14−1	3.43−1	3.71−1
$4f_{7/2}$	σ	1.860+2	7.715+1	2.004+1	7.166+0	3.109+0	1.537+0	8.353−1	4.878−1	3.014−1	1.948−1
E_b =	β	1.023	1.051	1.013	0.941	0.869	0.802	0.739	0.683	0.632	0.586
178.9 eV	γ	1.66−1	3.17−1	5.95−1	8.17−1	9.93−1	1.13+0	1.24+0	1.32+0	1.38+0	1.44+0
	δ	7.38−2	9.76−2	1.39−1	1.78−1	2.16−1	2.53−1	2.88−1	3.20−1	3.50−1	3.79−1
$5s_{1/2}$	σ	7.103+0	4.551+0	2.370+0	1.464+0	9.951−1	7.198−1	5.440−1	4.249−1	3.405−1	2.787−1
E_b =	β	1.794	1.813	1.833	1.846	1.857	1.866	1.875	1.882	1.888	1.894
177.5 eV	γ	5.37−1	4.75−1	3.28−1	1.91−1	7.61−2	−1.42−2	−8.20−2	−1.31−1	−1.63−1	−1.82−1
	δ	−3.11−4	−1.07−3	−2.15−3	−2.91−3	−3.49−3	−3.94−3	−4.30−3	−4.62−3	−4.89−3	−5.13−3
$5p_{1/2}$	σ	6.914+0	4.743+0	2.631+0	1.658+0	1.128+0	8.092−1	6.036−1	4.640−1	3.655−1	2.938−1
E_b =	β	1.519	1.619	1.692	1.710	1.709	1.698	1.682	1.663	1.642	1.620
131.8 eV	γ	4.12−1	2.72−1	7.11−2	−6.42−3	−2.82−3	4.84−2	1.27−1	2.21−1	3.24−1	4.31−1
	δ	−5.04−3	−8.03−3	−8.73−3	−8.52−3	−8.13−3	−7.40−3	−6.22−3	−4.52−3	−2.29−3	4.02−4
$5p_{3/2}$	σ	1.848+1	1.164+1	5.775+0	3.379+0	2.176+0	1.494+0	1.075+0	8.012−1	6.143−1	4.821−1
E_b =	β	1.464	1.576	1.688	1.740	1.765	1.775	1.776	1.770	1.760	1.747
103.7 eV	γ	2.40−1	1.28−1	−1.56−2	−5.07−2	−1.40−2	6.53−2	1.69−1	2.87−1	4.13−1	5.40−1
	δ	−8.84−4	−3.21−3	6.44−7	4.85−3	9.06−3	1.25−2	1.53−2	1.78−2	2.01−2	2.23−2
$5d_{3/2}$	σ	1.675+1	1.001+1	4.322+0	2.208+0	1.259+0	7.752−1	5.059−1	3.454−1	2.445−1	1.783−1
E_b =	β	1.214	1.328	1.411	1.420	1.399	1.365	1.325	1.281	1.237	1.192
33.8 eV	γ	−1.25−2	−3.94−2	7.58−2	2.74−1	4.85−1	6.89−1	8.78−1	1.05+0	1.20+0	1.34+0
	δ	7.89−4	1.05−2	3.04−2	4.70−2	6.16−2	7.55−2	8.94−2	1.03−1	1.16−1	1.30−1
$5d_{5/2}$	σ	2.386+1	1.396+1	5.874+0	2.948+0	1.658+0	1.009+0	6.523−1	4.414−1	3.099−1	2.243−1
E_b =	β	1.334	1.393	1.406	1.372	1.323	1.270	1.216	1.163	1.113	1.064
30.6 eV	γ	−2.94−2	−3.23−2	1.19−1	3.32−1	5.45−1	7.42−1	9.19−1	1.08+0	1.21+0	1.33+0
	δ	2.55−3	1.04−2	2.76−2	4.45−2	6.14−2	7.86−2	9.65−2	1.14−1	1.32−1	1.49−1
$6s_{1/2}$	σ	9.964−1	6.294−1	3.230−1	1.983−1	1.343−1	9.694−2	7.314−2	5.705−2	4.568−2	3.734−2
E_b =	β	1.802	1.818	1.836	1.848	1.858	1.867	1.874	1.882	1.888	1.894
11.0 eV	γ	5.00−1	4.40−1	3.01−1	1.71−1	6.11−2	−2.57−2	−9.12−2	−1.38−1	−1.68−1	−1.84−1
	δ	−5.31−4	−1.22−3	−2.22−3	−2.94−3	−3.51−3	−3.97−3	−4.34−3	−4.66−3	−4.92−3	−5.13−3
$6p_{1/2}$	σ	6.855−1	4.635−1	2.538−1	1.591−1	1.080−1	7.738−2	5.764−2	4.427−2	3.485−2	2.799−2
E_b =	β	1.557	1.642	1.704	1.717	1.713	1.701	1.684	1.664	1.643	1.621
3.2 eV	γ	3.82−1	2.45−1	5.90−2	−9.42−3	−1.35−3	5.30−2	1.34−1	2.30−1	3.33−1	4.38−1
	δ	−7.53−3	−8.97−3	−8.83−3	−8.54−3	−8.23−3	−7.58−3	−6.45−3	−4.80−3	−2.66−3	−3.17−5
$6p_{3/2}$	σ	1.518+0	9.485−1	4.671−1	2.725−1	1.753−1	1.203−1	8.646−2	6.441−2	4.936−2	3.871−2
E_b =	β	1.492	1.594	1.699	1.747	1.769	1.778	1.778	1.771	1.761	1.748
1.4 eV	γ	2.23−1	1.14−1	−2.02−2	−4.96−2	−1.04−2	7.11−2	1.77−1	2.96−1	4.21−1	5.46−1
	δ	−2.55−3	−3.78−3	3.49−5	4.87−3	9.03−3	1.24−2	1.53−2	1.77−2	1.99−2	2.18−2
Z= 85, At: [Xe]$4f^6_{5/2}$ $4f^8_{7/2}$ $5d^4_{3/2}$ $5d^6_{5/2}$ $6s^2_{1/2}$ $6p^2_{1/2}$ $6p^3_{3/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$4s_{1/2}$	σ	2.613+1	1.840+1	1.036+1	6.611+0	4.574+0	3.346+0	2.550+0	2.005+0	1.615+0	1.327+0
E_b =	β	1.712	1.760	1.801	1.821	1.835	1.847	1.857	1.866	1.874	1.880
1038.2 eV	γ	8.34−1	7.51−1	5.42−1	3.57−1	2.03−1	8.14−2	−1.14−2	−8.09−2	−1.31−1	−1.65−1
	δ	2.29−3	3.41−4	−1.62−3	−2.74−3	−3.50−3	−4.07−3	−4.52−3	−4.90−3	−5.23−3	−5.52−3
$4p_{1/2}$	σ	2.753+1	2.130+1	1.300+1	8.498+0	5.895+0	4.281+0	3.221+0	2.493+0	1.973+0	1.592+0
E_b =	β	1.093	1.400	1.598	1.658	1.678	1.680	1.672	1.659	1.642	1.623
897.7 eV	γ	5.70−1	5.24−1	2.14−1	4.45−2	−6.46−3	1.30−2	7.27−2	1.56−1	2.53−1	3.56−1
	δ	5.30−2	1.19−2	−5.50−3	−7.97−3	−8.03−3	−7.36−3	−6.22−3	−4.60−3	−2.49−3	4.34−5
$4p_{3/2}$	σ	9.005+1	6.022+1	3.134+1	1.867+1	1.214+1	8.385+0	6.058+0	4.531+0	3.483+0	2.738+0
E_b =	β	1.161	1.396	1.598	1.687	1.731	1.753	1.762	1.763	1.758	1.748
753.7 eV	γ	3.81−1	2.80−1	5.35−2	−4.44−2	−4.47−2	1.31−2	1.05−1	2.16−1	3.38−1	4.64−1
	δ	3.25−2	7.83−3	2.98−4	3.98−3	8.67−3	1.27−2	1.62−2	1.91−2	2.16−2	2.39−2
$4d_{3/2}$	σ	1.293+2	8.053+1	3.547+1	1.814+1	1.032+1	6.347+0	4.136+0	2.820+0	1.994+0	1.453+0
E_b =	β	0.939	1.168	1.341	1.387	1.385	1.362	1.328	1.289	1.248	1.206
527.6 eV	γ	5.53−2	−4.57−2	5.15−3	1.90−1	4.04−1	6.16−1	8.13−1	9.91−1	1.15+0	1.29+0
	δ	8.97−3	8.19−3	2.88−2	4.75−2	6.31−2	7.77−2	9.15−2	1.05−1	1.17−1	1.29−1
$4d_{5/2}$	σ	1.910+2	1.157+2	4.936+1	2.476+1	1.389+1	8.438+0	5.444+0	3.679+0	2.580+0	1.866+0
E_b =	β	1.124	1.281	1.367	1.361	1.325	1.279	1.229	1.178	1.128	1.080
500.1 eV	γ	2.33−2	−5.47−2	4.56−2	2.55−1	4.74−1	6.81−1	8.67−1	1.03+0	1.17+0	1.30+0
	δ	7.78−3	8.75−3	2.62−2	4.40−2	6.13−2	7.88−2	9.66−2	1.14−1	1.31−1	1.47−1
$4f_{5/2}$	σ	1.595+2	6.690+1	1.767+1	6.402+0	2.806+0	1.399+0	7.658−1	4.501−1	2.797−1	1.818−1
E_b =	β	1.007	1.051	1.030	0.965	0.894	0.824	0.758	0.698	0.644	0.596
207.0 eV	γ	1.39−1	2.84−1	5.59−1	7.84−1	9.65−1	1.11+0	1.22+0	1.31+0	1.38+0	1.44+0
	δ	7.10−2	9.54−2	1.37−1	1.75−1	2.12−1	2.47−1	2.79−1	3.09−1	3.38−1	3.66−1
$4f_{7/2}$	σ	2.023+2	8.443+1	2.213+1	7.964+0	3.471+0	1.721+0	9.376−1	5.486−1	3.395−1	2.198−1

(*continued on next page*)

Table 1 (*continued*)

E_b =	β	1.017	1.051	1.018	0.949	0.878	0.810	0.747	0.691	0.640	0.596
200.8 eV	γ	1.51−1	3.01−1	5.79−1	8.04−1	9.84−1	1.12+0	1.23+0	1.32+0	1.39+0	1.44+0
	δ	7.16−2	9.55−2	1.37−1	1.75−1	2.14−1	2.50−1	2.83−1	3.15−1	3.45−1	3.74−1
$5s_{1/2}$	σ	7.395+0	4.745+0	2.476+0	1.532+0	1.043+0	7.556−1	5.718−1	4.471−1	3.587−1	2.938−1
E_b =	β	1.779	1.799	1.821	1.836	1.847	1.857	1.866	1.873	1.879	1.885
193.4 eV	γ	5.54−1	4.95−1	3.51−1	2.14−1	9.70−2	4.16−3	−6.73−2	−1.20−1	−1.57−1	−1.80−1
	δ	−2.35−4	−1.06−3	−2.23−3	−3.04−3	−3.65−3	−4.14−3	−4.55−3	−4.90−3	−5.21−3	−5.48−3
$5p_{1/2}$	σ	7.177+0	4.944+0	2.759+0	1.747+0	1.193+0	8.592−1	6.428−1	4.954−1	3.911−1	3.148−1
E_b =	β	1.501	1.608	1.687	1.709	1.710	1.700	1.686	1.668	1.648	1.627
145.6 eV	γ	4.36−1	2.96−1	8.70−2	−6.08−4	−6.19−3	3.73−2	1.10−1	2.01−1	3.01−1	4.05−1
	δ	−5.17−3	−8.49−3	−9.25−3	−8.95−3	−8.51−3	−7.85−3	−6.77−3	−5.20−3	−3.15−3	−6.43−4
$5p_{3/2}$	σ	1.967+1	1.240+1	6.166+0	3.615+0	2.333+0	1.606+0	1.157+0	8.638−1	6.632−1	5.210−1
E_b =	β	1.446	1.562	1.678	1.735	1.763	1.775	1.777	1.773	1.765	1.753
113.6 eV	γ	2.51−1	1.40−1	−8.55−3	−5.13−2	−2.23−2	5.05−2	1.50−1	2.65−1	3.87−1	5.13−1
	δ	−6.09−4	−3.39−3	−4.16−4	4.53−3	8.91−3	1.25−2	1.55−2	1.81−2	2.05−2	2.26−2
$5d_{3/2}$	σ	1.839+1	1.105+1	4.807+0	2.471+0	1.415+0	8.750−1	5.728−1	3.920−1	2.780−1	2.031−1
E_b =	β	1.199	1.319	1.409	1.423	1.405	1.374	1.335	1.293	1.249	1.206
40.9 eV	γ	−5.71−3	−4.08−2	6.18−2	2.52−1	4.61−1	6.65−1	8.56−1	1.03+0	1.18+0	1.32+0
	δ	1.91−4	9.52−3	2.94−2	4.59−2	6.05−2	7.46−2	8.82−2	1.01−1	1.14−1	1.26−1
$5d_{5/2}$	σ	2.627+1	1.544+1	6.540+0	3.301+0	1.864+0	1.139+0	7.384−1	5.008−1	3.523−1	2.555−1
E_b =	β	1.329	1.392	1.410	1.378	1.331	1.279	1.226	1.173	1.122	1.074
37.4 eV	γ	−2.52−2	−3.60−2	1.05−1	3.12−1	5.23−1	7.22−1	9.01−1	1.06+0	1.20+0	1.32+0
	δ	2.10−3	9.56−3	2.65−2	4.30−2	5.97−2	7.71−2	9.48−2	1.12−1	1.29−1	1.46−1
$6s_{1/2}$	σ	1.109+0	7.008−1	3.600−1	2.212−1	1.500−1	1.084−1	8.189−2	6.395−2	5.125−2	4.193−2
E_b =	β	1.788	1.805	1.825	1.838	1.848	1.858	1.866	1.874	1.881	1.887
15.0 eV	γ	5.14−1	4.58−1	3.22−1	1.91−1	8.01−2	−9.05−3	−7.71−2	−1.27−1	−1.61−1	−1.81−1
	δ	−4.91−4	−1.23−3	−2.31−3	−3.09−3	−3.70−3	−4.18−3	−4.57−3	−4.91−3	−5.20−3	−5.44−3
$6p_{1/2}$	σ	8.037−1	5.450−1	2.998−1	1.887−1	1.286−1	9.238−2	6.901−2	5.313−2	4.191−2	3.373−2
E_b =	β	1.543	1.634	1.700	1.716	1.714	1.704	1.688	1.670	1.649	1.628
5.7 eV	γ	4.02−1	2.66−1	7.27−2	−5.07−3	−5.02−3	4.24−2	1.17−1	2.08−1	3.07−1	4.10−1
	δ	−8.03−3	−9.59−3	−9.40−3	−9.05−3	−8.70−3	−8.07−3	−7.00−3	−5.45−3	−3.41−3	−8.81−4
$6p_{3/2}$	σ	1.838+0	1.149+0	5.668−1	3.313−1	2.135−1	1.468−1	1.057−1	7.882−2	6.048−2	4.750−2
E_b =	β	1.478	1.583	1.691	1.742	1.767	1.778	1.780	1.775	1.766	1.754
2.8 eV	γ	2.33−1	1.25−1	−1.40−2	−5.10−2	−1.86−2	5.68−2	1.57−1	2.72−1	3.93−1	5.16−1
	δ	−2.59−3	−4.08−3	−3.75−4	4.59−3	8.94−3	1.25−2	1.54−2	1.79−2	2.01−2	2.21−2

Z= 86, Rn: [Xe]$4f^6_{5/2}$ $4f^8_{7/2}$ $5d^4_{3/2}$ $5d^6_{5/2}$ $6s^2_{1/2}$ $6p^2_{1/2}$ $6p^4_{3/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$4s_{1/2}$	σ	2.611+1	1.853+1	1.051+1	6.734+0	4.671+0	3.425+0	2.615+0	2.058+0	1.660+0	1.366+0
E_b =	β	1.684	1.740	1.786	1.808	1.824	1.837	1.847	1.856	1.863	1.870
1090.5 eV	γ	8.62−1	7.83−1	5.77−1	3.90−1	2.33−1	1.08−1	1.09−2	−6.35−2	−1.19−1	−1.58−1
	δ	2.89−3	6.13−4	−1.59−3	−2.81−3	−3.65−3	−4.27−3	−4.77−3	−5.19−3	−5.56−3	−5.88−3
$4p_{1/2}$	σ	2.708+1	2.124+1	1.314+1	8.663+0	6.042+0	4.406+0	3.326+0	2.581+0	2.048+0	1.656+0
E_b =	β	1.034	1.367	1.584	1.652	1.676	1.680	1.674	1.662	1.647	1.629
946.2 eV	γ	5.65−1	5.58−1	2.47−1	6.17−2	−2.59−3	6.40−3	5.83−2	1.36−1	2.29−1	3.28−1
	δ	6.27−2	1.48−2	−5.45−3	−8.36−3	−8.47−3	−7.87−3	−6.81−3	−5.31−3	−3.36−3	−9.94−4
$4p_{3/2}$	σ	9.190+1	6.173+1	3.229+1	1.931+1	1.258+1	8.713+0	6.307+0	4.724+0	3.637+0	2.862+0
E_b =	β	1.118	1.369	1.583	1.677	1.726	1.751	1.762	1.764	1.761	1.753
791.2 eV	γ	3.87−1	3.00−1	6.90−2	−3.95−2	−4.95−2	1.68−4	8.57−2	1.93−1	3.11−1	4.35−1
	δ	3.73−2	9.49−3	1.30−4	3.57−3	8.37−3	1.26−2	1.62−2	1.93−2	2.19−2	2.42−2
$4d_{3/2}$	σ	1.327+2	8.344+1	3.714+1	1.911+1	1.093+1	6.745+0	4.408+0	3.012+0	2.134+0	1.557+0
E_b =	β	0.901	1.146	1.332	1.385	1.388	1.368	1.337	1.300	1.261	1.220
560.4 eV	γ	7.24−2	−3.98−2	−8.47−3	1.67−1	3.77−1	5.88−1	7.86−1	9.65−1	1.12+0	1.27+0
	δ	1.13−2	7.53−3	2.74−2	4.63−2	6.21−2	7.67−2	9.02−2	1.03−1	1.15−1	1.27−1
$4d_{5/2}$	σ	1.967+2	1.201+2	5.172+1	2.609+1	1.470+1	8.961+0	5.796+0	3.925+0	2.758+0	1.997+0
E_b =	β	1.102	1.270	1.366	1.364	1.331	1.287	1.238	1.188	1.139	1.091
531.1 eV	γ	3.88−2	−5.28−2	3.04−2	2.33−1	4.50−1	6.58−1	8.46−1	1.01+0	1.16+0	1.28+0
	δ	9.20−3	8.19−3	2.49−2	4.25−2	5.96−2	7.71−2	9.46−2	1.11−1	1.28−1	1.43−1
$4f_{5/2}$	σ	1.730+2	7.303+1	1.946+1	7.096+0	3.125+0	1.563+0	8.576−1	5.050−1	3.144−1	2.047−1
E_b =	β	0.999	1.049	1.034	0.973	0.903	0.833	0.767	0.708	0.655	0.607
230.1 eV	γ	1.24−1	2.67−1	5.43−1	7.70−1	9.55−1	1.10+0	1.21+0	1.30+0	1.38+0	1.44+0
	δ	6.87−2	9.32−2	1.35−1	1.72−1	2.09−1	2.43−1	2.74−1	3.05−1	3.34−1	3.62−1
$4f_{7/2}$	σ	2.194+2	9.215+1	2.437+1	8.824+0	3.863+0	1.922+0	1.049+0	6.152−1	3.814−1	2.473−1
E_b =	β	1.010	1.049	1.022	0.957	0.887	0.818	0.755	0.699	0.650	0.606
223.6 eV	γ	1.36−1	2.84−1	5.64−1	7.91−1	9.75−1	1.12+0	1.23+0	1.32+0	1.39+0	1.45+0
	δ	6.94−2	9.34−2	1.35−1	1.73−1	2.11−1	2.46−1	2.79−1	3.11−1	3.41−1	3.71−1
$5s_{1/2}$	σ	7.684+0	4.938+0	2.581+0	1.600+0	1.091+0	7.917−1	6.000−1	4.697−1	3.772−1	3.091−1
E_b =	β	1.762	1.785	1.809	1.825	1.837	1.847	1.855	1.863	1.870	1.876
209.6 eV	γ	5.70−1	5.15−1	3.75−1	2.37−1	1.19−1	2.34−2	−5.17−2	−1.09−1	−1.50−1	−1.77−1

(*continued on next page*)

Table 1 (*continued*)

	δ	−1.42−4	−1.04−3	−2.29−3	−3.17−3	−3.83−3	−4.37−3	−4.82−3	−5.21−3	−5.55−3	−5.84−3
$5p_{1/2}$	σ	7.427+0	5.138+0	2.885+0	1.835+0	1.259+0	9.096−1	6.825−1	5.273−1	4.171−1	3.364−1
E_b =	β	1.484	1.596	1.682	1.707	1.710	1.703	1.689	1.673	1.654	1.634
159.5 eV	γ	4.59−1	3.21−1	1.04−1	6.50−3	−8.22−3	2.76−2	9.48−2	1.81−1	2.77−1	3.78−1
	δ	−5.31−3	−8.97−3	−9.81−3	−9.43−3	−8.95−3	−8.33−3	−7.35−3	−5.91−3	−4.03−3	−1.73−3
$5p_{3/2}$	σ	2.089+1	1.319+1	6.569+0	3.860+0	2.497+0	1.721+0	1.243+0	9.291−1	7.142−1	5.616−1
E_b =	β	1.428	1.547	1.669	1.729	1.760	1.774	1.778	1.776	1.769	1.759
123.9 eV	γ	2.62−1	1.53−1	−7.61−4	−5.11−2	−2.95−2	3.69−2	1.31−1	2.42−1	3.62−1	4.85−1
	δ	−3.04−4	−3.55−3	−8.52−4	4.19−3	8.74−3	1.25−2	1.57−2	1.84−2	2.07−2	2.28−2
$5d_{3/2}$	σ	2.005+1	1.211+1	5.307+0	2.744+0	1.579+0	9.800−1	6.434−1	4.414−1	3.138−1	2.296−1
E_b =	β	1.184	1.309	1.406	1.425	1.411	1.382	1.345	1.304	1.262	1.220
48.0 eV	γ	1.75−3	−4.11−2	4.87−2	2.31−1	4.37−1	6.41−1	8.32−1	1.00+0	1.16+0	1.30+0
	δ	−3.41−4	8.54−3	2.83−2	4.49−2	5.96−2	7.35−2	8.67−2	9.91−2	1.11−1	1.23−1
$5d_{5/2}$	σ	2.872+1	1.695+1	7.228+0	3.667+0	2.080+0	1.276+0	8.291−1	5.636−1	3.973−1	2.886−1
E_b =	β	1.325	1.391	1.413	1.384	1.339	1.288	1.236	1.183	1.133	1.085
44.2 eV	γ	−2.02−2	−3.88−2	9.14−2	2.93−1	5.03−1	7.02−1	8.82−1	1.04+0	1.18+0	1.30+0
	δ	1.70−3	8.80−3	2.54−2	4.16−2	5.83−2	7.54−2	9.26−2	1.09−1	1.26−1	1.41−1
$6s_{1/2}$	σ	1.219+0	7.710−1	3.963−1	2.437−1	1.655−1	1.198−1	9.059−2	7.082−2	5.681−2	4.653−2
E_b =	β	1.772	1.792	1.813	1.827	1.838	1.848	1.857	1.865	1.872	1.878
18.7 eV	γ	5.28−1	4.75−1	3.43−1	2.12−1	1.00−1	8.91−3	−6.21−2	−1.15−1	−1.53−1	−1.78−1
	δ	−4.42−4	−1.23−3	−2.40−3	−3.24−3	−3.88−3	−4.39−3	−4.82−3	−5.19−3	−5.51−3	−5.79−3
$6p_{1/2}$	σ	9.187−1	6.249−1	3.454−1	2.183−1	1.492−1	1.076−1	8.058−2	6.220−2	4.917−2	3.965−2
E_b =	β	1.529	1.625	1.696	1.715	1.715	1.706	1.692	1.675	1.655	1.635
7.6 eV	γ	4.22−1	2.87−1	8.73−2	6.30−4	−7.47−3	3.26−2	1.01−1	1.87−1	2.83−1	3.84−1
	δ	−8.56−3	−1.02−2	−1.00−2	−9.56−3	−9.12−3	−8.49−3	−7.49−3	−6.05−3	−4.13−3	−1.74−3
$6p_{3/2}$	σ	2.165+0	1.354+0	6.688−1	3.916−1	2.528−1	1.741−1	1.255−1	9.378−2	7.206−2	5.666−2
E_b =	β	1.462	1.571	1.682	1.736	1.764	1.777	1.781	1.778	1.771	1.760
4.1 eV	γ	2.42−1	1.36−1	−7.47−3	−5.15−2	−2.60−2	4.30−2	1.38−1	2.48−1	3.66−1	4.89−1
	δ	−2.57−3	−4.37−3	−8.17−4	4.27−3	8.80−3	1.25−2	1.55−2	1.81−2	2.04−2	2.25−2
Z= 87, Fr: [Rn]$7s^1_{1/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$4s_{1/2}$	σ	2.601+1	1.863+1	1.065+1	6.850+0	4.767+0	3.503+0	2.678+0	2.111+0	1.704+0	1.403+0
E_b =	β	1.656	1.719	1.771	1.795	1.811	1.824	1.834	1.844	1.853	1.861
1149.0 eV	γ	8.84−1	8.11−1	6.10−1	4.22−1	2.65−1	1.37−1	3.44−2	−4.50−2	−1.05−1	−1.47−1
	δ	3.52−3	8.93−4	−1.54−3	−2.87−3	−3.79−3	−4.49−3	−5.06−3	−5.52−3	−5.90−3	−6.22−3
$4p_{1/2}$	σ	2.656+1	2.113+1	1.327+1	8.815+0	6.186+0	4.530+0	3.431+0	2.669+0	2.123+0	1.719+0
E_b =	β	0.945	1.330	1.572	1.646	1.672	1.679	1.675	1.665	1.652	1.635
1000.7 eV	γ	5.42−1	5.93−1	2.81−1	8.14−2	3.25−3	1.53−3	4.61−2	1.18−1	2.04−1	2.99−1
	δ	7.48−2	1.89−2	−5.33−3	−8.66−3	−8.98−3	−8.50−3	−7.51−3	−6.08−3	−4.24−3	−2.00−3
$4p_{3/2}$	σ	9.373+1	6.324+1	3.324+1	1.995+1	1.304+1	9.051+0	6.562+0	4.921+0	3.792+0	2.988+0
E_b =	β	1.059	1.334	1.568	1.667	1.719	1.746	1.760	1.765	1.763	1.757
835.1 eV	γ	3.86−1	3.18−1	8.55−2	−3.26−2	−5.32−2	−1.15−2	6.81−2	1.69−1	2.83−1	4.02−1
	δ	4.35−2	1.17−2	4.29−6	3.14−3	8.05−3	1.26−2	1.64−2	1.95−2	2.21−2	2.44−2
$4d_{3/2}$	σ	1.360+2	8.634+1	3.883+1	2.012+1	1.156+1	7.156+0	4.689+0	3.212+0	2.280+0	1.667+0
E_b =	β	0.861	1.121	1.323	1.382	1.390	1.374	1.345	1.311	1.274	1.235
598.7 eV	γ	9.01−2	−3.22−2	−2.12−2	1.44−1	3.53−1	5.61−1	7.55−1	9.33−1	1.10+0	1.24+0
	δ	1.46−2	7.05−3	2.59−2	4.52−2	6.15−2	7.55−2	8.81−2	1.00−1	1.12−1	1.24−1
$4d_{5/2}$	σ	2.024+2	1.245+2	5.411+1	2.747+1	1.554+1	9.502+0	6.160+0	4.180+0	2.943+0	2.135+0
E_b =	β	1.074	1.258	1.364	1.368	1.337	1.294	1.246	1.198	1.151	1.105
567.5 eV	γ	5.56−2	−4.94−2	1.54−2	2.11−1	4.30−1	6.36−1	8.21−1	9.86−1	1.13+0	1.26+0
	δ	1.12−2	7.74−3	2.34−2	4.12−2	5.85−2	7.52−2	9.14−2	1.08−1	1.24−1	1.40−1
$4f_{5/2}$	σ	1.872+2	7.949+1	2.139+1	7.845+0	3.468+0	1.740+0	9.577−1	5.653−1	3.526−1	2.299−1
E_b =	β	0.990	1.046	1.038	0.979	0.909	0.841	0.779	0.721	0.668	0.619
258.6 eV	γ	1.10−1	2.49−1	5.26−1	7.58−1	9.41−1	1.09+0	1.21+0	1.30+0	1.38+0	1.45+0
	δ	6.66−2	9.06−2	1.33−1	1.71−1	2.05−1	2.38−1	2.71−1	3.02−1	3.32−1	3.60−1
$4f_{7/2}$	σ	2.374+2	1.003+2	2.676+1	9.750+0	4.284+0	2.139+0	1.171+0	6.881−1	4.274−1	2.775−1
E_b =	β	1.003	1.048	1.027	0.963	0.892	0.826	0.766	0.712	0.662	0.616
251.6 eV	γ	1.21−1	2.66−1	5.48−1	7.81−1	9.63−1	1.11+0	1.22+0	1.32+0	1.39+0	1.45+0
	δ	6.74−2	9.09−2	1.33−1	1.72−1	2.07−1	2.41−1	2.75−1	3.08−1	3.39−1	3.68−1
$5s_{1/2}$	σ	7.971+0	5.131+0	2.688+0	1.669+0	1.140+0	8.285−1	6.286−1	4.925−1	3.958−1	3.246−1
E_b =	β	1.744	1.770	1.797	1.813	1.825	1.835	1.844	1.852	1.860	1.867
230.9 eV	γ	5.89−1	5.34−1	3.96−1	2.61−1	1.42−1	4.34−2	−3.55−2	−9.59−2	−1.40−1	−1.70−1
	δ	−1.48−5	−1.01−3	−2.36−3	−3.30−3	−4.04−3	−4.64−3	−5.13−3	−5.54−3	−5.87−3	−6.16−3
$5p_{1/2}$	σ	7.666+0	5.326+0	3.009+0	1.925+0	1.326+0	9.610−1	7.229−1	5.598−1	4.437−1	3.586−1
E_b =	β	1.460	1.585	1.678	1.705	1.710	1.704	1.693	1.677	1.660	1.641
178.7 eV	γ	4.83−1	3.46−1	1.23−1	1.51−2	−9.27−3	1.95−2	8.10−2	1.61−1	2.53−1	3.49−1
	δ	−5.33−3	−9.48−3	−1.03−2	−9.93−3	−9.52−3	−8.94−3	−8.00−3	−6.65−3	−4.88−3	−2.68−3

(*continued on next page*)

Table 1 (*continued*)

$5p_{3/2}$	σ	2.211+1	1.397+1	6.974+0	4.109+0	2.663+0	1.840+0	1.330+0	9.954−1	7.661−1	6.030−1
E_b =	β	1.406	1.534	1.661	1.722	1.755	1.772	1.779	1.778	1.773	1.764
138.7 eV	γ	2.73−1	1.66−1	7.97−3	−5.00−2	−3.60−2	2.46−2	1.14−1	2.19−1	3.34−1	4.53−1
	δ	1.24−4	−3.70−3	−1.27−3	3.82−3	8.58−3	1.26−2	1.59−2	1.86−2	2.09−2	2.30−2
$5d_{3/2}$	σ	2.174+1	1.319+1	5.827+0	3.031+0	1.752+0	1.091+0	7.181−1	4.939−1	3.519−1	2.580−1
E_b =	β	1.168	1.300	1.404	1.426	1.416	1.389	1.355	1.317	1.277	1.236
60.0 eV	γ	9.90−3	−4.06−2	3.56−2	2.13−1	4.16−1	6.16−1	8.03−1	9.75−1	1.13+0	1.27+0
	δ	−8.12−4	7.58−3	2.71−2	4.42−2	5.89−2	7.19−2	8.43−2	9.65−2	1.09−1	1.21−1
$5d_{5/2}$	σ	3.127+1	1.854+1	7.956+0	4.059+0	2.312+0	1.422+0	9.268−1	6.315−1	4.461−1	3.246−1
E_b =	β	1.319	1.390	1.415	1.389	1.346	1.296	1.244	1.194	1.146	1.099
55.6 eV	γ	−1.47−2	−4.09−2	7.75−2	2.76−1	4.86−1	6.82−1	8.60−1	1.02+0	1.16+0	1.29+0
	δ	1.34−3	8.05−3	2.42−2	4.06−2	5.71−2	7.33−2	8.93−2	1.06−1	1.22−1	1.38−1
$6s_{1/2}$	σ	1.389+0	8.792−1	4.524−1	2.785−1	1.894−1	1.373−1	1.040−1	8.134−2	6.530−2	5.352−2
E_b =	β	1.756	1.778	1.802	1.817	1.828	1.837	1.846	1.854	1.861	1.868
26.3 eV	γ	5.42−1	4.92−1	3.62−1	2.33−1	1.21−1	2.77−2	−4.70−2	−1.04−1	−1.46−1	−1.75−1
	δ	−3.85−4	−1.24−3	−2.48−3	−3.37−3	−4.06−3	−4.63−3	−5.12−3	−5.54−3	−5.90−3	−6.19−3
$6p_{1/2}$	σ	1.094+0	7.459−1	4.140−1	2.627−1	1.803−1	1.304−1	9.801−2	7.583−2	6.007−2	4.851−2
E_b =	β	1.513	1.616	1.693	1.715	1.716	1.708	1.696	1.679	1.661	1.641
13.2 eV	γ	4.43−1	3.09−1	1.03−1	7.87−3	−8.99−3	2.35−2	8.71−2	1.70−1	2.62−1	3.61−1
	δ	−9.16−3	−1.09−2	−1.06−2	−9.94−3	−9.50−3	−8.96−3	−8.07−3	−6.76−3	−4.99−3	−2.81−3
$6p_{3/2}$	σ	2.739+0	1.714+0	8.470−1	4.968−1	3.213−1	2.217−1	1.602−1	1.199−1	9.221−2	7.257−2
E_b =	β	1.446	1.557	1.674	1.731	1.762	1.776	1.782	1.780	1.775	1.765
8.8 eV	γ	2.52−1	1.47−1	−6.15−4	−5.06−2	−3.23−2	3.01−2	1.21−1	2.28−1	3.44−1	4.65−1
	δ	−2.59−3	−4.64−3	−1.28−3	3.92−3	8.58−3	1.25−2	1.57−2	1.84−2	2.08−2	2.29−2
$7s_{1/2}$	σ	8.657−2	5.463−2	2.802−2	1.722−2	1.170−2	8.470−3	6.410−3	5.014−3	4.024−3	3.297−3
E_b =	β	1.755	1.777	1.802	1.816	1.827	1.837	1.846	1.855	1.863	1.869
4.0 eV	γ	5.45−1	4.94−1	3.61−1	2.33−1	1.20−1	2.63−2	−4.79−2	−1.04−1	−1.45−1	−1.73−1
	δ	−3.90−4	−1.26−3	−2.48−3	−3.39−3	−4.09−3	−4.65−3	−5.11−3	−5.51−3	−5.84−3	−6.14−3

Z= 88, Ra: [Rn]$7s^2_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$4s_{1/2}$	σ	2.587+1	1.870+1	1.078+1	6.961+0	4.857+0	3.576+0	2.739+0	2.162+0	1.748+0	1.440+0
E_b =	β	1.622	1.694	1.753	1.779	1.797	1.811	1.823	1.834	1.843	1.851
1208.4 eV	γ	9.07−1	8.47−1	6.49−1	4.61−1	2.99−1	1.66−1	6.01−2	−2.28−2	−8.62−2	−1.33−1
	δ	4.33−3	1.34−3	−1.45−3	−2.94−3	−3.94−3	−4.70−3	−5.29−3	−5.77−3	−6.19−3	−6.54−3
$4p_{1/2}$	σ	2.595+1	2.097+1	1.337+1	8.958+0	6.320+0	4.647+0	3.532+0	2.756+0	2.197+0	1.784+0
E_b =	β	0.861	1.289	1.553	1.636	1.668	1.678	1.676	1.668	1.656	1.640
1057.6 eV	γ	5.08−1	6.23−1	3.19−1	1.04−1	1.16−2	−8.95−4	3.45−2	9.87−2	1.80−1	2.72−1
	δ	9.01−2	2.29−2	−5.06−3	−9.18−3	−9.56−3	−9.01−3	−8.04−3	−6.68−3	−4.92−3	−2.77−3
$4p_{3/2}$	σ	9.547+1	6.470+1	3.421+1	2.060+1	1.350+1	9.385+0	6.816+0	5.120+0	3.951+0	3.117+0
E_b =	β	1.016	1.308	1.547	1.654	1.711	1.742	1.758	1.765	1.765	1.761
879.1 eV	γ	3.87−1	3.37−1	1.03−1	−2.56−2	−5.55−2	−2.20−2	5.01−2	1.46−1	2.55−1	3.72−1
	δ	4.97−2	1.38−2	−3.36−5	2.67−3	7.67−3	1.23−2	1.63−2	1.96−2	2.24−2	2.49−2
$4d_{3/2}$	σ	1.392+2	8.916+1	4.052+1	2.113+1	1.219+1	7.576+0	4.980+0	3.420+0	2.434+0	1.783+0
E_b =	β	0.819	1.095	1.310	1.379	1.392	1.379	1.354	1.322	1.286	1.248
635.9 eV	γ	1.07−1	−2.35−2	−3.17−2	1.23−1	3.23−1	5.28−1	7.24−1	9.06−1	1.07+0	1.22+0
	δ	1.82−2	6.79−3	2.47−2	4.40−2	6.00−2	7.40−2	8.71−2	9.97−2	1.12−1	1.24−1
$4d_{5/2}$	σ	2.078+2	1.289+2	5.652+1	2.884+1	1.638+1	1.005+1	6.536+0	4.447+0	3.137+0	2.280+0
E_b =	β	1.052	1.244	1.362	1.370	1.343	1.303	1.257	1.210	1.163	1.117
602.7 eV	γ	7.27−2	−4.47−2	2.96−3	1.90−1	4.03−1	6.08−1	7.96−1	9.66−1	1.12+0	1.25+0
	δ	1.34−2	7.44−3	2.24−2	3.97−2	5.63−2	7.28−2	8.94−2	1.06−1	1.23−1	1.39−1
$4f_{5/2}$	σ	2.021+2	8.634+1	2.342+1	8.643+0	3.839+0	1.934+0	1.067+0	6.310−1	3.941−1	2.573−1
E_b =	β	0.979	1.043	1.042	0.986	0.920	0.854	0.790	0.730	0.676	0.625
287.9 eV	γ	9.49−2	2.33−1	5.07−1	7.40−1	9.29−1	1.08+0	1.20+0	1.30+0	1.38+0	1.45+0
	δ	6.41−2	8.86−2	1.30−1	1.67−1	2.03−1	2.37−1	2.69−1	2.99−1	3.27−1	3.54−1
$4f_{7/2}$	σ	2.563+2	1.089+2	2.929+1	1.074+1	4.741+0	2.375+0	1.304+0	7.675−1	4.774−1	3.104−1
E_b =	β	0.995	1.046	1.031	0.970	0.903	0.838	0.776	0.720	0.669	0.622
280.4 eV	γ	1.06−1	2.50−1	5.30−1	7.64−1	9.52−1	1.10+0	1.22+0	1.32+0	1.39+0	1.45+0
	δ	6.50−2	8.90−2	1.30−1	1.67−1	2.04−1	2.40−1	2.73−1	3.05−1	3.34−1	3.62−1
$5s_{1/2}$	σ	8.258+0	5.325+0	2.795+0	1.738+0	1.189+0	8.652−1	6.572−1	5.156−1	4.148−1	3.405−1
E_b =	β	1.725	1.753	1.782	1.799	1.813	1.824	1.834	1.843	1.851	1.858
254.4 eV	γ	6.04−1	5.58−1	4.24−1	2.87−1	1.66−1	6.50−2	−1.61−2	−7.94−2	−1.27−1	−1.61−1
	δ	9.39−5	−9.59−4	−2.42−3	−3.45−3	−4.23−3	−4.85−3	−5.36−3	−5.80−3	−6.18−3	−6.51−3
$5p_{1/2}$	σ	7.891+0	5.509+0	3.133+0	2.013+0	1.392+0	1.012+0	7.637−1	5.929−1	4.711−1	3.815−1
E_b =	β	1.441	1.568	1.669	1.702	1.709	1.706	1.695	1.681	1.665	1.647
200.4 eV	γ	5.08−1	3.75−1	1.43−1	2.52−2	−8.07−3	1.26−2	6.66−2	1.41−1	2.28−1	3.23−1
	δ	−5.34−3	−9.93−3	−1.11−2	−1.06−2	−1.00−2	−9.37−3	−8.47−3	−7.20−3	−5.52−3	−3.41−3
$5p_{3/2}$	σ	2.335+1	1.478+1	7.390+0	4.361+0	2.832+0	1.959+0	1.419+0	1.064+0	8.198−1	6.462−1
E_b =	β	1.389	1.514	1.647	1.714	1.751	1.770	1.778	1.780	1.776	1.769

(*continued on next page*)

Table 1 (*continued*)

152.8 eV	γ	2.84−1	1.79−1	1.65−2	−4.84−2	−4.12−2	1.24−2	9.53−2	1.96−1	3.08−1	4.26−1
	δ	6.09−4	−3.75−3	−1.76−3	3.41−3	8.33−3	1.25−2	1.59−2	1.88−2	2.13−2	2.35−2
$5d_{3/2}$	σ	2.344+1	1.429+1	6.359+0	3.325+0	1.930+0	1.207+0	7.971−1	5.498−1	3.926−1	2.884−1
E_b =	β	1.151	1.286	1.399	1.427	1.420	1.397	1.365	1.328	1.290	1.250
69.4 eV	γ	1.79−2	−3.95−2	2.50−2	1.93−1	3.89−1	5.88−1	7.77−1	9.53−1	1.11+0	1.26+0
	δ	−1.20−3	6.71−3	2.63−2	4.31−2	5.74−2	7.07−2	8.34−2	9.59−2	1.08−1	1.20−1
$5d_{5/2}$	σ	3.383+1	2.015+1	8.703+0	4.461+0	2.551+0	1.575+0	1.030+0	7.035−1	4.981−1	3.631−1
E_b =	β	1.313	1.387	1.418	1.394	1.353	1.305	1.256	1.206	1.158	1.111
63.8 eV	γ	−9.14−3	−4.24−2	6.67−2	2.58−1	4.62−1	6.58−1	8.38−1	1.00+0	1.15+0	1.27+0
	δ	1.04−3	7.42−3	2.33−2	3.91−2	5.49−2	7.10−2	8.75−2	1.04−1	1.21−1	1.37−1
$6s_{1/2}$	σ	1.567+0	9.927−1	5.113−1	3.151−1	2.145−1	1.556−1	1.179−1	9.236−2	7.421−2	6.086−2
E_b =	β	1.738	1.761	1.787	1.803	1.815	1.826	1.836	1.844	1.852	1.859
35.5 eV	γ	5.58−1	5.14−1	3.86−1	2.57−1	1.43−1	4.69−2	−3.02−2	−9.03−2	−1.35−1	−1.67−1
	δ	−3.09−4	−1.23−3	−2.56−3	−3.53−3	−4.28−3	−4.89−3	−5.39−3	−5.83−3	−6.20−3	−6.52−3
$6p_{1/2}$	σ	1.263+0	8.644−1	4.821−1	3.071−1	2.115−1	1.534−1	1.156−1	8.963−2	7.115−2	5.757−2
E_b =	β	1.496	1.601	1.686	1.712	1.716	1.710	1.699	1.684	1.667	1.648
19.2 eV	γ	4.64−1	3.33−1	1.20−1	1.57−2	−9.14−3	1.67−2	7.42−2	1.51−1	2.39−1	3.33−1
	δ	−9.62−3	−1.17−2	−1.14−2	−1.06−2	−1.01−2	−9.52−3	−8.66−3	−7.43−3	−5.79−3	−3.73−3
$6p_{3/2}$	σ	3.302+0	2.068+0	1.023+0	6.011−1	3.895−1	2.691−1	1.947−1	1.458−1	1.123−1	8.850−2
E_b =	β	1.427	1.539	1.662	1.723	1.757	1.774	1.782	1.782	1.778	1.770
13.7 eV	γ	2.61−1	1.58−1	6.92−3	−4.99−2	−3.80−2	1.89−2	1.04−1	2.06−1	3.18−1	4.35−1
	δ	−2.40−3	−4.90−3	−1.78−3	3.54−3	8.42−3	1.25−2	1.58−2	1.86−2	2.10−2	2.31−2
$7s_{1/2}$	σ	1.380−1	8.712−2	4.470−2	2.748−2	1.869−2	1.355−2	1.027−2	8.040−3	6.458−3	5.296−3
E_b =	β	1.738	1.761	1.787	1.804	1.817	1.827	1.836	1.844	1.851	1.858
5.0 eV	γ	5.58−1	5.12−1	3.84−1	2.54−1	1.40−1	4.59−2	−3.07−2	−9.07−2	−1.36−1	−1.68−1
	δ	−3.35−4	−1.24−3	−2.58−3	−3.55−3	−4.27−3	−4.86−3	−5.38−3	−5.84−3	−6.22−3	−6.58−3

Z= 89, Ac: [Rn]$6d^1_{3/2}$ $7s^2_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$4s_{1/2}$	σ	2.565+1	1.875+1	1.089+1	7.066+0	4.944+0	3.649+0	2.800+0	2.213+0	1.791+0	1.478+0
E_b =	β	1.585	1.667	1.735	1.764	1.784	1.799	1.811	1.822	1.831	1.839
1269.4 eV	γ	9.31−1	8.79−1	6.85−1	4.96−1	3.33−1	1.97−1	8.80−2	7.89−4	−6.75−2	−1.20−1
	δ	5.33−3	1.81−3	−1.35−3	−2.98−3	−4.07−3	−4.89−3	−5.54−3	−6.08−3	−6.55−3	−6.96−3
$4p_{1/2}$	σ	2.529+1	2.075+1	1.344+1	9.082+0	6.445+0	4.761+0	3.631+0	2.842+0	2.272+0	1.848+0
E_b =	β	0.750	1.244	1.537	1.628	1.664	1.677	1.677	1.670	1.659	1.645
1112.8 eV	γ	4.53−1	6.51−1	3.58−1	1.28−1	2.23−2	−1.70−3	2.47−2	8.22−2	1.59−1	2.47−1
	δ	1.07−1	2.80−2	−4.79−3	−9.56−3	−1.00−2	−9.54−3	−8.63−3	−7.36−3	−5.70−3	−3.68−3
$4p_{3/2}$	σ	9.720+1	6.620+1	3.518+1	2.125+1	1.396+1	9.729+0	7.079+0	5.326+0	4.116+0	3.251+0
E_b =	β	0.958	1.274	1.530	1.642	1.703	1.737	1.756	1.765	1.767	1.764
924.3 eV	γ	3.81−1	3.54−1	1.21−1	−1.65−2	−5.61−2	−3.13−2	3.40−2	1.25−1	2.30−1	3.45−1
	δ	5.73−2	1.66−2	−2.70−5	2.20−3	7.23−3	1.21−2	1.62−2	1.98−2	2.27−2	2.53−2
$4d_{3/2}$	σ	1.422+2	9.201+1	4.225+1	2.217+1	1.285+1	8.017+0	5.285+0	3.638+0	2.594+0	1.903+0
E_b =	β	0.775	1.067	1.299	1.374	1.392	1.384	1.361	1.331	1.296	1.260
673.9 eV	γ	1.25−1	−1.29−2	−4.13−2	1.00−1	2.95−1	5.00−1	6.98−1	8.81−1	1.05+0	1.20+0
	δ	2.31−2	6.78−3	2.33−2	4.26−2	5.89−2	7.33−2	8.64−2	9.87−2	1.10−1	1.21−1
$4d_{5/2}$	σ	2.134+2	1.335+2	5.904+1	3.029+1	1.728+1	1.064+1	6.935+0	4.728+0	3.341+0	2.432+0
E_b =	β	1.023	1.230	1.359	1.373	1.349	1.311	1.266	1.220	1.173	1.127
641.1 eV	γ	9.25−2	−3.80−2	−9.82−3	1.68−1	3.78−1	5.84−1	7.75−1	9.46−1	1.10+0	1.23+0
	δ	1.65−2	7.29−3	2.11−2	3.81−2	5.47−2	7.14−2	8.80−2	1.04−1	1.20−1	1.36−1
$4f_{5/2}$	σ	2.176+2	9.354+1	2.559+1	9.501+0	4.240+0	2.142+0	1.185+0	7.021−1	4.393−1	2.873−1
E_b =	β	0.968	1.039	1.045	0.994	0.929	0.862	0.798	0.738	0.684	0.635
316.4 eV	γ	8.04−2	2.15−1	4.89−1	7.25−1	9.18−1	1.07+0	1.20+0	1.30+0	1.38+0	1.45+0
	δ	6.17−2	8.63−2	1.28−1	1.65−1	2.01−1	2.34−1	2.65−1	2.94−1	3.22−1	3.49−1
$4f_{7/2}$	σ	2.761+2	1.179+2	3.199+1	1.180+1	5.233+0	2.630+0	1.447+0	8.535−1	5.318−1	3.463−1
E_b =	β	0.985	1.043	1.035	0.977	0.911	0.845	0.783	0.727	0.676	0.630
308.4 eV	γ	9.06−2	2.33−1	5.13−1	7.50−1	9.42−1	1.09+0	1.21+0	1.31+0	1.39+0	1.46+0
	δ	6.26−2	8.67−2	1.28−1	1.66−1	2.02−1	2.37−1	2.69−1	2.99−1	3.29−1	3.57−1
$5s_{1/2}$	σ	8.526+0	5.509+0	2.898+0	1.805+0	1.237+0	9.014−1	6.857−1	5.386−1	4.338−1	3.564−1
E_b =	β	1.704	1.735	1.768	1.787	1.801	1.813	1.823	1.832	1.839	1.847
273.5 eV	γ	6.20−1	5.77−1	4.46−1	3.11−1	1.90−1	8.78−2	3.94−3	−6.30−2	−1.15−1	−1.53−1
	δ	2.47−4	−9.06−4	−2.48−3	−3.57−3	−4.41−3	−5.09−3	−5.65−3	−6.14−3	−6.57−3	−6.94−3
$5p_{1/2}$	σ	8.096+0	5.677+0	3.250+0	2.098+0	1.457+0	1.063+0	8.046−1	6.264−1	4.988−1	4.047−1
E_b =	β	1.417	1.555	1.663	1.699	1.709	1.707	1.698	1.685	1.670	1.653
216.9 eV	γ	5.31−1	4.01−1	1.64−1	3.68−2	−5.73−3	6.69−3	5.43−2	1.24−1	2.08−1	2.99−1
	δ	−5.38−3	−1.05−2	−1.17−2	−1.11−2	−1.05−2	−9.87−3	−9.03−3	−7.86−3	−6.29−3	−4.34−3
$5p_{3/2}$	σ	2.463+1	1.560+1	7.818+0	4.622+0	3.007+0	2.085+0	1.512+0	1.135+0	8.761−1	6.913−1
E_b =	β	1.367	1.498	1.637	1.707	1.746	1.767	1.778	1.781	1.779	1.773
167.8 eV	γ	2.95−1	1.92−1	2.62−2	−4.53−2	−4.55−2	1.46−3	7.91−2	1.76−1	2.85−1	4.00−1
	δ	1.14−3	−3.83−3	−2.23−3	2.96−3	8.03−3	1.24−2	1.60−2	1.91−2	2.17−2	2.40−2

(*continued on next page*)

Table 1 (*continued*)

$5d_{3/2}$	σ	2.525+1	1.548+1	6.933+0	3.644+0	2.125+0	1.333+0	8.832−1	6.107−1	4.369−1	3.216−1
E_b =	β	1.132	1.275	1.395	1.427	1.424	1.404	1.374	1.339	1.301	1.262
83.3 eV	γ	2.79−2	−3.72−2	1.36−2	1.72−1	3.66−1	5.64−1	7.54−1	9.30−1	1.09+0	1.23+0
	δ	−1.55−3	5.75−3	2.51−2	4.20−2	5.66−2	7.01−2	8.27−2	9.46−2	1.06−1	1.17−1
$5d_{5/2}$	σ	3.657+1	2.187+1	9.501+0	4.893+0	2.810+0	1.741+0	1.141+0	7.813−1	5.541−1	4.046−1
E_b =	β	1.307	1.385	1.420	1.400	1.360	1.314	1.265	1.216	1.167	1.120
77.7 eV	γ	−1.70−3	−4.31−2	5.40−2	2.39−1	4.42−1	6.38−1	8.20−1	9.83−1	1.13+0	1.26+0
	δ	7.47−4	6.69−3	2.21−2	3.77−2	5.36−2	6.98−2	8.61−2	1.02−1	1.18−1	1.34−1
$6s_{1/2}$	σ	1.722+0	1.092+0	5.632−1	3.474−1	2.368−1	1.719−1	1.305−1	1.023−1	8.230−2	6.755−2
E_b =	β	1.719	1.745	1.773	1.791	1.804	1.815	1.825	1.834	1.842	1.849
39.8 eV	γ	5.70−1	5.29−1	4.06−1	2.79−1	1.64−1	6.77−2	−1.16−2	−7.45−2	−1.23−1	−1.58−1
	δ	−2.32−4	−1.22−3	−2.64−3	−3.68−3	−4.47−3	−5.11−3	−5.66−3	−6.13−3	−6.54−3	−6.90−3
$6p_{1/2}$	σ	1.394+0	9.563−1	5.359−1	3.427−1	2.368−1	1.724−1	1.302−1	1.012−1	8.054−2	6.530−2
E_b =	β	1.479	1.592	1.682	1.711	1.717	1.712	1.702	1.688	1.672	1.654
24.1 eV	γ	4.85−1	3.56−1	1.38−1	2.53−2	−7.75−3	1.04−2	6.12−2	1.33−1	2.17−1	3.08−1
	δ	−1.03−2	−1.25−2	−1.21−2	−1.12−2	−1.06−2	−9.95−3	−9.14−3	−7.97−3	−6.42−3	−4.46−3
$6p_{3/2}$	σ	3.823+0	2.395+0	1.187+0	6.979−1	4.529−1	3.134−1	2.271−1	1.704−1	1.314−1	1.036−1
E_b =	β	1.411	1.527	1.652	1.717	1.753	1.772	1.782	1.784	1.781	1.774
17.0 eV	γ	2.70−1	1.69−1	1.48−2	−4.79−2	−4.25−2	7.85−3	8.71−2	1.84−1	2.93−1	4.07−1
	δ	−2.36−3	−5.17−3	−2.27−3	3.12−3	8.16−3	1.24−2	1.59−2	1.88−2	2.13−2	2.36−2
$6d_{3/2}$	σ	1.544+0	9.415−1	4.201−1	2.206−1	1.286−1	8.065−2	5.343−2	3.694−2	2.643−2	1.946−2
E_b =	β	1.158	1.294	1.405	1.433	1.428	1.406	1.375	1.340	1.303	1.264
6.0 eV	γ	2.37−2	−3.68−2	1.92−2	1.81−1	3.75−1	5.71−1	7.57−1	9.30−1	1.09+0	1.24+0
	δ	−2.48−3	5.67−3	2.51−2	4.20−2	5.65−2	6.93−2	8.13−2	9.29−2	1.04−1	1.16−1
$7s_{1/2}$	σ	1.724−1	1.089−1	5.591−2	3.441−2	2.342−2	1.700−2	1.289−2	1.011−2	8.124−3	6.666−3
E_b =	β	1.720	1.746	1.774	1.791	1.804	1.814	1.824	1.832	1.840	1.848
6.0 eV	γ	5.68−1	5.26−1	4.03−1	2.76−1	1.63−1	6.61−2	−1.36−2	−7.71−2	−1.26−1	−1.60−1
	δ	−2.75−4	−1.25−3	−2.67−3	−3.69−3	−4.48−3	−5.14−3	−5.71−3	−6.21−3	−6.60−3	−6.98−3
Z= 90, Th: [Rn]$6d^2_{3/2}$ $7s^2_{1/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$4s_{1/2}$	σ	2.535+1	1.876+1	1.099+1	7.163+0	5.027+0	3.718+0	2.858+0	2.263+0	1.834+0	1.514+0
E_b =	β	1.543	1.638	1.714	1.747	1.769	1.784	1.797	1.808	1.818	1.826
1329.5 eV	γ	9.53−1	9.08−1	7.22−1	5.34−1	3.68−1	2.30−1	1.17−1	2.57−2	−4.72−2	−1.04−1
	δ	6.56−3	2.35−3	−1.20−3	−3.00−3	−4.20−3	−5.09−3	−5.82−3	−6.42−3	−6.94−3	−7.38−3
$4p_{1/2}$	σ	2.455+1	2.048+1	1.348+1	9.192+0	6.563+0	4.870+0	3.728+0	2.926+0	2.345+0	1.912+0
E_b =	β	0.633	1.197	1.517	1.618	1.659	1.674	1.677	1.672	1.662	1.650
1168.2 eV	γ	3.77−1	6.75−1	3.98−1	1.55−1	3.52−2	−4.04−4	1.69−2	6.77−2	1.39−1	2.23−1
	δ	1.28−1	3.41−2	−4.39−3	−1.00−2	−1.06−2	−1.02−2	−9.31−3	−8.11−3	−6.54−3	−4.64−3
$4p_{3/2}$	σ	9.883+1	6.763+1	3.613+1	2.190+1	1.443+1	1.007+1	7.344+0	5.534+0	4.282+0	3.386+0
E_b =	β	0.899	1.238	1.509	1.629	1.694	1.731	1.752	1.763	1.767	1.766
967.2 eV	γ	3.70−1	3.70−1	1.40−1	−6.49−3	−5.56−2	−3.92−2	1.94−2	1.05−1	2.06−1	3.17−1
	δ	6.54−2	1.97−2	7.38−5	1.73−3	6.78−3	1.18−2	1.62−2	1.99−2	2.31−2	2.57−2
$4d_{3/2}$	σ	1.452+2	9.488+1	4.403+1	2.325+1	1.354+1	8.476+0	5.603+0	3.866+0	2.761+0	2.029+0
E_b =	β	0.727	1.035	1.285	1.369	1.392	1.387	1.368	1.340	1.307	1.272
713.7 eV	γ	1.42−1	−7.49−4	−4.96−2	7.99−2	2.69−1	4.72−1	6.69−1	8.51−1	1.02+0	1.17+0
	δ	2.93−2	7.09−3	2.19−2	4.14−2	5.80−2	7.25−2	8.54−2	9.72−2	1.08−1	1.19−1
$4d_{5/2}$	σ	2.186+2	1.379+2	6.153+1	3.175+1	1.819+1	1.123+1	7.342+0	5.016+0	3.551+0	2.589+0
E_b =	β	0.993	1.213	1.356	1.375	1.354	1.318	1.275	1.229	1.183	1.138
676.6 eV	γ	1.12−1	−3.01−2	−2.09−2	1.48−1	3.55−1	5.62−1	7.52−1	9.24−1	1.08+0	1.21+0
	δ	2.01−2	7.33−3	1.99−2	3.67−2	5.34−2	6.99−2	8.61−2	1.02−1	1.17−1	1.32−1
$4f_{5/2}$	σ	2.337+2	1.010+2	2.787+1	1.041+1	4.667+0	2.366+0	1.312+0	7.791−1	4.884−1	3.199−1
E_b =	β	0.956	1.034	1.047	1.000	0.936	0.870	0.807	0.748	0.695	0.646
344.4 eV	γ	6.66−2	1.99−1	4.71−1	7.10−1	9.06−1	1.06+0	1.19+0	1.29+0	1.38+0	1.45+0
	δ	5.94−2	8.41−2	1.26−1	1.63−1	1.98−1	2.30−1	2.61−1	2.90−1	3.18−1	3.45−1
$4f_{7/2}$	σ	2.962+2	1.273+2	3.480+1	1.291+1	5.754+0	2.901+0	1.601+0	9.461−1	5.905−1	3.852−1
E_b =	β	0.976	1.040	1.038	0.984	0.918	0.852	0.791	0.735	0.685	0.640
335.0 eV	γ	7.65−2	2.16−1	4.96−1	7.37−1	9.31−1	1.08+0	1.21+0	1.31+0	1.39+0	1.46+0
	δ	6.04−2	8.46−2	1.25−1	1.64−1	2.00−1	2.33−1	2.65−1	2.95−1	3.25−1	3.53−1
$5s_{1/2}$	σ	8.778+0	5.685+0	2.998+0	1.871+0	1.284+0	9.372−1	7.139−1	5.614−1	4.526−1	3.722−1
E_b =	β	1.681	1.716	1.752	1.773	1.788	1.799	1.810	1.819	1.827	1.835
290.2 eV	γ	6.36−1	5.97−1	4.70−1	3.36−1	2.15−1	1.11−1	2.47−2	−4.56−2	−1.01−1	−1.43−1
	δ	4.16−4	−8.28−4	−2.53−3	−3.70−3	−4.60−3	−5.35−3	−5.97−3	−6.51−3	−6.97−3	−7.37−3
$5p_{1/2}$	σ	8.281+0	5.835+0	3.362+0	2.181+0	1.521+0	1.114+0	8.455−1	6.599−1	5.266−1	4.280−1
E_b =	β	1.391	1.539	1.656	1.696	1.708	1.707	1.700	1.689	1.674	1.658
232.0 eV	γ	5.53−1	4.28−1	1.86−1	4.95−2	−2.11−3	2.37−3	4.35−2	1.08−1	1.88−1	2.76−1
	δ	−5.26−3	−1.11−2	−1.25−2	−1.18−2	−1.11−2	−1.05−2	−9.66−3	−8.56−3	−7.09−3	−5.28−3
$5p_{3/2}$	σ	2.591+1	1.644+1	8.252+0	4.887+0	3.186+0	2.212+0	1.607+0	1.209+0	9.337−1	7.375−1

(*continued on next page*)

Table 1 (*continued*)

E_b =	β	1.343	1.480	1.625	1.699	1.740	1.764	1.776	1.781	1.780	1.776
180.8 eV	γ	3.05−1	2.04−1	3.62−2	−4.17−2	−4.89−2	−8.33−3	6.41−2	1.57−1	2.62−1	3.74−1
	δ	1.83−3	−3.86−3	−2.72−3	2.49−3	7.72−3	1.23−2	1.61−2	1.93−2	2.20−2	2.44−2
$5d_{3/2}$	σ	2.707+1	1.668+1	7.521+0	3.973+0	2.327+0	1.465+0	9.735−1	6.746−1	4.837−1	3.566−1
E_b =	β	1.111	1.262	1.389	1.427	1.427	1.410	1.382	1.349	1.312	1.275
94.1 eV	γ	3.78−2	−3.42−2	3.75−3	1.54−1	3.43−1	5.40−1	7.28−1	9.03−1	1.06+0	1.21+0
	δ	−1.79−3	4.86−3	2.41−2	4.11−2	5.59−2	6.92−2	8.14−2	9.28−2	1.04−1	1.15−1
$5d_{5/2}$	σ	3.927+1	2.359+1	1.031+1	5.334+0	3.075+0	1.911+0	1.256+0	8.621−1	6.127−1	4.481−1
E_b =	β	1.299	1.383	1.423	1.405	1.367	1.322	1.274	1.225	1.177	1.131
87.3 eV	γ	5.63−3	−4.31−2	4.30−2	2.22−1	4.23−1	6.19−1	8.00−1	9.63−1	1.11+0	1.24+0
	δ	5.24−4	6.04−3	2.11−2	3.66−2	5.23−2	6.83−2	8.40−2	9.95−2	1.15−1	1.30−1
$6s_{1/2}$	σ	1.868+0	1.186+0	6.126−1	3.783−1	2.581−1	1.877−1	1.426−1	1.120−1	9.012−2	7.404−2
E_b =	β	1.699	1.727	1.758	1.777	1.791	1.803	1.813	1.821	1.830	1.837
41.4 eV	γ	5.83−1	5.46−1	4.27−1	3.01−1	1.87−1	8.91−2	7.51−3	−5.86−2	−1.10−1	−1.49−1
	δ	−1.36−4	−1.20−3	−2.72−3	−3.82−3	−4.67−3	−5.38−3	−5.97−3	−6.50−3	−6.95−3	−7.35−3
$6p_{1/2}$	σ	1.507+0	1.038+0	5.844−1	3.752−1	2.602−1	1.900−1	1.439−1	1.122−1	8.946−2	7.267−2
E_b =	β	1.460	1.580	1.677	1.708	1.716	1.713	1.704	1.692	1.677	1.660
25.8 eV	γ	5.05−1	3.79−1	1.56−1	3.59−2	−5.40−3	5.33−3	5.00−2	1.16−1	1.97−1	2.86−1
	δ	−1.09−2	−1.34−2	−1.29−2	−1.18−2	−1.11−2	−1.05−2	−9.71−3	−8.62−3	−7.18−3	−5.35−3
$6p_{3/2}$	σ	4.320+0	2.708+0	1.344+0	7.914−1	5.144−1	3.566−1	2.588−1	1.945−1	1.502−1	1.186−1
E_b =	β	1.391	1.512	1.642	1.710	1.748	1.770	1.781	1.784	1.783	1.778
17.3 eV	γ	2.78−1	1.79−1	2.31−2	−4.50−2	−4.60−2	−1.90−3	7.21−2	1.66−1	2.71−1	3.83−1
	δ	−2.22−3	−5.42−3	−2.76−3	2.68−3	7.86−3	1.23−2	1.60−2	1.91−2	2.17−2	2.41−2
$6d_{3/2}$	σ	2.074+0	1.270+0	5.703−1	3.009−1	1.761−1	1.109−1	7.368−2	5.108−2	3.664−2	2.702−2
E_b =	β	1.143	1.283	1.400	1.434	1.432	1.413	1.384	1.351	1.315	1.277
6.0 eV	γ	3.18−2	−3.44−2	1.04−2	1.64−1	3.51−1	5.44−1	7.30−1	9.05−1	1.07+0	1.22+0
	δ	−2.92−3	4.81−3	2.42−2	4.11−2	5.53−2	6.80−2	8.02−2	9.20−2	1.04−1	1.15−1
$7s_{1/2}$	σ	2.013−1	1.273−1	6.542−2	4.029−2	2.745−2	1.994−2	1.514−2	1.188−2	9.555−3	7.846−3
E_b =	β	1.700	1.728	1.759	1.777	1.790	1.801	1.811	1.821	1.830	1.838
6.0 eV	γ	5.80−1	5.42−1	4.24−1	2.99−1	1.86−1	8.70−2	4.97−3	−6.09−2	−1.12−1	−1.50−1
	δ	−1.89−4	−1.23−3	−2.75−3	−3.85−3	−4.72−3	−5.43−3	−6.02−3	−6.54−3	−6.95−3	−7.35−3

Z= 91, Pa: [Rn]$5f^2_{5/2}$ $6d^1_{3/2}$ $7s^2_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$4s_{1/2}$	σ	2.496+1	1.875+1	1.109+1	7.257+0	5.108+0	3.786+0	2.914+0	2.311+0	1.875+0	1.550+0
E_b =	β	1.495	1.606	1.691	1.727	1.751	1.768	1.783	1.795	1.805	1.814
1387.1 eV	γ	9.65−1	9.41−1	7.64−1	5.76−1	4.08−1	2.66−1	1.48−1	5.31−2	−2.34−2	−8.40−2
	δ	8.22−3	3.04−3	−9.80−4	−3.00−3	−4.33−3	−5.32−3	−6.09−3	−6.72−3	−7.27−3	−7.75−3
$4p_{1/2}$	σ	2.368+1	2.013+1	1.350+1	9.295+0	6.677+0	4.976+0	3.822+0	3.009+0	2.418+0	1.976+0
E_b =	β	0.472	1.133	1.492	1.604	1.651	1.671	1.676	1.673	1.665	1.654
1224.3 eV	γ	2.54−1	6.95−1	4.45−1	1.87−1	5.13−2	3.45−3	1.11−2	5.36−2	1.18−1	1.97−1
	δ	1.57−1	4.24−2	−3.70−3	−1.06−2	−1.14−2	−1.09−2	−9.99−3	−8.79−3	−7.29−3	−5.45−3
$4p_{3/2}$	σ	1.005+2	6.913+1	3.713+1	2.258+1	1.491+1	1.043+1	7.613+0	5.745+0	4.451+0	3.524+0
E_b =	β	0.824	1.199	1.484	1.612	1.682	1.724	1.748	1.761	1.767	1.767
1006.7 eV	γ	3.52−1	3.85−1	1.61−1	4.90−3	−5.41−2	−4.60−2	5.19−3	8.40−2	1.80−1	2.88−1
	δ	7.50−2	2.35−2	3.10−4	1.21−3	6.25−3	1.15−2	1.60−2	1.99−2	2.32−2	2.60−2
$4d_{3/2}$	σ	1.480+2	9.765+1	4.580+1	2.434+1	1.423+1	8.939+0	5.927+0	4.100+0	2.935+0	2.161+0
E_b =	β	0.677	1.003	1.269	1.362	1.391	1.390	1.374	1.348	1.318	1.284
743.4 eV	γ	1.57−1	1.26−2	−5.62−2	6.14−2	2.42−1	4.40−1	6.35−1	8.20−1	9.90−1	1.15+0
	δ	3.62−2	7.70−3	2.06−2	4.04−2	5.68−2	7.11−2	8.41−2	9.63−2	1.08−1	1.18−1
$4d_{5/2}$	σ	2.240+2	1.425+2	6.418+1	3.329+1	1.914+1	1.185+1	7.768+0	5.319+0	3.773+0	2.755+0
E_b =	β	0.959	1.195	1.351	1.376	1.359	1.325	1.284	1.240	1.195	1.150
708.2 eV	γ	1.33−1	−1.98−2	−3.12−2	1.29−1	3.31−1	5.33−1	7.25−1	8.99−1	1.06+0	1.19+0
	δ	2.47−2	7.57−3	1.89−2	3.55−2	5.16−2	6.75−2	8.36−2	9.97−2	1.15−1	1.31−1
$4f_{5/2}$	σ	2.531+2	1.099+2	3.051+1	1.145+1	5.152+0	2.620+0	1.457+0	8.667−1	5.441−1	3.568−1
E_b =	β	0.942	1.028	1.050	1.005	0.945	0.881	0.818	0.759	0.704	0.654
371.2 eV	γ	5.16−2	1.82−1	4.54−1	6.92−1	8.90−1	1.05+0	1.18+0	1.29+0	1.37+0	1.45+0
	δ	5.67−2	8.22−2	1.24−1	1.60−1	1.95−1	2.28−1	2.59−1	2.88−1	3.15−1	3.41−1
$4f_{7/2}$	σ	3.197+2	1.380+2	3.798+1	1.416+1	6.332+0	3.203+0	1.772+0	1.049+0	6.558−1	4.283−1
E_b =	β	0.964	1.036	1.041	0.989	0.926	0.863	0.802	0.746	0.694	0.647
359.5 eV	γ	6.14−2	2.00−1	4.80−1	7.19−1	9.16−1	1.08+0	1.20+0	1.31+0	1.39+0	1.46+0
	δ	5.80−2	8.28−2	1.24−1	1.60−1	1.96−1	2.30−1	2.63−1	2.93−1	3.21−1	3.48−1
$5s_{1/2}$	σ	9.016+0	5.850+0	3.091+0	1.932+0	1.327+0	9.697−1	7.394−1	5.821−1	4.698−1	3.867−1
E_b =	β	1.655	1.693	1.732	1.755	1.772	1.786	1.797	1.807	1.816	1.823
309.6 eV	γ	6.56−1	6.23−1	5.00−1	3.67−1	2.43−1	1.37−1	4.79−2	−2.51−2	−8.36−2	−1.29−1
	δ	6.53−4	−6.93−4	−2.56−3	−3.85−3	−4.82−3	−5.61−3	−6.26−3	−6.83−3	−7.32−3	−7.76−3
$5p_{1/2}$	σ	8.382+0	5.938+0	3.446+0	2.246+0	1.572+0	1.155+0	8.796−1	6.883−1	5.506−1	4.485−1
E_b =	β	1.360	1.517	1.645	1.690	1.706	1.707	1.702	1.692	1.679	1.664
244.6 eV	γ	5.78−1	4.60−1	2.12−1	6.45−2	3.40−3	−1.94−4	3.36−2	9.20−2	1.66−1	2.51−1

(*continued on next page*)

Table 1 (*continued*)

	δ	−5.12−3	−1.17−2	−1.35−2	−1.26−2	−1.18−2	−1.11−2	−1.02−2	−9.16−3	−7.77−3	−6.04−3
$5p_{3/2}$	σ	2.700+1	1.715+1	8.627+0	5.118+0	3.341+0	2.324+0	1.691+0	1.273+0	9.848−1	7.788−1
E_b =	β	1.318	1.458	1.609	1.688	1.733	1.759	1.774	1.781	1.782	1.779
186.3 eV	γ	3.15−1	2.18−1	4.69−2	−3.76−2	−5.15−2	−1.73−2	4.88−2	1.36−1	2.37−1	3.47−1
	δ	2.56−3	−3.82−3	−3.26−3	1.94−3	7.36−3	1.21−2	1.61−2	1.94−2	2.23−2	2.48−2
$5d_{3/2}$	σ	2.814+1	1.742+1	7.911+0	4.200+0	2.469+0	1.560+0	1.040+0	7.226−1	5.192−1	3.836−1
E_b =	β	1.089	1.245	1.382	1.425	1.430	1.415	1.390	1.359	1.324	1.288
97.3 eV	γ	4.84−2	−3.04−2	−4.96−3	1.37−1	3.19−1	5.11−1	6.99−1	8.76−1	1.04+0	1.19+0
	δ	−1.94−3	3.98−3	2.31−2	4.02−2	5.47−2	6.79−2	8.03−2	9.20−2	1.03−1	1.14−1
$5d_{5/2}$	σ	4.127+1	2.489+1	1.094+1	5.687+0	3.291+0	2.052+0	1.352+0	9.303−1	6.625−1	4.854−1
E_b =	β	1.291	1.379	1.424	1.409	1.374	1.330	1.284	1.237	1.189	1.143
89.2 eV	γ	1.39−2	−4.24−2	3.31−2	2.06−1	4.01−1	5.95−1	7.77−1	9.43−1	1.09+0	1.22+0
	δ	3.15−4	5.39−3	2.03−2	3.54−2	5.05−2	6.60−2	8.19−2	9.77−2	1.13−1	1.28−1
$5f_{5/2}$	σ	1.559+1	7.137+0	2.112+0	8.240−1	3.802−1	1.967−1	1.107−1	6.640−2	4.196−2	2.765−2
E_b =	β	1.075	1.104	1.074	1.012	0.945	0.879	0.815	0.756	0.701	0.650
6.0 eV	γ	1.06−1	2.36−1	4.90−1	7.12−1	9.00−1	1.06+0	1.19+0	1.29+0	1.38+0	1.45+0
	δ	5.47−2	7.79−2	1.18−1	1.55−1	1.90−1	2.24−1	2.55−1	2.85−1	3.13−1	3.39−1
$6s_{1/2}$	σ	1.894+0	1.204+0	6.225−1	3.847−1	2.627−1	1.912−1	1.454−1	1.143−1	9.207−2	7.569−2
E_b =	β	1.675	1.706	1.740	1.761	1.776	1.789	1.800	1.810	1.818	1.826
46.7 eV	γ	6.02−1	5.69−1	4.54−1	3.28−1	2.13−1	1.12−1	2.85−2	−4.01−2	−9.48−2	−1.37−1
	δ	1.61−5	−1.13−3	−2.79−3	−3.99−3	−4.91−3	−5.66−3	−6.28−3	−6.83−3	−7.31−3	−7.73−3
$6p_{1/2}$	σ	1.529+0	1.056+0	5.982−1	3.857−1	2.684−1	1.966−1	1.493−1	1.167−1	9.323−2	7.589−2
E_b =	β	1.433	1.562	1.668	1.704	1.715	1.714	1.706	1.695	1.681	1.665
28.1 eV	γ	5.31−1	4.07−1	1.79−1	4.85−2	−1.57−3	1.85−3	4.00−2	1.01−1	1.76−1	2.60−1
	δ	−1.15−2	−1.43−2	−1.39−2	−1.27−2	−1.18−2	−1.11−2	−1.03−2	−9.27−3	−7.90−3	−6.17−3
$6p_{3/2}$	σ	4.275+0	2.682+0	1.332+0	7.859−1	5.116−1	3.551−1	2.581−1	1.941−1	1.501−1	1.186−1
E_b =	β	1.368	1.491	1.628	1.699	1.741	1.765	1.779	1.784	1.784	1.781
18.9 eV	γ	2.89−1	1.92−1	3.30−2	−4.19−2	−4.95−2	−1.13−2	5.72−2	1.45−1	2.46−1	3.55−1
	δ	−1.88−3	−5.62−3	−3.35−3	2.15−3	7.54−3	1.22−2	1.60−2	1.92−2	2.20−2	2.44−2
$6d_{3/2}$	σ	1.928+0	1.186+0	5.362−1	2.844−1	1.672−1	1.056−1	7.037−2	4.890−2	3.514−2	2.596−2
E_b =	β	1.127	1.272	1.396	1.433	1.435	1.418	1.392	1.360	1.326	1.290
6.0 eV	γ	4.20−2	−3.08−2	7.08−4	1.46−1	3.30−1	5.22−1	7.06−1	8.79−1	1.04+0	1.19+0
	δ	−3.29−3	3.87−3	2.31−2	4.02−2	5.48−2	6.76−2	7.92−2	9.03−2	1.01−1	1.12−1
$7s_{1/2}$	σ	1.777−1	1.125−1	5.791−2	3.570−2	2.435−2	1.771−2	1.347−2	1.058−2	8.517−3	7.000−3
E_b =	β	1.677	1.707	1.741	1.762	1.777	1.789	1.799	1.808	1.816	1.825
6.0 eV	γ	5.97−1	5.64−1	4.49−1	3.24−1	2.10−1	1.10−1	2.65−2	−4.27−2	−9.78−2	−1.40−1
	δ	−5.43−5	−1.18−3	−2.82−3	−4.00−3	−4.91−3	−5.67−3	−6.32−3	−6.91−3	−7.38−3	−7.82−3
Z= 92, U : [Rn]$5f_{5/2}^3$ $6d_{3/2}^1$ $7s_{1/2}^2$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$4s_{1/2}$	σ	2.438+1	1.869+1	1.115+1	7.335+0	5.179+0	3.847+0	2.967+0	2.356+0	1.914+0	1.584+0
E_b =	β	1.444	1.572	1.666	1.707	1.732	1.751	1.767	1.780	1.791	1.801
1440.8 eV	γ	9.57−1	9.65−1	8.01−1	6.15−1	4.47−1	3.02−1	1.81−1	8.15−2	1.09−3	−6.33−2
	δ	1.05−2	3.73−3	−7.35−4	−2.97−3	−4.45−3	−5.53−3	−6.38−3	−7.06−3	−7.64−3	−8.16−3
$4p_{1/2}$	σ	2.287+1	1.976+1	1.348+1	9.367+0	6.771+0	5.070+0	3.909+0	3.087+0	2.486+0	2.037+0
E_b =	β	0.332	1.075	1.469	1.592	1.644	1.667	1.675	1.674	1.667	1.657
1271.8 eV	γ	1.26−1	7.04−1	4.88−1	2.19−1	6.89−2	9.21−3	7.44−3	4.23−2	1.01−1	1.74−1
	δ	1.84−1	5.04−2	−3.05−3	−1.11−2	−1.21−2	−1.16−2	−1.07−2	−9.53−3	−8.07−3	−6.31−3
$4p_{3/2}$	σ	1.021+2	7.052+1	3.807+1	2.323+1	1.538+1	1.078+1	7.882+0	5.956+0	4.621+0	3.662+0
E_b =	β	0.751	1.159	1.460	1.595	1.670	1.715	1.743	1.758	1.766	1.768
1044.9 eV	γ	3.28−1	3.97−1	1.80−1	1.71−2	−5.12−2	−5.13−2	−7.09−3	6.57−2	1.57−1	2.60−1
	δ	8.55−2	2.74−2	6.25−4	7.23−4	5.71−3	1.11−2	1.59−2	1.99−2	2.34−2	2.63−2
$4d_{3/2}$	σ	1.507+2	1.005+2	4.763+1	2.547+1	1.496+1	9.426+0	6.266+0	4.345+0	3.117+0	2.299+0
E_b =	β	0.621	0.968	1.252	1.354	1.389	1.392	1.379	1.356	1.327	1.296
780.2 eV	γ	1.71−1	2.79−2	−6.16−2	4.30−2	2.17−1	4.10−1	6.03−1	7.88−1	9.60−1	1.12+0
	δ	4.52−2	8.79−3	1.93−2	3.92−2	5.59−2	7.01−2	8.29−2	9.50−2	1.06−1	1.17−1
$4d_{5/2}$	σ	2.288+2	1.467+2	6.669+1	3.479+1	2.008+1	1.248+1	8.196+0	5.625+0	3.998+0	2.924+0
E_b =	β	0.926	1.178	1.347	1.377	1.363	1.331	1.292	1.249	1.205	1.161
737.7 eV	γ	1.52−1	−8.95−3	−3.98−2	1.11−1	3.09−1	5.09−1	6.99−1	8.74−1	1.03+0	1.17+0
	δ	2.96−2	8.01−3	1.78−2	3.43−2	5.03−2	6.58−2	8.14−2	9.73−2	1.13−1	1.28−1
$4f_{5/2}$	σ	2.696+2	1.179+2	3.300+1	1.246+1	5.635+0	2.876+0	1.604+0	9.566−1	6.017−1	3.952−1
E_b =	β	0.930	1.023	1.051	1.010	0.952	0.890	0.829	0.770	0.715	0.664
390.7 eV	γ	3.90−2	1.66−1	4.38−1	6.76−1	8.75−1	1.04+0	1.17+0	1.28+0	1.37+0	1.44+0
	δ	5.42−2	8.00−2	1.22−1	1.58−1	1.92−1	2.25−1	2.56−1	2.85−1	3.12−1	3.37−1
$4f_{7/2}$	σ	3.409+2	1.480+2	4.107+1	1.540+1	6.920+0	3.513+0	1.949+0	1.157+0	7.244−1	4.737−1
E_b =	β	0.953	1.032	1.043	0.994	0.933	0.871	0.811	0.755	0.703	0.655
379.9 eV	γ	4.80−2	1.84−1	4.65−1	7.05−1	9.03−1	1.07+0	1.20+0	1.30+0	1.39+0	1.46+0
	δ	5.56−2	8.08−2	1.22−1	1.58−1	1.92−1	2.27−1	2.59−1	2.90−1	3.18−1	3.45−1

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Table 1 (*continued*)

$5s_{1/2}$	σ	9.227+0	6.002+0	3.180+0	1.990+0	1.370+0	1.002+0	7.651−1	6.030−1	4.871−1	4.013−1
E_b =	β	1.627	1.669	1.713	1.738	1.756	1.771	1.783	1.794	1.803	1.811
323.3 eV	γ	6.71−1	6.43−1	5.27−1	3.95−1	2.71−1	1.63−1	7.15−2	−4.19−3	−6.57−2	−1.15−1
	δ	8.98−4	−5.59−4	−2.58−3	−3.98−3	−5.03−3	−5.88−3	−6.58−3	−7.18−3	−7.71−3	−8.19−3
$5p_{1/2}$	σ	8.484+0	6.043+0	3.532+0	2.314+0	1.626+0	1.199+0	9.157−1	7.184−1	5.760−1	4.702−1
E_b =	β	1.327	1.496	1.635	1.685	1.703	1.707	1.703	1.694	1.682	1.668
259.3 eV	γ	6.02−1	4.91−1	2.38−1	8.11−2	1.03−2	−1.44−3	2.54−2	7.76−2	1.47−1	2.27−1
	δ	−4.96−3	−1.24−2	−1.44−2	−1.35−2	−1.26−2	−1.17−2	−1.09−2	−9.83−3	−8.51−3	−6.87−3
$5p_{3/2}$	σ	2.817+1	1.792+1	9.030+0	5.366+0	3.509+0	2.444+0	1.781+0	1.342+0	1.040+0	8.232−1
E_b =	β	1.291	1.437	1.594	1.677	1.725	1.754	1.771	1.780	1.782	1.781
195.9 eV	γ	3.25−1	2.31−1	5.83−2	−3.25−2	−5.32−2	−2.53−2	3.52−2	1.17−1	2.14−1	3.20−1
	δ	3.41−3	−3.76−3	−3.79−3	1.37−3	6.95−3	1.19−2	1.60−2	1.96−2	2.26−2	2.52−2
$5d_{3/2}$	σ	2.952+1	1.837+1	8.399+0	4.481+0	2.645+0	1.677+0	1.121+0	7.808−1	5.623−1	4.162−1
E_b =	β	1.067	1.230	1.374	1.423	1.431	1.420	1.397	1.368	1.335	1.300
104.4 eV	γ	5.94−2	−2.56−2	−1.32−2	1.20−1	2.96−1	4.84−1	6.70−1	8.48−1	1.01+0	1.16+0
	δ	−1.98−3	3.12−3	2.21−2	3.94−2	5.39−2	6.69−2	7.91−2	9.08−2	1.02−1	1.12−1
$5d_{5/2}$	σ	4.355+1	2.638+1	1.166+1	6.088+0	3.535+0	2.211+0	1.461+0	1.007+0	7.189−1	5.276−1
E_b =	β	1.283	1.376	1.426	1.414	1.380	1.338	1.293	1.247	1.201	1.155
95.2 eV	γ	2.28−2	−4.08−2	2.33−2	1.90−1	3.82−1	5.73−1	7.54−1	9.21−1	1.07+0	1.21+0
	δ	1.72−4	4.77−3	1.93−2	3.43−2	4.91−2	6.42−2	7.97−2	9.54−2	1.11−1	1.26−1
$5f_{5/2}$	σ	1.821+1	8.402+0	2.513+0	9.877−1	4.583−1	2.382−1	1.345−1	8.098−2	5.129−2	3.387−2
E_b =	β	1.074	1.106	1.080	1.019	0.952	0.887	0.825	0.766	0.711	0.660
6.0 eV	γ	9.62−2	2.24−1	4.77−1	6.98−1	8.87−1	1.05+0	1.18+0	1.29+0	1.38+0	1.45+0
	δ	5.26−2	7.58−2	1.16−1	1.52−1	1.87−1	2.20−1	2.52−1	2.82−1	3.09−1	3.35−1
$6s_{1/2}$	σ	1.965+0	1.251+0	6.479−1	4.008−1	2.740−1	1.996−1	1.520−1	1.195−1	9.639−2	7.932−2
E_b =	β	1.650	1.684	1.721	1.744	1.760	1.774	1.786	1.796	1.805	1.814
49.5 eV	γ	6.17−1	5.88−1	4.78−1	3.55−1	2.39−1	1.37−1	5.04−2	−2.09−2	−7.85−2	−1.24−1
	δ	1.78−4	−1.05−3	−2.85−3	−4.14−3	−5.14−3	−5.94−3	−6.62−3	−7.20−3	−7.71−3	−8.17−3
$6p_{1/2}$	σ	1.580+0	1.096+0	6.241−1	4.041−1	2.822−1	2.073−1	1.579−1	1.237−1	9.906−2	8.078−2
E_b =	β	1.408	1.546	1.660	1.700	1.713	1.714	1.708	1.698	1.685	1.671
30.8 eV	γ	5.54−1	4.35−1	2.01−1	6.25−2	3.64−3	−5.38−4	3.11−2	8.63−2	1.57−1	2.37−1
	δ	−1.22−2	−1.53−2	−1.49−2	−1.35−2	−1.26−2	−1.18−2	−1.10−2	−9.94−3	−8.65−3	−7.02−3
$6p_{3/2}$	σ	4.456+0	2.798+0	1.392+0	8.222−1	5.360−1	3.727−1	2.712−1	2.042−1	1.581−1	1.251−1
E_b =	β	1.345	1.473	1.615	1.690	1.734	1.761	1.776	1.783	1.785	1.783
18.6 eV	γ	2.98−1	2.04−1	4.28−2	−3.77−2	−5.17−2	−1.94−2	4.38−2	1.27−1	2.24−1	3.29−1
	δ	−1.60−3	−5.82−3	−3.91−3	1.60−3	7.16−3	1.20−2	1.60−2	1.94−2	2.23−2	2.48−2
$6d_{3/2}$	σ	2.064+0	1.275+0	5.802−1	3.092−1	1.825−1	1.157−1	7.731−2	5.385−2	3.878−2	2.871−2
E_b =	β	1.110	1.260	1.390	1.432	1.437	1.423	1.399	1.370	1.337	1.302
6.0 eV	γ	5.19−2	−2.68−2	−7.35−3	1.29−1	3.08−1	4.97−1	6.80−1	8.53−1	1.01+0	1.16+0
	δ	−3.62−3	2.98−3	2.20−2	3.92−2	5.39−2	6.68−2	7.84−2	8.92−2	9.99−2	1.11−1
$7s_{1/2}$	σ	1.787−1	1.133−1	5.840−2	3.604−2	2.461−2	1.792−2	1.363−2	1.072−2	8.641−3	7.107−3
E_b =	β	1.652	1.685	1.723	1.746	1.762	1.775	1.785	1.795	1.803	1.812
6.0 eV	γ	6.12−1	5.84−1	4.73−1	3.49−1	2.35−1	1.34−1	4.86−2	−2.32−2	−8.15−2	−1.27−1
	δ	9.05−5	−1.11−3	−2.89−3	−4.16−3	−5.14−3	−5.94−3	−6.64−3	−7.27−3	−7.79−3	−8.27−3

Z= 93, Np: [Rn]$5f^4_{5/2}$ $6d^1_{3/2}$ $7s^2_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$4p_{1/2}$	σ	2.191+1	1.931+1	1.343+1	9.427+0	6.860+0	5.161+0	3.994+0	3.164+0	2.555+0	2.098+0
E_b =	β	0.113	1.000	1.441	1.577	1.635	1.662	1.673	1.674	1.669	1.660
1327.7 eV	γ	−7.36−2	7.04−1	5.35−1	2.55−1	9.02−2	1.75−2	5.64−3	3.25−2	8.43−2	1.52−1
	δ	2.22−1	6.17−2	−2.12−3	−1.16−2	−1.29−2	−1.25−2	−1.15−2	−1.03−2	−8.89−3	−7.20−3
$4p_{3/2}$	σ	1.035+2	7.192+1	3.903+1	2.389+1	1.586+1	1.114+1	8.157+0	6.173+0	4.794+0	3.804+0
E_b =	β	0.685	1.116	1.435	1.578	1.657	1.706	1.736	1.754	1.764	1.768
1086.0 eV	γ	3.02−1	4.08−1	2.01−1	3.09−2	−4.67−2	−5.54−2	−1.83−2	4.85−2	1.35−1	2.34−1
	δ	9.71−2	3.20−2	1.08−3	2.35−4	5.11−3	1.06−2	1.56−2	1.99−2	2.35−2	2.66−2
$4d_{3/2}$	σ	1.531+2	1.032+2	4.944+1	2.660+1	1.570+1	9.924+0	6.615+0	4.597+0	3.305+0	2.442+0
E_b =	β	0.563	0.931	1.234	1.345	1.386	1.394	1.383	1.363	1.337	1.307
816.1 eV	γ	1.82−1	4.40−2	−6.52−2	2.56−2	1.93−1	3.82−1	5.72−1	7.55−1	9.28−1	1.09+0
	δ	5.55−2	1.04−2	1.79−2	3.79−2	5.50−2	6.93−2	8.19−2	9.38−2	1.05−1	1.16−1
$4d_{5/2}$	σ	2.337+2	1.511+2	6.931+1	3.635+1	2.106+1	1.313+1	8.645+0	5.946+0	4.234+0	3.102+0
E_b =	β	0.889	1.159	1.342	1.378	1.367	1.337	1.300	1.258	1.216	1.173
770.8 eV	γ	1.72−1	4.03−3	−4.76−2	9.28−2	2.87−1	4.85−1	6.74−1	8.50−1	1.01+0	1.15+0
	δ	3.58−2	8.74−3	1.67−2	3.30−2	4.89−2	6.42−2	7.94−2	9.50−2	1.10−1	1.26−1
$4f_{5/2}$	σ	2.881+2	1.267+2	3.574+1	1.357+1	6.162+0	3.156+0	1.765+0	1.055+0	6.649−1	4.373−1
E_b =	β	0.916	1.017	1.053	1.016	0.959	0.898	0.838	0.780	0.725	0.674
414.3 eV	γ	2.57−2	1.50−1	4.21−1	6.60−1	8.60−1	1.03+0	1.16+0	1.28+0	1.37+0	1.44+0
	δ	5.14−2	7.76−2	1.20−1	1.56−1	1.89−1	2.21−1	2.53−1	2.81−1	3.08−1	3.34−1
$4f_{7/2}$	σ	3.641+2	1.589+2	4.443+1	1.675+1	7.557+0	3.849+0	2.141+0	1.274+0	7.990−1	5.233−1
E_b =	β	0.941	1.027	1.045	0.999	0.940	0.879	0.820	0.764	0.713	0.665

(*continued on next page*)

Table 1 (*continued*)

403.4 eV	γ	3.40−2	1.67−1	4.48−1	6.90−1	8.89−1	1.05+0	1.19+0	1.30+0	1.39+0	1.46+0
	δ	5.30−2	7.86−2	1.20−1	1.56−1	1.90−1	2.23−1	2.56−1	2.86−1	3.15−1	3.41−1
$5s_{1/2}$	σ	9.428+0	6.149+0	3.266+0	2.048+0	1.411+0	1.034+0	7.902−1	6.235−1	5.042−1	4.157−1
E_b =	β	1.597	1.644	1.693	1.719	1.739	1.754	1.767	1.779	1.789	1.798
339.8 eV	γ	6.88−1	6.65−1	5.53−1	4.24−1	3.01−1	1.91−1	9.69−2	1.84−2	−4.61−2	−9.80−2
	δ	1.20−3	−3.93−4	−2.58−3	−4.10−3	−5.25−3	−6.16−3	−6.92−3	−7.56−3	−8.12−3	−8.63−3
$5p_{1/2}$	σ	8.565+0	6.137+0	3.614+0	2.381+0	1.680+0	1.243+0	9.517−1	7.486−1	6.016−1	4.920−1
E_b =	β	1.287	1.471	1.623	1.678	1.700	1.706	1.704	1.697	1.686	1.673
283.4 eV	γ	6.30−1	5.27−1	2.69−1	1.01−1	1.94−2	−1.26−3	1.83−2	6.43−2	1.28−1	2.04−1
	δ	−4.50−3	−1.31−2	−1.55−2	−1.45−2	−1.34−2	−1.25−2	−1.16−2	−1.06−2	−9.28−3	−7.72−3
$5p_{3/2}$	σ	2.934+1	1.868+1	9.433+0	5.615+0	3.678+0	2.565+0	1.872+0	1.413+0	1.095+0	8.682−1
E_b =	β	1.264	1.415	1.579	1.665	1.716	1.748	1.767	1.778	1.782	1.782
206.0 eV	γ	3.34−1	2.44−1	7.03−2	−2.65−2	−5.40−2	−3.24−2	2.25−2	9.96−2	1.92−1	2.94−1
	δ	4.34−3	−3.65−3	−4.32−3	7.65−4	6.48−3	1.16−2	1.60−2	1.97−2	2.28−2	2.56−2
$5d_{3/2}$	σ	3.085+1	1.929+1	8.883+0	4.763+0	2.823+0	1.795+0	1.203+0	8.403−1	6.065−1	4.498−1
E_b =	β	1.044	1.214	1.366	1.420	1.432	1.424	1.404	1.377	1.346	1.312
109.3 eV	γ	7.03−2	−2.01−2	−2.03−2	1.04−1	2.75−1	4.59−1	6.42−1	8.19−1	9.85−1	1.14+0
	δ	−1.92−3	2.33−3	2.11−2	3.86−2	5.32−2	6.61−2	7.81−2	8.96−2	1.01−1	1.11−1
$5d_{5/2}$	σ	4.579+1	2.785+1	1.239+1	6.494+0	3.783+0	2.373+0	1.572+0	1.087+0	7.769−1	5.712−1
E_b =	β	1.275	1.373	1.427	1.418	1.386	1.345	1.302	1.257	1.211	1.167
101.2 eV	γ	3.24−2	−3.85−2	1.40−2	1.75−1	3.63−1	5.52−1	7.32−1	8.99−1	1.05+0	1.19+0
	δ	8.62−5	4.17−3	1.84−2	3.33−2	4.78−2	6.25−2	7.77−2	9.30−2	1.08−1	1.23−1
$5f_{5/2}$	σ	2.081+1	9.673+0	2.923+0	1.157+0	5.401−1	2.820−1	1.598−1	9.650−2	6.128−2	4.054−2
E_b =	β	1.073	1.108	1.085	1.025	0.960	0.896	0.835	0.776	0.722	0.670
6.0 eV	γ	8.60−2	2.11−1	4.65−1	6.86−1	8.74−1	1.04+0	1.17+0	1.28+0	1.37+0	1.45+0
	δ	5.05−2	7.37−2	1.14−1	1.50−1	1.84−1	2.17−1	2.48−1	2.78−1	3.06−1	3.31−1
$6s_{1/2}$	σ	2.028+0	1.294+0	6.711−1	4.156−1	2.844−1	2.074−1	1.581−1	1.245−1	1.005−1	8.274−2
E_b =	β	1.623	1.661	1.702	1.726	1.744	1.758	1.771	1.782	1.792	1.800
50.0 eV	γ	6.30−1	6.06−1	5.02−1	3.81−1	2.65−1	1.62−1	7.36−2	−3.16−4	−6.08−2	−1.09−1
	δ	3.54−4	−9.70−4	−2.90−3	−4.29−3	−5.36−3	−6.24−3	−6.96−3	−7.59−3	−8.14−3	−8.63−3
$6p_{1/2}$	σ	1.622+0	1.130+0	6.471−1	4.208−1	2.950−1	2.174−1	1.661−1	1.304−1	1.046−1	8.550−2
E_b =	β	1.382	1.530	1.652	1.695	1.711	1.714	1.710	1.701	1.689	1.675
29.3 eV	γ	5.76−1	4.61−1	2.24−1	7.75−2	1.02−2	−1.55−3	2.37−2	7.33−2	1.39−1	2.15−1
	δ	−1.30−2	−1.65−2	−1.59−2	−1.44−2	−1.33−2	−1.25−2	−1.16−2	−1.06−2	−9.39−3	−7.85−3
$6p_{3/2}$	σ	4.618+0	2.903+0	1.446+0	8.555−1	5.586−1	3.889−1	2.834−1	2.137−1	1.656−1	1.311−1
E_b =	β	1.323	1.456	1.602	1.680	1.726	1.755	1.773	1.782	1.785	1.785
17.5 eV	γ	3.06−1	2.15−1	5.29−2	−3.27−2	−5.30−2	−2.67−2	3.12−2	1.10−1	2.03−1	3.04−1
	δ	−1.31−3	−6.01−3	−4.48−3	1.03−3	6.74−3	1.18−2	1.60−2	1.96−2	2.26−2	2.52−2
$6d_{3/2}$	σ	2.177+0	1.351+0	6.185−1	3.312−1	1.962−1	1.248−1	8.366−2	5.841−2	4.216−2	3.126−2
E_b =	β	1.092	1.247	1.383	1.430	1.439	1.428	1.406	1.378	1.347	1.314
6.0 eV	γ	6.21−2	−2.20−2	−1.46−2	1.12−1	2.86−1	4.72−1	6.54−1	8.27−1	9.88−1	1.14+0
	δ	−3.88−3	2.11−3	2.10−2	3.82−2	5.31−2	6.61−2	7.77−2	8.83−2	9.87−2	1.09−1
$7s_{1/2}$	σ	1.793−1	1.139−1	5.879−2	3.632−2	2.482−2	1.809−2	1.378−2	1.084−2	8.750−3	7.203−3
E_b =	β	1.625	1.662	1.703	1.728	1.746	1.760	1.771	1.781	1.790	1.798
6.0 eV	γ	6.27−1	6.02−1	4.98−1	3.76−1	2.61−1	1.59−1	7.19−2	−2.14−3	−6.34−2	−1.12−1
	δ	2.68−4	−1.03−3	−2.94−3	−4.32−3	−5.37−3	−6.22−3	−6.97−3	−7.65−3	−8.22−3	−8.74−3

Z= 94, Pu: [Rn]$5f^6_{5/2}$ $7s^2_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$4p_{1/2}$	σ	2.094+1	1.882+1	1.335+1	9.463+0	6.934+0	5.244+0	4.075+0	3.238+0	2.622+0	2.157+0
E_b =	β		0.924	1.413	1.564	1.627	1.657	1.670	1.673	1.670	1.663
1377.4 eV	γ	−3.12−1	6.95−1	5.81−1	2.92−1	1.14−1	2.83−2	5.72−3	2.47−2	7.03−2	1.33−1
	δ	2.62−1	7.46−2	−1.12−3	−1.21−2	−1.37−2	−1.33−2	−1.25−2	−1.13−2	−9.84−3	−8.17−3
$4p_{3/2}$	σ	1.050+2	7.328+1	3.997+1	2.455+1	1.633+1	1.150+1	8.435+0	6.392+0	4.970+0	3.947+0
E_b =	β	0.593	1.072	1.411	1.562	1.645	1.696	1.729	1.749	1.761	1.767
1120.9 eV	γ	2.63−1	4.15−1	2.21−1	4.56−2	−4.06−2	−5.81−2	−2.82−2	3.30−2	1.14−1	2.08−1
	δ	1.10−1	3.69−2	1.58−3	−2.29−4	4.48−3	1.01−2	1.54−2	1.99−2	2.37−2	2.69−2
$4d_{3/2}$	σ	1.555+2	1.058+2	5.126+1	2.776+1	1.646+1	1.044+1	6.978+0	4.860+0	3.499+0	2.590+0
E_b =	β	0.500	0.892	1.216	1.336	1.382	1.394	1.387	1.369	1.345	1.317
848.9 eV	γ	1.89−1	6.14−2	−6.71−2	8.80−3	1.69−1	3.55−1	5.43−1	7.23−1	8.94−1	1.05+0
	δ	6.79−2	1.25−2	1.65−2	3.64−2	5.41−2	6.89−2	8.13−2	9.26−2	1.03−1	1.14−1
$4d_{5/2}$	σ	2.385+2	1.556+2	7.200+1	3.797+1	2.209+1	1.381+1	9.115+0	6.280+0	4.479+0	3.287+0
E_b =	β	0.847	1.138	1.336	1.378	1.371	1.343	1.307	1.266	1.225	1.184
801.5 eV	γ	1.92−1	1.91−2	−5.43−2	7.42−2	2.64−1	4.63−1	6.52−1	8.25−1	9.84−1	1.13+0
	δ	4.33−2	9.80−3	1.55−2	3.15−2	4.76−2	6.31−2	7.79−2	9.24−2	1.07−1	1.22−1
$4f_{5/2}$	σ	3.088+2	1.365+2	3.876+1	1.480+1	6.744+0	3.464+0	1.942+0	1.163+0	7.345−1	4.839−1
E_b =	β	0.900	1.009	1.054	1.021	0.965	0.905	0.846	0.790	0.737	0.687
437.4 eV	γ	1.22−2	1.32−1	4.02−1	6.46−1	8.47−1	1.01+0	1.15+0	1.27+0	1.36+0	1.44+0
	δ	4.84−2	7.49−2	1.18−1	1.55−1	1.87−1	2.18−1	2.48−1	2.77−1	3.05−1	3.31−1

(*continued on next page*)

Table 1 (*continued*)

$4f_{7/2}$	σ	3.895+2	1.708+2	4.808+1	1.822+1	8.250+0	4.213+0	2.349+0	1.400+0	8.802−1	5.775−1
E_b =	β	0.927	1.022	1.047	1.005	0.946	0.885	0.827	0.773	0.723	0.676
425.2 eV	γ	1.99−2	1.50−1	4.30−1	6.76−1	8.78−1	1.04+0	1.18+0	1.29+0	1.39+0	1.46+0
	δ	5.03−2	7.61−2	1.18−1	1.55−1	1.88−1	2.19−1	2.51−1	2.82−1	3.11−1	3.39−1
$5s_{1/2}$	σ	9.602+0	6.280+0	3.344+0	2.101+0	1.450+0	1.064+0	8.139−1	6.428−1	5.202−1	4.293−1
E_b =	β	1.563	1.616	1.672	1.701	1.720	1.736	1.749	1.762	1.773	1.783
351.9 eV	γ	7.03−1	6.85−1	5.78−1	4.53−1	3.31−1	2.21−1	1.24−1	4.22−2	−2.56−2	−8.04−2
	δ	1.54−3	−1.97−4	−2.58−3	−4.20−3	−5.44−3	−6.45−3	−7.30−3	−8.00−3	−8.59−3	−9.11−3
$5p_{1/2}$	σ	8.580+0	6.182+0	3.668+0	2.429+0	1.722+0	1.279+0	9.823−1	7.746−1	6.238−1	5.112−1
E_b =	β	1.255	1.452	1.614	1.673	1.696	1.704	1.704	1.698	1.689	1.677
282.5 eV	γ	6.47−1	5.53−1	2.95−1	1.20−1	2.93−2	2.08−4	1.31−2	5.37−2	1.12−1	1.83−1
	δ	−4.61−3	−1.41−2	−1.66−2	−1.54−2	−1.43−2	−1.33−2	−1.24−2	−1.14−2	−1.01−2	−8.56−3
$5p_{3/2}$	σ	3.044+1	1.941+1	9.815+0	5.851+0	3.839+0	2.682+0	1.959+0	1.480+0	1.149+0	9.113−1
E_b =	β	1.233	1.394	1.565	1.654	1.707	1.741	1.762	1.775	1.781	1.783
215.3 eV	γ	3.44−1	2.59−1	8.35−2	−1.90−2	−5.37−2	−3.87−2	1.07−2	8.30−2	1.71−1	2.68−1
	δ	5.44−3	−3.53−3	−4.86−3	1.15−4	5.94−3	1.13−2	1.59−2	1.98−2	2.31−2	2.59−2
$5d_{3/2}$	σ	3.190+1	2.005+1	9.293+0	5.008+0	2.980+0	1.901+0	1.277+0	8.939−1	6.464−1	4.803−1
E_b =	β	1.019	1.198	1.358	1.416	1.432	1.427	1.409	1.385	1.356	1.324
116.0 eV	γ	8.34−2	−1.31−2	−2.72−2	8.79−2	2.55−1	4.36−1	6.15−1	7.89−1	9.53−1	1.11+0
	δ	−1.72−3	1.50−3	1.98−2	3.76−2	5.27−2	6.56−2	7.71−2	8.80−2	9.87−2	1.09−1
$5d_{5/2}$	σ	4.774+1	2.916+1	1.304+1	6.865+0	4.015+0	2.525+0	1.676+0	1.161+0	8.316−1	6.125−1
E_b =	β	1.267	1.369	1.428	1.422	1.392	1.352	1.309	1.265	1.221	1.178
105.2 eV	γ	4.33−2	−3.52−2	4.69−3	1.59−1	3.46−1	5.34−1	7.12−1	8.76−1	1.03+0	1.17+0
	δ	4.54−5	3.57−3	1.73−2	3.21−2	4.69−2	6.14−2	7.57−2	9.02−2	1.05−1	1.20−1
$5f_{5/2}$	σ	2.189+1	1.025+1	3.125+0	1.246+0	5.843−1	3.063−1	1.742−1	1.055−1	6.713−2	4.450−2
E_b =	β	1.070	1.109	1.090	1.033	0.967	0.903	0.842	0.786	0.733	0.683
6.0 eV	γ	7.50−2	1.97−1	4.50−1	6.74−1	8.64−1	1.02+0	1.16+0	1.27+0	1.37+0	1.45+0
	δ	4.82−2	7.13−2	1.12−1	1.49−1	1.82−1	2.13−1	2.43−1	2.73−1	3.02−1	3.28−1
$6s_{1/2}$	σ	2.029+0	1.297+0	6.739−1	4.180−1	2.864−1	2.091−1	1.595−1	1.257−1	1.016−1	8.370−2
E_b =	β	1.593	1.636	1.683	1.709	1.727	1.741	1.753	1.765	1.775	1.785
48.6 eV	γ	6.44−1	6.23−1	5.24−1	4.07−1	2.93−1	1.89−1	9.88−2	2.18−2	−4.21−2	−9.37−2
	δ	5.70−4	−8.77−4	−2.94−3	−4.42−3	−5.58−3	−6.54−3	−7.35−3	−8.04−3	−8.63−3	−9.14−3
$6p_{1/2}$	σ	1.616+0	1.130+0	6.512−1	4.254−1	2.994−1	2.214−1	1.696−1	1.335−1	1.074−1	8.789−2
E_b =	β	1.352	1.513	1.644	1.691	1.709	1.713	1.711	1.703	1.693	1.680
30.6 eV	γ	6.01−1	4.91−1	2.50−1	9.51−2	1.87−2	−1.56−3	1.70−2	6.14−2	1.23−1	1.95−1
	δ	−1.39−2	−1.77−2	−1.71−2	−1.53−2	−1.41−2	−1.33−2	−1.24−2	−1.15−2	−1.03−2	−8.78−3
$6p_{3/2}$	σ	4.483+0	2.821+0	1.407+0	8.334−1	5.449−1	3.800−1	2.773−1	2.094−1	1.624−1	1.288−1
E_b =	β	1.299	1.439	1.590	1.671	1.719	1.749	1.769	1.780	1.785	1.786
18.4 eV	γ	3.16−1	2.28−1	6.43−2	−2.64−2	−5.31−2	−3.34−2	1.91−2	9.39−2	1.83−1	2.81−1
	δ	−9.01−4	−6.18−3	−5.06−3	4.02−4	6.22−3	1.15−2	1.60−2	1.98−2	2.30−2	2.57−2
$7s_{1/2}$	σ	1.520−1	9.674−2	5.005−2	3.095−2	2.117−2	1.544−2	1.177−2	9.275−3	7.492−3	6.174−3
E_b =	β	1.595	1.638	1.683	1.708	1.727	1.742	1.756	1.767	1.776	1.785
6.0 eV	γ	6.41−1	6.20−1	5.22−1	4.05−1	2.90−1	1.86−1	9.65−2	2.08−2	−4.26−2	−9.46−2
	δ	4.90−4	−9.39−4	−2.98−3	−4.47−3	−5.62−3	−6.54−3	−7.30−3	−8.00−3	−8.61−3	−9.19−3

Z= 95, Am: [Rn]$5f^6_{5/2}$ $5f^1_{7/2}$ $7s^2_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$4p_{1/2}$	σ	1.986+1	1.827+1	1.323+1	9.481+0	6.995+0	5.319+0	4.150+0	3.308+0	2.686+0	2.215+0
E_b =	β		0.842	1.381	1.548	1.617	1.651	1.666	1.672	1.671	1.665
1435.1 eV	γ	−6.14−1	6.72−1	6.31−1	3.33−1	1.41−1	4.21−2	8.38−3	1.84−2	5.72−2	1.14−1
	δ	2.94−1	8.99−2	3.83−4	−1.27−2	−1.45−2	−1.42−2	−1.33−2	−1.22−2	−1.08−2	−9.12−3
$4p_{3/2}$	σ	1.063+2	7.469+1	4.097+1	2.523+1	1.683+1	1.187+1	8.723+0	6.620+0	5.153+0	4.097+0
E_b =	β	0.496	1.020	1.383	1.543	1.631	1.685	1.721	1.744	1.758	1.765
1168.0 eV	γ	2.12−1	4.22−1	2.44−1	6.20−2	−3.31−2	−5.93−2	−3.72−2	1.77−2	9.40−2	1.84−1
	δ	1.26−1	4.33−2	2.40−3	−6.89−4	3.78−3	9.54−3	1.50−2	1.98−2	2.38−2	2.72−2
$4d_{3/2}$	σ	1.575+2	1.082+2	5.298+1	2.887+1	1.720+1	1.095+1	7.340+0	5.123+0	3.697+0	2.741+0
E_b =	β	0.443	0.855	1.197	1.326	1.378	1.394	1.390	1.374	1.352	1.326
880.4 eV	γ	1.90−1	7.73−2	−6.74−2	−5.82−3	1.45−1	3.27−1	5.14−1	6.93−1	8.63−1	1.02+0
	δ	8.04−2	1.51−2	1.53−2	3.50−2	5.30−2	6.81−2	8.08−2	9.20−2	1.02−1	1.13−1
$4d_{5/2}$	σ	2.428+2	1.597+2	7.452+1	3.951+1	2.308+1	1.448+1	9.581+0	6.615+0	4.727+0	3.474+0
E_b =	β	0.808	1.118	1.330	1.378	1.374	1.349	1.314	1.275	1.234	1.194
830.0 eV	γ	2.07−1	3.35−2	−5.90−2	5.78−2	2.42−1	4.39−1	6.28−1	8.03−1	9.61−1	1.11+0
	δ	5.08−2	1.10−2	1.46−2	3.02−2	4.61−2	6.16−2	7.64−2	9.07−2	1.05−1	1.19−1
$4f_{5/2}$	σ	3.291+2	1.462+2	4.182+1	1.605+1	7.345+0	3.785+0	2.127+0	1.277+0	8.077−1	5.330−1
E_b =	β	0.883	1.001	1.054	1.026	0.972	0.913	0.854	0.799	0.747	0.697
463.3 eV	γ	−5.88−4	1.15−1	3.83−1	6.28−1	8.33−1	1.00+0	1.14+0	1.26+0	1.36+0	1.44+0
	δ	4.53−2	7.22−2	1.15−1	1.52−1	1.85−1	2.15−1	2.44−1	2.73−1	3.01−1	3.28−1
$4f_{7/2}$	σ	4.147+2	1.828+2	5.181+1	1.974+1	8.976+0	4.599+0	2.571+0	1.536+0	9.671−1	6.354−1

(*continued on next page*)

Table 1 (*continued*)

E_b =	β	0.914	1.016	1.049	1.010	0.953	0.892	0.835	0.781	0.732	0.685
449.0 eV	γ	6.34−3	1.32−1	4.11−1	6.60−1	8.65−1	1.03+0	1.17+0	1.29+0	1.38+0	1.46+0
	δ	4.73−2	7.36−2	1.16−1	1.52−1	1.86−1	2.17−1	2.47−1	2.78−1	3.07−1	3.35−1
$5s_{1/2}$	σ	9.787+0	6.419+0	3.427+0	2.156+0	1.490+0	1.094+0	8.384−1	6.629−1	5.370−1	4.435−1
E_b =	β	1.527	1.587	1.648	1.680	1.702	1.718	1.732	1.744	1.756	1.767
373.0 eV	γ	7.19−1	7.07−1	6.07−1	4.83−1	3.63−1	2.52−1	1.53−1	6.88−2	−2.27−3	−6.07−2
	δ	1.98−3	5.01−5	−2.54−3	−4.29−3	−5.63−3	−6.72−3	−7.64−3	−8.40−3	−9.05−3	−9.63−3
$5p_{1/2}$	σ	8.619+0	6.249+0	3.738+0	2.489+0	1.772+0	1.321+0	1.018+0	8.045−1	6.494−1	5.332−1
E_b =	β	1.210	1.426	1.601	1.666	1.692	1.703	1.704	1.700	1.692	1.681
303.0 eV	γ	6.72−1	5.89−1	3.28−1	1.43−1	4.21−2	3.80−3	8.80−3	4.31−2	9.66−2	1.63−1
	δ	−4.15−3	−1.50−2	−1.78−2	−1.65−2	−1.52−2	−1.42−2	−1.32−2	−1.22−2	−1.09−2	−9.47−3
$5p_{3/2}$	σ	3.147+1	2.011+1	1.019+1	6.087+0	4.000+0	2.799+0	2.048+0	1.550+0	1.204+0	9.561−1
E_b =	β	1.209	1.374	1.550	1.642	1.698	1.734	1.757	1.771	1.779	1.782
216.4 eV	γ	3.49−1	2.69−1	9.47−2	−1.19−2	−5.24−2	−4.35−2	4.12−4	6.81−2	1.51−1	2.45−1
	δ	6.25−3	−3.39−3	−5.34−3	−5.04−4	5.41−3	1.10−2	1.58−2	1.99−2	2.33−2	2.63−2
$5d_{3/2}$	σ	3.329+1	2.103+1	9.811+0	5.312+0	3.174+0	2.031+0	1.369+0	9.603−1	6.959−1	5.180−1
E_b =	β	0.998	1.182	1.349	1.412	1.432	1.430	1.415	1.392	1.365	1.335
118.0 eV	γ	9.41−2	−6.47−3	−3.24−2	7.32−2	2.34−1	4.12−1	5.89−1	7.61−1	9.24−1	1.08+0
	δ	−1.45−3	8.16−4	1.87−2	3.66−2	5.20−2	6.51−2	7.65−2	8.72−2	9.75−2	1.08−1
$5d_{5/2}$	σ	4.978+1	3.053+1	1.373+1	7.260+0	4.260+0	2.688+0	1.789+0	1.242+0	8.912−1	6.575−1
E_b =	β	1.260	1.366	1.429	1.425	1.397	1.359	1.317	1.274	1.231	1.189
107.9 eV	γ	5.29−2	−3.16−2	−2.87−3	1.44−1	3.27−1	5.14−1	6.91−1	8.56−1	1.01+0	1.15+0
	δ	8.25−5	3.06−3	1.64−2	3.10−2	4.57−2	6.01−2	7.41−2	8.83−2	1.03−1	1.17−1
$5f_{5/2}$	σ	2.462+1	1.161+1	3.575+0	1.435+0	6.769−1	3.564−1	2.034−1	1.235−1	7.881−2	5.236−2
E_b =	β	1.068	1.110	1.095	1.040	0.975	0.911	0.851	0.795	0.742	0.692
6.0 eV	γ	6.52−2	1.85−1	4.36−1	6.61−1	8.51−1	1.01+0	1.15+0	1.27+0	1.36+0	1.45+0
	δ	4.60−2	6.90−2	1.09−1	1.46−1	1.79−1	2.10−1	2.40−1	2.69−1	2.97−1	3.24−1
$5f_{7/2}$	σ	2.918+1	1.365+1	4.155+0	1.653+0	7.735−1	4.045−1	2.294−1	1.385−1	8.797−2	5.818−2
E_b =	β	1.083	1.112	1.082	1.020	0.954	0.889	0.830	0.776	0.726	0.680
6.0 eV	γ	7.23−2	2.00−1	4.61−1	6.90−1	8.83−1	1.04+0	1.18+0	1.29+0	1.39+0	1.47+0
	δ	4.77−2	6.99−2	1.09−1	1.46−1	1.80−1	2.12−1	2.43−1	2.74−1	3.04−1	3.32−1
$6s_{1/2}$	σ	2.086+0	1.336+0	6.956−1	4.319−1	2.962−1	2.165−1	1.654−1	1.305−1	1.055−1	8.701−2
E_b =	β	1.562	1.610	1.661	1.689	1.708	1.723	1.736	1.748	1.759	1.769
50.4 eV	γ	6.56−1	6.41−1	5.49−1	4.34−1	3.21−1	2.17−1	1.25−1	4.59−2	−2.09−2	−7.56−2
	δ	8.12−4	−7.56−4	−2.98−3	−4.56−3	−5.79−3	−6.83−3	−7.71−3	−8.46−3	−9.10−3	−9.66−3
$6p_{1/2}$	σ	1.637+0	1.150+0	6.668−1	4.376−1	3.091−1	2.293−1	1.762−1	1.390−1	1.121−1	9.192−2
E_b =	β	1.323	1.494	1.635	1.686	1.706	1.712	1.711	1.705	1.696	1.684
31.1 eV	γ	6.24−1	5.20−1	2.77−1	1.14−1	2.86−2	4.20−4	1.18−2	5.03−2	1.07−1	1.75−1
	δ	−1.48−2	−1.91−2	−1.83−2	−1.64−2	−1.50−2	−1.40−2	−1.32−2	−1.22−2	−1.10−2	−9.63−3
$6p_{3/2}$	σ	4.654+0	2.931+0	1.465+0	8.687−1	5.687−1	3.971−1	2.902−1	2.194−1	1.704−1	1.352−1
E_b =	β	1.277	1.421	1.576	1.659	1.710	1.743	1.764	1.777	1.783	1.786
18.1 eV	γ	3.24−1	2.39−1	7.53−2	−2.00−2	−5.26−2	−3.88−2	8.10−3	7.80−2	1.63−1	2.58−1
	δ	−5.17−4	−6.29−3	−5.66−3	−2.50−4	5.69−3	1.11−2	1.59−2	1.99−2	2.33−2	2.61−2
$7s_{1/2}$	σ	1.525−1	9.723−2	5.040−2	3.121−2	2.136−2	1.560−2	1.190−2	9.385−3	7.588−3	6.259−3
E_b =	β	1.564	1.612	1.661	1.688	1.708	1.724	1.739	1.751	1.761	1.770
6.0 eV	γ	6.53−1	6.38−1	5.46−1	4.32−1	3.18−1	2.14−1	1.22−1	4.45−2	−2.13−2	−7.61−2
	δ	7.18−4	−8.22−4	−3.01−3	−4.61−3	−5.86−3	−6.85−3	−7.66−3	−8.41−3	−9.05−3	−9.67−3

Z= 96, Cm: [Rn]$5f^6_{5/2}$ $5f^1_{7/2}$ $6d^1_{3/2}$ $7s^2_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$4p_{1/2}$	σ		1.766+1	1.307+1	9.481+0	7.047+0	5.386+0	4.219+0	3.375+0	2.748+0	2.272+0
E_b =	β		0.736	1.345	1.527	1.605	1.643	1.662	1.670	1.671	1.667
1499.9 eV	γ		6.25−1	6.81−1	3.79−1	1.71−1	5.88−2	1.38−2	1.46−2	4.56−2	9.65−2
	δ		1.09−1	2.42−3	−1.32−2	−1.56−2	−1.53−2	−1.43−2	−1.31−2	−1.17−2	−1.00−2
$4p_{3/2}$	σ	1.075+2	7.594+1	4.188+1	2.588+1	1.730+1	1.223+1	9.000+0	6.839+0	5.331+0	4.244+0
E_b =	β	0.398	0.970	1.353	1.522	1.615	1.673	1.712	1.737	1.754	1.763
1211.0 eV	γ	1.55−1	4.23−1	2.64−1	7.81−2	−2.51−2	−5.93−2	−4.43−2	4.15−3	7.48−2	1.60−1
	δ	1.42−1	4.96−2	3.41−3	−1.08−3	3.09−3	8.93−3	1.46−2	1.96−2	2.38−2	2.74−2
$4d_{3/2}$	σ	1.593+2	1.106+2	5.476+1	3.003+1	1.796+1	1.148+1	7.713+0	5.398+0	3.903+0	2.899+0
E_b =	β	0.380	0.814	1.175	1.313	1.372	1.392	1.392	1.379	1.359	1.335
919.3 eV	γ	1.86−1	9.41−2	−6.64−2	−1.91−2	1.23−1	2.99−1	4.81−1	6.60−1	8.31−1	9.92−1
	δ	9.55−2	1.85−2	1.41−2	3.37−2	5.19−2	6.71−2	7.98−2	9.11−2	1.02−1	1.12−1
$4d_{5/2}$	σ	2.470+2	1.637+2	7.710+1	4.110+1	2.410+1	1.516+1	1.006+1	6.961+0	4.983+0	3.669+0
E_b =	β	0.766	1.097	1.323	1.377	1.377	1.354	1.321	1.284	1.244	1.204
864.8 eV	γ	2.20−1	4.93−2	−6.28−2	4.29−2	2.21−1	4.15−1	6.02−1	7.77−1	9.38−1	1.09+0
	δ	5.97−2	1.27−2	1.37−2	2.90−2	4.48−2	5.99−2	7.44−2	8.86−2	1.03−1	1.18−1
$4f_{5/2}$	σ	3.475+2	1.554+2	4.481+1	1.730+1	7.954+0	4.114+0	2.319+0	1.396+0	8.846−1	5.847−1
E_b =	β	0.867	0.993	1.055	1.030	0.979	0.921	0.864	0.809	0.756	0.706
487.4 eV	γ	−1.20−2	9.93−2	3.66−1	6.11−1	8.16−1	9.87−1	1.13+0	1.25+0	1.35+0	1.44+0

(*continued on next page*)

Table 1 (*continued*)

	δ	4.22−2	6.96−2	1.13−1	1.50−1	1.82−1	2.12−1	2.42−1	2.71−1	2.98−1	3.24−1
$4f_{7/2}$	σ	4.380+2	1.942+2	5.549+1	2.126+1	9.711+0	4.994+0	2.800+0	1.677+0	1.058+0	6.962−1
E_b =	β	0.900	1.010	1.050	1.015	0.959	0.900	0.843	0.790	0.740	0.693
472.7 eV	γ	−6.07−3	1.16−1	3.95−1	6.44−1	8.50−1	1.02+0	1.16+0	1.28+0	1.38+0	1.46+0
	δ	4.44−2	7.11−2	1.14−1	1.50−1	1.82−1	2.14−1	2.45−1	2.75−1	3.04−1	3.31−1
$5s_{1/2}$	σ	9.951+0	6.545+0	3.506+0	2.209+0	1.529+0	1.124+0	8.625−1	6.827−1	5.536−1	4.577−1
E_b =	β	1.488	1.554	1.622	1.657	1.680	1.698	1.714	1.727	1.740	1.751
392.7 eV	γ	7.31−1	7.27−1	6.36−1	5.16−1	3.95−1	2.83−1	1.83−1	9.64−2	2.29−2	−3.84−2
	δ	2.43−3	3.28−4	−2.48−3	−4.38−3	−5.83−3	−7.01−3	−7.98−3	−8.80−3	−9.49−3	−1.01−2
$5p_{1/2}$	σ	8.636+0	6.298+0	3.799+0	2.544+0	1.819+0	1.360+0	1.051+0	8.334−1	6.744−1	5.551−1
E_b =	β	1.170	1.398	1.586	1.656	1.687	1.700	1.703	1.701	1.694	1.684
317.7 eV	γ	6.91−1	6.21−1	3.60−1	1.66−1	5.60−2	9.18−3	6.68−3	3.43−2	8.21−2	1.44−1
	δ	−3.92−3	−1.58−2	−1.92−2	−1.78−2	−1.63−2	−1.51−2	−1.40−2	−1.29−2	−1.17−2	−1.03−2
$5p_{3/2}$	σ	3.269+1	2.092+1	1.063+1	6.356+0	4.183+0	2.930+0	2.147+0	1.626+0	1.265+0	1.006+0
E_b =	β	1.179	1.348	1.531	1.627	1.687	1.725	1.751	1.768	1.777	1.782
231.7 eV	γ	3.57−1	2.82−1	1.08−1	−3.60−3	−5.03−2	−4.75−2	−9.47−3	5.28−2	1.32−1	2.22−1
	δ	7.51−3	−3.02−3	−5.88−3	−1.22−3	4.79−3	1.05−2	1.56−2	1.98−2	2.35−2	2.66−2
$5d_{3/2}$	σ	3.491+1	2.216+1	1.041+1	5.663+0	3.395+0	2.179+0	1.473+0	1.036+0	7.522−1	5.609−1
E_b =	β	0.972	1.162	1.337	1.407	1.431	1.432	1.419	1.399	1.374	1.345
130.4 eV	γ	1.07−1	1.55−3	−3.70−2	5.92−2	2.12−1	3.85−1	5.61−1	7.32−1	8.97−1	1.05+0
	δ	−9.78−4	1.08−4	1.77−2	3.57−2	5.11−2	6.42−2	7.57−2	8.65−2	9.70−2	1.07−1
$5d_{5/2}$	σ	5.213+1	3.211+1	1.453+1	7.711+0	4.540+0	2.872+0	1.917+0	1.334+0	9.591−1	7.089−1
E_b =	β	1.252	1.361	1.430	1.429	1.403	1.366	1.325	1.283	1.241	1.199
113.1 eV	γ	6.23−2	−2.76−2	−9.43−3	1.31−1	3.09−1	4.93−1	6.69−1	8.34−1	9.88−1	1.13+0
	δ	1.68−4	2.60−3	1.56−2	3.00−2	4.44−2	5.84−2	7.23−2	8.64−2	1.01−1	1.16−1
$5f_{5/2}$	σ	2.876+1	1.368+1	4.254+0	1.720+0	8.159−1	4.316−1	2.473−1	1.506−1	9.638−2	6.417−2
E_b =	β	1.066	1.111	1.100	1.046	0.983	0.920	0.861	0.805	0.752	0.701
6.0 eV	γ	5.66−2	1.74−1	4.24−1	6.47−1	8.37−1	1.00+0	1.14+0	1.26+0	1.36+0	1.44+0
	δ	4.39−2	6.71−2	1.07−1	1.43−1	1.76−1	2.07−1	2.37−1	2.67−1	2.94−1	3.20−1
$5f_{7/2}$	σ	3.531+1	1.665+1	5.120+0	2.051+0	9.651−1	5.071−1	2.887−1	1.749−1	1.113−1	7.378−2
E_b =	β	1.083	1.115	1.087	1.026	0.960	0.897	0.839	0.785	0.735	0.688
6.0 eV	γ	6.31−2	1.89−1	4.50−1	6.78−1	8.70−1	1.03+0	1.17+0	1.29+0	1.38+0	1.46+0
	δ	4.58−2	6.81−2	1.07−1	1.43−1	1.77−1	2.09−1	2.40−1	2.71−1	3.00−1	3.28−1
$6s_{1/2}$	σ	2.194+0	1.407+0	7.345−1	4.565−1	3.134−1	2.293−1	1.753−1	1.384−1	1.120−1	9.245−2
E_b =	β	1.528	1.580	1.636	1.667	1.687	1.704	1.718	1.731	1.743	1.754
56.9 eV	γ	6.70−1	6.61−1	5.76−1	4.64−1	3.51−1	2.47−1	1.53−1	7.14−2	2.37−3	−5.51−2
	δ	1.09−3	−5.79−4	−2.98−3	−4.69−3	−6.03−3	−7.14−3	−8.08−3	−8.87−3	−9.55−3	−1.02−2
$6p_{1/2}$	σ	1.702+0	1.200+0	7.003−1	4.617−1	3.273−1	2.436−1	1.877−1	1.485−1	1.199−1	9.859−2
E_b =	β	1.293	1.472	1.622	1.679	1.702	1.711	1.711	1.707	1.698	1.688
32.1 eV	γ	6.46−1	5.49−1	3.04−1	1.33−1	3.99−2	4.01−3	8.61−3	4.10−2	9.21−2	1.56−1
	δ	−1.58−2	−2.04−2	−1.98−2	−1.76−2	−1.60−2	−1.49−2	−1.40−2	−1.29−2	−1.18−2	−1.04−2
$6p_{3/2}$	σ	5.081+0	3.205+0	1.604+0	9.527−1	6.245−1	4.366−1	3.194−1	2.417−1	1.879−1	1.493−1
E_b =	β	1.254	1.399	1.559	1.646	1.700	1.735	1.758	1.773	1.782	1.785
18.9 eV	γ	3.30−1	2.50−1	8.64−2	−1.33−2	−5.14−2	−4.32−2	−1.59−3	6.33−2	1.44−1	2.35−1
	δ	−8.04−5	−6.37−3	−6.27−3	−9.33−4	5.14−3	1.08−2	1.57−2	1.99−2	2.34−2	2.64−2
$6d_{3/2}$	σ	2.318+0	1.459+0	6.804−1	3.692−1	2.212−1	1.421−1	9.604−2	6.755−2	4.906−2	3.658−2
E_b =	β	1.032	1.200	1.358	1.419	1.439	1.438	1.424	1.402	1.375	1.346
6.0 eV	γ	9.49−2	−3.60−3	−3.12−2	6.80−2	2.21−1	3.96−1	5.74−1	7.47−1	9.09−1	1.06+0
	δ	−4.21−3	−4.23−4	1.78−2	3.54−2	5.05−2	6.37−2	7.57−2	8.64−2	9.62−2	1.06−1
$7s_{1/2}$	σ	1.811−1	1.156−1	6.004−2	3.721−2	2.549−2	1.863−2	1.423−2	1.123−2	9.089−3	7.502−3
E_b =	β	1.531	1.582	1.636	1.666	1.689	1.707	1.721	1.733	1.743	1.753
6.0 eV	γ	6.67−1	6.58−1	5.73−1	4.60−1	3.46−1	2.42−1	1.50−1	6.97−2	1.04−3	−5.69−2
	δ	9.71−4	−6.54−4	−3.02−3	−4.75−3	−6.08−3	−7.14−3	−8.02−3	−8.84−3	−9.56−3	−1.02−2
Z= 97, Bk: [Rn]$5f^6_{5/2}$ $5f^2_{7/2}$ $6d^1_{3/2}$ $7s^2_{1/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$4p_{3/2}$	σ	1.085+2	7.715+1	4.277+1	2.652+1	1.777+1	1.258+1	9.278+0	7.062+0	5.511+0	4.392+0
E_b =	β	0.294	0.919	1.325	1.502	1.600	1.661	1.702	1.730	1.748	1.760
1248.0 eV	γ	9.10−2	4.20−1	2.83−1	9.46−2	−1.57−2	−5.77−2	−5.01−2	−7.91−3	5.76−2	1.38−1
	δ	1.58−1	5.61−2	4.48−3	−1.43−3	2.39−3	8.26−3	1.41−2	1.93−2	2.38−2	2.76−2
$4d_{3/2}$	σ	1.610+2	1.130+2	5.658+1	3.122+1	1.876+1	1.203+1	8.106+0	5.685+0	4.118+0	3.064+0
E_b =	β	0.313	0.770	1.153	1.301	1.365	1.390	1.393	1.383	1.366	1.343
957.7 eV	γ	1.76−1	1.12−1	−6.35−2	−3.18−2	1.00−1	2.71−1	4.51−1	6.28−1	7.98−1	9.59−1
	δ	1.14−1	2.29−2	1.30−2	3.22−2	5.07−2	6.63−2	7.93−2	9.06−2	1.01−1	1.11−1
$4d_{5/2}$	σ	2.511+2	1.680+2	7.985+1	4.278+1	2.518+1	1.589+1	1.057+1	7.328+0	5.255+0	3.875+0
E_b =	β	0.713	1.072	1.315	1.376	1.380	1.360	1.328	1.292	1.253	1.214
901.4 eV	γ	2.32−1	6.82−2	−6.54−2	2.73−2	1.99−1	3.91−1	5.78−1	7.53−1	9.14−1	1.06+0
	δ	7.15−2	1.50−2	1.28−2	2.76−2	4.33−2	5.85−2	7.29−2	8.69−2	1.01−1	1.15−1

(*continued on next page*)

Table 1 (*continued*)

$4f_{5/2}$	σ	3.691+2	1.660+2	4.819+1	1.869+1	8.629+0	4.478+0	2.530+0	1.526+0	9.689−1	6.414−1
E_b =	β	0.849	0.984	1.054	1.034	0.985	0.929	0.872	0.818	0.766	0.716
514.4 eV	γ	−2.38−2	8.26−2	3.46−1	5.93−1	8.01−1	9.74−1	1.12+0	1.24+0	1.35+0	1.43+0
	δ	3.89−2	6.68−2	1.11−1	1.48−1	1.80−1	2.10−1	2.39−1	2.67−1	2.94−1	3.20−1
$4f_{7/2}$	σ	4.657+2	2.075+2	5.965+1	2.297+1	1.053+1	5.433+0	3.054+0	1.833+0	1.158+0	7.634−1
E_b =	β	0.884	1.002	1.051	1.019	0.966	0.907	0.851	0.798	0.749	0.702
498.5 eV	γ	−1.91−2	9.91−2	3.76−1	6.27−1	8.36−1	1.01+0	1.15+0	1.27+0	1.37+0	1.46+0
	δ	4.12−2	6.85−2	1.11−1	1.48−1	1.80−1	2.11−1	2.41−1	2.71−1	3.00−1	3.27−1
$5s_{1/2}$	σ	1.008+1	6.650+0	3.574+0	2.257+0	1.564+0	1.152+0	8.848−1	7.011−1	5.691−1	4.710−1
E_b =	β	1.446	1.520	1.595	1.633	1.658	1.677	1.694	1.708	1.721	1.733
405.0 eV	γ	7.40−1	7.44−1	6.62−1	5.46−1	4.27−1	3.16−1	2.15−1	1.26−1	4.93−2	−1.50−2
	δ	2.94−3	6.38−4	−2.41−3	−4.45−3	−6.01−3	−7.28−3	−8.34−3	−9.23−3	−9.99−3	−1.07−2
$5p_{1/2}$	σ	8.619+0	6.323+0	3.846+0	2.590+0	1.860+0	1.396+0	1.083+0	8.608−1	6.983−1	5.759−1
E_b =	β	1.126	1.371	1.572	1.648	1.682	1.697	1.702	1.701	1.696	1.687
326.8 eV	γ	7.08−1	6.52−1	3.92−1	1.91−1	7.18−2	1.62−2	5.91−3	2.70−2	6.94−2	1.26−1
	δ	−3.76−3	−1.68−2	−2.06−2	−1.90−2	−1.74−2	−1.61−2	−1.49−2	−1.38−2	−1.26−2	−1.12−2
$5p_{3/2}$	σ	3.383+1	2.169+1	1.104+1	6.610+0	4.355+0	3.056+0	2.241+0	1.700+0	1.324+0	1.053+0
E_b =	β	1.147	1.324	1.513	1.613	1.675	1.716	1.744	1.762	1.774	1.780
245.9 eV	γ	3.65−1	2.96−1	1.22−1	5.90−3	−4.71−2	−5.07−2	−1.84−2	3.88−2	1.13−1	1.99−1
	δ	8.97−3	−2.62−3	−6.41−3	−1.98−3	4.09−3	1.00−2	1.53−2	1.98−2	2.36−2	2.69−2
$5d_{3/2}$	σ	3.622+1	2.311+1	1.093+1	5.972+0	3.594+0	2.315+0	1.569+0	1.106+0	8.048−1	6.013−1
E_b =	β	0.949	1.144	1.327	1.401	1.429	1.433	1.423	1.405	1.382	1.355
130.4 eV	γ	1.17−1	9.12−3	−4.03−2	4.62−2	1.93−1	3.62−1	5.35−1	7.04−1	8.67−1	1.02+0
	δ	−4.88−4	−4.62−4	1.66−2	3.47−2	5.04−2	6.37−2	7.52−2	8.58−2	9.60−2	1.06−1
$5d_{5/2}$	σ	5.411+1	3.347+1	1.523+1	8.115+0	4.794+0	3.042+0	2.035+0	1.419+0	1.022+0	7.569−1
E_b =	β	1.243	1.357	1.430	1.432	1.408	1.373	1.333	1.292	1.250	1.209
115.1 eV	γ	7.23−2	−2.29−2	−1.57−2	1.17−1	2.92−1	4.74−1	6.49−1	8.13−1	9.67−1	1.11+0
	δ	2.99−4	2.15−3	1.47−2	2.89−2	4.32−2	5.71−2	7.08−2	8.46−2	9.86−2	1.13−1
$5f_{5/2}$	σ	3.152+1	1.510+1	4.741+0	1.929+0	9.201−1	4.888−1	2.810−1	1.717−1	1.101−1	7.346−2
E_b =	β	1.063	1.112	1.104	1.053	0.991	0.929	0.870	0.814	0.761	0.711
6.0 eV	γ	4.75−2	1.62−1	4.09−1	6.34−1	8.25−1	9.88−1	1.13+0	1.25+0	1.35+0	1.44+0
	δ	4.18−2	6.48−2	1.05−1	1.41−1	1.74−1	2.04−1	2.34−1	2.63−1	2.90−1	3.16−1
$5f_{7/2}$	σ	3.879+1	1.842+1	5.716+0	2.305+0	1.090+0	5.752−1	3.287−1	1.997−1	1.274−1	8.460−2
E_b =	β	1.081	1.116	1.092	1.033	0.968	0.905	0.847	0.793	0.743	0.696
6.0 eV	γ	5.32−2	1.77−1	4.36−1	6.66−1	8.59−1	1.02+0	1.16+0	1.28+0	1.38+0	1.46+0
	δ	4.38−2	6.60−2	1.05−1	1.41−1	1.74−1	2.06−1	2.37−1	2.67−1	2.96−1	3.24−1
$6s_{1/2}$	σ	2.240+0	1.441+0	7.536−1	4.691−1	3.224−1	2.361−1	1.807−1	1.428−1	1.157−1	9.556−2
E_b =	β	1.491	1.550	1.611	1.644	1.666	1.684	1.699	1.712	1.725	1.736
55.7 eV	γ	6.80−1	6.78−1	6.00−1	4.92−1	3.81−1	2.77−1	1.82−1	9.86−2	2.69−2	−3.35−2
	δ	1.40−3	−3.99−4	−2.98−3	−4.81−3	−6.25−3	−7.44−3	−8.45−3	−9.31−3	−1.01−2	−1.07−2
$6p_{1/2}$	σ	1.710+0	1.211+0	7.118−1	4.715−1	3.355−1	2.505−1	1.936−1	1.535−1	1.243−1	1.024−1
E_b =	β	1.257	1.449	1.610	1.672	1.698	1.709	1.711	1.708	1.701	1.691
34.0 eV	γ	6.70−1	5.81−1	3.34−1	1.55−1	5.33−2	9.17−3	6.41−3	3.26−2	7.86−2	1.38−1
	δ	−1.68−2	−2.19−2	−2.13−2	−1.89−2	−1.71−2	−1.59−2	−1.48−2	−1.38−2	−1.26−2	−1.13−2
$6p_{3/2}$	σ	5.243+0	3.312+0	1.661+0	9.875−1	6.481−1	4.537−1	3.323−1	2.518−1	1.960−1	1.558−1
E_b =	β	1.230	1.378	1.543	1.633	1.690	1.727	1.752	1.769	1.779	1.784
18.3 eV	γ	3.38−1	2.61−1	9.81−2	−5.65−3	−4.92−2	−4.68−2	−1.06−2	4.94−2	1.26−1	2.13−1
	δ	4.12−4	−6.41−3	−6.88−3	−1.65−3	4.51−3	1.03−2	1.55−2	1.99−2	2.37−2	2.68−2
$6d_{3/2}$	σ	2.276+0	1.439+0	6.754−1	3.680−1	2.213−1	1.425−1	9.663−2	6.814−2	4.958−2	3.704−2
E_b =	β	1.010	1.182	1.347	1.414	1.438	1.440	1.428	1.409	1.384	1.356
6.0 eV	γ	1.06−1	3.90−3	−3.52−2	5.50−2	2.01−1	3.70−1	5.47−1	7.19−1	8.81−1	1.03+0
	δ	−4.13−3	−1.22−3	1.68−2	3.45−2	4.96−2	6.29−2	7.50−2	8.58−2	9.56−2	1.05−1
$7s_{1/2}$	σ	1.820−1	1.164−1	6.059−2	3.760−2	2.578−2	1.886−2	1.442−2	1.139−2	9.226−3	7.622−3
E_b =	β	1.494	1.551	1.610	1.643	1.667	1.686	1.702	1.715	1.726	1.736
6.0 eV	γ	6.79−1	6.76−1	5.98−1	4.90−1	3.77−1	2.72−1	1.78−1	9.65−2	2.58−2	−3.46−2
	δ	1.29−3	−4.70−4	−3.02−3	−4.87−3	−6.31−3	−7.46−3	−8.40−3	−9.27−3	−1.00−2	−1.08−2
Z= 98, Cf: [Rn]$5f^6_{5/2}$ $5f^4_{7/2}$ $7s^2_{1/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$4p_{3/2}$	σ	1.095+2	7.847+1	4.373+1	2.720+1	1.827+1	1.296+1	9.571+0	7.296+0	5.702+0	4.549+0
E_b =	β	0.166	0.854	1.296	1.480	1.584	1.649	1.692	1.722	1.742	1.755
1291.5 eV	γ	−4.06−4	4.13−1	3.05−1	1.14−1	−4.38−3	−5.44−2	−5.46−2	−1.94−2	4.07−2	1.18−1
	δ	1.79−1	6.49−2	5.92−3	−1.75−3	1.61−3	7.45−3	1.34−2	1.90−2	2.38−2	2.79−2
$4d_{3/2}$	σ	1.624+2	1.154+2	5.842+1	3.244+1	1.957+1	1.259+1	8.513+0	5.984+0	4.343+0	3.236+0
E_b =	β	0.243	0.722	1.129	1.287	1.357	1.387	1.393	1.386	1.371	1.350
993.7 eV	γ	1.59−1	1.30−1	−5.89−2	−4.31−2	7.71−2	2.41−1	4.20−1	5.99−1	7.68−1	9.28−1
	δ	1.35−1	2.85−2	1.19−2	3.06−2	4.92−2	6.51−2	7.88−2	9.06−2	1.01−1	1.10−1
$4d_{5/2}$	σ	2.550+2	1.722+2	8.260+1	4.448+1	2.628+1	1.663+1	1.109+1	7.708+0	5.536+0	4.088+0
E_b =	β	0.659	1.046	1.307	1.374	1.382	1.365	1.335	1.300	1.261	1.222

(*continued on next page*)

Table 1 (*continued*)

933.1 eV	γ	2.39−1	8.83−2	−6.65−2	1.27−2	1.76−1	3.64−1	5.53−1	7.31−1	8.93−1	1.04+0
	δ	8.51−2	1.77−2	1.19−2	2.63−2	4.16−2	5.67−2	7.16−2	8.58−2	9.94−2	1.13−1
$4f_{5/2}$	σ	3.934+2	1.778+2	5.188+1	2.021+1	9.365+0	4.874+0	2.760+0	1.668+0	1.060+0	7.030−1
E_b =	β	0.827	0.973	1.053	1.038	0.993	0.938	0.880	0.825	0.773	0.725
541.1 eV	γ	−3.54−2	6.51−2	3.24−1	5.71−1	7.84−1	9.62−1	1.11+0	1.23+0	1.34+0	1.43+0
	δ	3.54−2	6.37−2	1.08−1	1.45−1	1.78−1	2.09−1	2.37−1	2.63−1	2.89−1	3.15−1
$4f_{7/2}$	σ	4.969+2	2.223+2	6.423+1	2.484+1	1.143+1	5.916+0	3.332+0	2.003+0	1.268+0	8.369−1
E_b =	β	0.866	0.994	1.051	1.024	0.973	0.916	0.858	0.804	0.755	0.709
523.3 eV	γ	−3.20−2	8.08−2	3.55−1	6.07−1	8.21−1	9.98−1	1.14+0	1.26+0	1.37+0	1.45+0
	δ	3.77−2	6.55−2	1.08−1	1.45−1	1.78−1	2.10−1	2.39−1	2.67−1	2.94−1	3.22−1
$5s_{1/2}$	σ	1.021+1	6.757+0	3.641+0	2.303+0	1.598+0	1.179+0	9.064−1	7.191−1	5.843−1	4.839−1
E_b =	β	1.397	1.483	1.566	1.608	1.636	1.657	1.673	1.687	1.700	1.712
423.6 eV	γ	7.52−1	7.64−1	6.91−1	5.79−1	4.61−1	3.50−1	2.49−1	1.58−1	7.91−2	1.10−2
	δ	3.62−3	1.03−3	−2.30−3	−4.51−3	−6.17−3	−7.52−3	−8.67−3	−9.66−3	−1.05−2	−1.13−2
$5p_{1/2}$	σ	8.567+0	6.327+0	3.884+0	2.631+0	1.898+0	1.431+0	1.113+0	8.875−1	7.217−1	5.965−1
E_b =	β	1.072	1.340	1.557	1.639	1.677	1.694	1.701	1.701	1.697	1.690
341.9 eV	γ	7.29−1	6.89−1	4.31−1	2.20−1	9.06−2	2.56−2	6.60−3	2.05−2	5.75−2	1.10−1
	δ	−3.13−3	−1.79−2	−2.22−2	−2.05−2	−1.86−2	−1.71−2	−1.59−2	−1.48−2	−1.36−2	−1.22−2
$5p_{3/2}$	σ	3.478+1	2.234+1	1.139+1	6.834+0	4.509+0	3.168+0	2.328+0	1.768+0	1.378+0	1.098+0
E_b =	β	1.118	1.303	1.495	1.600	1.665	1.708	1.737	1.757	1.770	1.777
248.8 eV	γ	3.70−1	3.08−1	1.36−1	1.54−2	−4.27−2	−5.23−2	−2.61−2	2.61−2	9.66−2	1.79−1
	δ	1.02−2	−2.26−3	−6.89−3	−2.72−3	3.37−3	9.42−3	1.49−2	1.97−2	2.39−2	2.73−2
$5d_{3/2}$	σ	3.742+1	2.401+1	1.143+1	6.271+0	3.788+0	2.448+0	1.663+0	1.175+0	8.566−1	6.409−1
E_b =	β	0.922	1.125	1.315	1.395	1.426	1.434	1.427	1.410	1.389	1.364
136.0 eV	γ	1.31−1	1.90−2	−4.31−2	3.24−2	1.71−1	3.37−1	5.10−1	6.79−1	8.40−1	9.92−1
	δ	2.88−4	−1.10−3	1.53−2	3.35−2	4.93−2	6.31−2	7.51−2	8.57−2	9.54−2	1.05−1
$5d_{5/2}$	σ	5.591+1	3.474+1	1.589+1	8.497+0	5.036+0	3.204+0	2.149+0	1.501+0	1.083+0	8.030−1
E_b =	β	1.232	1.351	1.430	1.435	1.413	1.380	1.342	1.300	1.259	1.218
124.5 eV	γ	8.67−2	−1.63−2	−2.22−2	1.02−1	2.71−1	4.52−1	6.29−1	7.95−1	9.47−1	1.09+0
	δ	5.72−4	1.62−3	1.38−2	2.76−2	4.17−2	5.59−2	6.99−2	8.35−2	9.68−2	1.10−1
$5f_{5/2}$	σ	3.289+1	1.586+1	5.022+0	2.056+0	9.852−1	5.255−1	3.030−1	1.856−1	1.193−1	7.974−2
E_b =	β	1.058	1.112	1.108	1.060	1.000	0.938	0.878	0.821	0.769	0.720
6.0 eV	γ	3.78−2	1.48−1	3.92−1	6.17−1	8.12−1	9.79−1	1.12+0	1.24+0	1.34+0	1.43+0
	δ	3.96−2	6.25−2	1.02−1	1.38−1	1.72−1	2.03−1	2.31−1	2.58−1	2.85−1	3.11−1
$5f_{7/2}$	σ	3.978+1	1.900+1	5.944+0	2.411+0	1.146+0	6.071−1	3.479−1	2.119−1	1.355−1	9.013−2
E_b =	β	1.078	1.117	1.097	1.040	0.976	0.914	0.854	0.799	0.749	0.703
6.0 eV	γ	4.26−2	1.63−1	4.20−1	6.50−1	8.48−1	1.01+0	1.15+0	1.27+0	1.37+0	1.46+0
	δ	4.16−2	6.38−2	1.02−1	1.38−1	1.72−1	2.04−1	2.34−1	2.63−1	2.91−1	3.18−1
$6s_{1/2}$	σ	2.232+0	1.438+0	7.539−1	4.698−1	3.232−1	2.369−1	1.815−1	1.436−1	1.164−1	9.628−2
E_b =	β	1.451	1.516	1.583	1.620	1.646	1.664	1.680	1.693	1.705	1.716
58.1 eV	γ	6.91−1	6.96−1	6.28−1	5.22−1	4.12−1	3.08−1	2.13−1	1.29−1	5.46−2	−9.28−3
	δ	1.80−3	−1.71−4	−2.96−3	−4.93−3	−6.44−3	−7.71−3	−8.80−3	−9.74−3	−1.06−2	−1.13−2
$6p_{1/2}$	σ	1.662+0	1.183+0	7.000−1	4.659−1	3.329−1	2.494−1	1.933−1	1.537−1	1.248−1	1.030−1
E_b =	β	1.220	1.426	1.597	1.664	1.694	1.707	1.710	1.708	1.703	1.694
34.9 eV	γ	6.97−1	6.16−1	3.68−1	1.80−1	6.90−2	1.64−2	5.70−3	2.49−2	6.55−2	1.21−1
	δ	−1.81−2	−2.36−2	−2.30−2	−2.03−2	−1.82−2	−1.68−2	−1.57−2	−1.47−2	−1.36−2	−1.23−2
$6p_{3/2}$	σ	5.108+0	3.231+0	1.623+0	9.662−1	6.348−1	4.449−1	3.263−1	2.476−1	1.929−1	1.536−1
E_b =	β	1.206	1.357	1.525	1.619	1.679	1.719	1.746	1.764	1.775	1.782
19.4 eV	γ	3.47−1	2.74−1	1.11−1	2.86−3	−4.60−2	−4.92−2	−1.90−2	3.56−2	1.08−1	1.92−1
	δ	1.09−3	−6.33−3	−7.52−3	−2.47−3	3.78−3	9.76−3	1.51−2	1.97−2	2.38−2	2.72−2
$7s_{1/2}$	σ	1.518−1	9.738−2	5.081−2	3.158−2	2.168−2	1.587−2	1.215−2	9.602−3	7.783−3	6.435−3
E_b =	β	1.455	1.519	1.584	1.620	1.644	1.663	1.679	1.694	1.708	1.719
6.0 eV	γ	6.88−1	6.92−1	6.23−1	5.18−1	4.10−1	3.05−1	2.10−1	1.25−1	5.23−2	−1.00−2
	δ	1.65−3	−2.81−4	−3.01−3	−4.97−3	−6.52−3	−7.79−3	−8.83−3	−9.74−3	−1.05−2	−1.12−2

Z= 99, Es: [Rn]$5f^6_{5/2}$ $5f^5_{7/2}$ $7s^2_{1/2}$

		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$4p_{3/2}$	σ	1.102+2	7.968+1	4.465+1	2.786+1	1.875+1	1.333+1	9.860+0	7.526+0	5.890+0	4.704+0
E_b =	β	0.013	0.789	1.262	1.456	1.565	1.634	1.681	1.713	1.735	1.750
1335.5 eV	γ	−1.06−1	4.01−1	3.26−1	1.33−1	7.65−3	−5.01−2	−5.77−2	−2.92−2	2.51−2	9.73−2
	δ	2.01−1	7.44−2	7.67−3	−1.96−3	8.36−4	6.64−3	1.28−2	1.85−2	2.36−2	2.79−2
$4d_{3/2}$	σ	1.635+2	1.176+2	6.022+1	3.365+1	2.039+1	1.316+1	8.923+0	6.288+0	4.572+0	3.413+0
E_b =	β	0.167	0.673	1.103	1.271	1.348	1.382	1.393	1.389	1.376	1.357
1032.4 eV	γ	1.32−1	1.47−1	−5.28−2	−5.27−2	5.69−2	2.14−1	3.89−1	5.66−1	7.36−1	8.96−1
	δ	1.57−1	3.52−2	1.10−2	2.91−2	4.79−2	6.40−2	7.81−2	9.01−2	1.01−1	1.10−1
$4d_{5/2}$	σ	2.586+2	1.763+2	8.532+1	4.619+1	2.739+1	1.738+1	1.162+1	8.093+0	5.824+0	4.306+0
E_b =	β	0.607	1.018	1.298	1.372	1.384	1.369	1.342	1.308	1.270	1.232
968.4 eV	γ	2.42−1	1.09−1	−6.63−2	−3.18−4	1.56−1	3.40−1	5.27−1	7.05−1	8.69−1	1.02+0
	δ	1.00−1	2.11−2	1.12−2	2.51−2	4.02−2	5.51−2	6.98−2	8.42−2	9.79−2	1.11−1

(*continued on next page*)

Table 1 (*continued*)

$4f_{5/2}$	σ	4.160+2	1.891+2	5.555+1	2.175+1	1.011+1	5.282+0	2.999+0	1.816+0	1.157+0	7.679−1
E_b =	β	0.806	0.962	1.051	1.041	0.999	0.945	0.889	0.834	0.782	0.734
567.5 eV	γ	−4.57−2	4.93−2	3.05−1	5.52−1	7.66−1	9.47−1	1.10+0	1.22+0	1.33+0	1.42+0
	δ	3.19−2	6.08−2	1.06−1	1.42−1	1.75−1	2.06−1	2.35−1	2.60−1	2.86−1	3.11−1
$4f_{7/2}$	σ	5.275+2	2.371+2	6.889+1	2.676+1	1.236+1	6.416+0	3.623+0	2.182+0	1.384+0	9.146−1
E_b =	β	0.848	0.985	1.051	1.028	0.979	0.924	0.867	0.813	0.763	0.717
551.0 eV	γ	−4.39−2	6.36−2	3.36−1	5.89−1	8.05−1	9.85−1	1.13+0	1.26+0	1.36+0	1.45+0
	δ	3.42−2	6.27−2	1.06−1	1.42−1	1.76−1	2.07−1	2.37−1	2.64−1	2.91−1	3.17−1
$5s_{1/2}$	σ	1.033+1	6.855+0	3.705+0	2.348+0	1.632+0	1.205+0	9.276−1	7.368−1	5.993−1	4.968−1
E_b =	β	1.346	1.442	1.533	1.580	1.611	1.634	1.651	1.666	1.679	1.691
442.7 eV	γ	7.60−1	7.82−1	7.21−1	6.13−1	4.97−1	3.85−1	2.84−1	1.92−1	1.10−1	3.95−2
	δ	4.35−3	1.49−3	−2.14−3	−4.54−3	−6.34−3	−7.78−3	−9.01−3	−1.01−2	−1.10−2	−1.18−2
$5p_{1/2}$	σ	8.499+0	6.317+0	3.914+0	2.668+0	1.934+0	1.463+0	1.142+0	9.133−1	7.446−1	6.168−1
E_b =	β	1.017	1.305	1.538	1.628	1.670	1.690	1.699	1.700	1.698	1.692
357.4 eV	γ	7.45−1	7.25−1	4.70−1	2.50−1	1.11−1	3.70−2	9.65−3	1.61−2	4.69−2	9.45−2
	δ	−2.53−3	−1.90−2	−2.40−2	−2.21−2	−2.00−2	−1.83−2	−1.69−2	−1.58−2	−1.46−2	−1.32−2
$5p_{3/2}$	σ	3.584+1	2.307+1	1.179+1	7.084+0	4.680+0	3.293+0	2.422+0	1.842+0	1.437+0	1.146+0
E_b =	β	1.087	1.277	1.475	1.583	1.652	1.697	1.729	1.750	1.765	1.774
258.7 eV	γ	3.76−1	3.20−1	1.50−1	2.58−2	−3.78−2	−5.32−2	−3.28−2	1.42−2	8.01−2	1.59−1
	δ	1.17−2	−1.69−3	−7.37−3	−3.52−3	2.59−3	8.79−3	1.45−2	1.95−2	2.39−2	2.76−2
$5d_{3/2}$	σ	3.873+1	2.499+1	1.197+1	6.599+0	4.000+0	2.593+0	1.766+0	1.251+0	9.137−1	6.849−1
E_b =	β	0.896	1.104	1.302	1.387	1.423	1.433	1.429	1.415	1.395	1.372
141.7 eV	γ	1.43−1	2.87−2	−4.48−2	2.07−2	1.52−1	3.12−1	4.82−1	6.51−1	8.12−1	9.64−1
	δ	1.20−3	−1.61−3	1.41−2	3.24−2	4.84−2	6.23−2	7.46−2	8.54−2	9.50−2	1.04−1
$5d_{5/2}$	σ	5.797+1	3.619+1	1.664+1	8.931+0	5.308+0	3.386+0	2.277+0	1.594+0	1.152+0	8.553−1
E_b =	β	1.221	1.344	1.429	1.438	1.418	1.387	1.349	1.309	1.268	1.228
133.1 eV	γ	9.99−2	−9.39−3	−2.75−2	8.85−2	2.53−1	4.31−1	6.07−1	7.74−1	9.27−1	1.07+0
	δ	9.12−4	1.18−3	1.29−2	2.66−2	4.03−2	5.43−2	6.83−2	8.19−2	9.51−2	1.08−1
$5f_{5/2}$	σ	3.572+1	1.736+1	5.543+0	2.283+0	1.100+0	5.890−1	3.408−1	2.093−1	1.349−1	9.033−2
E_b =	β	1.054	1.111	1.113	1.066	1.007	0.947	0.887	0.830	0.778	0.729
6.0 eV	γ	2.95−2	1.37−1	3.79−1	6.02−1	7.99−1	9.67−1	1.11+0	1.23+0	1.34+0	1.43+0
	δ	3.75−2	6.04−2	9.99−2	1.36−1	1.69−1	2.00−1	2.29−1	2.55−1	2.81−1	3.07−1
$5f_{7/2}$	σ	4.336+1	2.086+1	6.582+0	2.686+0	1.283+0	6.824−1	3.924−1	2.396−1	1.536−1	1.024−1
E_b =	β	1.076	1.118	1.101	1.046	0.984	0.922	0.863	0.807	0.757	0.711
6.0 eV	γ	3.34−2	1.51−1	4.06−1	6.37−1	8.35−1	1.00+0	1.15+0	1.26+0	1.37+0	1.45+0
	δ	3.97−2	6.19−2	1.00−1	1.35−1	1.69−1	2.02−1	2.31−1	2.60−1	2.87−1	3.14−1
$6s_{1/2}$	σ	2.273+0	1.468+0	7.714−1	4.813−1	3.314−1	2.432−1	1.865−1	1.476−1	1.198−1	9.918−2
E_b =	β	1.407	1.479	1.553	1.594	1.621	1.642	1.658	1.672	1.684	1.696
60.4 eV	γ	7.01−1	7.14−1	6.55−1	5.53−1	4.45−1	3.41−1	2.45−1	1.60−1	8.35−2	1.72−2
	δ	2.23−3	1.11−4	−2.89−3	−5.02−3	−6.66−3	−8.01−3	−9.17−3	−1.02−2	−1.11−2	−1.19−2
$6p_{1/2}$	σ	1.659+0	1.186+0	7.072−1	4.732−1	3.394−1	2.551−1	1.983−1	1.581−1	1.287−1	1.064−1
E_b =	β	1.179	1.397	1.581	1.655	1.689	1.704	1.709	1.708	1.704	1.697
37.7 eV	γ	7.22−1	6.51−1	4.03−1	2.06−1	8.63−2	2.54−2	7.12−3	1.95−2	5.42−2	1.05−1
	δ	−1.92−2	−2.54−2	−2.49−2	−2.20−2	−1.96−2	−1.79−2	−1.67−2	−1.56−2	−1.45−2	−1.32−2
$6p_{3/2}$	σ	5.247+0	3.324+0	1.673+0	9.971−1	6.558−1	4.600−1	3.377−1	2.565−1	2.001−1	1.594−1
E_b =	β	1.179	1.333	1.504	1.603	1.666	1.709	1.738	1.758	1.771	1.779
22.2 eV	γ	3.54−1	2.86−1	1.24−1	1.20−2	−4.22−2	−5.09−2	−2.61−2	2.34−2	9.10−2	1.72−1
	δ	1.87−3	−6.21−3	−8.16−3	−3.30−3	3.02−3	9.17−3	1.47−2	1.96−2	2.38−2	2.75−2
$7s_{1/2}$	σ	1.513−1	9.721−2	5.084−2	3.164−2	2.175−2	1.594−2	1.220−2	9.656−3	7.833−3	6.482−3
E_b =	β	1.412	1.482	1.555	1.594	1.620	1.639	1.657	1.673	1.687	1.699
6.0 eV	γ	6.98−1	7.10−1	6.49−1	5.49−1	4.42−1	3.38−1	2.42−1	1.56−1	8.03−2	1.57−2
	δ	2.06−3	−1.71−5	−2.96−3	−5.07−3	−6.73−3	−8.09−3	−9.22−3	−1.02−2	−1.10−2	−1.18−2
Z=100, Fm: [Rn]$5f^6_{5/2}$ $5f^6_{7/2}$ $7s^2_{1/2}$											
		k (eV)									
Shell		1500	2000	3000	4000	5000	6000	7000	8000	9000	10000
$4p_{3/2}$	σ	1.106+2	8.083+1	4.556+1	2.852+1	1.924+1	1.370+1	1.015+1	7.759+0	6.080+0	4.861+0
E_b =	β		0.720	1.227	1.430	1.545	1.618	1.668	1.703	1.727	1.744
1379.9 eV	γ	−2.28−1	3.84−1	3.45−1	1.53−1	2.09−2	−4.46−2	−5.93−2	−3.76−2	1.07−2	7.79−2
	δ	2.21−1	8.51−2	9.74−3	−2.07−3	5.70−5	5.77−3	1.20−2	1.80−2	2.33−2	2.79−2
$4d_{3/2}$	σ	1.645+2	1.197+2	6.200+1	3.487+1	2.122+1	1.374+1	9.341+0	6.598+0	4.808+0	3.595+0
E_b =	β	0.091	0.623	1.075	1.254	1.338	1.377	1.391	1.390	1.380	1.363
1071.0 eV	γ	9.57−2	1.61−1	−4.52−2	−6.08−2	3.81−2	1.87−1	3.57−1	5.33−1	7.03−1	8.63−1
	δ	1.79−1	4.31−2	1.02−2	2.76−2	4.66−2	6.30−2	7.72−2	8.96−2	1.00−1	1.10−1
$4d_{5/2}$	σ	2.618+2	1.802+2	8.805+1	4.792+1	2.851+1	1.815+1	1.216+1	8.488+0	6.119+0	4.532+0
E_b =	β	0.553	0.989	1.287	1.370	1.386	1.373	1.348	1.316	1.279	1.241
1003.8 eV	γ	2.38−1	1.30−1	−6.46−2	−1.23−2	1.37−1	3.16−1	5.01−1	6.79−1	8.45−1	9.96−1
	δ	1.16−1	2.51−2	1.05−2	2.38−2	3.88−2	5.34−2	6.80−2	8.24−2	9.61−2	1.09−1
$4f_{5/2}$	σ	4.396+2	2.010+2	5.943+1	2.337+1	1.091+1	5.715+0	3.254+0	1.974+0	1.260+0	8.375−1

(*continued on next page*)

Table 1 (*continued*)

E_b =	β	0.784	0.950	1.049	1.044	1.004	0.953	0.898	0.843	0.791	0.742
594.9 eV	γ	−5.53−2	3.37−2	2.86−1	5.33−1	7.48−1	9.32−1	1.08+0	1.21+0	1.32+0	1.41+0
	δ	2.82−2	5.78−2	1.03−1	1.40−1	1.73−1	2.04−1	2.32−1	2.58−1	2.83−1	3.07−1
$4f_{7/2}$	σ	5.582+2	2.522+2	7.370+1	2.875+1	1.333+1	6.941+0	3.930+0	2.372+0	1.506+0	9.972−1
E_b =	β	0.829	0.976	1.051	1.031	0.985	0.931	0.875	0.821	0.770	0.724
577.4 eV	γ	−5.49−2	4.69−2	3.17−1	5.71−1	7.88−1	9.72−1	1.12+0	1.25+0	1.35+0	1.44+0
	δ	3.06−2	5.98−2	1.04−1	1.39−1	1.72−1	2.04−1	2.34−1	2.61−1	2.88−1	3.13−1
$5s_{1/2}$	σ	1.043+1	6.943+0	3.765+0	2.390+0	1.664+0	1.230+0	9.479−1	7.537−1	6.137−1	5.093−1
E_b =	β	1.290	1.397	1.498	1.549	1.583	1.608	1.628	1.643	1.657	1.670
461.4 eV	γ	7.66−1	7.99−1	7.51−1	6.48−1	5.33−1	4.22−1	3.20−1	2.27−1	1.44−1	7.05−2
	δ	5.18−3	2.02−3	−1.92−3	−4.54−3	−6.49−3	−8.05−3	−9.36−3	−1.05−2	−1.15−2	−1.24−2
$5p_{1/2}$	σ	8.409+0	6.287+0	3.932+0	2.698+0	1.965+0	1.492+0	1.169+0	9.373−1	7.662−1	6.361−1
E_b =	β	0.962	1.269	1.517	1.616	1.662	1.685	1.696	1.699	1.698	1.693
367.0 eV	γ	7.58−1	7.58−1	5.09−1	2.82−1	1.33−1	5.01−2	1.46−2	1.38−2	3.81−2	8.04−2
	δ	−2.25−3	−2.01−2	−2.58−2	−2.39−2	−2.15−2	−1.95−2	−1.81−2	−1.68−2	−1.56−2	−1.42−2
$5p_{3/2}$	σ	3.688+1	2.379+1	1.219+1	7.335+0	4.852+0	3.418+0	2.517+0	1.916+0	1.497+0	1.195+0
E_b =	β	1.055	1.249	1.453	1.566	1.638	1.686	1.719	1.743	1.759	1.770
268.5 eV	γ	3.80−1	3.31−1	1.64−1	3.69−2	−3.20−2	−5.31−2	−3.83−2	3.27−3	6.45−2	1.39−1
	δ	1.34−2	−1.01−3	−7.81−3	−4.34−3	1.75−3	8.10−3	1.40−2	1.93−2	2.39−2	2.78−2
$5d_{3/2}$	σ	4.001+1	2.595+1	1.252+1	6.930+0	4.215+0	2.740+0	1.872+0	1.329+0	9.725−1	7.302−1
E_b =	β	0.867	1.081	1.287	1.378	1.419	1.432	1.431	1.419	1.402	1.380
147.1 eV	γ	1.55−1	3.89−2	−4.56−2	1.01−2	1.33−1	2.88−1	4.55−1	6.22−1	7.83−1	9.35−1
	δ	2.29−3	−2.04−3	1.30−2	3.14−2	4.75−2	6.16−2	7.40−2	8.50−2	9.48−2	1.04−1
$5d_{5/2}$	σ	5.997+1	3.760+1	1.739+1	9.367+0	5.583+0	3.571+0	2.406+0	1.688+0	1.222+0	9.090−1
E_b =	β	1.210	1.338	1.428	1.440	1.423	1.393	1.357	1.318	1.278	1.237
139.4 eV	γ	1.13−1	−2.08−3	−3.19−2	7.65−2	2.35−1	4.10−1	5.85−1	7.52−1	9.07−1	1.05+0
	δ	1.32−3	7.79−4	1.20−2	2.55−2	3.91−2	5.29−2	6.67−2	8.04−2	9.36−2	1.06−1
$5f_{5/2}$	σ	3.861+1	1.890+1	6.089+0	2.523+0	1.221+0	6.566−1	3.812−1	2.348−1	1.516−1	1.018−1
E_b =	β	1.049	1.111	1.116	1.072	1.015	0.956	0.896	0.839	0.786	0.738
7.0 eV	γ	2.15−2	1.25−1	3.65−1	5.88−1	7.84−1	9.54−1	1.10+0	1.22+0	1.33+0	1.42+0
	δ	3.54−2	5.84−2	9.78−2	1.33−1	1.66−1	1.97−1	2.26−1	2.53−1	2.78−1	3.03−1
$5f_{7/2}$	σ	4.702+1	2.278+1	7.248+0	2.974+0	1.428+0	7.624−1	4.399−1	2.694−1	1.730−1	1.156−1
E_b =	β	1.073	1.119	1.106	1.052	0.991	0.930	0.872	0.816	0.765	0.718
7.0 eV	γ	2.44−2	1.39−1	3.93−1	6.23−1	8.22−1	9.93−1	1.14+0	1.26+0	1.36+0	1.45+0
	δ	3.77−2	6.00−2	9.80−2	1.33−1	1.66−1	1.99−1	2.29−1	2.57−1	2.84−1	3.10−1
$6s_{1/2}$	σ	2.310+0	1.495+0	7.879−1	4.923−1	3.393−1	2.492−1	1.912−1	1.516−1	1.231−1	1.020−1
E_b =	β	1.360	1.439	1.520	1.564	1.595	1.617	1.635	1.650	1.663	1.675
62.7 eV	γ	7.10−1	7.32−1	6.83−1	5.86−1	4.79−1	3.75−1	2.79−1	1.92−1	1.14−1	4.58−2
	δ	2.72−3	4.44−4	−2.79−3	−5.09−3	−6.86−3	−8.32−3	−9.55−3	−1.06−2	−1.16−2	−1.25−2
$6p_{1/2}$	σ	1.652+0	1.186+0	7.126−1	4.793−1	3.451−1	2.603−1	2.029−1	1.623−1	1.324−1	1.097−1
E_b =	β	1.133	1.366	1.564	1.644	1.682	1.700	1.707	1.708	1.705	1.699
39.1 eV	γ	7.46−1	6.87−1	4.39−1	2.35−1	1.06−1	3.63−2	1.03−2	1.58−2	4.44−2	8.96−2
	δ	−2.05−2	−2.73−2	−2.69−2	−2.38−2	−2.11−2	−1.92−2	−1.77−2	−1.66−2	−1.54−2	−1.42−2
$6p_{3/2}$	σ	5.374+0	3.411+0	1.720+0	1.027+0	6.759−1	4.746−1	3.488−1	2.652−1	2.071−1	1.652−1
E_b =	β	1.152	1.308	1.484	1.586	1.653	1.698	1.729	1.751	1.766	1.775
22.9 eV	γ	3.61−1	2.98−1	1.37−1	2.17−2	−3.76−2	−5.17−2	−3.21−2	1.23−2	7.52−2	1.52−1
	δ	2.68−3	−6.02−3	−8.77−3	−4.15−3	2.21−3	8.54−3	1.43−2	1.94−2	2.38−2	2.77−2
$7s_{1/2}$	σ	1.506−1	9.697−2	5.084−2	3.168−2	2.180−2	1.599−2	1.226−2	9.705−3	7.878−3	6.524−3
E_b =	β	1.365	1.442	1.522	1.566	1.594	1.615	1.633	1.649	1.665	1.678
6.0 eV	γ	7.07−1	7.28−1	6.77−1	5.80−1	4.75−1	3.73−1	2.76−1	1.88−1	1.11−1	4.32−2
	δ	2.53−3	3.01−4	−2.87−3	−5.15−3	−6.93−3	−8.39−3	−9.62−3	−1.07−2	−1.16−2	−1.24−2