



Chapter 2.25

Keywords: X-ray absorption; XAFS; physical parameters; Fermi energy; Debye–Waller; IMF; excited-state lifetimes.

Significance and tables of key physico-chemical parameters

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For general X-ray absorption spectroscopy (XAS) or X-ray absorption fine-structure (XAFS) analysis, whether focusing on the pre-edge, the X-ray absorption near-edge structure (XANES), the standard full XAFS region or the higher-energy extended XAFS region (EXAFS), a series of important parameters come into the theory across the whole *International Tables for Crystallography*. For near-edge and pre-edge structure, the definition of the Fermi level E_F is critical. The ionization hole width Γ_H and inner-shell hole excited-state lifetime τ_H are another pair of critical parameters that limit the information content of the near-edge spectrum, revealing key physics. The Debye temperature Θ_D represents the complex dynamical behaviour of electrons in the quantum system. Much less understood is the damping of the signal due to the photoelectron wave inelastic mean free path λ_{IMFP} , the electron energy-loss function, the complex and anisotropic refractive index n and the complex and anisotropic permittivity or dielectric function ϵ . Here, an attempt is made to give a brief summary of the key issues and typical values, and also a discussion of scales and units for representation of key data and critical parameters.

1. Introduction

For general X-ray absorption spectroscopy (XAS; Chantler & Creagh, 2024; Paolasini & Di Matteo, 2024; Natoli *et al.*, 2024) or X-ray absorption fine-structure (XAFS) analysis, whether focusing on the pre-edge (de Groot, 2024; Yamamoto, 2024), the X-ray absorption near-edge structure (XANES; Fujikawa, 2024; Joly *et al.*, 2024), the standard full XAFS region or the higher-energy extended XAFS region (EXAFS; Rehr *et al.*, 2024; Kas *et al.*, 2024), a series of important parameters come into the theory across the whole *International Tables for Crystallography*. Several of these are obvious but are often fitted empirically with limited theoretical or experimental provenance. Others are well-known, well-understood and regularly tabulated. This chapter presents and discusses these.

For near-edge and pre-edge structure, the definition of the Fermi level E_F is critical. This also impacts upon the definition of χ , especially for low- k regions of experiment and analysis. The ionization hole width Γ_H and the inner-shell hole excited-state lifetime τ_H are another pair of critical parameters that limit the information content of the near-edge spectrum and also reveal key physics. The complex dynamical behaviour of electrons in the quantum system, and especially the static and dynamic behaviour of anisotropic thermal ellipsoids, whether representable by correlated Debye theory and a Debye temperature Θ_D or not, is a huge area which particularly impacts upon the realistic (anisotropic) thermal parameters, contrasted with crystal lattice thermal anisotropic parameters usually from crystallography (B , B_{ij} , U_{ij} , σ_{ij}), for dynamic bonding and the broadening of theoretical scattering paths i

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and path lengths σ_i [or the equivalent mean-square relative displacement (MSRD) parameters σ_i^2 and the much less significant transverse broadening parameters $\sigma_{i,\perp}$] (Fornasini, 2024; Castellano, 2024). This is particularly important for high- k , high- n -leg paths and long path lengths, where this broadening can dominate.

Perhaps much less understood is the damping of the signal due to the photoelectron wave inelastic mean free path (IMFP) λ_{IMFP} (Tanuma & Powell, 2024), which in turn arises from the electron-loss function (ELF), which is closely related to the complex and anisotropic refractive index n and the complex and anisotropic permittivity or dielectric function ϵ . This can be discussed in relation to the meaning and origin of the ‘electron self energy’ $\Sigma(E)$. Less well-defined again are the multiple-electron excitations, the satellite or shake excitations, and the net consequence of these, including the impact on the ‘amplitude-reduction factor’ S_0^2 . For fluorescence measurements, but also as a correction for attenuation measurements, the fluorescence yield ω_i or f is critical, and the current status of this parameter is also discussed.

Additional to these are typical or example structures of any and all atoms, metals, molecules, lattices, surfaces *etc.* Indeed, several of the above parameters are an intrinsic part of the material structure, and can be structure-, molecule- and orientation-dependent. In this chapter, an attempt is made to give a brief summary of the key issues and typical values, and also initially a discussion of scales and units for the representation of key data and critical parameters. However, the main discussion of the theory behind these parameters, or of the typical software implementation, is given in the relevant chapters elsewhere.

This volume of *International Tables for Crystallography* also discusses other experimental modalities, including electron energy-loss spectroscopy (EELS; Joly *et al.*, 2024; Shirley *et al.*, 2024), X-ray emission spectroscopy (XES), X-ray magnetic circular dichroism (XMCD), nuclear resonant inelastic X-ray scattering (NRIXS) and resonant inelastic X-ray scattering (RIXS) (Glatzel *et al.*, 2024), where other parameters can be very important. We do not extend the discussion of critical parameters in the space available, but refer to other work on these subjects. A summary of the contents of this chapter follows.

Section 2 contains a discussion of amplitude options, μ , $[\mu/\rho]$, χ , $k^2\chi$ and $k^3\chi$, and the scale of absorption and XAFS, and Section 3 contains a discussion of the corresponding x -axis options, monochromator setting, E , k and r , and the determination of structure and its comparison with theory, both clarifying and defining terms in relation to tabulations and data formats. This both enables portability of the discussions in different chapters of this volume and in the wider literature and also engenders a discussion of data-output scales.

Section 4 contains a discussion of edge energies E_K , $E_{L\text{I}}$, $E_{L\text{II}}$, $E_{L\text{III}}$, $E_M \dots$ and E_0 , the energy offset for XAFS fitting or calibration, especially explaining the current status of different approaches in the literature and different approaches from a theoretical standpoint. This briefly addresses the calibration of the x axis in any format, and the variability of the terms used currently in the literature.

Section 5 contains a tabulation and a discussion of the Fermi energy E_F and of the significance of pre-edge structure and bound-bound transitions. This section discusses the first compilation of data for this article, primarily from a theoretical perspective. The table is particularly relevant as a key set of parameters for theoretical computations as in Section 10.

Section 6 contains a discussion, tabulation and plots of hole widths and excited-state lifetimes across the periodic table, new and reviewed, as required in theoretical predictions of edge widths, XANES and XAFS resolution. This addresses both the agreement and disagreement between theory and experiment and the information content of XAS. Section 7 contains a discussion, tabulation and plots of fluorescence (radiative) yields ω and Coster–Kronig probabilities f , particularly for fluorescence spectroscopy or XES, and more generally linked to Section 6.

Section 8 contains a tabulation of selected exemplar elemental crystal structures, particularly providing the values used for the theory and computation of inelastic mean free paths in Section 10. The selection is partly made on the basis of provenance and material stability permitting use as reference or calibration materials.

Section 9 contains a brief discussion of multiple scattering, shake processes and the amplitude-reduction factor S_0^2 and its current status.

Section 10 contains an extensive presentation of theory, discussion, equations, tabulation and plots of inelastic mean free paths of the (photo)electron and links to low electron energy diffraction (LEED), EELS and electron diffraction, with new tabulations and references. Section 11 contains a brief discussion of analysis and applications of IMFP and ELF data and Section 12 presents a brief outlook and conclusion.

2. Amplitude options: μ , $[\mu/\rho]$, χ , $k^2\chi$ and $k^3\chi$

Many older XAFS spectra present the linear attenuation coefficient μ (cm^{-1}) versus E (keV), and many published spectra present χ versus k , the effective photoelectron momentum (\AA^{-1}). In the interests of data portability and cross-platform analysis and intercomparison, we note that for any solid material there will be a well-defined thickness t (μm or cm) and thickness profile which can be measured, and there will be a well-defined mass M and cross-sectional area A , defining a mean $M/A = (\rho t)$ or integrated column density. This may be temperature-dependent but is to be contrasted with a usually poorly defined density ρ (g cm^{-3}), even for ideal samples and for flat plates with no voids, cracks *etc.* Hence, whilst the Beer–Lambert formula can be expressed as $I/I_0 = \exp(-\mu t)$, it is better and more readily characterizable as $I/I_0 = \exp[-(\mu/\rho)(\rho t)]$, where $[\mu/\rho]$ is the mass absorption coefficient, and this applies for transmission measurements and also for XAFS. It is common and important to separate the linear attenuation coefficient μ or μ_{tot} from the linear absorption coefficient μ or μ_{pe} and the mass attenuation coefficient $[\mu/\rho]_{\text{tot}}$ from the mass absorption coefficient $[\mu/\rho]$ or $[\mu/\rho]_{\text{pe}}$ in different literature: the Beer–Lambert formula only applies to the absorption coefficients. For solutions or frozen solutions,

the density may be fairly uniform and the thickness can be well defined by the cell depth, so once again $[\mu/\rho]$ is preferred as a more repeatable and transferable measure. Definitions of concentration, solvent and matrix are important. Conversely, for complex mixed-phase, heterogeneous grains or powders, ‘earth science’ samples or very dilute ‘biomedical nano-samples’ it is unlikely that a direct calibration can be made on either axis; we recommend the careful use of reference materials to enable the quantification of experimentally measured axes.

In principle, the raw data signals for upstream monitor and downstream detector or, for example, each of 100 fluorescence detector pixels, each with an energy spectrum, for sample and for blank and for dark currents *etc.* can be defined as a source set of spectra; however, for portability it is hoped that these sets of information are processed or preprocessed to yield, for example, $[\mu/\rho]$ as a function of the energy E .

Non-uniformity issues can be dealt with by normalization of the edge jump to unity, although this means that the resulting measurements will be relative. Theory can still compare above-edge with below-edge behaviour and experiment can compare this with standards, although note that this does differ if attenuation or photoabsorption coefficients are used.

As commented in many software and theoretical analyses in this volume, the primary information for structural fitting *etc.* is often $k^2\chi$ or $k^3\chi$, whether versus k or r (see below). This particularly makes fits and discrepancies easier to observe in a plot or publication. If a pointwise uncertainty is propagated from $[\mu/\rho]$ versus E , then the y -axis measure should be equivalent and should fit equivalently. That is, the value and the uncertainty should scale and the fit parameters and uncertainties should be unaffected by the choice of y axis. For deposition in this context, χ is to be preferred over scaled versions, and $[\mu/\rho]$ is to be preferred over this as avoiding certain processing approximations and systematics. Conversely, for plotting fits, residuals and discrepancies it is often very convenient to plot $k^2\chi$ or some similar scaled measure to highlight the weaker high- k oscillations.

3. x -axis options: monochromator setting, E , k and r

All raw data streams have a monochromator angle setting for the primary crystal, usually with a secondary monochromator crystal tuned, nontuned or detuned with respect to the primary crystal. The primary crystal usually has significant heat load and strain so, in principle, there will be an energy offset even if the Bragg angle and energy are carefully calibrated in the absence of heat load. Often there are other optics such as a harmonic rejection mirror at a synchrotron or, for example, a monochromator filter for X-ray units; see Sutter (2024), Hulbert (2024) and Arndt *et al.* (1999). On a number of beamlines an energy offset is added to the spectral nominal energy to match the determined edge energy for a metal reference foil to the relevant edge. This depends upon the bandwidth *etc.* and generally the correction will change with energy, and hence there may be a scale or correcting functional from the reference position across the range of

XAFS. Irrespective of these details, which should be recorded in as much detail as possible for cross-platform portability of XAFS spectra, the basic x axis presented is that of energy, typically in eV, and preferably with some defined uncertainty.

As explained across these Tables and elsewhere, the standard transform to an effective photoelectron wavevector magnitude k is given by $k = (2\pi/\lambda) = \{[2m_e(E - E_0)]/\hbar^2\}^{1/2}$, which only depends upon a unique definition of both E and E_0 , an offset representing the edge energy for XAFS data analysis or the onset of a propagating photoelectron wave inside the material. This does not make sense for the analysis or fingerprinting of pre-edge spectral regions, and is not usually performed for similar XANES analysis for the same reasons. There are very good reasons for transforming to the k axis for XAFS analysis, but there are challenges and systematics in a free fit of E_0 or in the application of a purely theoretical or empirical value; see Chantler (2024a) and Bunker (2024a). For data deposition, we currently strongly recommend that the deposited data be in $[\mu/\rho]$ versus E , so that any beamline-dependent variation of corrections can be addressed separately. Many analysis software packages transform from k -space (the scaled space of the experimental data) to Fourier r -space. In this transform, it is common that errors or uncertainties are not propagated or are aliased, and that information content is lost. Some analysis goes further and filters the r -space spectrum with a high-pass/low-pass filter and then back-transforms to k -space. For reference spectra we recommend depositing $[\mu/\rho]$ versus E , which is appropriate for any spectral range or analysis; additional transformed spectra can be deposited as might be useful.

4. Edge energies $E_K, E_{L1}, E_{LII}, E_{LIII}, E_M \dots$ and the energy offset E_0

Edge energies are problematic in that several distinct definitions are correctly presented, as summarized in Authier & Chapuis (2017) and in Section 11 below. The absorption threshold should indicate the first allowed transition in an absorption spectrum. Many definitions are used in common parlance. Practically, these yield very different numbers in common analysis. The most commonly used are the following.

(i) The energy at which the open continuum channel for photoelectric absorption becomes available, producing a continuum photoelectron (wave). Subject to convergence issues, this has an exact eigenvalue from theory (*cf.* Fermi energy). This more commonly refers to the crystal or material zero, whilst, for example, in a free atom the threshold is the vacuum level.

(ii) At a higher energy, a secondary (two-step) photoionization channel becomes energetically possible (n.b. shake-up, shake-off and multi-electron excitations). In general, this is more challenging to compute theoretically and less easily separable in conventional XAS, but can be investigated incisively in RIXS, XFS and related spectroscopies. In photoemission, zero kinetic energy begins at the vacuum level, whereas in XAFS any allowed transitions begin at the Fermi

level, below the edge energy. Such multi-electron processes lie at higher energies than definition (i); but also note that multi-electron processes (excitations) can also occur in bound-bound transitions.

(iii) Experimentally, the absorption threshold is very often defined as the inflection point in the first derivative of the experimental edge spectrum, *i.e.* the point of maximum slope on the rising edge for a particular subshell; this is a convenient marker for experimentalists but (1) it is source- (beamline-), monochromation- and bandwidth-dependent, (2) it is affected by pre-edge structure and the Fermi level due to potential contributions from bound-bound channels and (3) the experimental edge may, and often does, contain two or more such inflection points, and the determination of even which peak is defined as the edge, or which effective energy is used, depends upon the instrumental resolution.

(iv) Experimentally, the absorption threshold is sometimes defined as the point exactly 50% of the jump ratio from the background absorption (from other shells, including scattering) to the peak absorption coefficient of the XANES spectrum, defined either by the clear maximum or by the smooth line representing the background to be subtracted in the determination of $\chi(k)$ (q.v. EXAFS); this is a problematic measure, since it depends upon beamline-dependent effects [as in (iii)] and a wide variety of different predictions of the ‘true background level’ μ_0 above the edge (q.v. EXAFS).

(v) Computationally, an ‘absorption threshold’ is defined for XAFS fitting (and occasionally XANES fitting) as E_0 , which is considered either as an arbitrary fitting coefficient or the starting point of the k transform, which in turn generates the Fourier transform for the XAFS structure $\chi(k)$; as the latter, it should be defined as per (i) above; as the former, this will often yield a function of r and errors in E_0 of the order of 10 eV or more, which can result in bond-length errors of the order of 0.02 Å or more.

Both computationally and experimentally, the energy axis is often not defined except in a relative sense, so that inconsistencies between the implementations of these definitions are at this point relatively common. As a general guide, the Fermi level energy is less than the first available bound-bound transition (which will have the first inflection point), which is often below the marker for the first inflection point (usually on the main edge region and often a bound-bound transition) [definition (iii)], which is often below the continuum ‘edge’ energy [definition (i)], which is lower or higher than the 50% marker [definition (iv)], which is lower than the several two-step channels [definition (ii)]. As it depends upon many experimental details and systematic effects of pre-analysis, definition (v) can vary quite significantly from all of the other definitions.

For this chapter, we will refer to an ideal theoretical absorption threshold given by definition (i) as E_{K_0} , $E_{L_{I_0}}$, $E_{L_{II_0}}$, $E_{L_{III_0}}$, $E_{M_{i,i=1-V_0}}$, an experimentally characterized edge energy E_K , E_{L_I} , $E_{L_{II}}$, $E_{L_{III}}$, $E_{M_{i,i=1-V}}$ *et seq.* given by definition (iii), and an energy offset E_0 usually empirically determined for an individual XAFS transform from E to k , usually referencing definition (v) (for XAFS analysis).

The best current definition with uncertainties for the experimentally characterized edge energies, and especially E_K , E_{L_I} , $E_{L_{II}}$ and $E_{L_{III}}$, is given by Chantler *et al.* (2024). This is directly applicable for metals and elemental solids, especially noting the chemical shifts of the edge due to binding, geometry and pre-edge features. Further, the number of well-calibrated lines is sparse [see Table 4 in Chantler *et al.* (2024) for K -edge energies] and indeed is dominated by a single publication from 1996 (Kraft *et al.*, 1996). Much more research and measurement on this is needed for most of the periodic table and for many applications.

It is common to cite Arndt *et al.* (1999) and a sequel publication Deslattes *et al.* (2003) or the corresponding NIST database. A useful summary is given in Bunker (2010). There are two problems: in the experimental tabulation, the measured values are equally sparse. In Table 4.2.2.4 in Arndt *et al.* (1999), wavelengths are given with conversion factors. Whilst there are two numbers for each absorption-edge energy from $Z = 10$ through $Z = 92$, most edge energies have poor provenance or accuracy or are a rough approximation to E_{K_0} rather than E_K . Similarly, for Table 4.2.2.5 therein the entries for L -edge energies are almost entirely rough approximations to $E_{L_{I_0}}$, $E_{L_{II_0}}$ and $E_{L_{III_0}}$ rather than E_{L_I} , $E_{L_{II}}$ and $E_{L_{III}}$, with the possible stated exceptions of $Z = 72, 78, 79$ and 82 .

For the sequel publication Deslattes *et al.* (2003) or the corresponding NIST database, Table IV therein illustrates the potential systematic errors of ± 0 –16 eV or even -100 to $+254$ eV between theory, vapour and a set of solid samples. Table V therein provides energies E_{K_0} , $E_{L_{I_0}}$, $E_{L_{II_0}}$, $E_{L_{III_0}}$ and E_K , E_{L_I} , $E_{L_{II}}$, $E_{L_{III}}$ up to $Z = 100$. The error between these is usually a limitation of the theory, yet the experimental edge energies are not calculated for a known experimental resolution nor follow the precise definitions above. This is a valuable work and is worthy of use in the absence of a new tabulation or more detailed analysis of the absorption-edge profiles. For X-ray fluorescence microscopy (XFM) there is a need for additional energies for M -shell edges and characteristic spectra. Hence, we can cite any generic tabulation, such as, for example, the very popular and well used *X-ray Data Booklet* (Williams, 2001) with sources Bearden & Burr (1967), Cardona & Ley (1978) and Fuggle & Martensson (1980).

Regarding an (the?) empirical offset energy E_0 in definition (v) that is almost always fitted in XAFS analysis, it is challenging to have a reliable estimation for a given edge and material but, in principle, it should lie within the uncertainty of the calibrated experimental edge energy, with some allowance for chemical shifts, the adjustment of the Fermi level and ergo pre-edge bound-bound transitions. Equally, given a known edge hole width (see below), the ‘edge energy’ E_0 should lie (well) within a half-width (see below) of the reference edge energy, depending a little upon bound-bound structural features and the instrumental resolution.

A related set of energies correspond to the fluorescence or characteristic X-ray energies ($K\alpha_1$, $K\alpha_2$, $K\beta$. . .), whether for the identification of fluorescence yields or windowing as a region of interest (ROI) for a pixel-based or other detector in fluorescence. Some of the fluorescence energies and spectra

Table 1

Table of the values for Fermi energies, as defined in definition (iii) in Section 5, needed for theoretical computations of electron scattering parameters in this chapter.

These energies, in combination with the associated chemical potentials, are also determinative for bound-bound transitions and observable pre-edge structure, and for structure at the edge and equation (1).

Z	Element	Form	E_F (eV)	E_F source
3	Li	Crystal	4.74	Shinotsuka <i>et al.</i> (2015)
4	Be	Crystal	14.3	Shinotsuka <i>et al.</i> (2015)
6	C	Graphite/diamond	20.4	Tanuma <i>et al.</i> (2011)
11	Na	Crystal	3.24	Shinotsuka <i>et al.</i> (2015)
12	Mg	Crystal	7.1	Shinotsuka <i>et al.</i> (2015)
13	Al	Crystal	11.2	Shinotsuka <i>et al.</i> (2015)
14	Si	Crystal	12.5	Shinotsuka <i>et al.</i> (2015)
19	K	Crystal	2.12	Shinotsuka <i>et al.</i> (2015)
20	Ca	Crystal	4.69	Rumble (2018)
21	Sc	Crystal	5.8	Shinotsuka <i>et al.</i> (2015)
22	Ti	Crystal	6.0	Shinotsuka <i>et al.</i> (2015)
23	V	Crystal	6.4	Shinotsuka <i>et al.</i> (2015)
24	Cr	Crystal	7.8	Shinotsuka <i>et al.</i> (2015)
26	Fe	Crystal	8.9	Shinotsuka <i>et al.</i> (2015)
27	Co	Crystal	10.0	Shinotsuka <i>et al.</i> (2015)
28	Ni	Crystal	9.1	Shinotsuka <i>et al.</i> (2015)
29	Cu	Crystal	8.7	Shinotsuka <i>et al.</i> (2015)
30	Zn	Crystal	9.47	Rumble (2018)
31	Ga	Crystal	10.4	Rumble (2018)
32	Ge	Crystal	12.6	Tanuma <i>et al.</i> (2011)
38	Sr	Crystal	3.93	Rumble (2018)
39	Y	Crystal	4.4	Shinotsuka <i>et al.</i> (2015)
41	Nb	Crystal	5.3	Shinotsuka <i>et al.</i> (2015)
42	Mo	Crystal	6.5	Shinotsuka <i>et al.</i> (2015)
44	Ru	Crystal	6.9	Shinotsuka <i>et al.</i> (2015)
45	Rh	Crystal	6.9	Shinotsuka <i>et al.</i> (2015)
46	Pd	Crystal	6.2	Shinotsuka <i>et al.</i> (2015)
47	Ag	Crystal	7.2	Shinotsuka <i>et al.</i> (2015)
48	Cd	Crystal	7.47	Rumble (2018)
49	In	Crystal	4.82	Tanuma <i>et al.</i> (2011)
50	Sn	Crystal	5.51	Shinotsuka <i>et al.</i> (2015)
55	Cs	Crystal	1.73	Shinotsuka <i>et al.</i> (2015)
56	Ba	Crystal	3.84	Rumble (2018)
64	Gd	Crystal	3.5	Shinotsuka <i>et al.</i> (2015)
65	Tb	Crystal	4.0	Shinotsuka <i>et al.</i> (2015)
66	Dy	Crystal	3.5	Shinotsuka <i>et al.</i> (2015)
72	Hf	Crystal	7.9	Shinotsuka <i>et al.</i> (2015)
73	Ta	Crystal	8.4	Shinotsuka <i>et al.</i> (2015)
74	W	Crystal	10.1	Shinotsuka <i>et al.</i> (2015)
75	Re	Crystal	10.7	Shinotsuka <i>et al.</i> (2015)
76	Os	Crystal	11.4	Shinotsuka <i>et al.</i> (2015)
77	Ir	Crystal	11.2	Shinotsuka <i>et al.</i> (2015)
78	Pt	Crystal	10.6	Shinotsuka <i>et al.</i> (2015)
79	Au	Crystal	9.0	Shinotsuka <i>et al.</i> (2015)
81	Tl	Crystal	8.15	Rumble (2018)
82	Pb	Crystal	9.47	Rumble (2018)
83	Bi	Crystal	12.6	Tanuma <i>et al.</i> (2011)

are very well-defined for atomic or metallic systems, but of course can vary significantly according to bonding, molecular and local structure *etc.* One of the best current references on these is Chantler *et al.* (2024). Note that the energies must include satellite and shake processes to represent the spectra. See also Yamamoto (2024), Chantler (2024*b*) and Bunker (2024*a*).

5. Fermi energy E_F

This is closely linked to the previous section. The Fermi level is also known as the Fermi energy. A first definition concentrates on a general formal definition, while a second one focuses on

theoretical convergence for use by XAS users and programs. A third definition is given that is conceptually equivalent but is numerically geared towards applications in electron scattering that are needed for XANES and XAFS parameters.

(i) In an independent-particle approach to the description of a fermionic system (*i.e.* particles obeying Pauli's exclusion principle), the Fermi level is the energy value lying between the highest occupied level and the lowest unoccupied level, usually defined as their average. If the energy level spectrum is in the continuum (or almost continuum) the three levels coincide. In a many-body approach the Fermi level coincides with the chemical potential, which is the energy necessary to add or subtract a particle from the system. This definition encompasses the non-interacting case. Like all energy states, the Fermi level is measured from the vacuum level. In a molecular system or band-structure analysis we label the highest occupied molecular orbital (HOMO) and the lowest unoccupied molecular orbital (LUMO) (Natoli *et al.*, 2024; de Groot, 2024; Fujikawa, 2024; Yamamoto, 2024). In XAS spectra the Fermi level is below or at the first allowed transition, depending on the system and the absorption edge.

(ii) In XAS, the Fermi energy dictates possible pre-edge features and explains the possibility or impossibility of open scattering channels adding to the near-edge structure. When theoretical formalisms compute the reference Fermi energy, which is crucial for the XANES region, the convergence of the complete quantum-mechanical system is an absolute requirement, whether atomic, cluster or periodic boundary conditions are used. The lack of convergence for theoretical formalisms can at this time lead to systematic errors in the determination of the Fermi energy and corresponding pre-edge structure of the order of 1–10 eV in the X-ray regime and should be considered carefully.

In other words, the Fermi level is the level below the ionization (edge energy) where the energy levels become unoccupied and hence available for discrete bound-bound transitions; that is, where the pre-edge structure appears. This assumes that the values of E_K , $E_{L\text{I}}$, $E_{L\text{II}}$ and $E_{L\text{III}}$ are well-defined and accurate.

The experimental definition of the edge can already include some of the pre-edge bound-bound transitions, and hence can be lower than the corresponding true ionization edge energy. It is also affected by changes in the Fermi level due to bonding and charge transfer. The parameter remains critical for theoretical predictions of the pre-edge and XANES structure and also affects the definition of E_0 and k for XAFS analysis (Yamamoto, 2024; Chantler, 2024*b*; Bunker, 2024*b*).

(iii) While the physical concept of the Fermi level is well-defined and consistently understood in accordance with the above description, its numerical value can alternatively be defined with respect to the bottom of the highest occupied band in a condensed-matter environment. This definition is pervasive in works focused on electron scattering parameters and is particularly useful in the determination of electron inelastic mean free paths (IMFPs) for XAFS because it provides an upper bound on the permitted energy loss of scattered photoelectrons. Accordingly, we quote explicit

Fermi levels in this chapter according to this definition because of their direct utility in Section 10. The Fermi levels used in this chapter follow this third definition and derive from Shinotsuka *et al.* (2015), Rumble (2018) and Tanuma *et al.* (2011) as in Table 1.

Some models and theoretical predictions require the use or determination of the plasmon energy E_p and the gap energy E_g for semiconductors and insulators. In the case of the theory presented later in this chapter, however, the plasmon energy is not required or considered. The gap energy is incorporated in the treatment of Section 10 via the definition of the complex dielectric function of the material and thus is not required as a separate explicit parameter. These Fermi levels may also be compared with (contrasted with) ionization energies, as for example represented in Table 10.3 in Martin & Wiese (1996).

6. Hole widths and excited-state lifetimes

The ionization hole width Γ_H and inner-shell hole excited-state lifetime $\tau_H = \hbar/\Gamma_H$ are another pair of critical parameters that both limit the information content of the near-edge spectrum and also reveal key physics.

The basic equations are as follows: a level width in eV (or rate) $\Gamma_i = \Gamma_{R,i} + \Gamma_{A,i} + \Gamma_{CK,i}$, which is the sum of the widths (or rates) from fluorescence (radiative) processes, Auger (nonradiative) processes and Coster–Kronig (nonradiative) processes as and when they are allowed channels, with $i = K, L_I, L_{II}, L_{III}, M_{I-V}, N_{I-VII}$ *et seq.* Similarly, the diagram X-ray line width can be estimated as the sum of the widths of levels involved in the transitions $\Gamma(K\alpha_1) = \Gamma_K + \Gamma_{L_{III}}$, $\Gamma(K\alpha_2) = \Gamma_K + \Gamma_{L_{III}}$ *et seq.* and an Auger line width can be estimated as $\Gamma(KL_kL_l) = \Gamma_K + \Gamma_{L_kL_l} \simeq \Gamma_K + \Gamma_{L_k} + \Gamma_{L_l}$, with the latter approximation implying invariance of the decay width regardless of the number of holes present.

A key issue relates to the energy offsets for satellite and shake processes which broaden standard XAS beyond an intrinsic or lifetime width, and similarly for most modalities of detection, but which can be separated in, for example, the RIXS plane. Hence, it is important to know what the experimental data or theory are measuring or assuming. Krause & Oliver (1979) provide K and L subshell widths, extrapolated up to atomic number $Z = 110$. The K -shell widths (Fig. 1) with claimed uncertainties of 10% for $Z = 10$ –20 and 3–5% for $Z = 20$ –110, are largely consistent with the later work of Campbell & Papp (2001), with claimed uncertainties of 5–25% for $Z = 10$ –30 and 5–10% for $Z = 30$ –92, and with earlier compilations compiled from Bambynek *et al.* (1972), McGuire (1969, 1970), Scofield (1969) and Kostroun *et al.* (1971), with an estimated uncertainty of 10% for $Z = 10$ –100. Nonetheless, discrepancies of 10% are seen between Campbell & Papp (2001) and the earlier compilation by magnitudes and of up to 14% between Campbell & Papp (2001) and Krause & Oliver (1979). In Tables 2 and 3 we present total level widths following Campbell & Papp (2001) to $Z = 92$.

The L_{III} subshell widths have no available Coster–Kronig processes, so are relatively stable in the tabulations (Fig. 2), with stated uncertainties of 25–20% for $Z = 10$ –40 and 15–8%

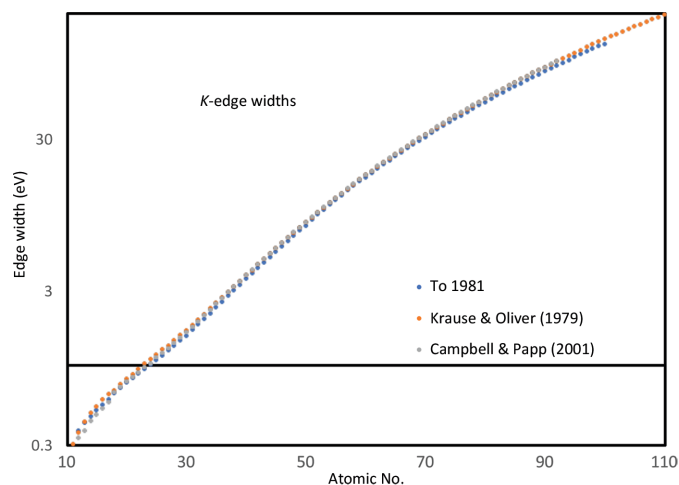


Figure 1
 K -shell widths versus atomic number are generally consistent within uncertainties above $Z = 10$ (Krause & Oliver, 1979; Campbell & Papp, 2001; Bambynek *et al.*, 1972; McGuire, 1969, 1970; Scofield, 1969; Kostroun *et al.*, 1971).

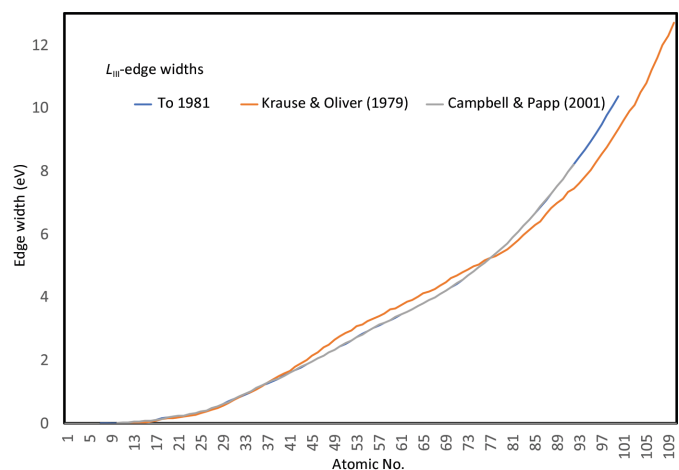


Figure 2
 L_{III} subshell widths versus atomic number are consistent within uncertainties up to $Z = 40$ but diverge strongly for higher Z (Krause & Oliver, 1979; Campbell & Papp, 2001; Bambynek *et al.*, 1972; McGuire, 1970; Scofield, 1969; Kostroun *et al.*, 1971).

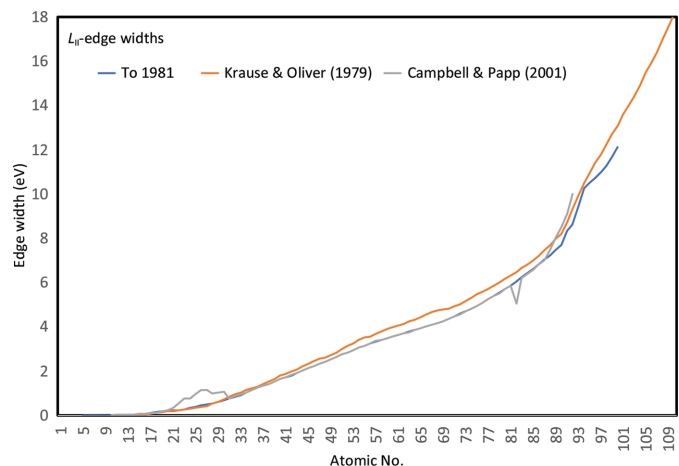


Figure 3
Reported L_{II} subshell widths show strong structural anomalies across Z .

Table 2
Table of edge hole widths in eV following Campbell & Papp (2001).

Z	K shell	L _I total	L _{II} total	L _{III} total	M _I shell	M _{II}	M _{III}	M _{IV}	M _V
3	0.03								
6	0.08								
7	0.13								
8	0.14								
9									
10	0.24		0.01	0.01					
11	0.28	0.28	0.02	0.02					
12	0.33	0.46	0.03	0.03					
13	0.37	0.78	0.04	0.04					
14	0.43	0.90	0.05	0.05					
15	0.47	1.10	0.07	0.07					
16	0.52	1.30	0.09	0.09					
17	0.57	1.50	0.11	0.11					
18	0.66	1.80	0.13	0.13	0.14				
19	0.71	2.10	0.18	0.18	0.70				
20	0.77	2.50	0.21	0.21	1.10	1.20	1.20		
21	0.83	3.30	0.36	0.23	1.70	1.20	1.20		
22	0.89	3.90	0.52	0.25	2.10	1.20	1.20		
23	0.96	4.60	0.78	0.28	2.20	1.20	1.20		
24	1.02	5.20	0.76	0.32	2.30	1.20	1.20		
25	1.11	6.20	0.97	0.36	2.40	1.20	1.20		
26	1.19	7.00	1.14	0.41	2.40	1.23	1.23		
27	1.28	7.20	1.13	0.47	2.40	1.25	1.27		
28	1.39	6.40	0.98	0.53	2.30	1.30	1.30		
29	1.49	5.50	1.04	0.61	2.20	1.90	1.80		
30	1.62	4.80	1.06	0.68	2.10	2.10	2.15		
31	1.76	4.10	0.77	0.77	2.00	2.25	2.30	0.01	
32	1.92	3.80	0.86	0.86	2.10	2.30	2.30	0.05	0.04
33	2.09	3.80	0.95	0.94	2.40	2.25	2.25	0.06	0.06
34	2.28	3.80	1.05	1.02	2.80	2.20	2.20	0.07	0.07
35	2.49	3.80	1.14	1.11	3.20	2.10	2.15	0.07	0.07
36	2.71	3.75	1.25	1.19	3.50	1.60	1.10	0.07	0.07
37	2.96	3.75	1.34	1.27	4.00	1.90	1.95	0.07	0.07
38	3.23	3.75	1.43	1.35	4.40	1.90	1.90	0.06	0.06
39	3.51	3.75	1.53	1.43	4.90	1.95	1.95	0.06	0.07
40	3.83	3.75	1.63	1.51	5.40	2.00	2.00	0.07	0.07
41	4.16	3.80	1.73	1.60	5.80	2.05	2.05	0.09	0.10
42	4.52	3.80	1.83	1.69	6.30	2.10	2.10	0.22	0.12
43	4.91	3.80	1.93	1.78	6.70	2.15	2.15	0.50	0.14
44	5.33	3.90	2.03	1.87	7.20	2.20	2.20	0.59	0.17
45	5.77	4.00	2.13	1.96	7.60	2.25	2.25	0.61	0.21
46	6.25	3.90	2.23	2.05	8.00	2.35	2.35	0.26	0.26
47	6.76	3.80	2.32	2.15	8.40	2.45	2.55	0.30	0.31
48	7.32	3.50	2.42	2.24	8.80	2.55	2.80	0.34	0.35
49	7.90	3.00	2.53	2.34	9.20	2.70	3.05	0.38	0.39
50	8.53	2.40	2.64	2.43	9.60	2.85	3.30	0.43	0.44
51	9.20	2.30	2.74	2.53	10.00	3.00	3.60	0.47	0.48
52	9.91	2.20	2.84	2.62	10.20	3.20	3.90	0.52	0.52
53	10.70	2.10	2.95	2.72	10.40	3.35	4.30	0.56	0.56
54	11.50	2.00	3.05	2.82	10.60	3.50	4.70	0.60	0.60
55	12.30	2.00	3.15	2.92	10.80	3.70	5.00	0.63	0.63
56	13.20	2.10	3.25	3.02	11.10	3.90	5.40	0.67	0.67
57	14.20	2.20	3.35	3.12	11.40	4.10	5.80	0.70	0.70
58	15.20	2.50	3.41	3.19	11.60	4.30	6.20	0.72	0.72
59	16.20	2.70	3.48	3.27	11.80	4.50	6.70	0.75	0.75
60	17.40	2.90	3.55	3.36	12.00	4.70	7.30	0.78	0.78
61	18.50	3.10	3.63	3.44	12.20	5.00	7.80	0.82	0.82
62	19.80	3.30	3.70	3.53	12.40	5.20	8.20	0.86	0.86
63	21.10	3.60	3.77	3.62	12.60	5.40	8.20	0.90	0.90
64	22.40	3.80	3.87	3.72	12.80	5.60	8.30	0.95	0.95
65	23.80	4.00	3.93	3.80	13.00	5.80	8.20	1.01	1.01
66	25.30	4.30	4.01	3.90	13.20	6.00	8.00	1.07	1.07
67	26.90	4.50	4.09	4.00	13.40	6.30	7.80	1.13	1.13
68	28.50	4.70	4.18	4.10	13.60	6.60	7.50	1.20	1.20
69	30.20	4.90	4.26	4.20	13.80	6.85	7.10	1.27	1.27
70	32.00	5.20	4.36	4.31	13.90	7.10	6.70	1.35	1.35
71	33.90	5.40	4.46	4.43	14.10	7.30	6.00	1.43	1.43
72	35.90	5.70	4.57	4.55	14.20	7.50	5.60	1.52	1.52
73	37.90	6.00	4.69	4.68	14.30	7.80	5.70	1.61	1.61
74	40.10	6.30	4.82	4.81	14.50	8.10	6.40	1.70	1.70
75	42.20	6.70	4.95	4.95	14.60	8.40	6.90	1.79	1.79

Table 2 (continued)

Z	K shell	L _I total	L _{II} total	L _{III} total	M _I shell	M _{II}	M _{III}	M _{IV}	M _V
76	44.60	7.20	5.09	5.09	14.70	8.60	7.50	1.89	1.89
77	47.00	7.90	5.23	5.24	14.80	8.90	8.00	1.99	1.99
78	49.50	8.80	5.38	5.39	14.90	9.20	8.30	2.08	2.08
79	52.10	9.80	5.53	5.54	15.00	9.50	8.50	2.18	2.18
80	54.80	10.50	5.69	5.71	15.10	9.80	8.60	2.28	2.28
81	57.60	11.10	5.87	5.89	15.10	10.10	8.70	2.38	2.38
82	60.60	11.80	5.04	6.07	15.20	10.40	8.70	2.48	2.48
83	63.60	12.30	6.22	6.27	15.20	10.70	8.60	2.58	2.58
84	66.80	12.70	6.41	6.46	15.30	11.10	8.50	2.68	2.68
85	70.00	13.00	6.60	6.66	15.30	11.40	8.40	2.78	2.78
86	73.40	13.20	6.81	6.87	15.30	11.70	8.30	2.88	2.88
87	76.90	13.50	7.02	7.08	15.40	12.10	8.20	2.98	2.98
88	80.60	13.70	7.50	7.29	15.40	12.50	8.20	3.08	3.08
89	84.40	14.00	8.00	7.51	15.40	12.90	8.00	3.18	3.18
90	88.20	14.30	8.50	7.74	15.50	13.20	8.00	3.28	3.28
91	92.10	14.70	9.10	7.97	15.50	13.60	7.90	3.39	3.39
92	96.30	16.00	10.00	8.20	15.50	14.10	7.90	3.50	3.50

for $Z = 41-110$ (Krause & Oliver, 1979), 30% for $Z < 20$ and 30–10% for $Z = 20-40$ and 5–10% for $Z = 40-92$ (Campbell & Papp, 2001), and estimated uncertainties of 10% from the earlier compilation (McGuire, 1971; Chen *et al.*, 1981). They seem consistent within uncertainty across $18 < Z < 40$, with large discrepancies above 50% below $Z = 18$ and systematic discrepancies of around 10–11% towards higher Z . The L_{II} subshell widths are more structured (Fig. 3), with stated uncertainties of 25–20% for $Z = 10-50$ and 15–10% for $Z = 51-110$ (Krause & Oliver, 1979), 30% for $Z < 20$ and 30–10% for $Z = 20-40$ and 5–10% for $Z = 40-92$ (Campbell & Papp, 2001), and estimated uncertainties of 10% or more from the earlier compilation (McGuire, 1971; Chen *et al.*, 1981). They display discrepancies above 50% below $Z = 19$ and systematic discrepancies of up to 70% up to $Z = 31$ and a variation of 20% across higher Z .

The L subshell total widths show significant structures revealing discrepancies of a factor of two or even an order of magnitude, possibly due to the inclusion or exclusion of key processes. This is exemplified in the L_I subshell widths (Fig. 4), with stated uncertainties of 30–25% for $Z = 10-50$ and 20–15%

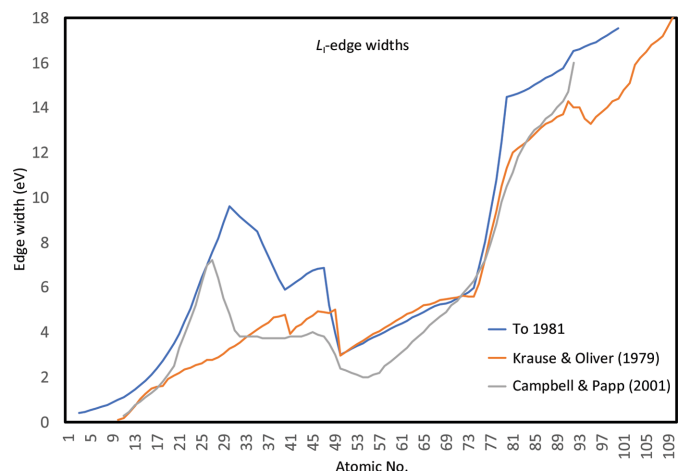


Figure 4
 L_I subshell widths show large anomalies with Z . There are irregularities when a new decay channel is turned on. Coster–Kronig and super Coster–Kronig transitions, in the rare earths, for example, can wipe out the single-particle core state entirely, as has been observed in XPS.

for $Z = 51\text{--}110$ (Krause & Oliver, 1979), 10% for $10 < Z < 30$ and 25–10% for $Z = 30\text{--}56$ and 1.5–2 eV for $Z = 57\text{--}92$ (Campbell & Papp, 2001), and estimated uncertainties of 10% or more from the earlier compilation (McGuire, 1971; Chen *et al.*, 1981). They regularly display discrepancies above 60% in a structured manner, which are certainly linked to the complexity of Coster–Kronig amplitudes.

Comparisons are more limited for the other subshell widths, which remain important for fluorescence spectroscopy, XES and RIXS. In Table 2 we present total level widths following Campbell & Papp (2001) to $Z = 92$, which we also present versus atomic number in Fig. 5. In summary, the uncertainty in the outer shells is generally much greater than in the inner shells. As a guiding rule, for a given energy the K -shell width is narrower than the given L_{II} - and L_{III} -edge widths, which in turn are narrower than the given L_{I} -edge widths for similar energies. Conversely, for investigating local structure around a particular element in a molecule or system the L_{II} - and L_{III} -edge widths are narrower than the K -shell width for $Z < 47$, which in turn is narrower than the L_{I} -edge widths, whilst for $Z > 47$ the L_{II} - and L_{III} -edge widths are narrower than the L_{I} -shell width, which in turn is narrower than the K -edge widths, so that there may be more information content in L -edge spectra.

7. Fluorescence (radiative) yields ω and Coster–Kronig probabilities f

For fluorescence detection of XAFS and many related phenomena, the probability or rate of fluorescence energy is critical to the signal strength, the estimation of saturation and dead-time corrections, and the contributions of absorption and self-absorption. It is, for example, given by $f\sigma(I)$ or the fluorescence yield multiplied by the probability of ionization. The symbol f is used generically for the fluorescence yield in this context in many publications. For greater clarity (as presented here and in XRF theory and experiments) the

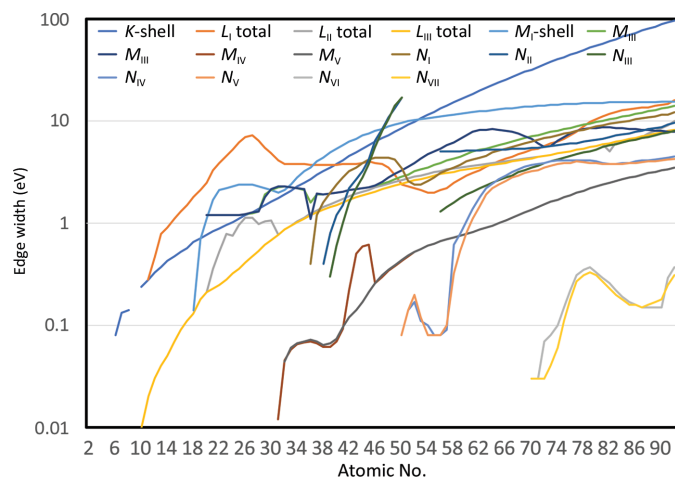


Figure 5
Subshell widths versus atomic number $Z \rightarrow 92$ following Campbell & Papp (2001).

Table 3
Table of edge hole widths in eV following Campbell & Papp (2001).

Z	N_{I}	N_{II}	N_{III}	N_{IV}	N_{V}	N_{VI}	N_{VII}
36	0.40						
37	1.20						
38	1.60	0.40					
39	2.00	0.80	0.30				
40	2.40	1.20	0.60				
41	2.80	1.50	1.00				
42	3.20	2.20	1.60				
43	3.50	2.70	2.20				
44	3.90	3.20	2.80				
45	4.20	4.20	3.80				
46	4.35	6.40	5.60				
47	4.40	8.40	8.00				
48	4.40	10.80	10.50				
49	4.20	13.20	14.00				
50	3.40	17.00	17.00	0.08	0.08		
51	2.60			0.14	0.14		
52	2.40			0.17	0.20		
53	2.40			0.11	0.12		
54	2.60			0.10	0.08		
55	2.80			0.08	0.08		
56	3.10	5.00	1.30	0.08	0.08		
57	3.30	5.03	1.45	0.09	0.10		
58	3.50	5.06	1.60	0.61	0.32		
59	3.70	5.08	1.75	0.78	0.53		
60	4.00	5.10	1.90	1.05	0.80		
61	4.20	5.13	2.05	1.38	1.11		
62	4.40	5.16	2.20	1.78	1.48		
63	4.60	5.20	2.35	2.20	1.90		
64	4.90	5.23	2.50	2.45	2.20		
65	5.10	5.26	2.65	2.70	2.40		
66	5.40	5.30	2.80	2.95	2.60		
67	5.60	5.33	2.95	3.15	2.80		
68	5.80	5.36	3.15	3.35	2.95		
69	6.10	5.40	3.30	3.55	3.10		
70	6.30	5.50	3.50	3.70	3.20	0.03	0.03
71	6.60	5.50	3.65	3.80	3.30	0.03	0.03
72	6.80	5.60	3.85	3.90	3.50	0.07	0.03
73	7.00	5.70	4.00	4.00	3.65	0.08	0.04
74	7.30	5.80	4.20	4.10	3.80	0.10	0.06
75	7.50	5.90	4.40	4.10	3.90	0.15	0.11
76	7.70	6.00	4.60	4.10	3.90	0.22	0.18
77	8.00	6.10	4.75	4.10	4.00	0.31	0.27
78	8.25	6.25	4.90	4.10	3.95	0.35	0.31
79	8.50	6.40	5.05	4.10	3.90	0.37	0.33
80	8.80	6.55	5.30	4.00	3.85	0.33	0.31
81	9.10	6.70	5.60	3.90	3.80	0.29	0.27
82	9.35	6.90	5.80	3.80	3.80	0.26	0.23
83	9.60	7.20	5.95	3.80	3.80	0.22	0.20
84	9.90	7.35	6.20	3.90	3.80	0.19	0.18
85	10.10	7.60	6.40	3.90	3.85	0.17	0.16
86	10.40	7.80	6.60	4.00	3.90	0.16	0.16
87	10.70	8.10	6.80	4.10	3.95	0.15	0.15
88	10.95	8.30	7.00	4.15	4.00	0.15	0.16
89	11.20	8.50	7.25	4.20	4.05	0.15	0.17
90	11.50	8.75	7.50	4.30	4.10	0.15	0.18
91	11.60	9.20	7.75	4.40	4.20	0.29	0.25
92	12.20	9.60	8.00	4.50	4.25	0.37	0.31

fluorescence yields can be given as $\omega_i = \Gamma_{\text{R},i}/\Gamma_i$, where $\Gamma_{\text{R},i}$ is the radiative width, for the $i = K$ -shell fluorescence yield, the L_{I} -subshell fluorescence yield, the L_{II} -subshell fluorescence yield *et seq.*

The symbol f is then reserved for Coster–Kronig probabilities for transfer between subshells, as in f_{12} for a Coster–Kronig transfer from the L_{I} to the L_{II} subshell. Similarly, the Auger probability for nonradiative transfer from a higher shell is given by a_i . The sum of all probabilities of filling a subshell is then $\omega_i + a_i + \sum_{j=i+1}^k f_{ij} = 1$. Hence, $a_i = 1 - \omega_i - \sum_{j=i+1}^k f_{ij}$,

$a_K = 1 - \omega_K$, $a_{L_{III}} = 1 - \omega_{L_{III}}$, $a_{L_{II}} = 1 - \omega_{L_{II}} - f_{23}$, $a_{L_I} = 1 - \omega_{L_I} - f_{12} - f_{13}$. The total number of radiative photons per vacancy in the L_I subshell is then $\nu_{L_I} = \omega_{L_I} + f_{12}\omega_{L_{II}} + (f_{13} + f_{12}f_{23})\omega_{L_{III}}$; $\nu_{L_{II}} = \omega_{L_{II}} + f_{23}\omega_{L_{III}}$; $\nu_{L_{III}} = \omega_{L_{III}}$ *et seq.*

If component widths are provided then the yields can be trivially determined, but to determine the component widths from the yields one requires a total width or one of the partial widths. Whilst the yields are primarily used to quantify the dominance and the contributions of the different relaxation processes, the widths indicate the broadening of the edge and XANES features, and XES or fluorescence intrinsic width *etc.* Thus, both are important for different purposes.

Some compilations report discrete subshell fluorescence yields for the K shell and L subshells following Krause (1979), as in Figs. 6 and 7 (Bunker, 2010). Other compilations (Bambynek *et al.*, 1972; Bambynek, 1984; Hubbell *et al.*, 1994) present higher shell yields as an effective average (Fig. 8) and provide consistent K -shell yields within 20% above $Z = 15$ and within 10% above $Z = 20$. Even now, the L , M and N subshell

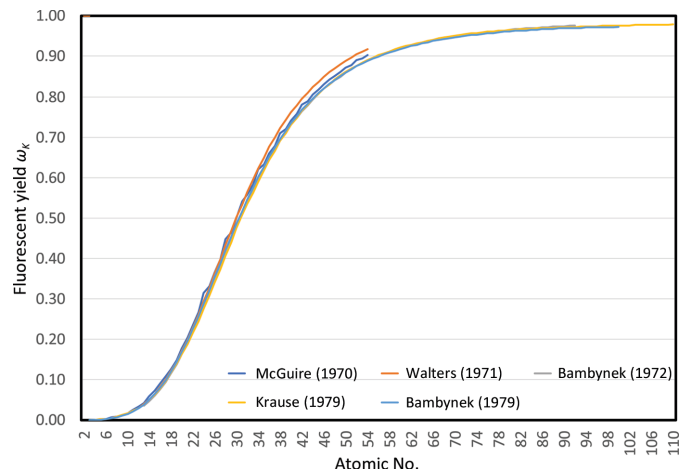


Figure 6
K-shell fluorescence (radiative) yields versus atomic number diverge by large factors at low Z but are in close agreement for higher Z (McGuire, 1969, 1970; Walters & Bhalla, 1971*b*; Bambynek *et al.*, 1972; Krause, 1979; Bambynek, 1984; Hubbell *et al.*, 1994).

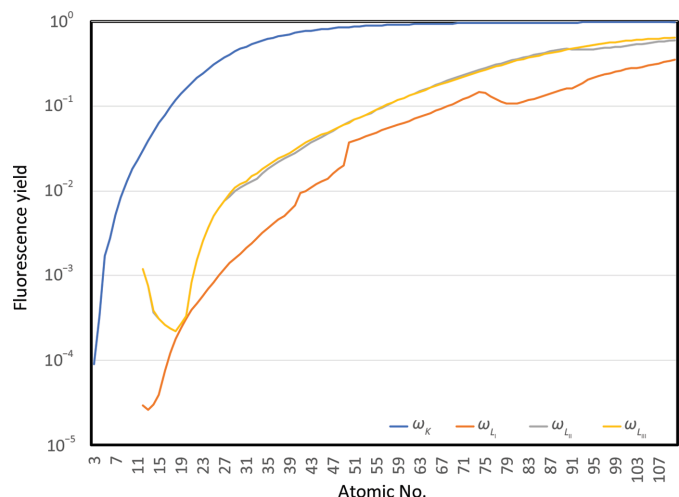


Figure 7
 Fluorescence (radiative) yields versus atomic number for the K shell and L subshells show significant complexity for the subshells (Krause, 1979).

yields remain an open question and an area of significant uncertainty and investigation. The previous section tabulated and surveyed total level widths; this section particularly presents fluorescence yields and provides a review of Coster–Kronig processes for completeness (Fig. 9).

We also derive a plot of the Auger probabilities for completeness (Fig. 10). Uncertainties in the Coster–Kronig and Auger probabilities are quite variable. For the purposes of fluorescence XAS detection, we tabulate K and L shells in Table 4; other valuable sources for L -subshell fluorescence yields include McGuire (1971) and Walters & Bhalla (1971*a,c*). $f_1 = f_{12} + f_{13}$ denotes all Coster–Kronig processes from the upper original L_I vacancy. We have represented the Coster–Kronig probabilities with necessary additional significant figures for ease of comparison, and here derive the consequent Auger probabilities. We do not make particular

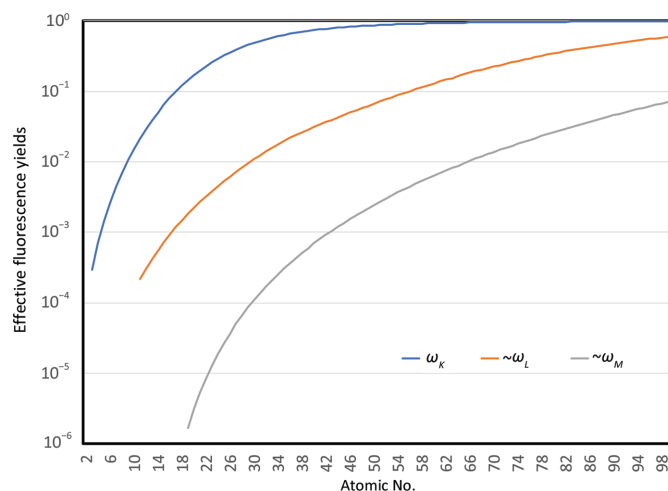


Figure 8
 Fluorescence (radiative) yields following Hubbell present effective average fluorescence yields versus atomic number. For the K shell, these are the same fluorescence yields ω_K (Bambynek *et al.*, 1972; Bambynek, 1984; Hubbell *et al.*, 1994).

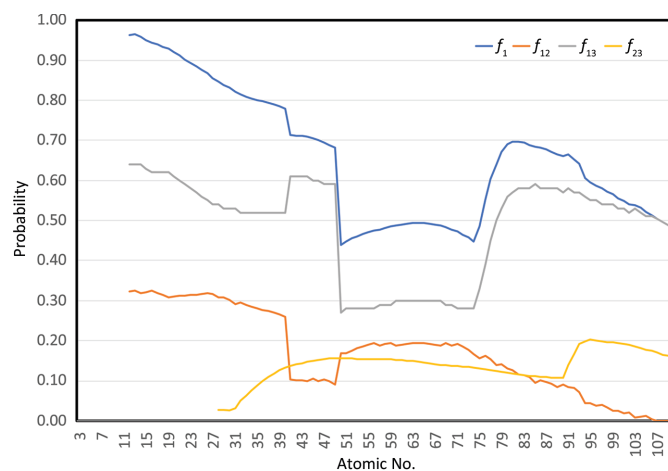


Figure 9
 Coster–Kronig probabilities versus atomic number: this work but edited from Krause (1979). There are irregularities when a new decay channel is turned on. Coster–Kronig and super Coster–Kronig transitions, in the rare earths, for example, can wipe out the single-particle core state entirely, as has been observed in XPS.

Table 4

Table of fluorescence yields (radiative probabilities), Coster–Kronig and Auger probabilities for *K* shells and *L* subshells edited but following Krause (1979).

<i>Z</i>	ω_K	ω_{L_I}	$\omega_{L_{II}}$	$\omega_{L_{III}}$	f_1	f_{12}	f_{13}	f_{23}	a_K	a_{L_I}	$a_{L_{II}}$	$a_{L_{III}}$
3	9.00E-04								1.00E+00			
4	3.30E-04								1.00E+00			
5	1.70E-03								9.98E-01			
6	2.80E-03								9.97E-01			
7	5.20E-03								9.95E-01			
8	8.30E-03								9.92E-01			
9	1.30E-02								9.87E-01			
10	1.80E-02								9.82E-01			
11	2.30E-02								9.77E-01			
12	3.00E-02	2.90E-05	1.20E-03	1.20E-03	9.62E-01	3.22E-01	6.40E-01		9.70E-01	3.80E-02	9.99E-01	9.99E-01
13	3.90E-02	2.60E-05	7.50E-04	7.50E-04	9.65E-01	3.25E-01	6.40E-01		9.61E-01	3.50E-02	9.99E-01	9.99E-01
14	5.00E-02	3.00E-05	3.70E-04	3.80E-04	9.59E-01	3.19E-01	6.40E-01		9.50E-01	4.10E-02	1.00E+00	1.00E+00
15	6.30E-02	3.90E-05	3.10E-04	3.10E-04	9.51E-01	3.21E-01	6.30E-01		9.37E-01	4.90E-02	1.00E+00	1.00E+00
16	7.80E-02	7.40E-05	2.60E-04	2.60E-04	9.44E-01	3.24E-01	6.20E-01		9.22E-01	5.59E-02	1.00E+00	1.00E+00
17	9.70E-02	1.20E-04	2.40E-04	2.40E-04	9.39E-01	3.19E-01	6.20E-01		9.03E-01	6.09E-02	1.00E+00	1.00E+00
18	1.18E-01	1.80E-04	2.20E-04	2.20E-04	9.34E-01	3.14E-01	6.20E-01		8.82E-01	6.58E-02	1.00E+00	1.00E+00
19	1.40E-01	2.40E-04	2.70E-04	2.70E-04	9.29E-01	3.09E-01	6.20E-01		8.60E-01	7.08E-02	1.00E+00	1.00E+00
20	1.63E-01	3.10E-04	3.30E-04	3.30E-04	9.20E-01	3.10E-01	6.10E-01		8.37E-01	7.97E-02	1.00E+00	1.00E+00
21	1.88E-01	3.90E-04	8.40E-04	8.40E-04	9.12E-01	3.12E-01	6.00E-01		8.12E-01	8.76E-02	9.99E-01	9.99E-01
22	2.14E-01	4.70E-04	1.50E-03	1.50E-03	9.02E-01	3.12E-01	5.90E-01		7.86E-01	9.75E-02	9.99E-01	9.99E-01
23	2.43E-01	5.80E-04	2.60E-03	2.60E-03	8.94E-01	3.14E-01	5.80E-01		7.57E-01	1.05E-01	9.97E-01	9.97E-01
24	2.75E-01	7.10E-04	3.70E-03	3.70E-03	8.85E-01	3.15E-01	5.70E-01		7.25E-01	1.14E-01	9.96E-01	9.96E-01
25	3.08E-01	8.40E-04	5.00E-03	5.00E-03	8.77E-01	3.17E-01	5.60E-01		6.92E-01	1.22E-01	9.95E-01	9.95E-01
26	3.40E-01	1.00E-03	6.30E-03	6.30E-03	8.68E-01	3.18E-01	5.50E-01		6.60E-01	1.31E-01	9.94E-01	9.94E-01
27	3.73E-01	1.20E-03	7.70E-03	7.70E-03	8.56E-01	3.16E-01	5.40E-01		6.27E-01	1.43E-01	9.92E-01	9.92E-01
28	4.06E-01	1.40E-03	8.60E-03	9.30E-03	8.47E-01	3.07E-01	5.40E-01	2.80E-02	5.94E-01	1.52E-01	9.63E-01	9.91E-01
29	4.40E-01	1.60E-03	1.00E-02	1.10E-02	8.39E-01	3.09E-01	5.30E-01	2.80E-02	5.60E-01	1.59E-01	9.62E-01	9.89E-01
30	4.74E-01	1.80E-03	1.10E-02	1.20E-02	8.31E-01	3.01E-01	5.30E-01	2.60E-02	5.26E-01	1.67E-01	9.63E-01	9.88E-01
31	5.07E-01	2.10E-03	1.20E-02	1.30E-02	8.22E-01	2.92E-01	5.30E-01	3.20E-02	4.93E-01	1.76E-01	9.56E-01	9.87E-01
32	5.35E-01	2.40E-03	1.30E-02	1.50E-02	8.15E-01	2.95E-01	5.20E-01	5.00E-02	4.65E-01	1.83E-01	9.37E-01	9.85E-01
33	5.62E-01	2.80E-03	1.40E-02	1.60E-02	8.09E-01	2.89E-01	5.20E-01	6.30E-02	4.38E-01	1.88E-01	9.23E-01	9.84E-01
34	5.89E-01	3.20E-03	1.60E-02	1.80E-02	8.04E-01	2.84E-01	5.20E-01	7.60E-02	4.11E-01	1.93E-01	9.08E-01	9.82E-01
35	6.18E-01	3.60E-03	1.80E-02	2.00E-02	8.00E-01	2.80E-01	5.20E-01	8.80E-02	3.82E-01	1.96E-01	8.94E-01	9.80E-01
36	6.43E-01	4.10E-03	2.00E-02	2.20E-02	7.97E-01	2.77E-01	5.20E-01	1.00E-01	3.57E-01	1.99E-01	8.80E-01	9.78E-01
37	6.67E-01	4.60E-03	2.20E-02	2.40E-02	7.94E-01	2.74E-01	5.20E-01	1.09E-01	3.33E-01	2.01E-01	8.69E-01	9.76E-01
38	6.90E-01	5.10E-03	2.40E-02	2.60E-02	7.90E-01	2.70E-01	5.20E-01	1.17E-01	3.10E-01	2.05E-01	8.59E-01	9.74E-01
39	7.10E-01	5.90E-03	2.60E-02	2.80E-02	7.85E-01	2.65E-01	5.20E-01	1.26E-01	2.90E-01	2.09E-01	8.48E-01	9.72E-01
40	7.30E-01	6.80E-03	2.80E-02	3.10E-02	7.79E-01	2.59E-01	5.20E-01	1.32E-01	2.70E-01	2.14E-01	8.40E-01	9.69E-01
41	7.47E-01	9.40E-03	3.10E-02	3.40E-02	7.73E-01	1.03E-01	6.10E-01	1.37E-01	2.53E-01	2.78E-01	8.32E-01	9.66E-01
42	7.65E-01	1.00E-02	3.40E-02	3.70E-02	7.71E-01	1.02E-01	6.10E-01	1.41E-01	2.35E-01	2.78E-01	8.25E-01	9.63E-01
43	7.80E-01	1.10E-02	3.70E-02	4.00E-02	7.71E-01	1.01E-01	6.10E-01	1.44E-01	2.20E-01	2.78E-01	8.19E-01	9.60E-01
44	7.94E-01	1.20E-02	4.00E-02	4.30E-02	7.09E-01	9.90E-02	6.10E-01	1.48E-01	2.06E-01	2.79E-01	8.12E-01	9.57E-01
45	8.08E-01	1.30E-02	4.30E-02	4.60E-02	7.05E-01	1.05E-01	6.00E-01	1.50E-01	1.92E-01	2.82E-01	8.07E-01	9.54E-01
46	8.20E-01	1.40E-02	4.70E-02	4.90E-02	7.00E-01	1.00E-01	6.00E-01	1.51E-01	1.80E-01	2.86E-01	8.02E-01	9.51E-01
47	8.31E-01	1.60E-02	5.10E-02	5.20E-02	6.94E-01	1.04E-01	5.90E-01	1.53E-01	1.69E-01	2.90E-01	7.96E-01	9.48E-01
48	8.43E-01	1.80E-02	5.60E-02	5.60E-02	6.88E-01	9.80E-02	5.90E-01	1.55E-01	1.57E-01	2.94E-01	7.89E-01	9.44E-01
49	8.53E-01	2.00E-02	6.10E-02	6.00E-02	6.81E-01	9.10E-02	5.90E-01	1.57E-01	1.47E-01	2.99E-01	7.82E-01	9.40E-01
50	8.62E-01	3.70E-02	6.50E-02	6.40E-02	4.39E-01	1.69E-01	2.70E-01	1.57E-01	1.38E-01	5.24E-01	7.78E-01	9.36E-01
51	8.70E-01	3.90E-02	6.90E-02	6.90E-02	4.48E-01	1.68E-01	2.80E-01	1.56E-01	1.30E-01	5.13E-01	7.75E-01	9.31E-01
52	8.77E-01	4.10E-02	7.40E-02	7.40E-02	4.55E-01	1.75E-01	2.80E-01	1.55E-01	1.23E-01	5.04E-01	7.71E-01	9.26E-01
53	8.84E-01	4.40E-02	7.90E-02	7.90E-02	4.61E-01	1.81E-01	2.80E-01	1.54E-01	1.16E-01	4.95E-01	7.67E-01	9.21E-01
54	8.91E-01	4.60E-02	8.30E-02	8.50E-02	4.66E-01	1.86E-01	2.80E-01	1.54E-01	1.09E-01	4.88E-01	7.63E-01	9.15E-01
55	8.97E-01	4.90E-02	9.00E-02	9.10E-02	4.70E-01	1.90E-01	2.80E-01	1.54E-01	1.03E-01	4.81E-01	7.56E-01	9.09E-01
56	9.02E-01	5.20E-02	9.60E-02	9.70E-02	4.74E-01	1.94E-01	2.80E-01	1.53E-01	9.80E-02	4.74E-01	7.51E-01	9.03E-01
57	9.07E-01	5.50E-02	1.03E-01	1.04E-01	4.78E-01	1.88E-01	2.90E-01	1.53E-01	9.30E-02	4.67E-01	7.44E-01	8.96E-01
58	9.12E-01	5.80E-02	1.10E-01	1.11E-01	4.82E-01	1.92E-01	2.90E-01	1.53E-01	8.80E-02	4.60E-01	7.37E-01	8.89E-01
59	9.17E-01	6.10E-02	1.17E-01	1.18E-01	4.85E-01	1.95E-01	2.90E-01	1.53E-01	8.30E-02	4.54E-01	7.30E-01	8.82E-01
60	9.21E-01	6.40E-02	1.24E-01	1.25E-01	4.88E-01	1.88E-01	3.00E-01	1.52E-01	7.90E-02	4.48E-01	7.24E-01	8.75E-01
61	9.25E-01	6.60E-02	1.32E-01	1.32E-01	4.90E-01	1.90E-01	3.00E-01	1.51E-01	7.50E-02	4.44E-01	7.17E-01	8.68E-01
62	9.29E-01	7.10E-02	1.40E-01	1.39E-01	4.92E-01	1.92E-01	3.00E-01	1.50E-01	7.10E-02	4.37E-01	7.10E-01	8.61E-01
63	9.32E-01	7.50E-02	1.49E-01	1.47E-01	4.93E-01	1.93E-01	3.00E-01	1.49E-01	6.80E-02	4.32E-01	7.02E-01	8.53E-01
64	9.35E-01	7.90E-02	1.58E-01	1.55E-01	4.93E-01	1.93E-01	3.00E-01	1.47E-01	6.50E-02	4.28E-01	6.95E-01	8.45E-01
65	9.38E-01	8.30E-02	1.67E-01	1.64E-01	4.93E-01	1.93E-01	3.00E-01	1.45E-01	6.20E-02	4.24E-01	6.88E-01	8.36E-01
66	9.41E-01	8.90E-02	1.78E-01	1.74E-01	4.92E-01	1.92E-01	3.00E-01	1.43E-01	5.90E-02	4.19E-01	6.79E-01	8.26E-01
67	9.44E-01	9.40E-02	1.89E-01	1.82E-01	4.90E-01	1.90E-01	3.00E-01	1.42E-01	5.60E-02	4.16E-01	6.69E-01	8.18E-01
68	9.47E-01	1.00E-01	2.00E-01	1.92E-01	4.87E-01	1.87E-01	3.00E-01	1.40E-01	5.30E-02	4.13E-01	6.60E-01	8.08E-01
69	9.49E-01	1.06E-01	2.11E-01	2.01E-01	4.83E-01	1.93E-01	2.90E-01	1.39E-01	5.10E-02	4.11E-01	6.50E-01	7.99E-01
70	9.51E-01	1.12E-01	2.22E-01	2.10E-01	4.78E-01	1.88E-01	2.90E-01	1.38E-01	4.90E-02	4.10E-01	6.40E-01	7.90E-01
71	9.53E-01	1.20E-01	2.34E-01	2.20E-01	4.72E-01	1.92E-01	2.80E-01	1.36E-01	4.70E-02	4.08E-01	6.30E-01	7.80E-01
72	9.55E-01	1.28E-01	2.46E-01	2.31E-01	4.65E-01	1.85E-01	2.80E-01	1.35E-01	4.50E-02	4.07E-01	6.19E-01	7.69E-01

Table 4 (continued)

Z	ω_K	ω_{L_I}	$\omega_{L_{II}}$	$\omega_{L_{III}}$	f_1	f_{12}	f_{13}	f_{23}	a_K	a_{L_I}	$a_{L_{II}}$	$a_{L_{III}}$
73	9.57E-01	1.37E-01	2.58E-01	2.43E-01	4.57E-01	1.77E-01	2.80E-01	1.34E-01	4.30E-02	4.06E-01	6.08E-01	7.57E-01
74	9.58E-01	1.47E-01	2.70E-01	2.55E-01	4.47E-01	1.67E-01	2.80E-01	1.33E-01	4.20E-02	4.06E-01	5.97E-01	7.45E-01
75	9.59E-01	1.44E-01	2.83E-01	2.68E-01	4.85E-01	1.55E-01	3.30E-01	1.30E-01	4.10E-02	3.71E-01	5.87E-01	7.32E-01
76	9.61E-01	1.30E-01	2.95E-01	2.81E-01	5.52E-01	1.62E-01	3.90E-01	1.28E-01	3.90E-02	3.18E-01	5.77E-01	7.19E-01
77	9.62E-01	1.20E-01	3.08E-01	2.94E-01	6.03E-01	1.53E-01	4.50E-01	1.26E-01	3.80E-02	2.77E-01	5.66E-01	7.06E-01
78	9.63E-01	1.14E-01	3.21E-01	3.06E-01	6.40E-01	1.40E-01	5.00E-01	1.24E-01	3.70E-02	2.46E-01	5.55E-01	6.94E-01
79	9.64E-01	1.07E-01	3.34E-01	3.20E-01	6.72E-01	1.42E-01	5.30E-01	1.22E-01	3.60E-02	2.21E-01	5.44E-01	6.80E-01
80	9.65E-01	1.07E-01	3.47E-01	3.33E-01	6.90E-01	1.30E-01	5.60E-01	1.20E-01	3.50E-02	2.03E-01	5.33E-01	6.67E-01
81	9.66E-01	1.07E-01	3.60E-01	3.47E-01	6.96E-01	1.26E-01	5.70E-01	1.18E-01	3.40E-02	1.97E-01	5.22E-01	6.53E-01
82	9.67E-01	1.12E-01	3.73E-01	3.60E-01	6.96E-01	1.16E-01	5.80E-01	1.16E-01	3.30E-02	1.92E-01	5.11E-01	6.40E-01
83	9.68E-01	1.17E-01	3.87E-01	3.73E-01	6.94E-01	1.14E-01	5.80E-01	1.13E-01	3.20E-02	1.89E-01	5.00E-01	6.27E-01
84	9.68E-01	1.22E-01	4.01E-01	3.86E-01	6.89E-01	1.09E-01	5.80E-01	1.11E-01	3.20E-02	1.89E-01	4.88E-01	6.14E-01
85	9.69E-01	1.28E-01	4.15E-01	3.99E-01	6.85E-01	9.50E-02	5.90E-01	1.11E-01	3.10E-02	1.87E-01	4.74E-01	6.01E-01
86	9.69E-01	1.34E-01	4.29E-01	4.11E-01	6.82E-01	1.02E-01	5.80E-01	1.10E-01	3.10E-02	1.84E-01	4.61E-01	5.89E-01
87	9.70E-01	1.39E-01	4.43E-01	4.24E-01	6.77E-01	9.70E-02	5.80E-01	1.09E-01	3.00E-02	1.84E-01	4.48E-01	5.76E-01
88	9.70E-01	1.46E-01	4.56E-01	4.37E-01	6.72E-01	9.20E-02	5.80E-01	1.08E-01	3.00E-02	1.82E-01	4.36E-01	5.63E-01
89	9.71E-01	1.53E-01	4.68E-01	4.50E-01	6.64E-01	8.40E-02	5.80E-01	1.08E-01	2.90E-02	1.83E-01	4.24E-01	5.50E-01
90	9.71E-01	1.61E-01	4.79E-01	4.63E-01	6.60E-01	9.00E-02	5.70E-01	1.08E-01	2.90E-02	1.79E-01	4.13E-01	5.37E-01
91	9.72E-01	1.62E-01	4.72E-01	4.76E-01	6.64E-01	8.40E-02	5.80E-01	1.39E-01	2.80E-02	1.74E-01	3.89E-01	5.24E-01
92	9.72E-01	1.76E-01	4.67E-01	4.89E-01	6.52E-01	8.20E-02	5.70E-01	1.67E-01	2.80E-02	1.72E-01	3.66E-01	5.11E-01
93	9.73E-01	1.87E-01	4.66E-01	5.02E-01	6.42E-01	7.20E-02	5.70E-01	1.92E-01	2.70E-02	1.71E-01	3.42E-01	4.98E-01
94	9.73E-01	2.05E-01	4.64E-01	5.14E-01	6.05E-01	4.50E-02	5.60E-01	1.98E-01	2.70E-02	1.90E-01	3.38E-01	4.86E-01
95	9.74E-01	2.18E-01	4.71E-01	5.26E-01	5.95E-01	4.50E-02	5.50E-01	2.03E-01	2.60E-02	1.87E-01	3.26E-01	4.74E-01
96	9.74E-01	2.28E-01	4.79E-01	5.39E-01	5.87E-01	3.70E-02	5.50E-01	2.00E-01	2.60E-02	1.85E-01	3.21E-01	4.61E-01
97	9.75E-01	2.36E-01	4.85E-01	5.50E-01	5.80E-01	4.00E-02	5.40E-01	1.98E-01	2.50E-02	1.84E-01	3.17E-01	4.50E-01
98	9.75E-01	2.44E-01	4.90E-01	5.60E-01	5.73E-01	3.30E-02	5.40E-01	1.97E-01	2.50E-02	1.83E-01	3.13E-01	4.40E-01
99	9.75E-01	2.53E-01	4.97E-01	5.70E-01	5.65E-01	2.50E-02	5.40E-01	1.96E-01	2.50E-02	1.82E-01	3.07E-01	4.30E-01
100	9.76E-01	2.63E-01	5.06E-01	5.79E-01	5.56E-01	2.60E-02	5.30E-01	1.94E-01	2.40E-02	1.81E-01	3.00E-01	4.21E-01
101	9.76E-01	2.72E-01	5.15E-01	5.88E-01	5.48E-01	1.80E-02	5.30E-01	1.91E-01	2.40E-02	1.80E-01	2.94E-01	4.12E-01
102	9.76E-01	2.80E-01	5.24E-01	5.96E-01	5.40E-01	2.00E-02	5.20E-01	1.89E-01	2.40E-02	1.80E-01	2.87E-01	4.04E-01
103	9.77E-01	2.82E-01	5.33E-01	6.04E-01	5.38E-01	8.00E-03	5.30E-01	1.85E-01	2.30E-02	1.80E-01	2.82E-01	3.96E-01
104	9.77E-01	2.91E-01	5.44E-01	6.11E-01	5.31E-01	1.10E-02	5.20E-01	1.81E-01	2.30E-02	1.78E-01	2.75E-01	3.89E-01
105	9.77E-01	3.00E-01	5.53E-01	6.18E-01	5.22E-01	1.20E-02	5.10E-01	1.78E-01	2.30E-02	1.78E-01	2.69E-01	3.82E-01
106	9.78E-01	3.10E-01	5.62E-01	6.24E-01	5.13E-01	3.00E-03	5.10E-01	1.74E-01	2.20E-02	1.77E-01	2.64E-01	3.76E-01
107	9.78E-01	3.20E-01	5.73E-01	6.30E-01	5.05E-01	0.00E+00	5.05E-01	1.71E-01	2.20E-02	1.75E-01	2.56E-01	3.70E-01
108	9.78E-01	3.31E-01	5.84E-01	6.35E-01	4.97E-01	0.00E+00	4.97E-01	1.65E-01	2.20E-02	1.72E-01	2.51E-01	3.65E-01
109	9.78E-01	3.43E-01	5.90E-01	6.40E-01	4.88E-01	0.00E+00	4.88E-01	1.63E-01	2.20E-02	1.69E-01	2.47E-01	3.60E-01
110	9.79E-01	3.54E-01	5.98E-01	6.44E-01	4.77E-01	0.00E+00	4.77E-01	1.58E-01	2.10E-02	1.69E-01	2.44E-01	3.56E-01

recommendations as to tabulations of preference here, but simply seek to present a useful reference on these key parameters. Information on outer subshells is presented graphically for cognate techniques. For detailed summaries for M subshells and N subshells, see McGuire (1972*a,b*, 1974, 1975) and Chen *et al.* (1981), noting that Ohno & Wendin (1985) and Fuggle & Alvarado (1980) revealed large differences between theoretical and experimental Coster–Kronig and hence Auger transition probabilities. See also Chen (1985) and Melhorn (1985) for further detailed discussion.

8. Exemplar elemental crystal structures

Limited crystallographic data for elemental materials for *FEFF*, *FDMX* and for DFT computations *etc.* is provided in Table 5. As many elemental solids display complex polymorphism with numerous allotropes (boron, carbon, phosphorus, sulfur, arsenic, selenium, tin, antimony ...), it is important to ensure that the reference sample or calculation matches the correct structural determination of the lattice. Those elements which are liquid or gas at room temperature are generally unsuitable as reference standards, although they will become solid and crystalline at suitably low temperatures. As reference samples, users may use oxides, well-defined or well-prepared simple binary or ternary compounds, or indeed

something as complex as ferrocene. For fingerprinting, many more complex and ill-defined systems are used a benchmarks; however, we list these elemental compounds as leading to potential primary references without being exclusive. We commend some regularly updated online resources as reference materials here, such as those at <https://periodictable.com/Properties/A/CrystalStructure.html> and at

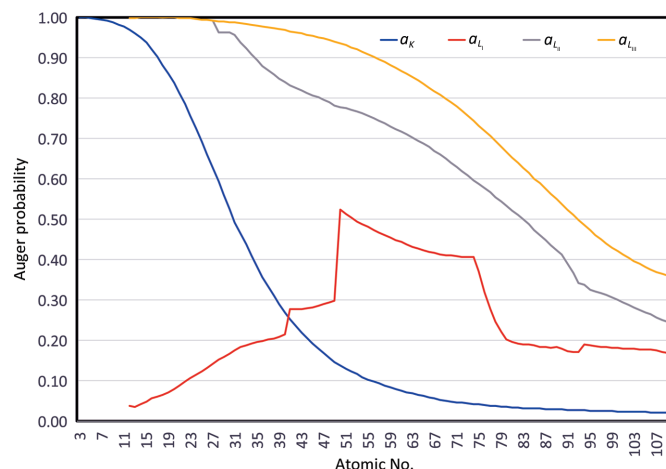


Figure 10 Auger probabilities versus atomic number: this work, based upon Krause (1979).

http://wwwhomes.uni-bielefeld.de/achim/ele_structures.html and even more strongly commend the original structural determinations or the corresponding CIF files from structural databases. As an illustration for zinc metal, Nuss *et al.* (2010) include temperature variation from XRD.

9. Multiple scattering, shake processes and the amplitude-reduction factor S_0^2

We comment that in XAFS analysis the fitting parameter S_0^2 causes great pain and confusion in publications. If this is, as claimed, an amplitude-reduction factor, it must always be less than unity. However, the parameter is highly correlated with (i) errors in the fitted edge offset parameter E_0 discussed earlier, (ii) errors in spline removal and background subtraction, as a function of k , (iii) scaling of the data signal amplitude or normalization errors from fluorescence spectra and (iv) the range of k fit in, for example, the Hanning window.

Hence, it is common to find S_0^2 reported as above unity or below, for example, 0.5 as a consequence of other errors. The uncertainty in this as a physical parameter may be very large; yet the fit may still provide robust and reliable structural and local dynamical parameters of valid significance with small uncertainty.

An early table of *suggested* S_0^2 values can be found as Table 1.1 of Stern (1988), for example, but we note that most other parameters could give good and meaningful physical insight in different experiments and analyses with S_0^2 values differing by for example 0.2 or more; therefore, we currently do not make any explicit recommendation.

The shake process is likely to become worse (more significant and hence impacting upon the interpretation of S_0^2) for high angular momentum core states. Fortunately for EXAFS, most structural determination are obtained at the K edge or L_{III} edge, where the behaviour of multi-electronic process, and hence amplitude reduction, at energy significantly above the threshold is likely to be monotonic and can be addressed by the fitting process to a better degree. M and N shells are more likely to suffer from Coster–Kronig or super Coster–Kronig processes, which can wipe out the single-particle feature of the core state entirely. The complexity particularly lies around the XANES region, where the adiabatic to sudden transition takes place and shake processes also commence, and indeed also where multiple scattering prevails.

However, it is hoped that if uncertainties are provided with a fitted S_0^2 parameter then it would be consistent with a sensible value within error. Much more work is required to tie down this parameter in context with tying down other correlated parameters in conventional analysis.

10. Inelastic mean free paths of the (photo)electron and links to LEED, EELS and electron diffraction

The inelastic mean free path (IMFP) of the photoelectron is a necessary parameter for the computation and quantitative analysis of any ionizing X-ray spectroscopy. In this section, we

tabulate IMFPs for various elemental solids over the range 1–2000 eV relative to the Fermi energy.

The values are calculated using the coupled plasmon model (CPM) presented by Bourke & Chantler (2015). This model is based on the optical data model presented by Penn (1987) and can be considered as a generalization of the full Penn algorithm (FPA) widely used in alternative tabulations (Shinotsuka *et al.*, 2015; Tanuma *et al.* 1991, 2011). A key advantage of the CPM is its self-consistent account of excitation lifetimes, which demonstrably improve the accuracy of the IMFP for energies below 200 eV (Chantler & Bourke, 2014b).

The CPM is best described in terms of its defining equation, given by

$$\lambda(E, k)_N^{-1} = \frac{\hbar}{a_0 \pi E} \int_0^{\frac{E-E_F}{\hbar/2\pi}} \int_{q_-}^{q_+} \int_0^\infty \frac{2}{\pi \omega' q} \text{Im} \left[\frac{-1}{\epsilon_{\text{data}}(0, \omega')} \right] \times \text{Im} \left\{ \frac{-1}{\epsilon_M[q, \omega, \gamma_i(q)_{N-1}; \omega_p = \omega_i]} \right\} d\omega' dq d\omega, \quad (1a)$$

$$\gamma_i(q)_N = \hbar \frac{d\omega_q}{dq} \Big|_{\omega_q, q} \lambda(\omega_q, q)_N^{-1} \Theta(N - \delta). \quad (1b)$$

In this model the IMFP, $\lambda(E, k)$, is determined via integration over $\hbar\omega$ and $\hbar q$, which are the energy and momentum, respectively, that may be transferred by an incident electron to the scattering material during a collision event. The energy transfer may take any value up to $E - E_F$, where E is the incident energy and E_F is the Fermi energy of the material, while the momentum limits are kinematically constrained and are given by

$$q^* \pm = k \pm k \left(1 - \frac{\hbar\omega}{E} \right)^{1/2}, \quad (2)$$

where k is the momentum of the scattered particle. This is conventionally related as $k = (2mE)^{1/2}/\hbar$ for the incident electron but potentially has other values for states excited within the absorbing material. The inner integral of equation (1) is a summation over Mermin-type free-electron gas dielectric functions (Mermin, 1970), which form a basis set for the potential electronic excitations. These terms are broadened by their $\gamma_i(q)$ parameters, which are inverse lifetimes calculated self-consistently by equation (2). The magnitudes of the excitation channels are provided by the $\text{Im}\{-1/[\epsilon_{\text{data}}(0, \omega')]\}$ term, which corresponds to an optical energy-loss function and must be provided by external data. Finally, the ω_q parameter dictates the effective dispersion relation quantified by Lindhard's theory, and in turn determines the group velocity of excitations $v_g = d\omega_q/dq$.

The optical energy-loss function (optical ELF) provides the excitation magnitudes also commonly known as optical oscillator strengths. For this work they are derived theoretically across the entire spectrum of interest. At low energies, typically meaning for losses of less than a few tens of eV up to 100 eV, depending on the material, they are calculated using density-functional theory via the *WIEN2k* package (Blaha *et al.*, 2001). This package uses a linearized augmented plane-

Table 5

Crystal structures used for the calculation of optical losses and electron IMFP data for various elements.

In all cases structural data are sourced from Wyckoff (1963).

Z	Element	Space group	<i>a</i> (Å)	<i>b</i> (Å)	<i>c</i> (Å)	Notes
3	Li	<i>Im-3m</i>	3.509	3.509	3.509	
4	Be	<i>P63/mmc</i>	2.287	2.287	3.583	
11	Na	<i>Im-3m</i>	4.291	4.291	4.291	
12	Mg	<i>P63/mmc</i>	3.209	3.209	5.210	
13	Al	<i>Fm-3m</i>	4.050	4.050	4.050	
14	Si	<i>Fd-3m</i>	5.431	5.431	5.431	
19	K	<i>Im-3m</i>	5.247	5.247	5.247	<i>T</i> = 78 K
20	Ca	<i>Fm-3m</i>	5.576	5.576	5.576	
21	Sc	<i>P63/mmc</i>	3.309	3.309	5.273	
22	Ti	<i>P63/mmc</i>	2.950	2.950	4.686	
23	V	<i>Im-3m</i>	3.024	3.024	3.024	
24	Cr	<i>Im-3m</i>	2.884	2.884	2.884	
26	Fe	<i>Im-3m</i>	2.867	2.867	2.867	α -Iron
27	Co	<i>Fm-3m</i>	3.548	3.548	3.548	
28	Ni	<i>Fm-3m</i>	3.524	3.524	3.524	
29	Cu	<i>Fm-3m</i>	3.615	3.615	3.615	
30	Zn	<i>P63/mmc</i>	2.665	2.665	4.947	
31	Ga	<i>Bmab</i>	4.511	4.517	7.645	
38	Sr	<i>Fm-3m</i>	6.085	6.085	6.085	
39	Y	<i>P63/mmc</i>	3.647	3.647	5.731	
41	Nb	<i>Im-3m</i>	3.300	3.300	3.300	
42	Mo	<i>Im-3m</i>	3.147	3.147	3.147	
44	Ru	<i>P63/mmc</i>	2.704	2.704	4.282	
45	Rh	<i>Fm-3m</i>	3.803	3.803	3.803	
46	Pd	<i>Fm-3m</i>	3.890	3.890	3.890	
47	Ag	<i>Fm-3m</i>	4.086	4.086	4.086	
48	Cd	<i>P63/mmc</i>	2.979	2.979	5.618	
50	Sn	<i>I41/amd</i>	5.820	5.820	3.175	β -Tin (white)
55	Cs	<i>Im-3m</i>	6.067	6.067	6.067	<i>T</i> = 78 K
56	Ba	<i>Im-3m</i>	5.025	5.025	5.025	
64	Gd	<i>P63/mmc</i>	3.636	3.636	5.783	
65	Tb	<i>P63/mmc</i>	3.601	3.601	5.694	
66	Dy	<i>P63/mmc</i>	3.590	3.590	5.647	
72	Hf	<i>P63/mmc</i>	3.197	3.197	5.058	
73	Ta	<i>Im-3m</i>	3.306	3.306	3.306	
74	W	<i>Im-3m</i>	3.165	3.165	3.165	α -Tungsten
75	Re	<i>P63/mmc</i>	2.761	2.761	4.458	
76	Os	<i>P63/mmc</i>	2.735	2.735	4.319	
77	Ir	<i>Fm-3m</i>	3.839	3.839	3.839	
78	Pt	<i>Fm-3m</i>	3.923	3.923	3.923	
79	Au	<i>Fm-3m</i>	4.078	4.078	4.078	
81	Tl	<i>P63/mmc</i>	3.456	3.456	5.525	
82	Pb	<i>Fm-3m</i>	4.950	4.950	4.950	

wave (LAPW) representation for the periodic band structure of the solid calculated within a self-consistent Kohn–Sham algorithm. Details of the calculation of optical spectra are given by Ambrosch-Draxl & Sofo (2006), while the connection to generalized ELF data and electron IMFPs has previously been described by Chantler & Bourke (2014a). Limited crystallographic data used for each element in the *WIEN2k* calculation are provided in Table 5.

At higher energies the optical ELF is calculated using the *FFAST* package (Chantler, 1995, 2000). *FFAST* is an atomic code that uses a multi-configurational Dirac–Hartree–Fock technique for the self-consistent evaluation of relativistic atomic wavefunctions and a local density approximation for the treatment of the Coulomb and exchange–correlation potentials. It is known to be highly accurate at keV energies, but is not capable of obtaining the detailed loss spectrum for energies below a few hundred eV due to its lack of account of the band structure of the solid. Further, the atomistic valence

Table 6

Table of values for energy transition between *WIEN2k* optical data and *FFAST* optical data, plus the Fermi energies needed for equation (1) discussed in Section 10.

Z	Element	Transition (eV)	<i>E_F</i> (eV)	<i>E_F</i> source
3	Li	54	4.74	Shinotsuka <i>et al.</i> (2015)
4	Be	34	14.3	Shinotsuka <i>et al.</i> (2015)
11	Na	48	3.24	Shinotsuka <i>et al.</i> (2015)
12	Mg	54	7.1	Shinotsuka <i>et al.</i> (2015)
13	Al	39	11.2	Shinotsuka <i>et al.</i> (2015)
14	Si	100	12.5	Shinotsuka <i>et al.</i> (2015)
19	K	39	2.12	Shinotsuka <i>et al.</i> (2015)
20	Ca	55	4.69	Rumble (2018)
21	Sc	68	5.8	Shinotsuka <i>et al.</i> (2015)
22	Ti	82	6.0	Shinotsuka <i>et al.</i> (2015)
23	V	78	6.4	Shinotsuka <i>et al.</i> (2015)
24	Cr	100	7.8	Shinotsuka <i>et al.</i> (2015)
26	Fe	84	8.9	Shinotsuka <i>et al.</i> (2015)
27	Co	92	10	Shinotsuka <i>et al.</i> (2015)
28	Ni	95	9.1	Shinotsuka <i>et al.</i> (2015)
29	Cu	103	8.7	Shinotsuka <i>et al.</i> (2015)
30	Zn	62	9.47	Rumble (2018)
31	Ga	55	10.4	Rumble (2018)
38	Sr	90	3.93	Rumble (2018)
39	Y	83	4.4	Shinotsuka <i>et al.</i> , (2015)
41	Nb	88	5.3	Shinotsuka <i>et al.</i> (2015)
42	Mo	75	6.5	Shinotsuka <i>et al.</i> (2015)
44	Ru	74	6.9	Shinotsuka <i>et al.</i> (2015)
45	Rh	77	6.9	Shinotsuka <i>et al.</i> (2015)
46	Pd	114	6.2	Shinotsuka <i>et al.</i> (2015)
47	Ag	88	7.2	Shinotsuka <i>et al.</i> (2015)
48	Cd	109	7.47	Rumble (2018)
50	Sn	102	5.51	Shinotsuka <i>et al.</i> (2015)
55	Cs	93	1.73	Shinotsuka <i>et al.</i> (2015)
56	Ba	87	3.84	Rumble (2018)
64	Gd	60	3.5	Shinotsuka <i>et al.</i> (2015)
65	Tb	60	4.0	Shinotsuka <i>et al.</i> (2015)
66	Dy	59	3.5	Shinotsuka <i>et al.</i> (2015)
72	Hf	70	7.9	Shinotsuka <i>et al.</i> (2015)
73	Ta	83	8.4	Shinotsuka <i>et al.</i> (2015)
74	W	95	10.1	Shinotsuka <i>et al.</i> (2015)
75	Re	100	10.7	Shinotsuka <i>et al.</i> (2015)
76	Os	101	11.4	Shinotsuka <i>et al.</i> (2015)
77	Ir	110	11.2	Shinotsuka <i>et al.</i> (2015)
78	Pt	112	10.6	Shinotsuka <i>et al.</i> (2015)
79	Au	104	9.0	Shinotsuka <i>et al.</i> (2015)
81	Tl	74	8.15	Rumble (2018)
82	Pb	72	9.47	Rumble (2018)

states lead to a low-energy breakdown of the real part of the form factor. To reduce this problem, we apply a transform of the imaginary part of the form factor calculated by *FFAST* to determine the complex refractive index $n = 1 - \delta + i\beta$ in such a way that $\delta \simeq 0$. This is then converted to a dielectric function $\epsilon = 1 - \beta^2 - 2i\beta$ and in turn to an optical ELF that can be matched with the data from *WIEN2k*.

For most elements studied it is possible to transition smoothly from an ELF calculated using *WIEN2k* to one inferred from *FFAST*, with no significant discontinuity in either the value or the derivative of $\text{Im}\{-1/[\epsilon(0, \omega)]\}$. The energies at which the transition is made vary based on element, and are given in Table 6. Also provided in this table are the Fermi energies used for each element in equation (1) discussed in Section 10.

Tables 7–14 provide the optical ELF data used for each element and the resulting inelastic mean free paths. Figs. 11–21 illustrate these functionals.

Table 7
ELF and IMFP data calculated for Li, Be, Na, Mg, Al and Si.

Energy (eV)	Li		Be		Na		Mg		Al		Si	
	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)
1.0	4.939×10^{-3}	144.972	5.962×10^{-2}	330.932	6.283×10^{-3}	89.964	7.382×10^{-3}	274.847	2.547×10^{-3}	614.056	2.000×10^{-2}	558.041
2.0	1.224×10^{-2}	46.344	4.983×10^{-2}	124.060	1.555×10^{-2}	30.538	1.138×10^{-2}	87.013	1.027×10^{-2}	178.023	2.774×10^{-2}	183.951
3.0	3.125×10^{-2}	24.802	5.501×10^{-2}	72.739	3.806×10^{-2}	17.030	1.850×10^{-2}	46.254	1.133×10^{-2}	90.198	4.108×10^{-2}	98.824
4.0	3.697×10^{-1}	15.792	5.659×10^{-2}	50.918	1.097×10^{-1}	11.344	2.891×10^{-2}	30.123	1.529×10^{-2}	57.198	3.896×10^{-2}	65.284
5.0	9.001×10^{-1}	10.936	5.117×10^{-2}	38.879	6.784×10^{-1}	8.230	4.619×10^{-2}	21.793	2.002×10^{-2}	40.680	4.329×10^{-2}	48.055
6.0	$1.767 \times 10^{+0}$	8.170	7.506×10^{-2}	31.295	$3.600 \times 10^{+0}$	6.331	8.186×10^{-2}	16.794	2.628×10^{-2}	31.029	7.790×10^{-2}	37.660
7.0	$3.025 \times 10^{+0}$	6.550	1.146×10^{-1}	26.019	2.416×10^{-1}	5.238	1.647×10^{-1}	13.471	3.461×10^{-2}	24.797	8.447×10^{-2}	30.675
8.0	$1.822 \times 10^{+0}$	5.573	1.256×10^{-1}	22.098	8.168×10^{-2}	4.600	3.951×10^{-1}	11.100	4.641×10^{-2}	20.468	8.553×10^{-2}	25.761
9.0	$1.055 \times 10^{+0}$	4.965	1.517×10^{-1}	19.111	4.469×10^{-2}	4.214	$1.541 \times 10^{+0}$	9.312	6.639×10^{-2}	17.300	1.239×10^{-1}	22.162
10.0	6.763×10^{-1}	4.561	2.070×10^{-1}	16.793	2.708×10^{-2}	3.964	$1.232 \times 10^{+1}$	7.916	1.017×10^{-1}	14.887	1.290×10^{-1}	19.432
11.0	4.343×10^{-1}	4.292	2.737×10^{-1}	14.934	1.817×10^{-2}	3.801	$1.760 \times 10^{+0}$	6.843	1.765×10^{-1}	12.981	1.636×10^{-1}	17.280
12.0	3.298×10^{-1}	4.101	3.787×10^{-1}	13.407	1.405×10^{-2}	3.701	5.007×10^{-1}	6.045	3.584×10^{-1}	11.440	2.127×10^{-1}	15.546
13.0	2.438×10^{-1}	3.963	6.222×10^{-1}	12.123	1.045×10^{-2}	3.647	2.383×10^{-1}	5.464	$1.052 \times 10^{+0}$	10.158	3.239×10^{-1}	14.118
14.0	1.631×10^{-1}	3.868	$1.005 \times 10^{+0}$	11.037	8.188×10^{-3}	3.618	1.411×10^{-1}	5.042	$8.236 \times 10^{+0}$	9.069	4.682×10^{-1}	12.921
15.0	1.043×10^{-1}	3.805	$1.264 \times 10^{+0}$	10.098	8.513×10^{-3}	3.610	9.476×10^{-2}	4.725	$5.016 \times 10^{+0}$	8.139	5.644×10^{-1}	11.900
16.0	6.232×10^{-2}	3.761	$1.883 \times 10^{+0}$	9.281	9.440×10^{-3}	3.621	7.200×10^{-2}	4.483	9.234×10^{-1}	7.347	6.492×10^{-1}	11.018
17.0	3.918×10^{-2}	3.737	$3.080 \times 10^{+0}$	8.571	5.671×10^{-3}	3.640	5.420×10^{-2}	4.295	3.748×10^{-1}	6.687	8.702×10^{-1}	10.251
18.0	2.621×10^{-2}	3.722	$3.527 \times 10^{+0}$	7.952	5.506×10^{-3}	3.670	4.229×10^{-2}	4.151	2.055×10^{-1}	6.152	$1.333 \times 10^{+0}$	9.581
19.0	2.709×10^{-2}	3.723	$3.545 \times 10^{+0}$	7.416	4.778×10^{-3}	3.707	3.564×10^{-2}	4.038	1.370×10^{-1}	5.722	$1.727 \times 10^{+0}$	8.987
20.0	1.182×10^{-2}	3.726	$2.850 \times 10^{+0}$	6.951	3.344×10^{-3}	3.752	2.954×10^{-2}	3.951	8.912×10^{-2}	5.375	$2.603 \times 10^{+0}$	8.463
21.0	1.929×10^{-2}	3.742	$1.922 \times 10^{+0}$	6.555	2.504×10^{-3}	3.799	2.674×10^{-2}	3.883	6.839×10^{-2}	5.093	$3.699 \times 10^{+0}$	8.001
22.0	8.111×10^{-3}	3.762	$1.328 \times 10^{+0}$	6.212	2.577×10^{-3}	3.850	2.371×10^{-2}	3.835	5.654×10^{-2}	4.859	$3.715 \times 10^{+0}$	7.590
23.0	8.045×10^{-3}	3.785	9.172×10^{-1}	5.919	2.800×10^{-3}	3.906	2.120×10^{-2}	3.797	4.575×10^{-2}	4.666	$4.199 \times 10^{+0}$	7.223
24.0	8.492×10^{-3}	3.814	6.140×10^{-1}	5.664	2.971×10^{-3}	3.960	1.835×10^{-2}	3.772	3.690×10^{-2}	4.504	$2.883 \times 10^{+0}$	6.897
25.0	6.361×10^{-3}	3.847	4.302×10^{-1}	5.447	2.642×10^{-2}	4.018	1.418×10^{-2}	3.755	2.946×10^{-2}	4.369	$1.912 \times 10^{+0}$	6.607
26.0	6.720×10^{-3}	3.881	3.113×10^{-1}	5.258	2.788×10^{-2}	4.078	1.218×10^{-2}	3.746	2.565×10^{-2}	4.253	$1.088 \times 10^{+0}$	6.347
27.0	5.538×10^{-3}	3.918	2.281×10^{-1}	5.094	4.793×10^{-2}	4.140	1.067×10^{-2}	3.744	2.213×10^{-2}	4.158	7.167×10^{-1}	6.112
28.0	4.568×10^{-3}	3.961	1.854×10^{-1}	4.950	4.648×10^{-2}	4.200	1.060×10^{-2}	3.748	2.028×10^{-2}	4.076	5.254×10^{-1}	5.903
29.0	3.787×10^{-3}	4.000	1.625×10^{-1}	4.825	4.914×10^{-2}	4.266	9.893×10^{-3}	3.754	1.771×10^{-2}	4.010	4.324×10^{-1}	5.714
30.0	4.190×10^{-3}	4.043	1.105×10^{-1}	4.714	4.896×10^{-2}	4.328	9.373×10^{-3}	3.765	1.646×10^{-2}	3.956	3.192×10^{-1}	5.544
31.0	3.580×10^{-3}	4.087	1.642×10^{-1}	4.618	5.153×10^{-2}	4.392	7.900×10^{-3}	3.781	1.531×10^{-2}	3.907	3.086×10^{-1}	5.391
32.0	3.739×10^{-3}	4.133	6.645×10^{-2}	4.533	5.599×10^{-2}	4.457	7.199×10^{-3}	3.800	1.317×10^{-2}	3.870	2.391×10^{-1}	5.251
33.0	2.517×10^{-3}	4.179	5.082×10^{-2}	4.459	5.701×10^{-2}	4.522	7.257×10^{-3}	3.819	1.182×10^{-2}	3.840	1.910×10^{-1}	5.123
34.0	1.907×10^{-3}	4.225	4.420×10^{-2}	4.393	5.297×10^{-2}	4.590	6.112×10^{-3}	3.841	1.252×10^{-2}	3.816	1.595×10^{-1}	5.008
35.0	2.270×10^{-3}	4.273	4.159×10^{-2}	4.336	6.002×10^{-2}	4.653	5.925×10^{-3}	3.864	1.272×10^{-2}	3.797	1.502×10^{-1}	4.902
36.0	2.394×10^{-3}	4.324	3.756×10^{-2}	4.286	7.529×10^{-2}	4.721	5.896×10^{-3}	3.890	1.092×10^{-2}	3.783	1.217×10^{-1}	4.806
37.0	1.747×10^{-3}	4.372	3.490×10^{-2}	4.242	6.266×10^{-2}	4.786	4.972×10^{-3}	3.917	1.097×10^{-2}	3.774	1.415×10^{-1}	4.718
38.0	1.369×10^{-3}	4.423	3.251×10^{-2}	4.203	7.402×10^{-2}	4.852	4.839×10^{-3}	3.946	1.101×10^{-2}	3.767	1.337×10^{-1}	4.637
39.0	1.392×10^{-3}	4.473	3.033×10^{-2}	4.170	7.435×10^{-2}	4.918	4.523×10^{-3}	3.975	9.328×10^{-3}	3.765	1.297×10^{-1}	4.565
40.0	1.481×10^{-3}	4.523	2.832×10^{-2}	4.141	9.165×10^{-2}	4.984	4.353×10^{-3}	4.006	7.226×10^{-3}	3.764	1.134×10^{-1}	4.499
41.0	1.315×10^{-3}	4.576	2.646×10^{-2}	4.117	9.743×10^{-2}	5.047	4.146×10^{-3}	4.036	8.139×10^{-3}	3.767	1.011×10^{-1}	4.439
42.0	1.412×10^{-3}	4.629	2.479×10^{-2}	4.098	6.652×10^{-2}	5.115	4.200×10^{-3}	4.068	7.861×10^{-3}	3.772	8.412×10^{-2}	4.384
43.0	1.583×10^{-3}	4.680	2.322×10^{-2}	4.080	7.881×10^{-2}	5.183	2.234×10^{-2}	4.101	7.705×10^{-3}	3.778	7.723×10^{-2}	4.334
44.0	1.733×10^{-3}	4.732	2.179×10^{-2}	4.066	7.691×10^{-2}	5.248	3.469×10^{-2}	4.134	7.530×10^{-3}	3.786	7.556×10^{-2}	4.290
45.0	2.166×10^{-3}	4.786	2.049×10^{-2}	4.055	8.293×10^{-2}	5.313	3.846×10^{-2}	4.168	7.303×10^{-3}	3.795	7.990×10^{-2}	4.249
46.0	4.010×10^{-3}	4.839	1.927×10^{-2}	4.046	7.272×10^{-2}	5.377	3.792×10^{-2}	4.202	7.074×10^{-3}	3.806	7.211×10^{-2}	4.212
47.0	4.267×10^{-2}	4.892	1.814×10^{-2}	4.040	8.138×10^{-2}	5.443	3.725×10^{-2}	4.236	6.849×10^{-3}	3.819	7.601×10^{-2}	4.179
48.0	2.967×10^{-2}	4.946	1.712×10^{-2}	4.036	8.163×10^{-2}	5.507	3.893×10^{-2}	4.271	6.626×10^{-3}	3.833	7.958×10^{-2}	4.149
49.0	1.397×10^{-2}	4.998	1.615×10^{-2}	4.034	8.040×10^{-2}	5.574	4.689×10^{-2}	4.307	6.405×10^{-3}	3.847	7.613×10^{-2}	4.124
50.0	3.669×10^{-2}	5.050	1.525×10^{-2}	4.033	7.133×10^{-2}	5.636	4.701×10^{-2}	4.344	6.188×10^{-3}	3.864	7.443×10^{-2}	4.100
52.0	4.236×10^{-2}	5.157	1.367×10^{-2}	4.037	6.876×10^{-2}	5.766	4.902×10^{-2}	4.415	5.766×10^{-3}	3.899	7.448×10^{-2}	4.062
54.0	4.613×10^{-2}	5.264	1.227×10^{-2}	4.047	6.796×10^{-2}	5.902	5.058×10^{-2}	4.486	5.362×10^{-3}	3.935	8.248×10^{-2}	4.032
56.0	5.280×10^{-2}	5.372	1.107×10^{-2}	4.061	6.547×10^{-2}	6.027	4.645×10^{-2}	4.563	4.984×10^{-3}	3.974	7.322×10^{-2}	4.011
58.0	4.975×10^{-2}	5.480	1.001×10^{-2}	4.078	6.285×10^{-2}	6.154	5.327×10^{-2}	4.636	4.631×10^{-3}	4.017	3.994×10^{-2}	3.997
60.0	4.693×10^{-2}	5.587	9.080×10^{-3}	4.100	6.015×10^{-2}	6.277	5.859×10^{-2}	4.710	4.302×10^{-3}	4.060	3.100×10^{-2}	3.989
62.0	4.424×10^{-2}	5.695	8.262×10^{-3}	4.124	5.742×10^{-2}	6.404	6.298×10^{-2}	4.786	3.999×10^{-3}	4.105	2.439×10^{-2}	3.985
64.0	4.165×10^{-2}	5.800	7.537×10^{-3}	4.151	5.825×10^{-2}	6.528	6.614×10^{-2}	4.861	3.717×10^{-3}	4.151	2.168×10^{-2}	3.987
66.0	3.915×10^{-2}	5.909	6.890×10^{-3}	4.180	5.441×10^{-2}	6.648	6.850×10^{-2}	4.936	3.457×10^{-3}	4.197	1.533×10^{-2}	3.993
68.0	3.673×10^{-2}	6.016	6.319×10^{-3}	4.212	5.192×10^{-2}	6.767	7.006×10^{-2}	5.009	3.219×10^{-3}	4.245	1.628×10^{-2}	4.003
70.0	3.439×10^{-2}	6.122	5.799×10^{-3}	4.245	4.950×10^{-2}	6.885	7.107×10^{-2}	5.085	2.9			

Table 7 (continued)

Energy (eV)	Li		Be		Na		Mg		Al		Si	
	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)
76.0	2.816×10^{-2}	6.439	4.556×10^{-3}	4.353	4.276×10^{-2}	7.250	7.043×10^{-2}	5.311	6.216×10^{-2}	4.444	1.003×10^{-2}	4.066
78.0	2.632×10^{-2}	6.542	4.219×10^{-3}	4.390	4.069×10^{-2}	7.366	6.937×10^{-2}	5.384	6.371×10^{-2}	4.495	1.258×10^{-2}	4.087
80.0	2.459×10^{-2}	6.648	3.909×10^{-3}	4.429	3.869×10^{-2}	7.480	6.805×10^{-2}	5.459	6.516×10^{-2}	4.546	1.096×10^{-2}	4.110
82.0	2.300×10^{-2}	6.752	3.636×10^{-3}	4.470	3.681×10^{-2}	7.596	6.641×10^{-2}	5.534	6.643×10^{-2}	4.598	9.842×10^{-3}	4.134
84.0	2.149×10^{-2}	6.857	3.380×10^{-3}	4.510	3.499×10^{-2}	7.713	6.462×10^{-2}	5.609	6.763×10^{-2}	4.650	9.589×10^{-3}	4.159
86.0	2.010×10^{-2}	6.955	3.151×10^{-3}	4.551	3.328×10^{-2}	7.824	6.268×10^{-2}	5.682	6.831×10^{-2}	4.702	8.469×10^{-3}	4.186
88.0	1.882×10^{-2}	7.058	2.943×10^{-3}	4.594	3.166×10^{-2}	7.942	6.063×10^{-2}	5.757	6.854×10^{-2}	4.755	7.175×10^{-3}	4.213
90.0	1.759×10^{-2}	7.162	2.747×10^{-3}	4.634	3.009×10^{-2}	8.048	6.349×10^{-2}	5.834	6.859×10^{-2}	4.807	6.884×10^{-3}	4.241
92.0	1.648×10^{-2}	7.264	2.572×10^{-3}	4.676	2.863×10^{-2}	8.162	6.072×10^{-2}	5.905	6.825×10^{-2}	4.860	6.546×10^{-3}	4.270
94.0	1.545×10^{-2}	7.365	2.412×10^{-3}	4.719	2.725×10^{-2}	8.270	5.852×10^{-2}	5.977	6.763×10^{-2}	4.913	6.764×10^{-3}	4.299
96.0	1.446×10^{-2}	7.466	2.260×10^{-3}	4.762	2.592×10^{-2}	8.378	5.632×10^{-2}	6.051	6.687×10^{-2}	4.965	5.493×10^{-3}	4.330
98.0	1.356×10^{-2}	7.567	2.123×10^{-3}	4.804	2.467×10^{-2}	8.485	5.417×10^{-2}	6.124	6.590×10^{-2}	5.018	5.351×10^{-3}	4.362
100.0	1.274×10^{-2}	7.666	1.998×10^{-3}	4.849	2.350×10^{-2}	8.597	5.206×10^{-2}	6.200	6.472×10^{-2}	5.070	4.814×10^{-3}	4.393
106.2	1.051×10^{-2}	7.977	1.662×10^{-3}	4.985	2.023×10^{-2}	8.925	4.582×10^{-2}	6.425	6.048×10^{-2}	5.229	4.767×10^{-2}	4.492
112.7	8.628×10^{-3}	8.294	6.616×10^{-2}	5.132	1.732×10^{-2}	9.260	3.983×10^{-2}	6.661	5.529×10^{-2}	5.398	4.563×10^{-2}	4.602
119.7	7.050×10^{-3}	8.634	4.472×10^{-2}	5.289	1.474×10^{-2}	9.614	3.427×10^{-2}	6.905	5.454×10^{-2}	5.579	4.290×10^{-2}	4.723
127.1	5.738×10^{-3}	8.992	3.708×10^{-2}	5.457	1.249×10^{-2}	9.978	2.924×10^{-2}	7.161	4.839×10^{-2}	5.770	3.947×10^{-2}	4.854
134.9	4.655×10^{-3}	9.371	3.066×10^{-2}	5.637	1.053×10^{-2}	10.374	2.477×10^{-2}	7.427	4.238×10^{-2}	5.973	3.565×10^{-2}	4.995
143.3	3.774×10^{-3}	9.775	2.532×10^{-2}	5.830	8.846×10^{-3}	10.792	2.089×10^{-2}	7.755	3.673×10^{-2}	6.189	3.170×10^{-2}	5.143
152.1	3.052×10^{-3}	10.188	2.084×10^{-2}	6.035	7.400×10^{-3}	11.235	1.753×10^{-2}	8.036	3.153×10^{-2}	6.422	3.074×10^{-2}	5.298
161.5	2.461×10^{-3}	10.629	1.710×10^{-2}	6.256	6.166×10^{-3}	11.700	1.465×10^{-2}	8.363	2.684×10^{-2}	6.673	2.681×10^{-2}	5.465
171.5	1.980×10^{-3}	11.091	1.399×10^{-2}	6.498	5.120×10^{-3}	12.187	1.220×10^{-2}	8.703	2.268×10^{-2}	6.937	2.314×10^{-2}	5.647
182.1	1.590×10^{-3}	11.579	1.142×10^{-2}	6.756	4.237×10^{-3}	12.701	1.012×10^{-2}	9.061	1.906×10^{-2}	7.214	1.980×10^{-2}	5.844
193.3	1.275×10^{-3}	12.080	9.294×10^{-3}	7.025	3.497×10^{-3}	13.237	8.378×10^{-3}	9.434	1.593×10^{-2}	7.506	1.681×10^{-2}	6.058
205.2	1.021×10^{-3}	12.609	7.549×10^{-3}	7.309	2.879×10^{-3}	13.811	6.919×10^{-3}	9.819	1.326×10^{-2}	7.813	1.418×10^{-2}	6.293
217.9	8.169×10^{-4}	13.173	6.120×10^{-3}	7.609	2.365×10^{-3}	14.408	5.703×10^{-3}	10.222	1.099×10^{-2}	8.130	1.190×10^{-2}	6.539
231.4	6.527×10^{-4}	13.767	4.953×10^{-3}	7.925	1.939×10^{-3}	15.044	4.690×10^{-3}	10.645	9.089×10^{-3}	8.462	9.928×10^{-3}	6.800
245.6	5.212×10^{-4}	14.389	4.003×10^{-3}	8.257	1.588×10^{-3}	15.713	3.853×10^{-3}	11.092	7.500×10^{-3}	8.809	8.256×10^{-3}	7.073
260.8	4.167×10^{-4}	15.048	3.237×10^{-3}	8.608	1.301×10^{-3}	16.418	3.165×10^{-3}	11.556	6.185×10^{-3}	9.174	6.852×10^{-3}	7.359
276.9	3.326×10^{-4}	15.739	2.612×10^{-3}	8.976	1.063×10^{-3}	17.169	2.595×10^{-3}	12.047	5.089×10^{-3}	9.552	5.667×10^{-3}	7.660
294.0	2.651×10^{-4}	16.466	2.103×10^{-3}	9.364	8.679×10^{-4}	17.958	2.123×10^{-3}	12.561	4.178×10^{-3}	9.950	4.674×10^{-3}	7.975
312.2	2.110×10^{-4}	17.236	1.691×10^{-3}	9.771	7.074×10^{-4}	18.787	1.735×10^{-3}	13.102	3.424×10^{-3}	10.367	3.844×10^{-3}	8.432
331.4	1.678×10^{-4}	18.044	1.358×10^{-3}	10.194	5.758×10^{-4}	19.678	1.415×10^{-3}	13.673	2.801×10^{-3}	10.808	3.155×10^{-3}	8.844
351.9	1.333×10^{-4}	18.893	1.088×10^{-3}	10.636	4.682×10^{-4}	20.613	1.153×10^{-3}	14.271	2.287×10^{-3}	11.270	2.584×10^{-3}	9.249
373.6	1.058×10^{-4}	19.791	8.712×10^{-4}	11.101	3.804×10^{-4}	21.585	9.383×10^{-4}	14.905	1.865×10^{-3}	11.753	2.113×10^{-3}	9.626
396.7	8.387×10^{-5}	20.856	6.967×10^{-4}	11.590	3.088×10^{-4}	22.619	7.626×10^{-4}	15.562	1.518×10^{-3}	12.265	1.725×10^{-3}	10.042
421.2	6.647×10^{-5}	21.953	5.565×10^{-4}	12.104	2.505×10^{-4}	23.710	6.190×10^{-4}	16.269	1.235×10^{-3}	12.799	1.406×10^{-3}	10.479
447.2	5.271×10^{-5}	23.112	4.447×10^{-4}	12.645	2.033×10^{-4}	24.869	5.025×10^{-4}	16.992	1.005×10^{-3}	13.370	1.146×10^{-3}	10.937
474.8	4.182×10^{-5}	24.263	3.553×10^{-4}	13.214	1.651×10^{-4}	26.091	4.080×10^{-4}	17.762	8.176×10^{-4}	13.963	9.337×10^{-4}	11.419
504.1	3.314×10^{-5}	25.443	2.835×10^{-4}	13.811	1.340×10^{-4}	27.356	3.308×10^{-4}	18.571	6.642×10^{-4}	14.587	7.594×10^{-4}	11.926
535.3	2.623×10^{-5}	26.677	2.258×10^{-4}	14.439	1.087×10^{-4}	28.701	2.679×10^{-4}	19.423	5.389×10^{-4}	15.250	6.168×10^{-4}	12.460
568.3	2.073×10^{-5}	27.961	1.796×10^{-4}	15.134	8.802×10^{-5}	30.135	2.167×10^{-4}	20.308	4.367×10^{-4}	15.942	5.002×10^{-4}	13.021
603.4	1.637×10^{-5}	29.308	1.427×10^{-4}	15.954	7.112×10^{-5}	31.641	1.751×10^{-4}	21.243	3.535×10^{-4}	16.676	4.053×10^{-4}	13.609
640.7	1.292×10^{-5}	30.724	1.132×10^{-4}	16.789	5.721×10^{-5}	33.452	1.414×10^{-4}	22.241	2.859×10^{-4}	17.444	3.280×10^{-4}	14.230
680.2	1.019×10^{-5}	32.253	8.977×10^{-5}	17.634	4.603×10^{-5}	35.393	1.141×10^{-4}	23.281	2.310×10^{-4}	18.257	2.652×10^{-4}	14.881
722.2	8.029×10^{-6}	33.852	7.112×10^{-5}	18.498	3.702×10^{-5}	37.183	9.203×10^{-5}	24.372	1.866×10^{-4}	19.110	2.143×10^{-4}	15.564
766.8	6.324×10^{-6}	35.527	5.632×10^{-5}	19.353	2.978×10^{-5}	39.120	7.421×10^{-5}	25.522	1.507×10^{-4}	20.207	1.731×10^{-4}	16.285
814.2	4.989×10^{-6}	37.303	4.466×10^{-5}	20.279	2.400×10^{-5}	41.182	5.994×10^{-5}	26.730	1.218×10^{-4}	21.232	1.400×10^{-4}	17.043
864.5	3.936×10^{-6}	39.179	3.542×10^{-5}	21.247	1.935×10^{-5}	43.354	4.844×10^{-5}	27.996	9.855×10^{-5}	22.288	1.132×10^{-4}	17.839
917.8	3.102×10^{-6}	41.142	2.805×10^{-5}	22.265	1.560×10^{-5}	45.629	3.912×10^{-5}	29.339	7.966×10^{-5}	23.424	9.151×10^{-5}	18.678
974.5	2.442×10^{-6}	43.208	2.220×10^{-5}	23.336	1.257×10^{-5}	47.966	3.155×10^{-5}	30.747	6.436×10^{-5}	24.641	7.393×10^{-5}	19.560
1034.7	1.915×10^{-6}	45.375	1.751×10^{-5}	24.463	1.007×10^{-5}	50.439	2.527×10^{-5}	32.202	5.173×10^{-5}	25.918	5.936×10^{-5}	20.489
1098.6	1.494×10^{-6}	47.686	1.374×10^{-5}	25.647	1.066×10^{-4}	53.001	2.009×10^{-5}	33.756	4.126×10^{-5}	27.238	4.724×10^{-5}	21.464
1166.4	1.163×10^{-6}	50.100	1.079×10^{-5}	26.897	1.103×10^{-4}	55.721	1.600×10^{-5}	35.410	3.297×10^{-5}	28.617	3.767×10^{-5}	22.493
1238.4	9.054×10^{-7}	52.649	8.474×10^{-6}	28.210	9.129×10^{-5}	58.605	1.275×10^{-5}	37.147	2.636×10^{-5}	30.049	3.006×10^{-5}	23.575
1314.9	7.049×10^{-7}	55.308	6.654×10^{-6}	29.592	7.006×10^{-5}	61.663	1.579×10^{-4}	38.951	2.108×10^{-5}	31.550	2.400×10^{-5}	24.713
1396.1	5.488×10^{-7}	58.144	5.224×10^{-6}	31.045	5.222×10^{-5}	64.867	1.215×10^{-4}	40.784	1.686×10^{-5}	33.148	1.918×10^{-5}	25.911
1482.3	4.285×10^{-7}	61.129	4.113×10^{-6}	32.577	4.102×10^{-5}	68.141	1.001×10^{-4}	42.795	1.347×10^{-5}	34.770	1.537×10^{-5}	27.171
1573.8	3.346×10^{-7}	64.274	3.237×10^{-6}	34.188	3.268×10^{-5}	71.660	8.004×10^{-5}	44.951	1.631×10^{-4}	36.458	1.233×10^{-5}	28.496

Table 8
ELF and IMFP data calculated for K, Ca, Sc, Ti, V and Cr.

Energy (eV)	K		Ca		Sc		Ti		V		Cr	
	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)
1.0	1.333×10^{-2}	52.230	3.586×10^{-2}	121.023	3.008×10^{-2}	182.280	2.321×10^{-2}	251.400	1.099×10^{-2}	325.281	2.567×10^{-2}	366.090
2.0	5.940×10^{-2}	18.725	6.360×10^{-2}	42.437	5.021×10^{-2}	66.875	3.325×10^{-2}	92.366	4.155×10^{-2}	105.531	2.434×10^{-2}	135.303
3.0	4.122×10^{-1}	10.247	2.469×10^{-1}	23.035	1.061×10^{-1}	38.409	6.051×10^{-2}	53.387	3.329×10^{-2}	60.339	2.443×10^{-2}	79.010
4.0	$2.149 \times 10^{+0}$	6.834	4.888×10^{-1}	14.899	1.209×10^{-1}	26.328	5.260×10^{-2}	36.942	3.230×10^{-2}	42.641	2.860×10^{-2}	54.791
5.0	3.010×10^{-1}	5.412	2.243×10^{-1}	11.136	3.928×10^{-1}	19.840	8.742×10^{-2}	28.233	5.667×10^{-2}	33.014	4.439×10^{-2}	41.527
6.0	2.477×10^{-1}	4.773	4.464×10^{-1}	9.126	1.072×10^{-1}	15.940	3.085×10^{-1}	22.715	1.458×10^{-1}	26.834	1.281×10^{-1}	33.106
7.0	2.348×10^{-1}	4.441	$1.631 \times 10^{+0}$	7.824	3.170×10^{-1}	13.470	1.498×10^{-1}	18.849	1.068×10^{-1}	22.418	8.870×10^{-2}	27.253
8.0	1.189×10^{-1}	4.272	$3.196 \times 10^{+0}$	6.886	2.767×10^{-1}	11.767	2.277×10^{-1}	16.107	1.450×10^{-1}	19.216	1.245×10^{-1}	23.064
9.0	4.090×10^{-2}	4.188	9.839×10^{-1}	6.193	3.713×10^{-1}	10.512	5.394×10^{-1}	14.130	2.646×10^{-1}	16.831	2.468×10^{-1}	20.004
10.0	1.590×10^{-2}	4.158	3.354×10^{-1}	5.695	7.004×10^{-1}	9.527	3.471×10^{-1}	12.592	9.161×10^{-1}	14.992	7.193×10^{-1}	17.640
11.0	9.885×10^{-3}	4.162	1.895×10^{-1}	5.335	$1.359 \times 10^{+0}$	8.743	3.729×10^{-1}	11.381	5.913×10^{-1}	13.501	4.456×10^{-1}	15.732
12.0	7.673×10^{-3}	4.193	7.751×10^{-2}	5.070	$2.975 \times 10^{+0}$	8.096	5.024×10^{-1}	10.403	4.295×10^{-1}	12.273	5.730×10^{-1}	14.147
13.0	6.003×10^{-3}	4.236	3.746×10^{-2}	4.874	$2.451 \times 10^{+0}$	7.556	8.013×10^{-1}	9.614	4.703×10^{-1}	11.238	4.974×10^{-1}	12.837
14.0	6.281×10^{-3}	4.291	2.531×10^{-2}	4.732	$1.144 \times 10^{+0}$	7.101	9.837×10^{-1}	8.969	5.764×10^{-1}	10.382	5.197×10^{-1}	11.767
15.0	9.225×10^{-3}	4.352	2.278×10^{-2}	4.627	5.230×10^{-1}	6.716	$1.378 \times 10^{+0}$	8.431	6.818×10^{-1}	9.668	5.816×10^{-1}	10.885
16.0	8.371×10^{-2}	4.422	1.992×10^{-2}	4.550	2.913×10^{-1}	6.390	$1.838 \times 10^{+0}$	7.973	7.066×10^{-1}	9.069	6.814×10^{-1}	10.155
17.0	1.234×10^{-1}	4.495	1.787×10^{-2}	4.499	1.906×10^{-1}	6.110	$2.248 \times 10^{+0}$	7.585	6.061×10^{-1}	8.565	7.533×10^{-1}	9.546
18.0	1.599×10^{-1}	4.568	1.613×10^{-2}	4.465	1.316×10^{-1}	5.870	$1.772 \times 10^{+0}$	7.251	$1.049 \times 10^{+0}$	8.136	6.801×10^{-1}	9.029
19.0	2.520×10^{-1}	4.639	1.558×10^{-2}	4.445	9.350×10^{-2}	5.665	$1.193 \times 10^{+0}$	6.960	$1.578 \times 10^{+0}$	7.768	5.867×10^{-1}	8.585
20.0	2.183×10^{-1}	4.716	1.851×10^{-2}	4.439	6.816×10^{-2}	5.488	7.088×10^{-1}	6.705	$1.957 \times 10^{+0}$	7.451	8.478×10^{-1}	8.203
21.0	3.433×10^{-1}	4.790	1.310×10^{-2}	4.437	5.635×10^{-2}	5.335	5.006×10^{-1}	6.477	$1.680 \times 10^{+0}$	7.173	9.529×10^{-1}	7.869
22.0	3.193×10^{-1}	4.864	1.539×10^{-2}	4.444	4.794×10^{-2}	5.204	3.402×10^{-1}	6.277	$1.858 \times 10^{+0}$	6.932	$1.118 \times 10^{+0}$	7.579
23.0	$1.358 \times 10^{+0}$	4.939	2.632×10^{-2}	4.458	3.610×10^{-2}	5.091	2.210×10^{-1}	6.097	$1.253 \times 10^{+0}$	6.717	$1.263 \times 10^{+0}$	7.322
24.0	$1.043 \times 10^{+0}$	5.012	2.220×10^{-1}	4.476	3.239×10^{-2}	4.997	1.570×10^{-1}	5.934	$1.071 \times 10^{+0}$	6.524	$1.716 \times 10^{+0}$	7.094
25.0	4.599×10^{-1}	5.084	2.595×10^{-1}	4.497	2.759×10^{-2}	4.917	1.349×10^{-1}	5.789	8.772×10^{-1}	6.354	$2.828 \times 10^{+0}$	6.888
26.0	5.822×10^{-1}	5.156	4.183×10^{-1}	4.520	2.795×10^{-2}	4.850	1.141×10^{-1}	5.655	5.846×10^{-1}	6.199	$1.494 \times 10^{+0}$	6.706
27.0	4.134×10^{-1}	5.229	3.552×10^{-1}	4.549	2.664×10^{-2}	4.793	9.350×10^{-2}	5.535	3.869×10^{-1}	6.060	$1.241 \times 10^{+0}$	6.540
28.0	2.714×10^{-1}	5.289	$1.258 \times 10^{+0}$	4.578	7.445×10^{-2}	4.747	7.583×10^{-2}	5.426	2.244×10^{-1}	5.933	8.137×10^{-1}	6.389
29.0	2.301×10^{-1}	5.359	$2.382 \times 10^{+0}$	4.608	1.601×10^{-1}	4.709	6.240×10^{-2}	5.327	1.911×10^{-1}	5.816	8.440×10^{-1}	6.253
30.0	1.071×10^{-1}	5.425	$1.755 \times 10^{+0}$	4.640	4.363×10^{-1}	4.677	4.484×10^{-2}	5.236	1.648×10^{-1}	5.710	6.392×10^{-1}	6.128
31.0	8.583×10^{-2}	5.489	$1.146 \times 10^{+0}$	4.672	4.199×10^{-1}	4.652	3.611×10^{-2}	5.155	1.389×10^{-1}	5.612	4.796×10^{-1}	6.013
32.0	1.107×10^{-1}	5.553	5.026×10^{-1}	4.706	3.033×10^{-1}	4.633	3.208×10^{-2}	5.082	1.408×10^{-1}	5.522	3.619×10^{-1}	5.908
33.0	6.389×10^{-2}	5.611	2.302×10^{-1}	4.739	$1.068 \times 10^{+0}$	4.618	7.541×10^{-2}	5.014	9.951×10^{-2}	5.438	3.357×10^{-1}	5.813
34.0	4.226×10^{-2}	5.672	2.406×10^{-1}	4.773	$4.864 \times 10^{+0}$	4.607	2.973×10^{-1}	4.956	1.162×10^{-1}	5.361	2.226×10^{-1}	5.722
35.0	2.390×10^{-2}	5.729	9.174×10^{-2}	4.806	7.251×10^{-1}	4.602	4.992×10^{-1}	4.902	9.823×10^{-2}	5.289	2.197×10^{-1}	5.639
36.0	2.061×10^{-2}	5.785	8.086×10^{-2}	4.841	$2.125 \times 10^{+0}$	4.597	3.548×10^{-1}	4.853	6.626×10^{-2}	5.221	2.181×10^{-1}	5.563
37.0	1.727×10^{-2}	5.837	7.985×10^{-2}	4.876	$1.488 \times 10^{+0}$	4.597	4.771×10^{-1}	4.809	6.097×10^{-2}	5.160	1.823×10^{-1}	5.491
38.0	2.159×10^{-2}	5.891	8.610×10^{-2}	4.910	6.949×10^{-1}	4.598	$1.441 \times 10^{+0}$	4.773	1.873×10^{-1}	5.102	1.997×10^{-1}	5.423
39.0	1.927×10^{-2}	5.943	5.861×10^{-2}	4.944	6.673×10^{-1}	4.602	$3.183 \times 10^{+0}$	4.738	1.901×10^{-1}	5.048	1.527×10^{-1}	5.362
40.0	2.173×10^{-2}	5.995	7.732×10^{-2}	4.977	3.553×10^{-1}	4.606	$3.165 \times 10^{+0}$	4.708	2.794×10^{-1}	4.998	1.131×10^{-1}	5.303
41.0	1.686×10^{-2}	6.034	5.976×10^{-2}	5.010	2.132×10^{-1}	4.613	7.239×10^{-1}	4.683	4.725×10^{-1}	4.952	8.187×10^{-2}	5.248
42.0	1.582×10^{-2}	6.079	4.379×10^{-2}	5.046	1.369×10^{-1}	4.621	$1.179 \times 10^{+0}$	4.660	$1.109 \times 10^{+0}$	4.908	6.176×10^{-2}	5.196
43.0	1.487×10^{-2}	6.123	3.480×10^{-2}	5.077	1.556×10^{-1}	4.630	$1.334 \times 10^{+0}$	4.641	$2.642 \times 10^{+0}$	4.869	8.152×10^{-2}	5.148
44.0	1.402×10^{-2}	6.165	2.046×10^{-2}	5.110	9.319×10^{-2}	4.641	$1.000 \times 10^{+0}$	4.624	$3.003 \times 10^{+0}$	4.833	2.471×10^{-1}	5.103
45.0	1.330×10^{-2}	6.203	1.846×10^{-2}	5.141	7.666×10^{-2}	4.653	5.622×10^{-1}	4.610	$1.876 \times 10^{+0}$	4.799	4.023×10^{-1}	5.060
46.0	1.263×10^{-2}	6.244	1.880×10^{-2}	5.172	6.937×10^{-2}	4.664	5.511×10^{-1}	4.598	9.972×10^{-1}	4.769	7.388×10^{-1}	5.020
47.0	1.204×10^{-2}	6.278	1.801×10^{-2}	5.203	5.727×10^{-2}	4.676	4.094×10^{-1}	4.588	4.850×10^{-1}	4.740	$2.269 \times 10^{+0}$	4.983
48.0	1.151×10^{-2}	6.314	2.462×10^{-2}	5.233	6.516×10^{-2}	4.690	2.983×10^{-1}	4.581	$1.082 \times 10^{+0}$	4.714	$2.722 \times 10^{+0}$	4.948
49.0	1.102×10^{-2}	6.348	2.129×10^{-2}	5.262	4.561×10^{-2}	4.703	2.608×10^{-1}	4.575	9.812×10^{-1}	4.691	$1.873 \times 10^{+0}$	4.914
50.0	1.056×10^{-2}	6.383	1.545×10^{-2}	5.291	4.309×10^{-2}	4.718	1.723×10^{-1}	4.571	7.306×10^{-1}	4.670	$1.287 \times 10^{+0}$	4.884
52.0	9.779×10^{-3}	6.450	1.565×10^{-2}	5.347	5.068×10^{-2}	4.747	1.605×10^{-1}	4.569	4.527×10^{-1}	4.634	4.896×10^{-1}	4.828
54.0	9.098×10^{-3}	6.507	1.078×10^{-2}	5.403	4.152×10^{-2}	4.776	1.034×10^{-1}	4.569	2.774×10^{-1}	4.607	7.046×10^{-1}	4.780
56.0	8.509×10^{-3}	6.571	1.012×10^{-2}	5.451	3.172×10^{-2}	4.806	9.465×10^{-2}	4.574	2.664×10^{-1}	4.584	5.252×10^{-1}	4.739
58.0	7.989×10^{-3}	6.632	1.114×10^{-2}	5.499	2.912×10^{-2}	4.835	7.776×10^{-2}	4.582	1.622×10^{-1}	4.569	3.675×10^{-1}	4.704
60.0	7.525×10^{-3}	6.698	1.089×10^{-2}	5.546	2.352×10^{-2}	4.865	5.636×10^{-2}	4.592	1.735×10^{-1}	4.558	2.891×10^{-1}	4.676
62.0	7.109×10^{-3}	6.762	1.066×10^{-2}	5.590	2.295×10^{-2}	4.894	5.642×10^{-2}	4.605	1.773×10^{-1}	4.551	2.858×10^{-1}	4.652
64.0	6.732×10^{-3}	6.828	1.047×10^{-2}	5.632	2.241×10^{-2}	4.921	5.493×10^{-2}	4.619	1.578×10^{-1}	4.548	2.067×10^{-1}	4.632
66.0	6.388×10^{-3}	6.900	1.029×10^{-2}	5.675	1.880×10^{-2}	4.948	5.781×10^{-2}	4.634	1.161×10^{-1}	4.548	1.946×10^{-1}	4.617
68.0	6.075×10^{-3}	6.976	1.011×10^{-2}	5.717	1.528×10^{-2}	4.974	5.273×10^{-2}	4.650	8.877×10^{-2}	4.551	2.036×10^{-1}	4.606
70.0	5.783×10^{-3}	7.046	9.940×10^{-3}	5.763	1.431×10^{-2}	4.999	3.796×10^{-2}					

Table 8 (continued)

Energy (eV)	K		Ca		Sc		Ti		V		Cr	
	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)
76.0	5.036×10^{-3}	7.289	9.420×10^{-3}	5.893	1.382×10^{-2}	5.071	2.711×10^{-2}	4.717	5.646×10^{-2}	4.581	1.141×10^{-1}	4.593
78.0	4.819×10^{-3}	7.375	9.245×10^{-3}	5.939	1.361×10^{-2}	5.094	2.054×10^{-2}	4.734	5.468×10^{-2}	4.592	9.061×10^{-2}	4.594
80.0	4.614×10^{-3}	7.458	9.069×10^{-3}	5.988	1.341×10^{-2}	5.116	2.342×10^{-2}	4.752	4.949×10^{-2}	4.603	1.026×10^{-1}	4.599
82.0	4.426×10^{-3}	7.544	8.891×10^{-3}	6.037	1.322×10^{-2}	5.139	2.000×10^{-2}	4.768	4.672×10^{-2}	4.616	8.250×10^{-2}	4.604
84.0	4.244×10^{-3}	7.634	8.713×10^{-3}	6.089	1.302×10^{-2}	5.162	1.845×10^{-2}	4.785	4.522×10^{-2}	4.629	7.556×10^{-2}	4.613
86.0	4.075×10^{-3}	7.725	8.534×10^{-3}	6.140	1.283×10^{-2}	5.186	1.760×10^{-2}	4.801	4.354×10^{-2}	4.643	6.897×10^{-2}	4.622
88.0	3.916×10^{-3}	7.817	8.355×10^{-3}	6.192	1.263×10^{-2}	5.210	1.730×10^{-2}	4.818	4.169×10^{-2}	4.658	5.929×10^{-2}	4.632
90.0	3.763×10^{-3}	7.906	8.175×10^{-3}	6.248	1.244×10^{-2}	5.236	1.731×10^{-2}	4.835	3.993×10^{-2}	4.673	5.487×10^{-2}	4.643
92.0	3.620×10^{-3}	7.999	7.995×10^{-3}	6.305	1.224×10^{-2}	5.260	1.712×10^{-2}	4.854	3.834×10^{-2}	4.687	6.525×10^{-2}	4.655
94.0	3.485×10^{-3}	8.090	7.815×10^{-3}	6.362	1.204×10^{-2}	5.288	1.687×10^{-2}	4.871	3.686×10^{-2}	4.702	4.474×10^{-2}	4.667
96.0	3.354×10^{-3}	8.184	7.635×10^{-3}	6.420	1.185×10^{-2}	5.316	1.661×10^{-2}	4.888	3.545×10^{-2}	4.716	4.114×10^{-2}	4.680
98.0	3.232×10^{-3}	8.278	7.457×10^{-3}	6.480	1.165×10^{-2}	5.347	1.635×10^{-2}	4.907	3.415×10^{-2}	4.731	4.121×10^{-2}	4.692
100.0	3.116×10^{-3}	8.375	7.280×10^{-3}	6.538	1.145×10^{-2}	5.378	1.609×10^{-2}	4.925	3.295×10^{-2}	4.746	4.275×10^{-2}	4.706
106.2	2.789×10^{-3}	8.668	6.739×10^{-3}	6.726	1.082×10^{-2}	5.482	1.529×10^{-2}	4.984	2.962×10^{-2}	4.791	3.950×10^{-2}	4.748
112.7	2.490×10^{-3}	8.979	6.181×10^{-3}	6.931	1.016×10^{-2}	5.601	1.443×10^{-2}	5.054	2.665×10^{-2}	4.842	3.483×10^{-2}	4.794
119.7	2.216×10^{-3}	9.311	5.616×10^{-3}	7.154	9.456×10^{-3}	5.736	1.352×10^{-2}	5.135	2.398×10^{-2}	4.901	3.103×10^{-2}	4.845
127.1	1.966×10^{-3}	9.658	5.056×10^{-3}	7.395	8.732×10^{-3}	5.885	1.258×10^{-2}	5.231	2.156×10^{-2}	4.969	2.769×10^{-2}	4.902
134.9	1.740×10^{-3}	10.036	4.513×10^{-3}	7.650	7.993×10^{-3}	6.051	1.160×10^{-2}	5.341	1.934×10^{-2}	5.048	2.472×10^{-2}	4.966
143.3	1.536×10^{-3}	10.441	3.999×10^{-3}	7.920	7.249×10^{-3}	6.229	1.062×10^{-2}	5.467	1.732×10^{-2}	5.142	2.208×10^{-2}	5.042
152.1	1.351×10^{-3}	10.882	3.517×10^{-3}	8.204	6.513×10^{-3}	6.419	9.634×10^{-3}	5.606	1.545×10^{-2}	5.249	1.970×10^{-2}	5.129
161.5	1.184×10^{-3}	11.358	3.072×10^{-3}	8.580	5.800×10^{-3}	6.625	8.662×10^{-3}	5.761	1.372×10^{-2}	5.370	1.753×10^{-2}	5.229
171.5	1.035×10^{-3}	11.858	2.666×10^{-3}	8.943	5.123×10^{-3}	6.854	7.721×10^{-3}	5.928	1.211×10^{-2}	5.504	1.554×10^{-2}	5.343
182.1	9.012×10^{-4}	12.383	2.301×10^{-3}	9.318	4.489×10^{-3}	7.111	6.828×10^{-3}	6.106	1.064×10^{-2}	5.652	1.373×10^{-2}	5.469
193.3	7.825×10^{-4}	12.944	1.975×10^{-3}	9.711	3.906×10^{-3}	7.391	5.993×10^{-3}	6.296	9.287×10^{-3}	5.813	1.206×10^{-2}	5.607
205.2	6.774×10^{-4}	13.531	1.688×10^{-3}	10.127	3.376×10^{-3}	7.688	5.225×10^{-3}	6.508	8.067×10^{-3}	5.986	1.054×10^{-2}	5.760
217.9	5.847×10^{-4}	14.143	1.437×10^{-3}	10.562	2.902×10^{-3}	8.000	4.526×10^{-3}	6.750	6.970×10^{-3}	6.170	9.158×10^{-3}	5.925
231.4	5.033×10^{-4}	14.787	1.219×10^{-3}	11.023	2.481×10^{-3}	8.330	3.899×10^{-3}	7.013	5.994×10^{-3}	6.368	7.917×10^{-3}	6.187
245.6	4.324×10^{-4}	15.475	1.031×10^{-3}	11.506	2.112×10^{-3}	8.676	3.344×10^{-3}	7.290	5.134×10^{-3}	6.595	6.813×10^{-3}	6.398
260.8	3.709×10^{-4}	16.195	8.712×10^{-4}	12.017	1.793×10^{-3}	9.042	2.858×10^{-3}	7.585	4.384×10^{-3}	6.941	5.841×10^{-3}	6.640
276.9	3.175×10^{-4}	16.951	7.344×10^{-4}	12.552	1.517×10^{-3}	9.425	2.432×10^{-3}	7.894	3.729×10^{-3}	7.264	4.986×10^{-3}	6.894
294.0	9.074×10^{-5}	17.745	6.179×10^{-4}	13.115	1.279×10^{-3}	9.830	2.063×10^{-3}	8.220	3.161×10^{-3}	7.547	4.239×10^{-3}	7.161
312.2	2.754×10^{-3}	18.581	5.189×10^{-4}	13.707	1.076×10^{-3}	10.256	1.744×10^{-3}	8.564	2.671×10^{-3}	7.857	3.590×10^{-3}	7.442
331.4	2.300×10^{-3}	19.471	4.349×10^{-4}	14.331	9.026×10^{-4}	10.706	1.470×10^{-3}	8.927	2.251×10^{-3}	8.183	3.030×10^{-3}	7.738
351.9	1.915×10^{-3}	20.404	4.078×10^{-3}	14.987	7.559×10^{-4}	11.177	1.236×10^{-3}	9.310	1.893×10^{-3}	8.522	2.551×10^{-3}	8.049
373.6	1.584×10^{-3}	21.380	3.356×10^{-3}	15.680	6.320×10^{-4}	11.674	1.038×10^{-3}	9.858	1.588×10^{-3}	8.879	2.141×10^{-3}	8.376
396.7	1.487×10^{-3}	22.413	2.772×10^{-3}	16.403	5.273×10^{-4}	12.196	8.698×10^{-4}	10.321	1.330×10^{-3}	9.255	1.794×10^{-3}	8.722
421.2	1.231×10^{-3}	23.486	2.285×10^{-3}	17.165	4.669×10^{-4}	12.745	7.279×10^{-4}	10.787	1.112×10^{-3}	9.650	1.500×10^{-3}	9.084
447.2	1.019×10^{-3}	24.636	2.128×10^{-3}	17.969	3.852×10^{-4}	13.325	6.088×10^{-4}	11.258	9.298×10^{-4}	10.066	1.254×10^{-3}	9.467
474.8	8.413×10^{-4}	25.836	1.764×10^{-3}	18.818	3.175×10^{-4}	13.933	5.304×10^{-4}	11.767	7.773×10^{-4}	10.504	1.048×10^{-3}	9.870
504.1	6.930×10^{-4}	27.115	1.456×10^{-3}	19.709	3.011×10^{-4}	14.572	4.374×10^{-4}	12.298	6.475×10^{-4}	10.965	8.740×10^{-4}	10.293
535.3	5.694×10^{-4}	28.449	1.199×10^{-3}	20.645	2.444×10^{-4}	15.247	3.591×10^{-4}	12.858	5.334×10^{-4}	11.449	7.283×10^{-4}	10.740
568.3	4.667×10^{-4}	29.844	9.852×10^{-4}	21.626	2.014×10^{-4}	15.953	3.413×10^{-4}	13.445	4.382×10^{-4}	11.960	6.047×10^{-4}	11.208
603.4	3.818×10^{-4}	31.459	8.077×10^{-4}	22.664	1.656×10^{-4}	16.698	2.755×10^{-4}	14.060	3.581×10^{-4}	12.496	4.949×10^{-4}	11.702
640.7	3.117×10^{-4}	33.244	6.610×10^{-4}	23.757	1.359×10^{-4}	17.484	2.264×10^{-4}	14.711	3.330×10^{-4}	13.060	4.021×10^{-4}	12.222
680.2	2.540×10^{-4}	34.981	5.400×10^{-4}	24.905	1.112×10^{-4}	18.309	1.858×10^{-4}	15.391	2.741×10^{-4}	13.655	3.258×10^{-4}	12.769
722.2	2.067×10^{-4}	36.725	4.406×10^{-4}	26.113	9.084×10^{-5}	19.177	1.522×10^{-4}	16.111	2.250×10^{-4}	14.278	3.025×10^{-4}	13.344
766.8	1.679×10^{-4}	38.541	3.588×10^{-4}	27.378	7.410×10^{-5}	20.088	1.246×10^{-4}	16.862	1.843×10^{-4}	14.934	2.478×10^{-4}	13.950
814.2	1.365×10^{-4}	40.520	2.921×10^{-4}	28.720	6.047×10^{-5}	21.300	1.018×10^{-4}	17.657	1.511×10^{-4}	15.626	2.032×10^{-4}	14.587
864.5	1.109×10^{-4}	42.565	2.377×10^{-4}	30.132	4.929×10^{-5}	22.428	8.312×10^{-5}	18.490	1.238×10^{-4}	16.352	1.666×10^{-4}	15.257
917.8	8.988×10^{-5}	44.732	1.931×10^{-4}	31.611	4.010×10^{-5}	23.554	6.778×10^{-5}	19.368	1.011×10^{-4}	17.116	1.363×10^{-4}	15.962
974.5	7.278×10^{-5}	47.009	1.566×10^{-4}	33.177	3.257×10^{-5}	24.666	5.522×10^{-5}	20.291	8.245×10^{-5}	17.921	1.114×10^{-4}	16.703
1034.7	5.880×10^{-5}	49.403	1.267×10^{-4}	34.825	2.638×10^{-5}	25.866	4.477×10^{-5}	21.262	6.695×10^{-5}	18.764	9.060×10^{-5}	17.482
1098.6	4.740×10^{-5}	51.906	1.022×10^{-4}	36.558	2.128×10^{-5}	27.137	3.606×10^{-5}	22.283	5.400×10^{-5}	19.654	7.316×10^{-5}	18.301
1166.4	3.814×10^{-5}	54.570	8.230×10^{-5}	38.362	1.716×10^{-5}	28.465	2.906×10^{-5}	23.357	4.352×10^{-5}	20.589	5.910×10^{-5}	19.165
1238.4	3.057×10^{-5}	57.304	6.626×10^{-5}	40.277	1.382×10^{-5}	29.864	2.340×10^{-5}	24.488	3.508×10^{-5}	21.573	4.767×10^{-5}	20.073
1314.9	2.444×10^{-5}	60.247	5.333×10^{-5}	42.293	1.112×10^{-5}	31.342	1.885×10^{-5}	25.679	2.826×10^{-5}	22.607	3.842×10^{-5}	21.027
1396.1	1.955×10^{-5}	63.354	4.291×10^{-5}	44.435	8.952×10^{-6}	32.892	1.519×10^{-5}	26.930	2.277×10^{-5}	23.697	3.096×10^{-5}	22.030
1482.3	1.570×10^{-5}	66.638	3.443×10^{-5}	46.692	7.220×10^{-6}	34.520	1.227×10^{-5}	28.247	1.839×10^{-5}	24.840	2.500×10^{-5}	23.086
1573.8	1.258×10^{-5}	70.089	2.763×10^{-5}	49.053	5.823×10^{-6}	36.239	9.907×10^{-6}	29.632	1.485×10^{-5}	26.047	2.018×10^{-5}	24.197
1671.0	1.007×10											

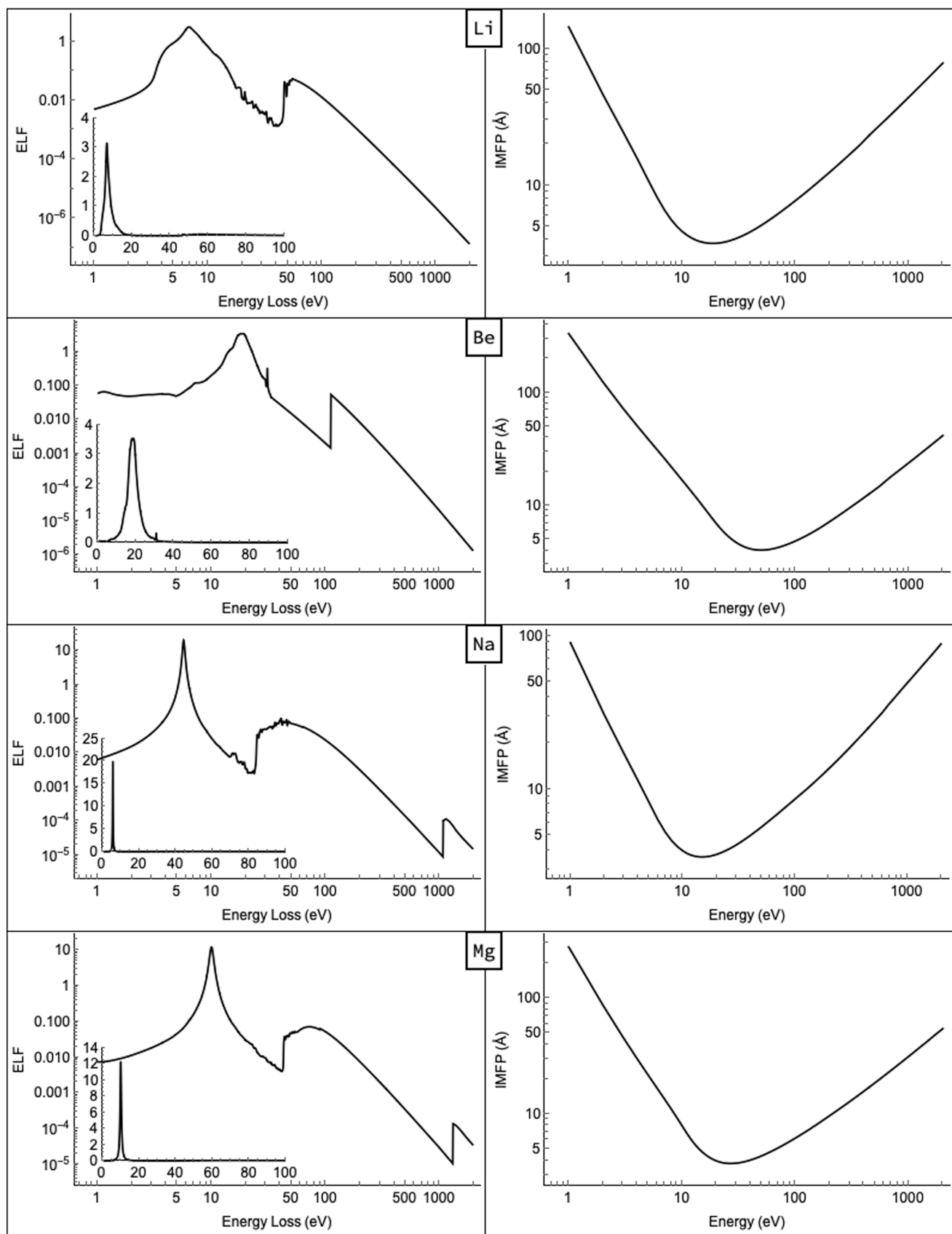


Figure 11

Optical energy-loss functions (ELFs, left) and resulting inelastic mean free paths (IMFPs, right) for the elements Li, Be, Na and Mg. The insets in the ELF plots are magnifications of the low-energy spectra.

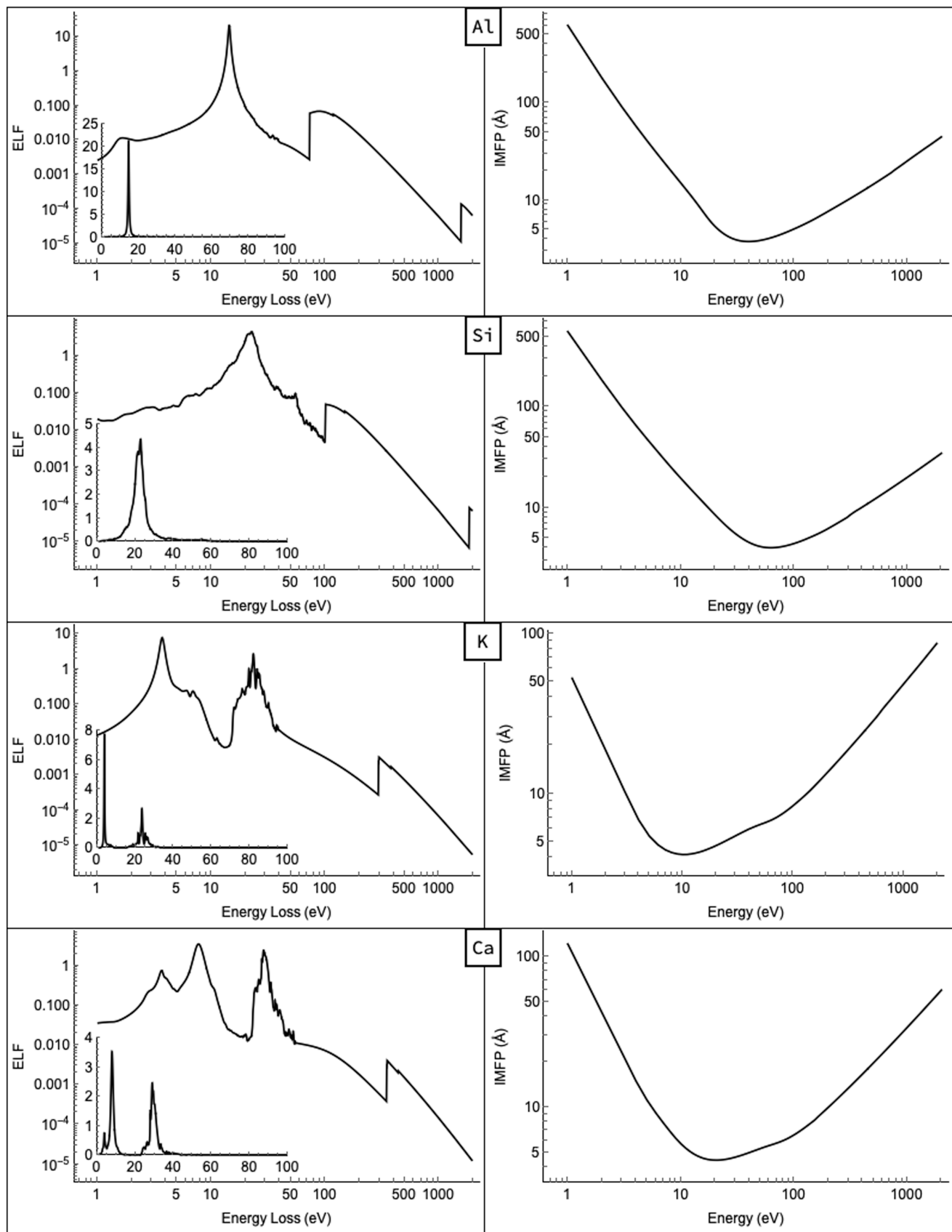


Figure 12
Optical energy-loss functions (ELFs, left) and resulting inelastic mean free paths (IMFPs, right) for the elements Al, Si, K and Ca. The insets in the ELF plots are magnifications of the low-energy spectra.

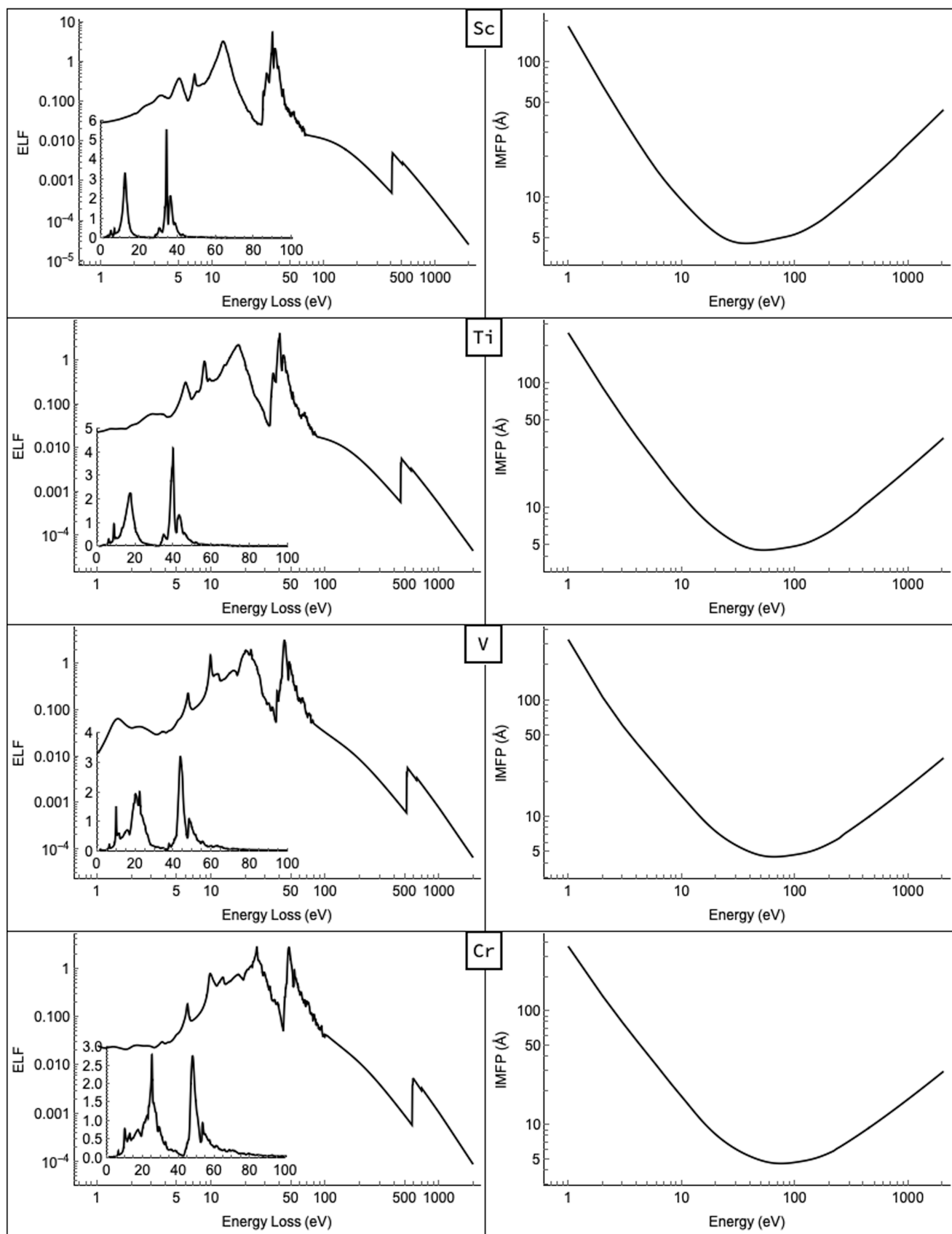


Figure 13

Optical energy-loss functions (ELFs, left) and resulting inelastic mean free paths (IMFPs, right) for the elements Sc, Ti, V and Cr. The insets in the ELF plots are magnifications of the low-energy spectra.

Table 9
ELF and IMFP data calculated for Fe, Co, Ni, Cu, Zn and Ga.

Energy (eV)	Fe		Co		Ni		Cu		Zn		Ga	
	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)
1.0	1.078×10^{-2}	478.401	9.993×10^{-3}	532.792	1.074×10^{-2}	465.988	3.150×10^{-3}	505.838	1.674×10^{-2}	374.014	9.115×10^{-3}	477.105
2.0	2.465×10^{-2}	154.690	2.437×10^{-2}	167.591	3.197×10^{-2}	144.162	4.718×10^{-2}	136.985	1.578×10^{-2}	129.822	2.658×10^{-2}	145.643
3.0	2.667×10^{-2}	84.747	4.148×10^{-2}	88.436	7.022×10^{-2}	74.242	1.046×10^{-1}	65.907	1.958×10^{-2}	72.664	2.848×10^{-2}	76.633
4.0	5.877×10^{-2}	56.272	8.484×10^{-2}	56.628	1.564×10^{-1}	46.794	1.757×10^{-1}	40.751	2.744×10^{-2}	48.591	4.058×10^{-2}	49.855
5.0	1.837×10^{-1}	40.638	2.547×10^{-1}	39.452	1.182×10^{-1}	33.069	1.518×10^{-1}	29.163	4.122×10^{-2}	35.660	5.288×10^{-2}	36.116
6.0	9.315×10^{-2}	31.137	1.190×10^{-1}	29.748	1.498×10^{-1}	25.745	2.295×10^{-1}	22.849	7.519×10^{-2}	27.723	7.077×10^{-2}	27.945
7.0	1.507×10^{-1}	25.242	2.604×10^{-1}	24.002	3.035×10^{-1}	21.297	3.017×10^{-1}	18.892	2.339×10^{-1}	22.340	9.469×10^{-2}	22.576
8.0	4.430×10^{-1}	21.259	3.796×10^{-1}	20.128	3.283×10^{-1}	18.146	3.567×10^{-1}	16.141	7.632×10^{-1}	18.308	1.488×10^{-1}	18.800
9.0	4.487×10^{-1}	18.249	3.884×10^{-1}	17.266	3.814×10^{-1}	15.814	4.230×10^{-1}	14.135	8.668×10^{-1}	15.149	2.292×10^{-1}	15.994
10.0	4.028×10^{-1}	15.911	4.802×10^{-1}	15.113	4.247×10^{-1}	14.048	5.476×10^{-1}	12.628	9.242×10^{-1}	12.738	3.440×10^{-1}	13.827
11.0	5.083×10^{-1}	14.105	5.318×10^{-1}	13.488	5.635×10^{-1}	12.686	5.574×10^{-1}	11.462	$1.076 \times 10^{+0}$	10.966	8.010×10^{-1}	12.099
12.0	4.959×10^{-1}	12.716	5.655×10^{-1}	12.227	5.208×10^{-1}	11.615	5.215×10^{-1}	10.530	$1.372 \times 10^{+0}$	9.668	$2.606 \times 10^{+0}$	10.678
13.0	5.344×10^{-1}	11.623	5.802×10^{-1}	11.225	5.239×10^{-1}	10.752	5.266×10^{-1}	9.784	$1.336 \times 10^{+0}$	8.688	$6.155 \times 10^{+0}$	9.486
14.0	6.072×10^{-1}	10.745	5.398×10^{-1}	10.413	4.594×10^{-1}	10.044	5.397×10^{-1}	9.167	$1.165 \times 10^{+0}$	7.934	$1.598 \times 10^{+0}$	8.481
15.0	6.949×10^{-1}	10.024	5.478×10^{-1}	9.745	4.834×10^{-1}	9.454	5.898×10^{-1}	8.658	$1.043 \times 10^{+0}$	7.345	6.570×10^{-1}	7.652
16.0	7.277×10^{-1}	9.427	6.030×10^{-1}	9.191	5.701×10^{-1}	8.966	7.005×10^{-1}	8.233	9.034×10^{-1}	6.869	9.119×10^{-1}	6.986
17.0	6.588×10^{-1}	8.920	6.704×10^{-1}	8.722	6.455×10^{-1}	8.547	8.054×10^{-1}	7.866	8.623×10^{-1}	6.486	6.841×10^{-1}	6.460
18.0	6.283×10^{-1}	8.490	7.139×10^{-1}	8.324	7.074×10^{-1}	8.188	9.190×10^{-1}	7.554	$1.004 \times 10^{+0}$	6.174	6.538×10^{-1}	6.044
19.0	6.356×10^{-1}	8.122	7.462×10^{-1}	7.982	7.754×10^{-1}	7.879	$1.033 \times 10^{+0}$	7.284	$1.198 \times 10^{+0}$	5.914	5.761×10^{-1}	5.710
20.0	6.531×10^{-1}	7.798	7.870×10^{-1}	7.684	8.540×10^{-1}	7.609	$1.018 \times 10^{+0}$	7.045	9.231×10^{-1}	5.696	5.885×10^{-1}	5.437
21.0	8.275×10^{-1}	7.517	7.635×10^{-1}	7.425	8.477×10^{-1}	7.368	8.510×10^{-1}	6.836	6.684×10^{-1}	5.512	4.950×10^{-1}	5.216
22.0	9.945×10^{-1}	7.267	6.617×10^{-1}	7.193	7.391×10^{-1}	7.157	6.707×10^{-1}	6.650	4.848×10^{-1}	5.356	4.020×10^{-1}	5.032
23.0	$1.184 \times 10^{+0}$	7.046	6.805×10^{-1}	6.990	6.328×10^{-1}	6.968	5.672×10^{-1}	6.485	4.217×10^{-1}	5.223	3.525×10^{-1}	4.879
24.0	$1.150 \times 10^{+0}$	6.847	7.688×10^{-1}	6.807	6.337×10^{-1}	6.799	6.249×10^{-1}	6.337	3.902×10^{-1}	5.108	3.160×10^{-1}	4.751
25.0	8.946×10^{-1}	6.670	8.006×10^{-1}	6.643	6.927×10^{-1}	6.646	8.056×10^{-1}	6.201	4.893×10^{-1}	5.008	3.350×10^{-1}	4.643
26.0	$1.469 \times 10^{+0}$	6.510	9.016×10^{-1}	6.494	8.523×10^{-1}	6.506	$1.090 \times 10^{+0}$	6.080	5.726×10^{-1}	4.919	2.758×10^{-1}	4.554
27.0	$1.235 \times 10^{+0}$	6.367	$1.145 \times 10^{+0}$	6.362	$1.097 \times 10^{+0}$	6.380	$1.296 \times 10^{+0}$	5.970	5.768×10^{-1}	4.846	2.436×10^{-1}	4.479
28.0	$1.103 \times 10^{+0}$	6.234	$1.496 \times 10^{+0}$	6.239	$1.340 \times 10^{+0}$	6.264	$1.383 \times 10^{+0}$	5.870	4.950×10^{-1}	4.779	2.233×10^{-1}	4.415
29.0	$1.029 \times 10^{+0}$	6.116	$1.471 \times 10^{+0}$	6.127	$1.618 \times 10^{+0}$	6.159	7.251×10^{-1}	5.778	3.239×10^{-1}	4.721	2.339×10^{-1}	4.361
30.0	$1.056 \times 10^{+0}$	6.006	9.331×10^{-1}	6.027	9.153×10^{-1}	6.063	6.083×10^{-1}	5.693	3.519×10^{-1}	4.671	2.637×10^{-1}	4.318
31.0	9.732×10^{-1}	5.907	8.285×10^{-1}	5.933	7.437×10^{-1}	5.973	6.373×10^{-1}	5.616	3.640×10^{-1}	4.626	2.036×10^{-1}	4.282
32.0	8.166×10^{-1}	5.815	8.594×10^{-1}	5.848	7.744×10^{-1}	5.890	6.276×10^{-1}	5.545	3.054×10^{-1}	4.588	1.784×10^{-1}	4.248
33.0	7.842×10^{-1}	5.731	8.322×10^{-1}	5.767	8.026×10^{-1}	5.814	5.219×10^{-1}	5.479	3.120×10^{-1}	4.555	1.779×10^{-1}	4.224
34.0	5.969×10^{-1}	5.653	7.077×10^{-1}	5.695	7.058×10^{-1}	5.743	5.093×10^{-1}	5.419	2.816×10^{-1}	4.527	1.766×10^{-1}	4.204
35.0	5.233×10^{-1}	5.580	6.995×10^{-1}	5.627	6.297×10^{-1}	5.676	5.173×10^{-1}	5.363	2.791×10^{-1}	4.502	1.748×10^{-1}	4.188
36.0	5.211×10^{-1}	5.513	7.416×10^{-1}	5.564	6.634×10^{-1}	5.615	5.395×10^{-1}	5.312	2.862×10^{-1}	4.480	1.804×10^{-1}	4.176
37.0	5.076×10^{-1}	5.451	7.772×10^{-1}	5.506	6.851×10^{-1}	5.558	5.325×10^{-1}	5.266	3.001×10^{-1}	4.461	1.728×10^{-1}	4.167
38.0	5.191×10^{-1}	5.392	7.345×10^{-1}	5.451	7.198×10^{-1}	5.506	5.104×10^{-1}	5.222	3.144×10^{-1}	4.446	1.640×10^{-1}	4.161
39.0	4.418×10^{-1}	5.339	6.657×10^{-1}	5.402	6.556×10^{-1}	5.456	5.000×10^{-1}	5.182	3.364×10^{-1}	4.433	1.601×10^{-1}	4.157
40.0	4.187×10^{-1}	5.288	5.377×10^{-1}	5.355	6.445×10^{-1}	5.410	4.553×10^{-1}	5.145	3.560×10^{-1}	4.422	1.677×10^{-1}	4.157
41.0	3.883×10^{-1}	5.241	4.302×10^{-1}	5.312	5.657×10^{-1}	5.368	4.713×10^{-1}	5.112	3.535×10^{-1}	4.415	1.617×10^{-1}	4.157
42.0	3.010×10^{-1}	5.196	3.743×10^{-1}	5.272	5.176×10^{-1}	5.328	4.448×10^{-1}	5.080	3.725×10^{-1}	4.407	1.601×10^{-1}	4.160
43.0	2.909×10^{-1}	5.155	3.347×10^{-1}	5.233	4.884×10^{-1}	5.291	4.319×10^{-1}	5.052	3.420×10^{-1}	4.403	1.691×10^{-1}	4.164
44.0	2.874×10^{-1}	5.117	3.247×10^{-1}	5.199	4.256×10^{-1}	5.256	4.092×10^{-1}	5.026	3.050×10^{-1}	4.401	1.651×10^{-1}	4.170
45.0	2.340×10^{-1}	5.081	3.673×10^{-1}	5.165	3.828×10^{-1}	5.224	4.121×10^{-1}	5.000	2.868×10^{-1}	4.399	1.632×10^{-1}	4.177
46.0	1.751×10^{-1}	5.047	3.281×10^{-1}	5.134	4.221×10^{-1}	5.193	4.357×10^{-1}	4.978	2.933×10^{-1}	4.399	1.606×10^{-1}	4.185
47.0	1.682×10^{-1}	5.014	2.962×10^{-1}	5.104	4.112×10^{-1}	5.164	4.324×10^{-1}	4.957	2.803×10^{-1}	4.400	1.584×10^{-1}	4.195
48.0	1.590×10^{-1}	4.985	2.831×10^{-1}	5.078	3.956×10^{-1}	5.137	4.372×10^{-1}	4.938	2.916×10^{-1}	4.402	1.548×10^{-1}	4.205
49.0	1.373×10^{-1}	4.956	2.758×10^{-1}	5.052	3.669×10^{-1}	5.112	4.401×10^{-1}	4.920	2.472×10^{-1}	4.405	1.550×10^{-1}	4.216
50.0	1.480×10^{-1}	4.930	2.697×10^{-1}	5.028	3.655×10^{-1}	5.089	4.200×10^{-1}	4.904	2.207×10^{-1}	4.409	1.610×10^{-1}	4.228
52.0	9.915×10^{-2}	4.884	2.200×10^{-1}	4.985	3.009×10^{-1}	5.047	3.508×10^{-1}	4.876	1.928×10^{-1}	4.420	1.780×10^{-1}	4.255
54.0	5.386×10^{-1}	4.843	1.896×10^{-1}	4.948	2.857×10^{-1}	5.010	3.205×10^{-1}	4.854	1.942×10^{-1}	4.435	1.574×10^{-1}	4.283
56.0	$1.450 \times 10^{+0}$	4.808	1.494×10^{-1}	4.915	2.453×10^{-1}	4.978	2.647×10^{-1}	4.835	1.799×10^{-1}	4.451	1.507×10^{-1}	4.315
58.0	6.541×10^{-1}	4.777	9.756×10^{-2}	4.886	2.059×10^{-1}	4.949	2.351×10^{-1}	4.820	1.928×10^{-1}	4.470	1.507×10^{-1}	4.347
60.0	3.474×10^{-1}	4.753	$1.109 \times 10^{+0}$	4.862	2.032×10^{-1}	4.925	2.279×10^{-1}	4.808	2.377×10^{-1}	4.490	1.478×10^{-1}	4.382
62.0	5.264×10^{-1}	4.731	6.171×10^{-1}	4.841	1.644×10^{-1}	4.904	2.548×10^{-1}	4.800	1.990×10^{-1}	4.513	1.448×10^{-1}	4.418
64.0	4.267×10^{-1}	4.714	3.478×10^{-1}	4.824	7.473×10^{-1}	4.886	2.661×10^{-1}	4.795	1.718×10^{-1}	4.536	1.416×10^{-1}	4.454
66.0	3.349×10^{-1}	4.700	4.134×10^{-1}	4.810	5.295×10^{-1}	4.872	1.807×10^{-1}	4.793	1.701×10^{-1}	4.562	1.384×10^{-1}	4.492
68.0	2.876×10^{-1}	4.689	2.863×10^{-1}	4.798	3.451×10^{-1}	4.860	1.653×10^{-1}	4.792	1.634×10^{-1}	4.587	1.350×10^{-1}	4.530
70.0	3.020×10^{-1}	4.681	3.084×10^{-1}	4.790	3.490×10^{-1}	4.852	1.835×10^{-1					

Table 9 (continued)

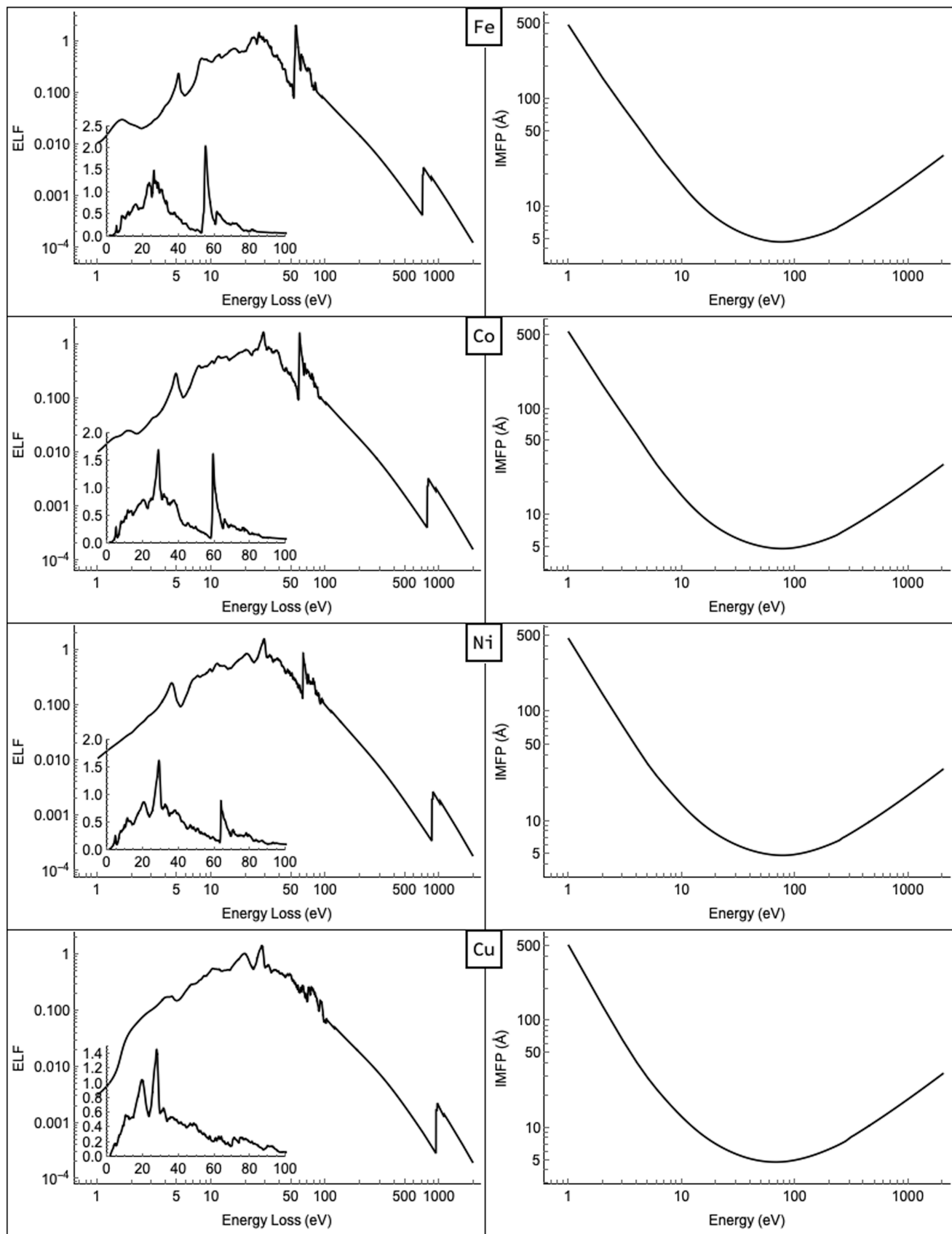
Energy (eV)	Fe		Co		Ni		Cu		Zn		Ga	
	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)
76.0	1.432×10^{-1}	4.673	2.850×10^{-1}	4.778	2.508×10^{-1}	4.839	2.512×10^{-1}	4.812	1.400×10^{-1}	4.701	1.209×10^{-1}	4.690
78.0	1.395×10^{-1}	4.675	2.422×10^{-1}	4.778	3.003×10^{-1}	4.839	2.357×10^{-1}	4.822	1.345×10^{-1}	4.731	1.173×10^{-1}	4.731
80.0	1.153×10^{-1}	4.679	1.635×10^{-1}	4.781	2.515×10^{-1}	4.840	1.971×10^{-1}	4.833	1.292×10^{-1}	4.761	1.137×10^{-1}	4.772
82.0	1.318×10^{-1}	4.684	1.628×10^{-1}	4.784	1.633×10^{-1}	4.844	1.823×10^{-1}	4.845	1.242×10^{-1}	4.793	1.101×10^{-1}	4.813
84.0	1.072×10^{-1}	4.692	1.578×10^{-1}	4.791	1.638×10^{-1}	4.849	1.646×10^{-1}	4.859	1.194×10^{-1}	4.825	1.066×10^{-1}	4.855
86.0	9.783×10^{-2}	4.702	1.227×10^{-1}	4.799	1.628×10^{-1}	4.856	1.266×10^{-1}	4.874	1.148×10^{-1}	4.858	1.031×10^{-1}	4.900
88.0	9.196×10^{-2}	4.713	1.018×10^{-1}	4.809	1.313×10^{-1}	4.866	1.060×10^{-1}	4.891	1.304×10^{-1}	4.891	9.967×10^{-2}	4.942
90.0	8.849×10^{-2}	4.725	9.810×10^{-2}	4.819	1.087×10^{-1}	4.875	1.482×10^{-1}	4.908	1.205×10^{-1}	4.924	9.630×10^{-2}	4.986
92.0	8.424×10^{-2}	4.738	9.871×10^{-2}	4.831	1.124×10^{-1}	4.886	1.425×10^{-1}	4.927	1.154×10^{-1}	4.958	9.305×10^{-2}	5.029
94.0	8.746×10^{-2}	4.752	1.009×10^{-1}	4.844	1.163×10^{-1}	4.898	1.088×10^{-1}	4.946	1.105×10^{-1}	4.991	8.988×10^{-2}	5.072
96.0	8.125×10^{-2}	4.767	9.153×10^{-2}	4.857	1.143×10^{-1}	4.911	7.021×10^{-2}	4.965	1.058×10^{-1}	5.025	8.676×10^{-2}	5.114
98.0	7.742×10^{-2}	4.782	8.387×10^{-2}	4.871	1.029×10^{-1}	4.925	6.525×10^{-2}	4.985	1.015×10^{-1}	5.059	8.374×10^{-2}	5.158
100.0	7.386×10^{-2}	4.799	7.980×10^{-2}	4.887	9.705×10^{-2}	4.940	6.351×10^{-2}	5.006	9.758×10^{-2}	5.093	8.083×10^{-2}	5.199
106.2	6.410×10^{-2}	4.853	7.404×10^{-2}	4.939	8.627×10^{-2}	4.989	6.573×10^{-2}	5.072	8.672×10^{-2}	5.198	7.545×10^{-2}	5.329
112.7	5.570×10^{-2}	4.914	6.432×10^{-2}	5.000	7.970×10^{-2}	5.048	5.588×10^{-2}	5.148	7.716×10^{-2}	5.311	6.873×10^{-2}	5.470
119.7	4.845×10^{-2}	4.983	5.595×10^{-2}	5.069	6.826×10^{-2}	5.116	4.870×10^{-2}	5.232	6.867×10^{-2}	5.430	6.106×10^{-2}	5.620
127.1	4.219×10^{-2}	5.058	4.871×10^{-2}	5.148	5.916×10^{-2}	5.194	4.557×10^{-2}	5.325	6.108×10^{-2}	5.559	5.399×10^{-2}	5.775
134.9	3.678×10^{-2}	5.138	4.246×10^{-2}	5.233	5.130×10^{-2}	5.280	4.013×10^{-2}	5.427	5.431×10^{-2}	5.699	4.754×10^{-2}	5.938
143.3	3.213×10^{-2}	5.226	3.709×10^{-2}	5.327	4.456×10^{-2}	5.377	3.543×10^{-2}	5.539	5.042×10^{-2}	5.845	4.174×10^{-2}	6.109
152.1	2.807×10^{-2}	5.320	3.241×10^{-2}	5.427	3.870×10^{-2}	5.481	3.130×10^{-2}	5.660	4.471×10^{-2}	5.999	3.652×10^{-2}	6.289
161.5	2.452×10^{-2}	5.424	2.832×10^{-2}	5.537	3.362×10^{-2}	5.595	2.768×10^{-2}	5.792	3.885×10^{-2}	6.162	3.321×10^{-2}	6.477
171.5	2.141×10^{-2}	5.538	2.475×10^{-2}	5.655	2.921×10^{-2}	5.717	2.449×10^{-2}	5.934	3.337×10^{-2}	6.334	2.904×10^{-2}	6.675
182.1	1.868×10^{-2}	5.663	2.161×10^{-2}	5.782	2.537×10^{-2}	5.849	2.167×10^{-2}	6.085	2.869×10^{-2}	6.516	2.529×10^{-2}	6.883
193.3	1.627×10^{-2}	5.799	1.886×10^{-2}	5.920	2.202×10^{-2}	5.989	1.917×10^{-2}	6.246	2.463×10^{-2}	6.708	2.198×10^{-2}	7.106
205.2	1.414×10^{-2}	5.947	1.643×10^{-2}	6.068	1.911×10^{-2}	6.140	1.694×10^{-2}	6.418	2.112×10^{-2}	6.910	1.907×10^{-2}	7.353
217.9	1.226×10^{-2}	6.109	1.429×10^{-2}	6.229	1.656×10^{-2}	6.302	1.496×10^{-2}	6.601	1.809×10^{-2}	7.128	1.651×10^{-2}	7.613
231.4	1.060×10^{-2}	6.283	1.240×10^{-2}	6.403	1.432×10^{-2}	6.476	1.318×10^{-2}	6.797	1.547×10^{-2}	7.365	1.427×10^{-2}	7.887
245.6	9.140×10^{-3}	6.575	1.073×10^{-2}	6.641	1.238×10^{-2}	6.663	1.159×10^{-2}	7.012	1.322×10^{-2}	7.619	1.232×10^{-2}	8.175
260.8	7.857×10^{-3}	6.789	9.267×10^{-3}	6.908	1.068×10^{-2}	6.991	1.017×10^{-2}	7.246	1.130×10^{-2}	7.887	1.063×10^{-2}	8.479
276.9	6.729×10^{-3}	7.048	7.972×10^{-3}	7.154	9.192×10^{-3}	7.218	8.894×10^{-3}	7.499	9.635×10^{-3}	8.172	9.154×10^{-3}	8.801
294.0	5.742×10^{-3}	7.312	6.833×10^{-3}	7.429	7.887×10^{-3}	7.488	7.752×10^{-3}	7.863	8.202×10^{-3}	8.472	7.868×10^{-3}	9.140
312.2	4.882×10^{-3}	7.595	5.836×10^{-3}	7.709	6.744×10^{-3}	7.771	6.728×10^{-3}	8.260	6.968×10^{-3}	8.791	6.749×10^{-3}	9.499
331.4	4.137×10^{-3}	7.893	4.966×10^{-3}	8.005	5.747×10^{-3}	8.066	5.815×10^{-3}	8.557	5.907×10^{-3}	9.130	5.749×10^{-3}	9.877
351.9	3.495×10^{-3}	8.203	4.213×10^{-3}	8.320	4.881×10^{-3}	8.378	5.003×10^{-3}	8.907	4.997×10^{-3}	9.486	4.836×10^{-3}	10.275
373.6	2.945×10^{-3}	8.531	3.562×10^{-3}	8.648	4.133×10^{-3}	8.709	4.287×10^{-3}	9.271	4.216×10^{-3}	9.952	4.051×10^{-3}	10.695
396.7	2.475×10^{-3}	8.877	3.004×10^{-3}	8.995	3.490×10^{-3}	9.055	3.659×10^{-3}	9.647	3.548×10^{-3}	10.516	3.389×10^{-3}	11.137
421.2	2.075×10^{-3}	9.239	2.527×10^{-3}	9.360	2.939×10^{-3}	9.420	3.112×10^{-3}	10.047	2.979×10^{-3}	10.978	2.830×10^{-3}	11.607
447.2	1.738×10^{-3}	9.622	2.123×10^{-3}	9.743	2.471×10^{-3}	9.803	2.640×10^{-3}	10.469	2.497×10^{-3}	11.431	2.361×10^{-3}	12.095
474.8	1.454×10^{-3}	10.026	1.781×10^{-3}	10.148	2.075×10^{-3}	10.207	2.235×10^{-3}	10.910	2.090×10^{-3}	11.905	1.968×10^{-3}	12.613
504.1	1.214×10^{-3}	10.449	1.491×10^{-3}	10.573	1.738×10^{-3}	10.632	1.886×10^{-3}	11.374	1.746×10^{-3}	12.415	1.636×10^{-3}	13.358
535.3	1.012×10^{-3}	10.895	1.246×10^{-3}	11.020	1.453×10^{-3}	11.081	1.588×10^{-3}	11.863	1.455×10^{-3}	12.954	1.358×10^{-3}	14.049
568.3	8.426×10^{-4}	11.366	1.040×10^{-3}	11.492	1.213×10^{-3}	11.552	1.334×10^{-3}	12.377	1.210×10^{-3}	13.515	1.125×10^{-3}	14.714
603.4	7.005×10^{-4}	11.860	8.661×10^{-4}	11.988	1.011×10^{-3}	12.048	1.118×10^{-3}	12.917	1.005×10^{-3}	14.108	9.312×10^{-4}	15.409
640.7	5.818×10^{-4}	12.380	7.206×10^{-4}	12.509	8.411×10^{-4}	12.570	9.357×10^{-4}	13.485	8.338×10^{-4}	14.730	7.695×10^{-4}	16.090
680.2	4.825×10^{-4}	12.927	5.990×10^{-4}	13.058	6.992×10^{-4}	13.117	7.820×10^{-4}	14.084	6.908×10^{-4}	15.385	6.352×10^{-4}	16.797
722.2	3.632×10^{-4}	13.503	4.975×10^{-4}	13.635	5.808×10^{-4}	13.696	6.520×10^{-4}	14.712	5.719×10^{-4}	16.072	5.239×10^{-4}	17.550
766.8	2.960×10^{-4}	14.109	4.129×10^{-4}	14.243	4.820×10^{-4}	14.304	5.373×10^{-4}	15.373	4.731×10^{-4}	16.796	4.318×10^{-4}	18.350
814.2	2.403×10^{-4}	14.746	2.999×10^{-4}	14.883	4.004×10^{-4}	14.942	4.424×10^{-4}	16.069	3.918×10^{-4}	17.554	3.564×10^{-4}	19.193
864.5	2.227×10^{-4}	15.416	2.429×10^{-4}	15.554	2.252×10^{-4}	15.614	3.645×10^{-4}	16.799	3.245×10^{-4}	18.353	2.941×10^{-4}	20.080
917.8	1.829×10^{-4}	16.121	1.960×10^{-4}	16.262	2.285×10^{-4}	16.321	2.996×10^{-4}	17.569	2.679×10^{-4}	19.194	2.419×10^{-4}	21.012
974.5	1.498×10^{-4}	16.863	1.824×10^{-4}	17.006	1.848×10^{-4}	17.065	2.089×10^{-4}	18.377	2.216×10^{-4}	20.078	1.995×10^{-4}	21.993
1034.7	1.224×10^{-4}	17.643	1.495×10^{-4}	17.788	1.700×10^{-4}	17.847	1.622×10^{-4}	19.229	1.035×10^{-4}	21.008	1.625×10^{-4}	23.032
1098.6	9.969×10^{-5}	18.464	1.221×10^{-4}	18.611	1.388×10^{-4}	18.671	1.343×10^{-4}	20.124	1.177×10^{-4}	21.986	1.313×10^{-4}	24.108
1166.4	8.115×10^{-5}	19.326	9.957×10^{-5}	19.477	1.131×10^{-4}	19.535	1.176×10^{-4}	21.064	9.417×10^{-5}	23.013	8.248×10^{-5}	25.237
1238.4	6.591×10^{-5}	20.235	8.113×10^{-5}	20.388	9.228×10^{-5}	20.446	9.619×10^{-5}	22.054	8.592×10^{-5}	24.094	6.630×10^{-5}	26.438
1314.9	5.320×10^{-5}	21.191	6.605×10^{-5}	21.346	7.529×10^{-5}	21.403	7.847×10^{-5}	23.094	6.942×10^{-5}	25.233	6.066×10^{-5}	27.699
1396.1	4.297×10^{-5}	22.196	5.340×10^{-5}	22.353	6.128×10^{-5}	22.411	6.397×10^{-5}	24.189	5.632×10^{-5}	26.429	4.932×10^{-5}	29.019
1482.3	3.474×10^{-5}	23.254	4.319×10^{-5}	23.413	4.982×10^{-5}	23.470	5.230×10^{-5}	25.341	4.579×10^{-5}	27.690	4.005×10^{-5}	30.415
1573.8	2.805×10^{-5}	24.365	3.490×10^{-5}	24.529	4.032×10^{-5}	24.584	4.275×10^{-5}	26.553	3.725×10^{-5}	29.012	3.253×10^{-5}	31.885
1671.0	2.263×10^{-5}	25.536	2.817×10^{-5}	25.703								

Table 10
ELF and IMFP data calculated for Sr, Y, Nb, Mo, Ru and Rh.

Energy (eV)	Sr		Y		Nb		Mo		Ru		Rh	
	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)
1.0	3.246×10^{-2}	107.079	3.409×10^{-2}	144.632	5.227×10^{-3}	369.388	1.351×10^{-2}	382.794	2.367×10^{-2}	390.303	7.024×10^{-3}	515.991
2.0	6.630×10^{-2}	38.576	5.313×10^{-2}	55.907	5.177×10^{-2}	111.192	3.030×10^{-2}	130.520	1.584×10^{-2}	147.705	1.570×10^{-2}	164.751
3.0	1.771×10^{-1}	21.855	1.031×10^{-1}	33.407	5.561×10^{-2}	60.621	4.115×10^{-2}	74.358	1.879×10^{-2}	86.679	2.884×10^{-2}	88.019
4.0	7.238×10^{-1}	14.618	2.075×10^{-1}	23.445	6.111×10^{-2}	41.605	3.565×10^{-2}	51.729	2.980×10^{-2}	60.180	3.816×10^{-2}	58.043
5.0	6.891×10^{-1}	10.842	2.568×10^{-1}	17.964	4.311×10^{-2}	32.015	3.802×10^{-2}	39.794	4.259×10^{-2}	45.464	8.309×10^{-2}	42.468
6.0	6.630×10^{-1}	8.727	2.651×10^{-1}	14.613	5.541×10^{-2}	26.271	4.243×10^{-2}	32.427	6.389×10^{-2}	36.251	1.393×10^{-1}	32.961
7.0	$2.641 \times 10^{+0}$	7.452	2.293×10^{-1}	12.434	1.020×10^{-1}	22.372	8.115×10^{-2}	27.390	8.682×10^{-2}	30.008	2.631×10^{-1}	26.644
8.0	$1.139 \times 10^{+0}$	6.612	2.735×10^{-1}	10.926	1.112×10^{-1}	19.509	7.948×10^{-2}	23.685	1.510×10^{-1}	25.537	5.407×10^{-1}	22.181
9.0	4.431×10^{-1}	6.037	5.369×10^{-1}	9.814	2.199×10^{-1}	17.300	1.385×10^{-1}	20.856	3.653×10^{-1}	22.181	7.609×10^{-1}	18.874
10.0	2.015×10^{-1}	5.630	$1.060 \times 10^{+0}$	8.970	7.590×10^{-1}	15.550	4.455×10^{-1}	18.629	8.315×10^{-1}	19.546	3.349×10^{-1}	16.352
11.0	8.302×10^{-2}	5.337	$2.446 \times 10^{+0}$	8.292	4.900×10^{-1}	14.130	7.041×10^{-1}	16.822	6.279×10^{-1}	17.387	3.109×10^{-1}	14.435
12.0	4.918×10^{-2}	5.125	$2.033 \times 10^{+0}$	7.743	4.987×10^{-1}	12.946	3.261×10^{-1}	15.315	4.234×10^{-1}	15.611	3.516×10^{-1}	13.001
13.0	3.113×10^{-2}	4.973	$1.013 \times 10^{+0}$	7.281	5.143×10^{-1}	11.949	3.725×10^{-1}	14.029	4.118×10^{-1}	14.137	3.592×10^{-1}	11.911
14.0	2.767×10^{-2}	4.861	3.842×10^{-1}	6.897	3.794×10^{-1}	11.100	4.500×10^{-1}	12.932	3.495×10^{-1}	12.934	3.395×10^{-1}	11.067
15.0	2.884×10^{-2}	4.783	1.856×10^{-1}	6.564	3.739×10^{-1}	10.374	4.655×10^{-1}	11.994	2.838×10^{-1}	11.952	3.388×10^{-1}	10.397
16.0	2.083×10^{-2}	4.727	1.344×10^{-1}	6.282	4.672×10^{-1}	9.755	3.177×10^{-1}	11.201	2.477×10^{-1}	11.151	3.170×10^{-1}	9.852
17.0	2.228×10^{-2}	4.694	9.737×10^{-2}	6.039	5.050×10^{-1}	9.223	3.075×10^{-1}	10.526	1.762×10^{-1}	10.489	3.019×10^{-1}	9.399
18.0	2.120×10^{-2}	4.671	7.246×10^{-2}	5.826	$1.219 \times 10^{+0}$	8.761	3.212×10^{-1}	9.953	1.731×10^{-1}	9.940	2.619×10^{-1}	9.020
19.0	1.661×10^{-1}	4.664	4.987×10^{-2}	5.642	$1.655 \times 10^{+0}$	8.360	3.684×10^{-1}	9.457	2.461×10^{-1}	9.474	2.093×10^{-1}	8.692
20.0	3.238×10^{-1}	4.664	3.535×10^{-2}	5.484	$1.973 \times 10^{+0}$	8.012	8.237×10^{-1}	9.031	2.925×10^{-1}	9.080	2.278×10^{-1}	8.409
21.0	2.808×10^{-1}	4.672	3.354×10^{-2}	5.348	$2.632 \times 10^{+0}$	7.708	$1.147 \times 10^{+0}$	8.662	4.003×10^{-1}	8.743	3.597×10^{-1}	8.164
22.0	4.904×10^{-1}	4.683	3.077×10^{-2}	5.233	$1.467 \times 10^{+0}$	7.440	$1.162 \times 10^{+0}$	8.334	5.162×10^{-1}	8.448	5.221×10^{-1}	7.944
23.0	4.828×10^{-1}	4.699	2.026×10^{-1}	5.133	9.158×10^{-1}	7.202	$1.681 \times 10^{+0}$	8.047	6.210×10^{-1}	8.192	4.680×10^{-1}	7.750
24.0	6.903×10^{-1}	4.719	2.469×10^{-1}	5.052	5.244×10^{-1}	6.990	$2.652 \times 10^{+0}$	7.793	6.334×10^{-1}	7.963	5.364×10^{-1}	7.574
25.0	$2.261 \times 10^{+0}$	4.741	6.065×10^{-1}	4.982	3.529×10^{-1}	6.800	$1.711 \times 10^{+0}$	7.561	6.688×10^{-1}	7.761	7.909×10^{-1}	7.417
26.0	$1.307 \times 10^{+0}$	4.767	5.508×10^{-1}	4.923	1.799×10^{-1}	6.630	$1.330 \times 10^{+0}$	7.354	8.862×10^{-1}	7.579	9.052×10^{-1}	7.272
27.0	$1.900 \times 10^{+0}$	4.793	4.149×10^{-1}	4.876	1.261×10^{-1}	6.473	$1.106 \times 10^{+0}$	7.167	$1.333 \times 10^{+0}$	7.415	8.800×10^{-1}	7.140
28.0	7.936×10^{-1}	4.821	4.814×10^{-1}	4.836	1.388×10^{-1}	6.331	6.726×10^{-1}	6.998	$1.370 \times 10^{+0}$	7.267	$1.037 \times 10^{+0}$	7.020
29.0	4.012×10^{-1}	4.847	$1.039 \times 10^{+0}$	4.804	1.018×10^{-1}	6.199	3.616×10^{-1}	6.843	$1.163 \times 10^{+0}$	7.134	8.930×10^{-1}	6.911
30.0	2.086×10^{-1}	4.875	$1.422 \times 10^{+0}$	4.779	2.141×10^{-1}	6.079	2.672×10^{-1}	6.700	$1.375 \times 10^{+0}$	7.009	7.193×10^{-1}	6.808
31.0	2.868×10^{-1}	4.905	$2.396 \times 10^{+0}$	4.757	2.278×10^{-1}	5.966	3.017×10^{-1}	6.570	$1.699 \times 10^{+0}$	6.895	9.369×10^{-1}	6.714
32.0	4.615×10^{-1}	4.934	$1.833 \times 10^{+0}$	4.742	2.458×10^{-1}	5.862	2.359×10^{-1}	6.448	$1.420 \times 10^{+0}$	6.788	$1.480 \times 10^{+0}$	6.625
33.0	3.115×10^{-1}	4.962	$1.526 \times 10^{+0}$	4.730	3.334×10^{-1}	5.763	1.878×10^{-1}	6.334	$1.377 \times 10^{+0}$	6.691	$1.729 \times 10^{+0}$	6.543
34.0	1.455×10^{-1}	4.990	$1.574 \times 10^{+0}$	4.722	3.586×10^{-1}	5.672	1.135×10^{-1}	6.229	$1.206 \times 10^{+0}$	6.599	$1.368 \times 10^{+0}$	6.466
35.0	1.808×10^{-1}	5.017	8.800×10^{-1}	4.715	4.912×10^{-1}	5.585	1.257×10^{-1}	6.130	9.888×10^{-1}	6.512	$1.249 \times 10^{+0}$	6.393
36.0	1.346×10^{-1}	5.044	4.904×10^{-1}	4.713	8.043×10^{-1}	5.504	2.697×10^{-1}	6.037	7.267×10^{-1}	6.431	9.575×10^{-1}	6.324
37.0	7.129×10^{-2}	5.071	3.487×10^{-1}	4.712	$1.591 \times 10^{+0}$	5.427	3.416×10^{-1}	5.950	6.556×10^{-1}	6.354	8.428×10^{-1}	6.259
38.0	7.441×10^{-2}	5.098	2.376×10^{-1}	4.712	$2.447 \times 10^{+0}$	5.355	4.976×10^{-1}	5.866	5.279×10^{-1}	6.281	7.761×10^{-1}	6.198
39.0	6.041×10^{-2}	5.123	2.286×10^{-1}	4.715	$2.784 \times 10^{+0}$	5.286	7.055×10^{-1}	5.787	4.469×10^{-1}	6.212	7.816×10^{-1}	6.140
40.0	5.350×10^{-2}	5.148	2.252×10^{-1}	4.719	$1.934 \times 10^{+0}$	5.223	$1.076 \times 10^{+0}$	5.712	3.718×10^{-1}	6.145	7.214×10^{-1}	6.083
41.0	4.231×10^{-2}	5.172	2.167×10^{-1}	4.723	$1.227 \times 10^{+0}$	5.164	$2.014 \times 10^{+0}$	5.640	3.433×10^{-1}	6.084	6.121×10^{-1}	6.032
42.0	4.269×10^{-2}	5.196	1.445×10^{-1}	4.729	$1.145 \times 10^{+0}$	5.109	$2.656 \times 10^{+0}$	5.571	2.617×10^{-1}	6.023	5.742×10^{-1}	5.980
43.0	4.533×10^{-2}	5.217	1.391×10^{-1}	4.734	$1.341 \times 10^{+0}$	5.056	$2.510 \times 10^{+0}$	5.507	1.999×10^{-1}	5.965	5.584×10^{-1}	5.931
44.0	2.959×10^{-2}	5.239	1.306×10^{-1}	4.741	$1.644 \times 10^{+0}$	5.008	$2.263 \times 10^{+0}$	5.444	3.273×10^{-1}	5.908	5.701×10^{-1}	5.882
45.0	2.910×10^{-2}	5.260	1.296×10^{-1}	4.748	$1.730 \times 10^{+0}$	4.964	$1.296 \times 10^{+0}$	5.385	4.130×10^{-1}	5.855	5.567×10^{-1}	5.838
46.0	2.811×10^{-2}	5.279	9.011×10^{-2}	4.755	$1.316 \times 10^{+0}$	4.924	8.718×10^{-1}	5.328	$1.307 \times 10^{+0}$	5.803	3.298×10^{-1}	5.794
47.0	2.396×10^{-2}	5.298	5.745×10^{-2}	4.763	8.057×10^{-1}	4.884	$1.070 \times 10^{+0}$	5.275	$1.784 \times 10^{+0}$	5.753	2.859×10^{-1}	5.751
48.0	2.077×10^{-2}	5.318	5.557×10^{-2}	4.771	4.898×10^{-1}	4.850	$1.326 \times 10^{+0}$	5.224	$1.853 \times 10^{+0}$	5.705	7.660×10^{-1}	5.710
49.0	1.571×10^{-2}	5.336	4.569×10^{-2}	4.779	4.333×10^{-1}	4.818	$1.707 \times 10^{+0}$	5.176	$1.746 \times 10^{+0}$	5.658	$1.696 \times 10^{+0}$	5.670
50.0	1.794×10^{-2}	5.353	4.582×10^{-2}	4.787	4.693×10^{-1}	4.789	$1.582 \times 10^{+0}$	5.131	$1.638 \times 10^{+0}$	5.613	$1.514 \times 10^{+0}$	5.633
52.0	1.343×10^{-2}	5.386	3.609×10^{-2}	4.803	2.018×10^{-1}	4.737	8.410×10^{-1}	5.047	$1.686 \times 10^{+0}$	5.527	$1.217 \times 10^{+0}$	5.559
54.0	1.020×10^{-2}	5.421	3.185×10^{-2}	4.819	1.850×10^{-1}	4.694	4.211×10^{-1}	4.972	6.946×10^{-1}	5.447	$1.366 \times 10^{+0}$	5.492
56.0	9.438×10^{-3}	5.452	2.618×10^{-2}	4.835	1.931×10^{-1}	4.661	2.736×10^{-1}	4.907	$1.483 \times 10^{+0}$	5.372	$1.155 \times 10^{+0}$	5.428
58.0	8.700×10^{-3}	5.484	2.040×10^{-2}	4.848	1.361×10^{-1}	4.632	1.976×10^{-1}	4.851	8.357×10^{-1}	5.302	9.327×10^{-1}	5.368
60.0	7.035×10^{-3}	5.517	1.798×10^{-2}	4.862	8.763×10^{-2}	4.609	1.604×10^{-1}	4.802	7.194×10^{-1}	5.236	9.657×10^{-1}	5.311
62.0	6.456×10^{-3}	5.550	1.721×10^{-2}	4.876	5.518×10^{-2}	4.590	1.639×10^{-1}	4.759	5.403×10^{-1}	5.176	7.175×10^{-1}	5.260
64.0	6.505×10^{-3}	5.586	1.371×10^{-2}	4.889	7.351×10^{-2}	4.575	1.239×10^{-1}	4.723	3.205×10^{-1}	5.120	5.249×10^{-1}	5.213
66.0	5.038×10^{-3}	5.623	1.165×10^{-2}	4.902	5.877×10^{-2}	4.564	1.071×10^{-1}	4.692	2.812×10^{-1}	5.068	3.621×10^{-1}	5.168
68.0	5.284×10^{-3}	5.663	1.131×10^{-2}	4.914	5.316×10^{-2}	4.554	6.250×10^{-2}	4.665	2.131×10^{-1}	5.021	2.841×10^{-1}	5.126
70.0	4.471×10^{-3}	5.702	9.361×10^{-3}	4.926								

Table 10 (continued)

Energy (eV)	Sr		Y		Nb		Mo		Ru		Rh	
	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)
76.0	3.075×10^{-3}	5.836	5.697×10^{-3}	4.968	1.854×10^{-2}	4.533	4.971×10^{-2}	4.594	1.158×10^{-1}	4.869	1.335×10^{-1}	4.991
78.0	2.409×10^{-3}	5.885	5.661×10^{-3}	4.984	1.943×10^{-2}	4.531	4.615×10^{-2}	4.583	1.068×10^{-1}	4.840	9.250×10^{-2}	4.964
80.0	2.330×10^{-3}	5.934	5.877×10^{-3}	5.001	2.059×10^{-2}	4.529	4.707×10^{-2}	4.572	9.942×10^{-2}	4.814	1.038×10^{-1}	4.939
82.0	2.751×10^{-3}	5.985	5.153×10^{-3}	5.020	1.849×10^{-2}	4.528	4.400×10^{-2}	4.564	9.283×10^{-2}	4.790	1.003×10^{-1}	4.917
84.0	2.470×10^{-3}	6.039	4.601×10^{-3}	5.040	1.398×10^{-2}	4.526	4.122×10^{-2}	4.556	8.664×10^{-2}	4.770	9.305×10^{-2}	4.897
86.0	2.185×10^{-3}	6.093	4.390×10^{-3}	5.061	1.211×10^{-2}	4.527	3.870×10^{-2}	4.552	8.110×10^{-2}	4.751	8.735×10^{-2}	4.879
88.0	2.120×10^{-3}	6.147	4.185×10^{-3}	5.085	1.183×10^{-2}	4.529	3.640×10^{-2}	4.548	7.611×10^{-2}	4.735	8.213×10^{-2}	4.863
90.0	1.980×10^{-3}	6.204	3.990×10^{-3}	5.109	1.122×10^{-2}	4.530	3.423×10^{-2}	4.544	7.139×10^{-2}	4.722	7.716×10^{-2}	4.849
92.0	1.753×10^{-3}	6.263	3.815×10^{-3}	5.137	1.100×10^{-2}	4.533	3.230×10^{-2}	4.542	6.718×10^{-2}	4.711	7.274×10^{-2}	4.838
94.0	1.670×10^{-3}	6.320	3.655×10^{-3}	5.163	1.053×10^{-2}	4.536	3.053×10^{-2}	4.540	6.333×10^{-2}	4.702	6.870×10^{-2}	4.829
96.0	1.673×10^{-3}	6.380	3.502×10^{-3}	5.193	1.003×10^{-2}	4.539	2.885×10^{-2}	4.538	5.968×10^{-2}	4.694	6.486×10^{-2}	4.821
98.0	1.643×10^{-3}	6.440	3.362×10^{-3}	5.225	9.598×10^{-3}	4.543	2.733×10^{-2}	4.537	5.637×10^{-2}	4.687	6.137×10^{-2}	4.815
100.0	1.584×10^{-3}	6.499	3.233×10^{-3}	5.258	9.218×10^{-3}	4.549	2.594×10^{-2}	4.537	5.337×10^{-2}	4.681	5.820×10^{-2}	4.809
106.2	1.421×10^{-3}	6.691	2.880×10^{-3}	5.366	8.182×10^{-3}	4.569	2.220×10^{-2}	4.540	4.526×10^{-2}	4.671	4.961×10^{-2}	4.800
112.7	1.276×10^{-3}	6.898	2.571×10^{-3}	5.490	7.284×10^{-3}	4.601	1.903×10^{-2}	4.550	3.843×10^{-2}	4.667	4.233×10^{-2}	4.800
119.7	1.146×10^{-3}	7.123	2.300×10^{-3}	5.627	6.497×10^{-3}	4.645	1.634×10^{-2}	4.570	3.267×10^{-2}	4.670	3.614×10^{-2}	4.807
127.1	1.031×10^{-3}	7.366	2.059×10^{-3}	5.782	5.805×10^{-3}	4.704	1.406×10^{-2}	4.602	2.780×10^{-2}	4.680	3.089×10^{-2}	4.821
134.9	1.715×10^{-3}	7.622	1.845×10^{-3}	5.950	5.191×10^{-3}	4.778	1.211×10^{-2}	4.647	2.369×10^{-2}	4.699	2.643×10^{-2}	4.845
143.3	2.837×10^{-3}	7.893	1.655×10^{-3}	6.131	4.648×10^{-3}	4.867	1.046×10^{-2}	4.707	2.024×10^{-2}	4.729	2.266×10^{-2}	4.877
152.1	3.867×10^{-3}	8.186	1.484×10^{-3}	6.324	4.161×10^{-3}	4.971	9.037×10^{-3}	4.781	1.730×10^{-2}	4.772	1.944×10^{-2}	4.921
161.5	5.080×10^{-3}	8.567	4.213×10^{-3}	6.537	3.723×10^{-3}	5.088	7.815×10^{-3}	4.870	1.480×10^{-2}	4.827	1.668×10^{-2}	4.977
171.5	6.281×10^{-3}	8.920	5.487×10^{-3}	6.771	3.328×10^{-3}	5.223	6.763×10^{-3}	4.975	1.267×10^{-2}	4.898	1.432×10^{-2}	5.048
182.1	7.301×10^{-3}	9.298	7.140×10^{-3}	7.035	2.971×10^{-3}	5.369	5.855×10^{-3}	5.093	1.086×10^{-2}	4.983	1.230×10^{-2}	5.132
193.3	8.014×10^{-3}	9.698	8.880×10^{-3}	7.316	2.649×10^{-3}	5.525	5.070×10^{-3}	5.228	9.307×10^{-3}	5.094	1.057×10^{-2}	5.232
205.2	8.357×10^{-3}	10.112	1.036×10^{-2}	7.612	3.697×10^{-3}	5.695	4.391×10^{-3}	5.390	7.981×10^{-3}	5.221	9.081×10^{-3}	5.363
217.9	8.335×10^{-3}	10.550	1.138×10^{-2}	7.926	7.685×10^{-3}	5.882	3.801×10^{-3}	5.582	6.846×10^{-3}	5.358	7.803×10^{-3}	5.505
231.4	8.004×10^{-3}	11.011	1.185×10^{-2}	8.256	9.766×10^{-3}	6.147	7.930×10^{-3}	5.783	5.873×10^{-3}	5.506	6.704×10^{-3}	5.657
245.6	7.444×10^{-3}	11.496	1.178×10^{-2}	8.602	1.200×10^{-2}	6.424	9.628×10^{-3}	5.997	5.041×10^{-3}	5.686	5.761×10^{-3}	5.833
260.8	6.747×10^{-3}	12.007	1.125×10^{-2}	8.969	1.376×10^{-2}	6.695	1.170×10^{-2}	6.222	4.330×10^{-3}	5.885	4.954×10^{-3}	6.035
276.9	6.498×10^{-3}	12.543	1.042×10^{-2}	9.355	1.486×10^{-2}	6.957	1.359×10^{-2}	6.461	3.712×10^{-3}	6.096	4.256×10^{-3}	6.250
294.0	5.920×10^{-3}	13.110	9.402×10^{-3}	9.760	1.520×10^{-2}	7.241	1.491×10^{-2}	6.711	9.546×10^{-3}	6.320	3.653×10^{-3}	6.478
312.2	5.163×10^{-3}	13.705	9.123×10^{-3}	10.188	1.485×10^{-2}	7.539	1.549×10^{-2}	6.975	1.100×10^{-2}	6.556	7.052×10^{-3}	6.720
331.4	4.455×10^{-3}	14.331	8.301×10^{-3}	10.638	1.395×10^{-2}	7.851	1.533×10^{-2}	7.255	1.247×10^{-2}	6.807	9.453×10^{-3}	6.976
351.9	3.807×10^{-3}	14.987	7.195×10^{-3}	11.112	1.269×10^{-2}	8.181	1.455×10^{-2}	7.548	1.342×10^{-2}	7.071	1.064×10^{-2}	7.245
373.6	3.390×10^{-3}	15.683	6.171×10^{-3}	11.612	1.250×10^{-2}	8.528	1.334×10^{-2}	7.857	1.369×10^{-2}	7.350	1.158×10^{-2}	7.529
396.7	2.873×10^{-3}	16.410	5.526×10^{-3}	12.137	1.141×10^{-2}	8.895	1.326×10^{-2}	8.183	1.331×10^{-2}	7.644	1.192×10^{-2}	7.830
421.2	2.426×10^{-3}	17.172	4.653×10^{-3}	12.689	9.852×10^{-3}	9.280	1.215×10^{-2}	8.527	1.243×10^{-2}	7.955	1.168×10^{-2}	8.147
447.2	2.042×10^{-3}	17.982	3.930×10^{-3}	13.272	8.414×10^{-3}	9.685	1.051×10^{-2}	8.889	1.122×10^{-2}	8.282	1.096×10^{-2}	8.480
474.8	1.717×10^{-3}	18.831	3.310×10^{-3}	13.883	7.523×10^{-3}	10.113	8.983×10^{-3}	9.270	1.113×10^{-2}	8.626	9.946×10^{-3}	8.831
504.1	1.439×10^{-3}	19.727	2.778×10^{-3}	14.528	6.287×10^{-3}	10.562	7.597×10^{-3}	9.671	1.013×10^{-2}	8.988	1.015×10^{-2}	9.201
535.3	1.203×10^{-3}	20.662	2.324×10^{-3}	15.205	5.280×10^{-3}	11.036	6.694×10^{-3}	10.094	8.688×10^{-3}	9.369	9.058×10^{-3}	9.589
568.3	1.003×10^{-3}	21.654	1.940×10^{-3}	15.919	4.418×10^{-3}	11.533	5.616×10^{-3}	10.539	7.352×10^{-3}	9.771	7.773×10^{-3}	10.000
603.4	8.349×10^{-4}	22.699	1.615×10^{-3}	16.667	3.685×10^{-3}	12.058	4.692×10^{-3}	11.007	6.457×10^{-3}	10.194	6.582×10^{-3}	10.432
640.7	6.933×10^{-4}	23.795	1.343×10^{-3}	17.458	3.066×10^{-3}	12.608	3.909×10^{-3}	11.500	5.416×10^{-3}	10.639	5.772×10^{-3}	10.886
680.2	5.748×10^{-4}	24.945	1.114×10^{-3}	18.287	2.546×10^{-3}	13.188	3.249×10^{-3}	12.019	4.518×10^{-3}	11.108	4.840×10^{-3}	11.365
722.2	4.757×10^{-4}	26.159	9.225×10^{-4}	19.161	2.110×10^{-3}	13.799	2.694×10^{-3}	12.566	3.758×10^{-3}	11.601	4.034×10^{-3}	11.868
766.8	3.932×10^{-4}	27.431	7.627×10^{-4}	20.079	1.747×10^{-3}	14.439	2.230×10^{-3}	13.141	3.120×10^{-3}	12.120	3.352×10^{-3}	12.397
814.2	3.251×10^{-4}	28.786	6.307×10^{-4}	21.264	1.446×10^{-3}	15.115	1.846×10^{-3}	13.745	2.589×10^{-3}	12.666	2.785×10^{-3}	12.954
864.5	2.686×10^{-4}	30.201	5.211×10^{-4}	22.323	1.196×10^{-3}	15.825	1.527×10^{-3}	14.381	2.143×10^{-3}	13.241	2.310×10^{-3}	13.540
917.8	2.216×10^{-4}	31.690	4.300×10^{-4}	23.496	9.872×10^{-4}	16.570	1.261×10^{-3}	15.051	1.772×10^{-3}	13.845	1.912×10^{-3}	14.157
974.5	1.826×10^{-4}	33.260	3.543×10^{-4}	24.626	8.139×10^{-4}	17.356	1.041×10^{-3}	15.754	1.463×10^{-3}	14.481	1.580×10^{-3}	14.807
1034.7	1.496×10^{-4}	34.907	2.900×10^{-4}	25.828	6.664×10^{-4}	18.182	8.518×10^{-4}	16.495	1.204×10^{-3}	15.151	1.300×10^{-3}	15.489
1098.6	1.213×10^{-4}	36.646	2.354×10^{-4}	27.108	5.406×10^{-4}	19.052	6.905×10^{-4}	17.274	9.843×10^{-4}	15.855	1.065×10^{-3}	16.207
1166.4	9.809×10^{-5}	38.483	1.914×10^{-4}	28.447	4.393×10^{-4}	19.966	5.610×10^{-4}	18.094	8.021×10^{-4}	16.597	8.718×10^{-4}	16.963
1238.4	7.924×10^{-5}	40.398	1.554×10^{-4}	29.850	3.572×10^{-4}	20.927	4.560×10^{-4}	18.956	6.497×10^{-4}	17.377	7.121×10^{-4}	17.760
1314.9	6.411×10^{-5}	42.425	1.256×10^{-4}	31.328	2.907×10^{-4}	21.939	3.711×10^{-4}	19.862	5.274×10^{-4}	18.197	5.775×10^{-4}	18.596
1396.1	5.192×10^{-5}	44.555	1.016×10^{-4}	32.893	2.368×10^{-4}	23.004	3.022×10^{-4}	20.818	4.286×10^{-4}	19.060	4.685×10^{-4}	19.477
1482.3	4.217×10^{-5}	46.811	8.246×10^{-5}	34.537	1.931×10^{-4}	24.124	2.469×10^{-4}	21.820	3.496×10^{-4}	19.966	3.815×10^{-4}	20.401
1573.8	3.427×10^{-5}	49.182	6.699×10^{-5}	36.260	1.570×10^{-4}	25.305	2.017×10^{-4}	22.877	2.854×10^{-4}	20.923	3.109×10^{-4}	21.376
1671.0	2.786×10^{-5}	51.666	5.442×10^{-5}	38.0								

**Figure 14**

Optical energy-loss functions (ELFs, left) and resulting inelastic mean free paths (IMFPs, right) for the elements Fe, Co, Ni and Cu. The insets in the ELF plots are magnifications of the low-energy spectra.

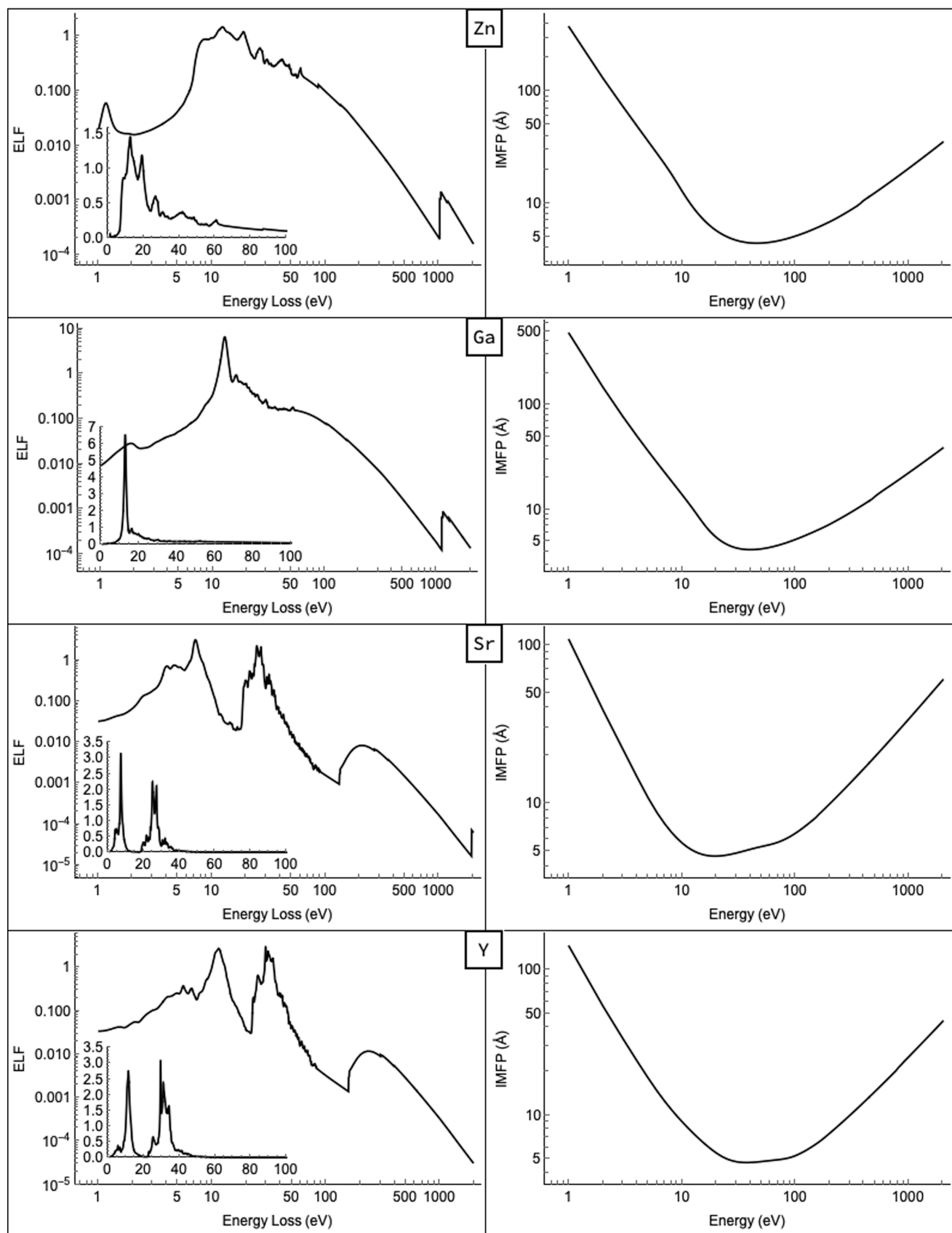
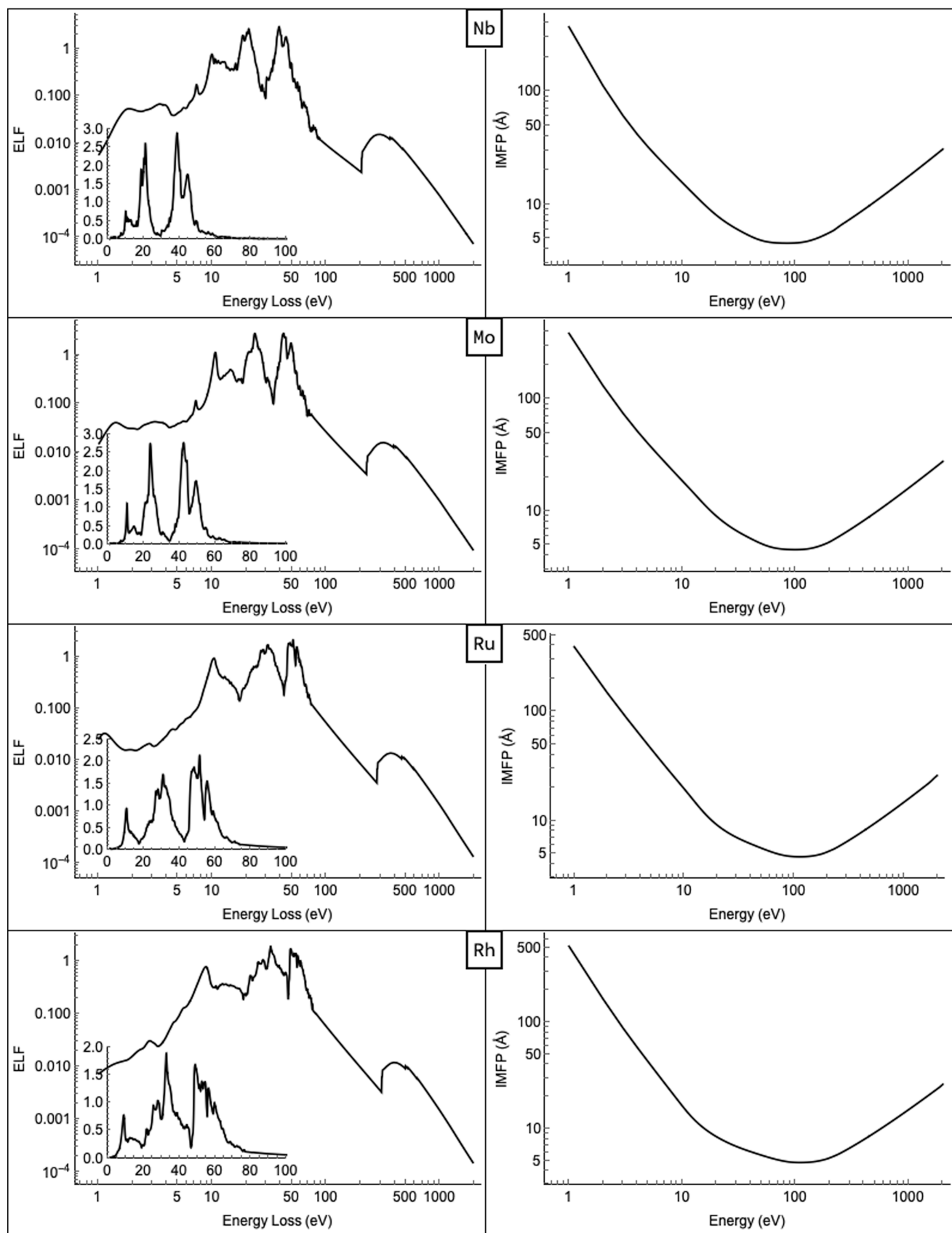


Figure 15

Optical energy-loss functions (ELFs, left) and resulting inelastic mean free paths (IMFPs, right) for the elements Zn, Ga, Sr and Y. The insets in the ELF plots are magnifications of the low-energy spectra.


Figure 16

Optical energy-loss functions (ELFs, left) and resulting inelastic mean free paths (IMFPs, right) for the elements Nb, Mo, Ru and Rh. The insets in the ELF plots are magnifications of the low-energy spectra.

Table 11
ELF and IMFP data calculated for Pd, Ag, Cd, Sn, Cs and Ba.

Energy (eV)	Pd		Ag		Cd		Sn		Cs		Ba	
	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)
1.0	1.168×10^{-2}	368.443	2.683×10^{-3}	448.773	2.627×10^{-2}	315.191	1.024×10^{-2}	315.694	2.567×10^{-2}	159.930	4.008×10^{-2}	103.398
2.0	2.866×10^{-2}	121.246	8.914×10^{-3}	134.913	1.434×10^{-2}	112.236	1.331×10^{-2}	104.039	2.434×10^{-2}	70.769	6.634×10^{-2}	38.993
3.0	6.083×10^{-2}	65.624	2.681×10^{-1}	61.807	2.033×10^{-2}	62.931	2.952×10^{-2}	56.406	2.443×10^{-2}	45.958	1.419×10^{-1}	22.971
4.0	1.144×10^{-1}	43.142	1.909×10^{-1}	35.752	3.190×10^{-2}	42.112	6.548×10^{-2}	37.094	2.860×10^{-2}	34.516	3.271×10^{-1}	15.832
5.0	1.764×10^{-1}	31.506	2.389×10^{-1}	24.980	5.904×10^{-2}	30.919	7.789×10^{-2}	27.189	4.439×10^{-2}	27.771	5.043×10^{-1}	11.993
6.0	2.558×10^{-1}	24.632	3.530×10^{-1}	19.574	1.316×10^{-1}	23.964	8.265×10^{-2}	21.404	1.281×10^{-1}	23.359	$1.057 \times 10^{+0}$	9.683
7.0	4.746×10^{-1}	20.220	4.948×10^{-1}	16.202	5.826×10^{-1}	19.119	1.117×10^{-1}	17.667	8.870×10^{-2}	20.230	$1.831 \times 10^{+0}$	8.184
8.0	4.701×10^{-1}	17.137	4.368×10^{-1}	13.926	$2.205 \times 10^{+0}$	15.315	1.751×10^{-1}	15.065	1.245×10^{-1}	17.877	4.110×10^{-1}	7.187
9.0	3.148×10^{-1}	14.909	3.985×10^{-1}	12.320	5.069×10^{-1}	12.353	2.971×10^{-1}	13.135	2.468×10^{-1}	16.050	1.438×10^{-1}	6.519
10.0	2.956×10^{-1}	13.282	3.575×10^{-1}	11.167	5.369×10^{-1}	10.333	4.626×10^{-1}	11.642	7.193×10^{-1}	14.587	9.708×10^{-2}	6.057
11.0	2.951×10^{-1}	12.089	3.810×10^{-1}	10.304	5.612×10^{-1}	9.044	7.492×10^{-1}	10.451	4.456×10^{-1}	13.408	3.137×10^{-2}	5.730
12.0	2.940×10^{-1}	11.182	3.326×10^{-1}	9.647	6.745×10^{-1}	8.184	$1.820 \times 10^{+0}$	9.484	5.730×10^{-1}	12.434	2.774×10^{-2}	5.497
13.0	2.781×10^{-1}	10.486	3.123×10^{-1}	9.123	5.833×10^{-1}	7.568	$4.604 \times 10^{+0}$	8.685	4.974×10^{-1}	11.616	2.034×10^{-2}	5.328
14.0	3.093×10^{-1}	9.923	3.816×10^{-1}	8.696	4.867×10^{-1}	7.110	$3.698 \times 10^{+0}$	8.020	5.197×10^{-1}	10.918	5.123×10^{-2}	5.203
15.0	3.126×10^{-1}	9.466	4.530×10^{-1}	8.343	4.485×10^{-1}	6.754	$1.334 \times 10^{+0}$	7.463	5.816×10^{-1}	10.307	2.977×10^{-1}	5.112
16.0	3.587×10^{-1}	9.084	4.875×10^{-1}	8.051	4.311×10^{-1}	6.476	5.297×10^{-1}	6.990	6.814×10^{-1}	9.766	3.166×10^{-1}	5.045
17.0	3.693×10^{-1}	8.764	4.913×10^{-1}	7.796	5.213×10^{-1}	6.257	2.991×10^{-1}	6.592	7.533×10^{-1}	9.287	3.404×10^{-1}	4.997
18.0	3.251×10^{-1}	8.486	4.801×10^{-1}	7.574	6.475×10^{-1}	6.067	1.728×10^{-1}	6.250	6.801×10^{-1}	8.858	4.088×10^{-1}	4.962
19.0	2.555×10^{-1}	8.241	3.986×10^{-1}	7.383	6.146×10^{-1}	5.915	1.178×10^{-1}	5.954	5.867×10^{-1}	8.474	$1.193 \times 10^{+0}$	4.936
20.0	2.711×10^{-1}	8.029	3.532×10^{-1}	7.213	4.794×10^{-1}	5.788	8.403×10^{-2}	5.697	8.478×10^{-1}	8.130	9.601×10^{-1}	4.917
21.0	3.692×10^{-1}	7.838	4.335×10^{-1}	7.063	3.274×10^{-1}	5.679	6.872×10^{-2}	5.473	9.529×10^{-1}	7.825	$1.493 \times 10^{+0}$	4.906
22.0	4.539×10^{-1}	7.670	6.237×10^{-1}	6.927	3.150×10^{-1}	5.587	2.438×10^{-1}	5.280	$1.118 \times 10^{+0}$	7.553	$2.415 \times 10^{+0}$	4.898
23.0	5.186×10^{-1}	7.516	6.766×10^{-1}	6.802	4.703×10^{-1}	5.508	2.473×10^{-1}	5.110	$1.263 \times 10^{+0}$	7.309	$1.893 \times 10^{+0}$	4.892
24.0	6.904×10^{-1}	7.375	9.548×10^{-1}	6.691	5.811×10^{-1}	5.440	2.757×10^{-1}	4.963	$1.716 \times 10^{+0}$	7.091	9.070×10^{-1}	4.890
25.0	9.448×10^{-1}	7.247	$1.023 \times 10^{+0}$	6.589	5.830×10^{-1}	5.380	2.689×10^{-1}	4.837	$2.828 \times 10^{+0}$	6.895	3.892×10^{-1}	4.890
26.0	9.312×10^{-1}	7.131	6.123×10^{-1}	6.495	4.676×10^{-1}	5.330	3.372×10^{-1}	4.726	$1.494 \times 10^{+0}$	6.718	5.528×10^{-1}	4.890
27.0	7.936×10^{-1}	7.022	5.867×10^{-1}	6.409	4.461×10^{-1}	5.284	3.230×10^{-1}	4.632	$1.241 \times 10^{+0}$	6.557	3.668×10^{-1}	4.890
28.0	8.561×10^{-1}	6.922	5.244×10^{-1}	6.330	3.973×10^{-1}	5.240	3.385×10^{-1}	4.553	8.137×10^{-1}	6.413	3.312×10^{-1}	4.892
29.0	6.154×10^{-1}	6.829	5.049×10^{-1}	6.257	3.729×10^{-1}	5.206	1.860×10^{-1}	4.486	8.440×10^{-1}	6.278	1.891×10^{-1}	4.891
30.0	6.335×10^{-1}	6.743	5.584×10^{-1}	6.188	3.404×10^{-1}	5.173	1.911×10^{-1}	4.428	6.392×10^{-1}	6.159	1.664×10^{-1}	4.895
31.0	6.676×10^{-1}	6.661	7.039×10^{-1}	6.124	4.315×10^{-1}	5.145	1.858×10^{-1}	4.379	4.796×10^{-1}	6.048	1.498×10^{-1}	4.894
32.0	$1.156 \times 10^{+0}$	6.585	9.601×10^{-1}	6.065	4.639×10^{-1}	5.121	1.876×10^{-1}	4.339	3.619×10^{-1}	5.945	1.213×10^{-1}	4.896
33.0	$1.466 \times 10^{+0}$	6.513	8.876×10^{-1}	6.010	5.669×10^{-1}	5.097	1.911×10^{-1}	4.305	3.357×10^{-1}	5.850	1.057×10^{-1}	4.897
34.0	$1.306 \times 10^{+0}$	6.446	7.020×10^{-1}	5.959	6.122×10^{-1}	5.078	2.030×10^{-1}	4.280	2.226×10^{-1}	5.761	8.202×10^{-2}	4.897
35.0	9.629×10^{-1}	6.382	7.087×10^{-1}	5.909	6.173×10^{-1}	5.061	2.354×10^{-1}	4.258	2.197×10^{-1}	5.681	7.415×10^{-2}	4.897
36.0	8.955×10^{-1}	6.322	6.640×10^{-1}	5.863	5.924×10^{-1}	5.046	1.935×10^{-1}	4.241	2.181×10^{-1}	5.605	5.759×10^{-2}	4.897
37.0	8.121×10^{-1}	6.264	6.670×10^{-1}	5.820	5.805×10^{-1}	5.033	2.602×10^{-1}	4.229	1.823×10^{-1}	5.533	4.835×10^{-2}	4.897
38.0	7.313×10^{-1}	6.209	7.949×10^{-1}	5.780	5.011×10^{-1}	5.022	2.340×10^{-1}	4.220	1.997×10^{-1}	5.466	3.454×10^{-2}	4.896
39.0	9.123×10^{-1}	6.158	7.782×10^{-1}	5.741	5.033×10^{-1}	5.010	2.212×10^{-1}	4.215	1.527×10^{-1}	5.404	3.373×10^{-2}	4.898
40.0	7.569×10^{-1}	6.109	7.651×10^{-1}	5.705	5.641×10^{-1}	5.003	2.272×10^{-1}	4.212	1.131×10^{-1}	5.346	2.706×10^{-2}	4.896
41.0	8.295×10^{-1}	6.061	7.668×10^{-1}	5.671	5.950×10^{-1}	4.995	2.586×10^{-1}	4.211	8.187×10^{-2}	5.291	3.014×10^{-2}	4.896
42.0	8.082×10^{-1}	6.016	8.303×10^{-1}	5.638	6.391×10^{-1}	4.989	2.942×10^{-1}	4.213	6.176×10^{-2}	5.239	2.977×10^{-2}	4.896
43.0	7.799×10^{-1}	5.972	8.872×10^{-1}	5.608	5.685×10^{-1}	4.984	3.188×10^{-1}	4.217	8.152×10^{-2}	5.190	3.007×10^{-2}	4.896
44.0	7.981×10^{-1}	5.931	8.481×10^{-1}	5.577	7.436×10^{-1}	4.979	3.074×10^{-1}	4.222	2.471×10^{-1}	5.143	1.842×10^{-2}	4.897
45.0	9.758×10^{-1}	5.889	9.345×10^{-1}	5.550	7.403×10^{-1}	4.977	2.932×10^{-1}	4.230	4.023×10^{-1}	5.100	1.493×10^{-2}	4.899
46.0	9.739×10^{-1}	5.851	$1.068 \times 10^{+0}$	5.523	6.995×10^{-1}	4.974	3.522×10^{-1}	4.238	7.388×10^{-1}	5.058	1.144×10^{-2}	4.902
47.0	7.717×10^{-1}	5.813	$1.175 \times 10^{+0}$	5.498	5.955×10^{-1}	4.973	3.638×10^{-1}	4.247	$2.269 \times 10^{+0}$	5.019	1.206×10^{-2}	4.904
48.0	6.653×10^{-1}	5.776	7.892×10^{-1}	5.474	5.323×10^{-1}	4.972	3.303×10^{-1}	4.258	$2.722 \times 10^{+0}$	4.982	1.038×10^{-2}	4.908
49.0	4.474×10^{-1}	5.741	6.152×10^{-1}	5.451	6.508×10^{-1}	4.972	3.645×10^{-1}	4.270	$1.873 \times 10^{+0}$	4.947	9.185×10^{-3}	4.912
50.0	5.646×10^{-1}	5.706	6.284×10^{-1}	5.429	6.220×10^{-1}	4.972	4.164×10^{-1}	4.281	$1.287 \times 10^{+0}$	4.913	1.028×10^{-2}	4.918
52.0	9.853×10^{-1}	5.641	5.969×10^{-1}	5.389	4.559×10^{-1}	4.975	4.835×10^{-1}	4.308	4.896×10^{-1}	4.852	1.014×10^{-2}	4.932
54.0	$1.175 \times 10^{+0}$	5.582	5.954×10^{-1}	5.351	6.967×10^{-1}	4.982	4.877×10^{-1}	4.337	7.046×10^{-1}	4.797	1.399×10^{-2}	4.950
56.0	9.270×10^{-1}	5.525	5.955×10^{-1}	5.319	3.843×10^{-1}	4.990	4.117×10^{-1}	4.368	5.252×10^{-1}	4.748	7.753×10^{-3}	4.972
58.0	9.178×10^{-1}	5.473	5.606×10^{-1}	5.290	3.505×10^{-1}	4.998	3.537×10^{-1}	4.400	3.675×10^{-1}	4.705	6.637×10^{-3}	4.997
60.0	6.676×10^{-1}	5.423	5.196×10^{-1}	5.264	3.374×10^{-1}	5.009	3.418×10^{-1}	4.432	2.891×10^{-1}	4.669	6.370×10^{-3}	5.026
62.0	7.148×10^{-1}	5.378	4.116×10^{-1}	5.241	2.514×10^{-1}	5.019	3.018×10^{-1}	4.468	2.858×10^{-1}	4.637	5.400×10^{-3}	5.058
64.0	5.644×10^{-1}	5.337	4.674×10^{-1}	5.221	2.224×10^{-1}	5.032	2.284×10^{-1}	4.502	2.067×10^{-1}	4.612	3.086×10^{-3}	5.094
66.0	4.517×10^{-1}	5.299	4.106×10^{-1}	5.203	2.952×10^{-1}	5.045	2.600×10^{-1}	4.538	1.946×10^{-1}	4.590	3.658×10^{-3}	5.133
68.0	3.280×10^{-1}	5.264	3.544×10^{-1}	5.187	2.310×10^{-1}	5.060	1.911×10^{-1}	4.574	2.036×10^{-1}	4.572	3.418×10^{-3}	5.175
70.0	2.758×10^{-1}	5.231	2.479×10^{-1}	5.174	2.136×10^{-1}	5.074	1.744×10^{-1}	4.611				

Table 11 (continued)

Energy (eV)	Pd		Ag		Cd		Sn		Cs		Ba	
	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)
76.0	1.427×10^{-1}	5.149	1.311×10^{-1}	5.142	1.106×10^{-1}	5.120	1.052×10^{-1}	4.722	1.141×10^{-1}	4.539	2.456×10^{-3}	5.360
78.0	1.221×10^{-1}	5.126	1.079×10^{-1}	5.135	1.235×10^{-1}	5.137	7.354×10^{-2}	4.760	9.061×10^{-2}	4.538	2.744×10^{-3}	5.411
80.0	9.962×10^{-2}	5.105	1.004×10^{-1}	5.128	8.557×10^{-2}	5.154	8.183×10^{-2}	4.798	1.026×10^{-1}	4.540	2.168×10^{-3}	5.463
82.0	9.385×10^{-2}	5.086	1.135×10^{-1}	5.123	7.312×10^{-2}	5.171	7.371×10^{-2}	4.836	8.250×10^{-2}	4.543	1.624×10^{-3}	5.516
84.0	9.941×10^{-2}	5.069	9.082×10^{-2}	5.119	7.089×10^{-2}	5.189	6.385×10^{-2}	4.872	7.556×10^{-2}	4.549	1.825×10^{-3}	5.570
86.0	7.041×10^{-2}	5.054	9.259×10^{-2}	5.117	6.693×10^{-2}	5.207	5.971×10^{-2}	4.910	6.897×10^{-2}	4.555	1.696×10^{-3}	5.625
88.0	9.268×10^{-2}	5.041	8.002×10^{-2}	5.115	6.315×10^{-2}	5.224	5.538×10^{-2}	4.948	5.929×10^{-2}	4.563	1.519×10^{-3}	5.680
90.0	6.758×10^{-2}	5.029	6.739×10^{-2}	5.114	5.247×10^{-2}	5.242	4.532×10^{-2}	4.985	5.487×10^{-2}	4.573	1.561×10^{-2}	5.738
92.0	4.915×10^{-2}	5.018	6.419×10^{-2}	5.114	4.052×10^{-2}	5.260	3.715×10^{-2}	5.024	6.525×10^{-2}	4.584	1.076×10^{-1}	5.796
94.0	3.551×10^{-2}	5.010	6.130×10^{-2}	5.117	3.267×10^{-2}	5.279	3.449×10^{-2}	5.062	4.470×10^{-2}	4.597	1.670×10^{-1}	5.855
96.0	2.778×10^{-2}	5.004	6.011×10^{-2}	5.121	2.897×10^{-2}	5.300	3.247×10^{-2}	5.101	4.378×10^{-2}	4.609	9.558×10^{-2}	5.913
98.0	2.606×10^{-2}	4.999	5.659×10^{-2}	5.125	2.599×10^{-2}	5.322	2.750×10^{-2}	5.139	4.556×10^{-2}	4.623	6.458×10^{-2}	5.973
100.0	1.974×10^{-2}	4.996	5.380×10^{-2}	5.129	2.474×10^{-2}	5.343	2.507×10^{-2}	5.176	4.352×10^{-2}	4.636	4.450×10^{-2}	6.033
106.2	1.749×10^{-2}	4.992	4.621×10^{-2}	5.149	1.880×10^{-2}	5.408	1.370×10^{-2}	5.290	3.919×10^{-2}	4.680	1.437×10^{-2}	6.219
112.7	1.245×10^{-2}	4.995	3.976×10^{-2}	5.175	1.595×10^{-2}	5.481	1.394×10^{-2}	5.408	3.483×10^{-2}	4.728	6.968×10^{-3}	6.420
119.7	1.033×10^{-2}	5.008	3.426×10^{-2}	5.208	1.340×10^{-2}	5.559	1.194×10^{-2}	5.532	3.103×10^{-2}	4.781	4.073×10^{-3}	6.635
127.1	9.341×10^{-3}	5.031	2.954×10^{-2}	5.253	1.140×10^{-2}	5.646	1.038×10^{-2}	5.661	2.769×10^{-2}	4.837	2.744×10^{-3}	6.868
134.9	8.481×10^{-3}	5.063	2.550×10^{-2}	5.307	9.781×10^{-3}	5.743	9.135×10^{-3}	5.796	2.472×10^{-2}	4.900	2.060×10^{-3}	7.104
143.3	7.723×10^{-3}	5.106	2.205×10^{-2}	5.372	8.474×10^{-3}	5.851	8.904×10^{-3}	5.938	2.208×10^{-2}	4.973	1.676×10^{-3}	7.390
152.1	7.040×10^{-3}	5.160	1.908×10^{-2}	5.450	7.387×10^{-3}	5.970	8.028×10^{-3}	6.088	1.970×10^{-2}	5.058	1.442×10^{-3}	7.689
161.5	6.421×10^{-3}	5.226	1.650×10^{-2}	5.539	6.474×10^{-3}	6.101	7.270×10^{-3}	6.247	1.753×10^{-2}	5.153	1.292×10^{-3}	8.009
171.5	5.856×10^{-3}	5.305	1.428×10^{-2}	5.642	5.703×10^{-3}	6.245	6.605×10^{-3}	6.419	1.554×10^{-2}	5.264	1.195×10^{-3}	8.345
182.1	5.337×10^{-3}	5.400	1.236×10^{-2}	5.758	5.071×10^{-3}	6.403	6.012×10^{-3}	6.603	1.373×10^{-2}	5.388	1.842×10^{-3}	8.699
193.3	4.860×10^{-3}	5.509	1.069×10^{-2}	5.888	4.555×10^{-3}	6.575	5.477×10^{-3}	6.805	1.206×10^{-2}	5.525	1.816×10^{-3}	9.072
205.2	4.420×10^{-3}	5.633	9.246×10^{-3}	6.032	4.093×10^{-3}	6.762	4.988×10^{-3}	7.028	1.054×10^{-2}	5.676	1.710×10^{-3}	9.464
217.9	4.012×10^{-3}	5.801	7.996×10^{-3}	6.192	3.680×10^{-3}	6.964	4.539×10^{-3}	7.269	9.158×10^{-3}	5.841	1.647×10^{-3}	9.875
231.4	3.634×10^{-3}	5.966	6.912×10^{-3}	6.365	3.310×10^{-3}	7.186	4.124×10^{-3}	7.528	7.917×10^{-3}	6.054	1.589×10^{-3}	10.303
245.6	3.284×10^{-3}	6.177	5.974×10^{-3}	6.567	2.975×10^{-3}	7.429	3.738×10^{-3}	7.808	6.813×10^{-3}	6.304	1.533×10^{-3}	10.745
260.8	2.962×10^{-3}	6.399	5.164×10^{-3}	6.883	2.674×10^{-3}	7.707	3.382×10^{-3}	8.116	5.841×10^{-3}	6.540	1.630×10^{-3}	11.209
276.9	2.664×10^{-3}	6.634	4.458×10^{-3}	7.126	2.399×10^{-3}	8.003	3.050×10^{-3}	8.441	4.986×10^{-3}	6.797	1.553×10^{-3}	11.691
294.0	2.389×10^{-3}	6.881	3.844×10^{-3}	7.402	2.148×10^{-3}	8.317	2.741×10^{-3}	8.788	4.239×10^{-3}	7.062	1.471×10^{-3}	12.199
312.2	2.137×10^{-3}	7.142	3.310×10^{-3}	7.688	1.919×10^{-3}	8.649	2.455×10^{-3}	9.151	3.590×10^{-3}	7.344	1.383×10^{-3}	12.737
331.4	1.903×10^{-3}	7.419	2.847×10^{-3}	7.990	1.710×10^{-3}	9.000	2.191×10^{-3}	9.534	3.030×10^{-3}	7.641	1.289×10^{-3}	13.305
351.9	5.851×10^{-3}	7.713	2.443×10^{-3}	8.307	1.519×10^{-3}	9.370	1.948×10^{-3}	9.939	2.551×10^{-3}	7.952	1.192×10^{-3}	13.903
373.6	6.986×10^{-3}	8.021	5.839×10^{-3}	8.639	1.346×10^{-3}	9.900	1.726×10^{-3}	10.366	2.141×10^{-3}	8.281	1.091×10^{-3}	14.535
396.7	8.169×10^{-3}	8.346	6.908×10^{-3}	8.990	1.189×10^{-3}	10.382	1.522×10^{-3}	10.816	1.794×10^{-3}	8.626	9.893×10^{-4}	15.198
421.2	8.903×10^{-3}	8.690	7.498×10^{-3}	9.360	6.170×10^{-3}	10.817	1.338×10^{-3}	11.288	1.500×10^{-3}	8.990	8.881×10^{-4}	15.895
447.2	9.092×10^{-3}	9.053	7.767×10^{-3}	9.748	6.229×10^{-3}	11.293	1.173×10^{-3}	11.786	1.254×10^{-3}	9.373	7.905×10^{-4}	16.635
474.8	8.798×10^{-3}	9.434	7.649×10^{-3}	10.158	6.129×10^{-3}	11.786	1.014×10^{-3}	12.478	1.048×10^{-3}	9.775	6.982×10^{-4}	17.410
504.1	8.160×10^{-3}	9.836	7.222×10^{-3}	10.589	5.797×10^{-3}	12.310	7.482×10^{-3}	13.131	8.740×10^{-4}	10.199	6.124×10^{-4}	18.229
535.3	8.455×10^{-3}	10.259	6.581×10^{-3}	11.043	5.302×10^{-3}	12.853	6.211×10^{-3}	13.702	7.283×10^{-4}	10.646	5.338×10^{-4}	19.086
568.3	7.699×10^{-3}	10.705	5.819×10^{-3}	11.521	4.725×10^{-3}	13.429	5.144×10^{-3}	14.331	6.047×10^{-4}	11.115	4.627×10^{-4}	19.994
603.4	6.586×10^{-3}	11.173	5.842×10^{-3}	12.023	4.117×10^{-3}	14.032	4.268×10^{-3}	14.986	4.949×10^{-3}	11.610	3.992×10^{-4}	20.949
640.7	5.590×10^{-3}	11.668	5.174×10^{-3}	12.554	4.044×10^{-3}	14.668	3.543×10^{-3}	15.686	4.021×10^{-3}	12.130	3.430×10^{-4}	21.951
680.2	4.942×10^{-3}	12.187	4.378×10^{-3}	13.110	3.655×10^{-3}	15.336	2.937×10^{-3}	16.414	3.258×10^{-3}	12.676	2.938×10^{-4}	23.008
722.2	4.110×10^{-3}	12.735	3.850×10^{-3}	13.695	3.095×10^{-3}	16.039	2.766×10^{-3}	17.183	3.025×10^{-3}	13.253	2.509×10^{-4}	24.118
766.8	3.425×10^{-3}	13.310	3.206×10^{-3}	14.313	2.592×10^{-3}	16.780	2.435×10^{-3}	17.985	2.478×10^{-3}	13.859	2.138×10^{-4}	25.285
814.2	2.849×10^{-3}	13.916	2.672×10^{-3}	14.960	2.266×10^{-3}	17.558	2.039×10^{-3}	18.833	2.032×10^{-3}	14.495	1.189×10^{-3}	26.523
864.5	2.367×10^{-3}	14.552	2.222×10^{-3}	15.643	1.894×10^{-3}	18.375	1.699×10^{-3}	19.724	1.666×10^{-3}	15.165	9.642×10^{-4}	27.820
917.8	1.962×10^{-3}	15.223	1.844×10^{-3}	16.361	1.578×10^{-3}	19.236	1.480×10^{-3}	20.658	1.363×10^{-3}	15.871	7.835×10^{-4}	29.187
974.5	1.624×10^{-3}	15.927	1.527×10^{-3}	17.115	1.313×10^{-3}	20.142	1.236×10^{-3}	21.643	1.114×10^{-3}	16.611	6.394×10^{-4}	30.623
1034.7	1.337×10^{-3}	16.670	1.259×10^{-3}	17.909	1.087×10^{-3}	21.096	1.023×10^{-3}	22.685	9.060×10^{-4}	17.391	5.206×10^{-4}	32.135
1098.6	1.095×10^{-3}	17.450	1.032×10^{-3}	18.744	8.918×10^{-4}	22.098	8.393×10^{-4}	23.771	7.316×10^{-4}	18.212	4.922×10^{-4}	33.732
1166.4	8.960×10^{-4}	18.271	8.455×10^{-4}	19.624	7.303×10^{-4}	23.152	6.890×10^{-4}	24.917	5.910×10^{-4}	19.073	4.287×10^{-4}	35.418
1238.4	7.327×10^{-4}	19.136	6.919×10^{-4}	20.548	5.975×10^{-4}	24.258	5.652×10^{-4}	26.132	4.767×10^{-4}	19.981	3.528×10^{-4}	37.183
1314.9	5.989×10^{-4}	20.044	5.657×10^{-4}	21.519	4.885×10^{-4}	25.427	4.623×10^{-4}	27.401	3.842×10^{-4}	20.935	3.061×10^{-4}	39.045
1396.1	4.873×10^{-4}	21.001	4.624×10^{-4}	22.541	3.989×10^{-4}	26.657	3.778×10^{-4}	28.729	3.096×10^{-4}	21.940	2.525×10^{-4}	40.998
1482.3	3.962×10^{-4}	22.006	3.783×10^{-4}	23.617	3.265×10^{-4}	27.953	3.095×10^{-4}	30.137	2.500×10^{-4}	22.993	2.076×10^{-4}	43.060
1573.8	3.225×10^{-4}	23.066	3.077×10^{-4}	24.749	2.672×10^{-4}	29.319	2.534×10^{-4}	31.623	2.018×10^{-4}	24.107	1.704×10^{-4}	45.247
1671.0	2.627×10^{-4}	24.181	$2.500 \$									

Table 12
ELF and IMFP data calculated for Gd, Tb, Dy, Hf, Ta and W.

Energy (eV)	Gd		Tb		Dy		Hf		Ta		W	
	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)
1.0	1.824×10^{-2}	168.034	1.887×10^{-2}	182.742	1.988×10^{-2}	164.786	2.565×10^{-2}	293.393	4.774×10^{-3}	531.524	2.150×10^{-2}	447.771
2.0	4.991×10^{-2}	60.564	5.080×10^{-2}	64.510	5.084×10^{-2}	59.955	3.874×10^{-2}	106.745	1.040×10^{-1}	133.908	3.734×10^{-2}	154.306
3.0	7.214×10^{-2}	35.543	7.201×10^{-2}	37.405	7.392×10^{-2}	35.312	5.227×10^{-2}	62.071	6.146×10^{-2}	68.744	4.539×10^{-2}	88.097
4.0	1.010×10^{-1}	25.117	1.036×10^{-1}	26.188	1.065×10^{-1}	25.010	9.344×10^{-2}	42.657	7.615×10^{-2}	46.721	5.257×10^{-2}	61.190
5.0	1.729×10^{-1}	19.465	1.912×10^{-1}	20.189	2.153×10^{-1}	19.406	1.296×10^{-1}	32.058	5.130×10^{-2}	35.888	4.084×10^{-2}	46.882
6.0	4.087×10^{-1}	15.924	3.927×10^{-1}	16.425	4.377×10^{-1}	15.880	1.447×10^{-1}	25.569	5.334×10^{-2}	29.486	4.398×10^{-2}	38.155
7.0	6.615×10^{-1}	13.469	6.740×10^{-1}	13.810	6.159×10^{-1}	13.435	1.920×10^{-1}	21.288	9.924×10^{-2}	25.159	7.096×10^{-2}	32.204
8.0	5.934×10^{-1}	11.692	5.813×10^{-1}	11.934	5.931×10^{-1}	11.677	2.678×10^{-1}	18.280	2.240×10^{-1}	21.941	1.282×10^{-1}	27.801
9.0	$1.020 \times 10^{+0}$	10.359	6.292×10^{-1}	10.535	4.886×10^{-1}	10.365	2.948×10^{-1}	16.039	2.016×10^{-1}	19.386	2.250×10^{-1}	24.361
10.0	$1.429 \times 10^{+0}$	9.358	$1.231 \times 10^{+0}$	9.482	$1.091 \times 10^{+0}$	9.385	1.731×10^{-1}	14.309	2.035×10^{-1}	17.326	2.302×10^{-1}	21.566
11.0	$1.111 \times 10^{+0}$	8.574	$1.204 \times 10^{+0}$	8.681	$1.319 \times 10^{+0}$	8.619	2.535×10^{-1}	12.967	2.888×10^{-1}	15.645	2.124×10^{-1}	19.292
12.0	7.374×10^{-1}	7.961	7.869×10^{-1}	8.045	8.929×10^{-1}	8.021	6.652×10^{-1}	11.898	3.488×10^{-1}	14.301	2.367×10^{-1}	17.449
13.0	5.346×10^{-1}	7.467	5.880×10^{-1}	7.544	6.781×10^{-1}	7.540	6.399×10^{-1}	11.030	4.987×10^{-1}	13.190	2.756×10^{-1}	15.947
14.0	3.853×10^{-1}	7.070	4.412×10^{-1}	7.134	5.138×10^{-1}	7.152	8.179×10^{-1}	10.301	4.771×10^{-1}	12.253	4.256×10^{-1}	14.709
15.0	2.505×10^{-1}	6.737	2.702×10^{-1}	6.801	3.002×10^{-1}	6.827	$1.183 \times 10^{+0}$	9.680	3.771×10^{-1}	11.457	5.155×10^{-1}	13.680
16.0	1.876×10^{-1}	6.461	1.903×10^{-1}	6.524	2.041×10^{-1}	6.556	$1.322 \times 10^{+0}$	9.141	4.261×10^{-1}	10.773	3.872×10^{-1}	12.801
17.0	1.051×10^{-1}	6.229	1.203×10^{-1}	6.290	1.354×10^{-1}	6.326	$1.648 \times 10^{+0}$	8.672	5.390×10^{-1}	10.179	3.338×10^{-1}	12.043
18.0	8.345×10^{-2}	6.031	1.015×10^{-1}	6.091	1.095×10^{-1}	6.127	$1.798 \times 10^{+0}$	8.257	$1.058 \times 10^{+0}$	9.660	3.683×10^{-1}	11.387
19.0	5.856×10^{-2}	5.865	6.413×10^{-2}	5.924	7.337×10^{-2}	5.959	$2.164 \times 10^{+0}$	7.892	$1.895 \times 10^{+0}$	9.204	3.279×10^{-1}	10.811
20.0	7.302×10^{-2}	5.725	5.841×10^{-2}	5.782	6.803×10^{-2}	5.815	7.934×10^{-1}	7.571	$1.912 \times 10^{+0}$	8.803	4.933×10^{-1}	10.298
21.0	2.202×10^{-1}	5.605	1.265×10^{-1}	5.661	5.920×10^{-2}	5.690	5.350×10^{-1}	7.283	$1.439 \times 10^{+0}$	8.447	$1.193 \times 10^{+0}$	9.845
22.0	2.295×10^{-1}	5.503	2.800×10^{-1}	5.559	2.084×10^{-1}	5.583	3.093×10^{-1}	7.028	$1.188 \times 10^{+0}$	8.127	$1.345 \times 10^{+0}$	9.441
23.0	4.141×10^{-1}	5.417	2.748×10^{-1}	5.471	2.000×10^{-1}	5.492	2.404×10^{-1}	6.797	9.943×10^{-1}	7.843	$1.613 \times 10^{+0}$	9.079
24.0	7.305×10^{-1}	5.346	6.163×10^{-1}	5.397	3.350×10^{-1}	5.414	1.867×10^{-1}	6.592	$1.401 \times 10^{+0}$	7.586	$3.230 \times 10^{+0}$	8.754
25.0	5.853×10^{-1}	5.283	6.910×10^{-1}	5.335	7.364×10^{-1}	5.346	1.561×10^{-1}	6.406	$1.188 \times 10^{+0}$	7.354	$1.761 \times 10^{+0}$	8.458
26.0	4.901×10^{-1}	5.233	5.221×10^{-1}	5.281	6.122×10^{-1}	5.291	1.125×10^{-1}	6.238	6.381×10^{-1}	7.143	$1.358 \times 10^{+0}$	8.191
27.0	5.537×10^{-1}	5.190	5.093×10^{-1}	5.237	4.800×10^{-1}	5.244	8.161×10^{-2}	6.087	3.709×10^{-1}	6.950	8.674×10^{-1}	7.948
28.0	9.030×10^{-1}	5.152	5.645×10^{-1}	5.198	5.222×10^{-1}	5.202	6.430×10^{-2}	5.949	2.871×10^{-1}	6.774	5.433×10^{-1}	7.727
29.0	$1.706 \times 10^{+0}$	5.120	$1.196 \times 10^{+0}$	5.166	6.499×10^{-1}	5.166	4.945×10^{-2}	5.824	2.029×10^{-1}	6.612	5.290×10^{-1}	7.524
30.0	$1.812 \times 10^{+0}$	5.095	$1.392 \times 10^{+0}$	5.139	$1.531 \times 10^{+0}$	5.138	4.299×10^{-2}	5.711	1.711×10^{-1}	6.461	5.098×10^{-1}	7.337
31.0	$1.644 \times 10^{+0}$	5.074	$2.250 \times 10^{+0}$	5.117	$1.506 \times 10^{+0}$	5.115	1.889×10^{-1}	5.607	1.082×10^{-1}	6.321	4.967×10^{-1}	7.165
32.0	$1.427 \times 10^{+0}$	5.056	$1.489 \times 10^{+0}$	5.097	$1.854 \times 10^{+0}$	5.095	3.986×10^{-1}	5.515	9.701×10^{-2}	6.193	8.159×10^{-1}	7.004
33.0	$1.334 \times 10^{+0}$	5.042	$1.470 \times 10^{+0}$	5.083	$1.389 \times 10^{+0}$	5.078	6.815×10^{-1}	5.431	8.363×10^{-2}	6.073	4.412×10^{-1}	6.856
34.0	$1.538 \times 10^{+0}$	5.030	$1.315 \times 10^{+0}$	5.069	$1.328 \times 10^{+0}$	5.066	5.691×10^{-1}	5.355	3.400×10^{-1}	5.960	2.655×10^{-1}	6.716
35.0	9.183×10^{-1}	5.020	$1.326 \times 10^{+0}$	5.058	$1.579 \times 10^{+0}$	5.054	4.724×10^{-1}	5.286	2.049×10^{-1}	5.858	2.015×10^{-1}	6.585
36.0	7.590×10^{-1}	5.012	8.882×10^{-1}	5.051	$1.006 \times 10^{+0}$	5.046	4.854×10^{-1}	5.223	2.689×10^{-1}	5.761	1.571×10^{-1}	6.464
37.0	4.388×10^{-1}	5.006	7.106×10^{-1}	5.044	7.661×10^{-1}	5.040	5.970×10^{-1}	5.167	3.612×10^{-1}	5.671	1.145×10^{-1}	6.348
38.0	4.094×10^{-1}	5.001	4.302×10^{-1}	5.039	5.565×10^{-1}	5.035	$1.112 \times 10^{+0}$	5.117	3.276×10^{-1}	5.588	9.531×10^{-2}	6.240
39.0	4.208×10^{-1}	4.998	3.961×10^{-1}	5.034	4.318×10^{-1}	5.032	$2.178 \times 10^{+0}$	5.071	4.405×10^{-1}	5.511	2.341×10^{-1}	6.137
40.0	3.851×10^{-1}	4.996	4.200×10^{-1}	5.033	3.796×10^{-1}	5.031	$1.461 \times 10^{+0}$	5.032	$1.071 \times 10^{+0}$	5.439	3.438×10^{-1}	6.041
41.0	4.045×10^{-1}	4.995	3.875×10^{-1}	5.031	4.432×10^{-1}	5.030	$2.352 \times 10^{+0}$	4.995	$1.659 \times 10^{+0}$	5.373	3.305×10^{-1}	5.950
42.0	3.044×10^{-1}	4.994	4.118×10^{-1}	5.028	4.087×10^{-1}	5.030	$1.509 \times 10^{+0}$	4.963	$1.665 \times 10^{+0}$	5.311	4.458×10^{-1}	5.863
43.0	2.886×10^{-1}	4.992	3.064×10^{-1}	5.028	3.642×10^{-1}	5.029	$1.260 \times 10^{+0}$	4.933	$1.712 \times 10^{+0}$	5.255	9.504×10^{-1}	5.782
44.0	2.277×10^{-1}	4.992	3.013×10^{-1}	5.027	2.948×10^{-1}	5.031	$1.235 \times 10^{+0}$	4.909	$1.273 \times 10^{+0}$	5.202	$1.480 \times 10^{+0}$	5.704
45.0	2.597×10^{-1}	4.992	2.326×10^{-1}	5.027	2.558×10^{-1}	5.032	$1.119 \times 10^{+0}$	4.886	$1.373 \times 10^{+0}$	5.154	$1.873 \times 10^{+0}$	5.632
46.0	2.364×10^{-1}	4.992	2.692×10^{-1}	5.027	2.404×10^{-1}	5.033	$1.080 \times 10^{+0}$	4.866	$1.577 \times 10^{+0}$	5.109	$1.874 \times 10^{+0}$	5.564
47.0	1.745×10^{-1}	4.993	2.448×10^{-1}	5.029	2.399×10^{-1}	5.036	6.435×10^{-1}	4.848	$1.424 \times 10^{+0}$	5.068	$1.598 \times 10^{+0}$	5.499
48.0	1.658×10^{-1}	4.992	1.777×10^{-1}	5.029	2.247×10^{-1}	5.037	4.979×10^{-1}	4.832	$1.576 \times 10^{+0}$	5.030	$1.372 \times 10^{+0}$	5.439
49.0	1.500×10^{-1}	4.992	1.713×10^{-1}	5.028	1.734×10^{-1}	5.039	4.361×10^{-1}	4.820	$1.243 \times 10^{+0}$	4.995	$1.273 \times 10^{+0}$	5.382
50.0	1.385×10^{-1}	4.992	1.445×10^{-1}	5.029	1.608×10^{-1}	5.041	2.884×10^{-1}	4.808	$1.032 \times 10^{+0}$	4.963	$1.460 \times 10^{+0}$	5.329
52.0	1.077×10^{-1}	4.992	1.174×10^{-1}	5.030	1.395×10^{-1}	5.045	2.572×10^{-1}	4.789	6.664×10^{-1}	4.907	$1.400 \times 10^{+0}$	5.233
54.0	1.067×10^{-1}	4.992	1.134×10^{-1}	5.032	1.077×10^{-1}	5.048	2.727×10^{-1}	4.777	5.933×10^{-1}	4.860	$1.101 \times 10^{+0}$	5.148
56.0	8.581×10^{-2}	4.992	1.000×10^{-1}	5.032	1.020×10^{-1}	5.052	2.068×10^{-1}	4.769	3.711×10^{-1}	4.821	8.072×10^{-1}	5.076
58.0	7.098×10^{-2}	4.992	8.241×10^{-2}	5.032	9.043×10^{-2}	5.056	2.004×10^{-1}	4.763	3.081×10^{-1}	4.789	5.418×10^{-1}	5.014
60.0	5.997×10^{-2}	4.992	7.066×10^{-2}	5.033	8.372×10^{-2}	5.060	2.007×10^{-1}	4.761	2.970×10^{-1}	4.762	4.391×10^{-1}	4.960
62.0	5.647×10^{-2}	4.991	5.925×10^{-2}	5.033	7.607×10^{-2}	5.062	1.564×10^{-1}	4.761	2.437×10^{-1}	4.741	3.204×10^{-1}	4.913
64.0	5.479×10^{-2}	4.991	5.874×10^{-2}	5.033	7.364×10^{-2}	5.065	1.102×10^{-1}	4.763	1.687×10^{-1}	4.724	2.641×10^{-1}	4.873
66.0	5.329×10^{-2}	4.990	5.882×10^{-2}	5.033	7.112×10^{-2}	5.066	9.882×10^{-2}	4.765	1.542×10^{-1}	4.711	3.050×10^{-1}	4.839
68.0	5.152×10^{-2}	4.991	5.682×10^{-2}	5.033	6.891×10^{-2}	5.069	8.667×10^{-2}	4.768	1.497×10^{-1}	4.700	2.442×10^{-1}	4.810
70.0	4.982×10^{-2}	4.992	5.493×10^{-2}	5.034								

Table 12 (continued)

Energy (eV)	Gd		Tb		Dy		Hf		Ta		W	
	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)
76.0	4.523×10^{-2}	5.002	4.995×10^{-2}	5.043	6.167×10^{-2}	5.081	7.519×10^{-2}	4.788	7.977×10^{-2}	4.679	1.239×10^{-1}	4.731
78.0	4.383×10^{-2}	5.008	4.845×10^{-2}	5.048	6.012×10^{-2}	5.086	7.360×10^{-2}	4.793	8.987×10^{-2}	4.677	1.002×10^{-1}	4.718
80.0	4.248×10^{-2}	5.015	4.701×10^{-2}	5.054	5.839×10^{-2}	5.092	7.206×10^{-2}	4.799	8.201×10^{-2}	4.677	9.485×10^{-2}	4.708
82.0	4.120×10^{-2}	5.025	4.566×10^{-2}	5.062	5.626×10^{-2}	5.099	7.081×10^{-2}	4.805	7.593×10^{-2}	4.677	8.185×10^{-2}	4.698
84.0	3.996×10^{-2}	5.036	4.433×10^{-2}	5.072	5.400×10^{-2}	5.108	6.963×10^{-2}	4.811	7.173×10^{-2}	4.678	7.149×10^{-2}	4.692
86.0	3.878×10^{-2}	5.049	4.310×10^{-2}	5.083	5.194×10^{-2}	5.118	6.850×10^{-2}	4.818	6.769×10^{-2}	4.681	6.833×10^{-2}	4.687
88.0	3.765×10^{-2}	5.064	4.191×10^{-2}	5.096	5.006×10^{-2}	5.130	6.742×10^{-2}	4.826	6.695×10^{-2}	4.684	6.869×10^{-2}	4.684
90.0	3.655×10^{-2}	5.080	4.075×10^{-2}	5.110	4.823×10^{-2}	5.143	6.636×10^{-2}	4.834	6.694×10^{-2}	4.686	6.421×10^{-2}	4.681
92.0	3.550×10^{-2}	5.097	3.965×10^{-2}	5.125	4.651×10^{-2}	5.157	6.532×10^{-2}	4.844	6.662×10^{-2}	4.690	5.980×10^{-2}	4.679
94.0	3.450×10^{-2}	5.116	3.859×10^{-2}	5.143	4.489×10^{-2}	5.173	6.431×10^{-2}	4.852	6.621×10^{-2}	4.694	5.833×10^{-2}	4.677
96.0	3.353×10^{-2}	5.138	3.755×10^{-2}	5.163	4.331×10^{-2}	5.190	6.331×10^{-2}	4.860	6.585×10^{-2}	4.698	5.343×10^{-2}	4.676
98.0	3.259×10^{-2}	5.162	3.656×10^{-2}	5.185	4.180×10^{-2}	5.210	6.232×10^{-2}	4.870	6.551×10^{-2}	4.702	5.493×10^{-2}	4.676
100.0	3.169×10^{-2}	5.187	3.561×10^{-2}	5.209	4.037×10^{-2}	5.232	6.134×10^{-2}	4.880	6.519×10^{-2}	4.707	5.524×10^{-2}	4.676
106.2	2.914×10^{-2}	5.270	3.289×10^{-2}	5.286	3.634×10^{-2}	5.306	5.836×10^{-2}	4.914	6.414×10^{-2}	4.724	5.557×10^{-2}	4.679
112.7	2.673×10^{-2}	5.368	3.032×10^{-2}	5.379	3.260×10^{-2}	5.393	5.528×10^{-2}	4.958	6.277×10^{-2}	4.747	5.605×10^{-2}	4.687
119.7	2.448×10^{-2}	5.480	2.791×10^{-2}	5.485	2.915×10^{-2}	5.496	5.211×10^{-2}	5.014	6.101×10^{-2}	4.778	5.650×10^{-2}	4.701
127.1	2.238×10^{-2}	5.607	2.564×10^{-2}	5.607	2.597×10^{-2}	5.613	4.888×10^{-2}	5.082	5.883×10^{-2}	4.819	5.671×10^{-2}	4.723
134.9	2.044×10^{-2}	5.747	2.352×10^{-2}	5.742	2.305×10^{-2}	5.745	4.563×10^{-2}	5.162	5.626×10^{-2}	4.872	5.654×10^{-2}	4.755
143.3	3.494×10^{-2}	5.900	2.155×10^{-2}	5.889	2.039×10^{-2}	5.889	4.241×10^{-2}	5.257	5.338×10^{-2}	4.939	5.585×10^{-2}	4.799
152.1	2.515×10^{-2}	6.071	3.995×10^{-2}	6.054	1.797×10^{-2}	6.049	3.925×10^{-2}	5.365	5.024×10^{-2}	5.018	5.456×10^{-2}	4.856
161.5	1.974×10^{-2}	6.252	2.684×10^{-2}	6.230	3.068×10^{-2}	6.222	3.618×10^{-2}	5.487	4.694×10^{-2}	5.112	5.266×10^{-2}	4.926
171.5	1.659×10^{-2}	6.444	2.049×10^{-2}	6.419	2.044×10^{-2}	6.408	3.322×10^{-2}	5.621	4.356×10^{-2}	5.219	5.023×10^{-2}	5.010
182.1	1.401×10^{-2}	6.647	1.679×10^{-2}	6.618	1.542×10^{-2}	6.605	3.041×10^{-2}	5.769	4.015×10^{-2}	5.340	4.737×10^{-2}	5.109
193.3	1.186×10^{-2}	6.866	1.400×10^{-2}	6.831	1.253×10^{-2}	6.815	2.776×10^{-2}	5.930	3.680×10^{-2}	5.471	4.422×10^{-2}	5.225
205.2	1.012×10^{-2}	7.105	1.184×10^{-2}	7.059	1.051×10^{-2}	7.039	2.527×10^{-2}	6.101	3.355×10^{-2}	5.618	4.089×10^{-2}	5.366
217.9	8.667×10^{-3}	7.378	1.009×10^{-2}	7.318	8.965×10^{-3}	7.286	2.583×10^{-2}	6.284	3.044×10^{-2}	5.806	3.749×10^{-2}	5.514
231.4	7.452×10^{-3}	7.667	8.635×10^{-3}	7.601	7.712×10^{-3}	7.563	2.439×10^{-2}	6.478	2.965×10^{-2}	5.995	3.410×10^{-2}	5.675
245.6	6.431×10^{-3}	7.973	7.412×10^{-3}	7.900	6.673×10^{-3}	7.857	2.122×10^{-2}	6.687	2.775×10^{-2}	6.213	3.233×10^{-2}	5.862
260.8	5.574×10^{-3}	8.295	6.384×10^{-3}	8.215	5.802×10^{-3}	8.168	1.876×10^{-2}	6.980	2.442×10^{-2}	6.438	2.982×10^{-2}	6.065
276.9	5.484×10^{-3}	8.633	5.520×10^{-3}	8.547	5.068×10^{-3}	8.495	1.677×10^{-2}	7.364	2.141×10^{-2}	6.677	2.633×10^{-2}	6.281
294.0	4.998×10^{-3}	8.991	5.364×10^{-3}	8.897	5.026×10^{-3}	8.841	1.504×10^{-2}	7.622	1.881×10^{-2}	6.925	2.316×10^{-2}	6.509
312.2	4.430×10^{-3}	9.370	4.860×10^{-3}	9.265	4.460×10^{-3}	9.206	1.344×10^{-2}	7.922	1.655×10^{-2}	7.188	2.032×10^{-2}	6.750
331.4	3.940×10^{-3}	9.765	4.296×10^{-3}	9.655	3.975×10^{-3}	9.590	1.175×10^{-2}	8.246	1.456×10^{-2}	7.465	1.780×10^{-2}	7.003
351.9	3.514×10^{-3}	10.182	3.812×10^{-3}	10.063	3.680×10^{-3}	9.994	1.011×10^{-2}	8.581	1.281×10^{-2}	7.757	1.556×10^{-2}	7.271
373.6	3.138×10^{-3}	10.621	3.392×10^{-3}	10.493	3.306×10^{-3}	10.420	8.693×10^{-3}	8.933	1.128×10^{-2}	8.064	1.358×10^{-2}	7.551
396.7	2.947×10^{-3}	11.081	3.023×10^{-3}	10.945	2.975×10^{-3}	10.868	8.011×10^{-3}	9.302	9.932×10^{-3}	8.387	1.185×10^{-2}	7.847
421.2	2.632×10^{-3}	11.564	2.825×10^{-3}	11.419	2.806×10^{-3}	11.338	6.924×10^{-3}	9.690	9.357×10^{-3}	8.726	1.032×10^{-2}	8.159
447.2	2.346×10^{-3}	12.071	2.518×10^{-3}	11.918	2.524×10^{-3}	11.833	6.097×10^{-3}	10.098	8.268×10^{-3}	9.083	9.637×10^{-3}	8.485
474.8	2.083×10^{-3}	12.606	2.240×10^{-3}	12.440	2.264×10^{-3}	12.424	5.284×10^{-3}	10.527	7.392×10^{-3}	9.458	8.422×10^{-3}	8.828
504.1	1.843×10^{-3}	13.187	1.985×10^{-3}	13.200	2.023×10^{-3}	13.185	4.582×10^{-3}	10.975	6.374×10^{-3}	9.851	7.481×10^{-3}	9.189
535.3	1.624×10^{-3}	13.994	1.753×10^{-3}	13.945	1.800×10^{-3}	13.851	3.972×10^{-3}	11.449	5.493×10^{-3}	10.267	6.539×10^{-3}	9.568
568.3	1.424×10^{-3}	14.759	1.540×10^{-3}	14.564	1.593×10^{-3}	14.432	3.543×10^{-3}	11.945	4.855×10^{-3}	10.702	5.710×10^{-3}	9.967
603.4	1.241×10^{-3}	15.418	1.347×10^{-3}	15.184	1.403×10^{-3}	15.080	3.070×10^{-3}	12.466	4.181×10^{-3}	11.159	5.109×10^{-3}	10.386
640.7	1.077×10^{-3}	16.091	1.172×10^{-3}	15.881	1.229×10^{-3}	15.777	2.655×10^{-3}	13.015	3.595×10^{-3}	11.641	4.442×10^{-3}	10.827
680.2	9.299×10^{-4}	16.842	1.014×10^{-3}	16.611	1.070×10^{-3}	16.499	2.291×10^{-3}	13.591	3.086×10^{-3}	12.147	3.827×10^{-3}	11.291
722.2	7.997×10^{-4}	17.625	8.731×10^{-4}	17.378	9.269×10^{-4}	17.254	1.972×10^{-3}	14.197	2.643×10^{-3}	12.679	3.271×10^{-3}	11.777
766.8	6.855×10^{-4}	18.445	7.492×10^{-4}	18.179	7.991×10^{-4}	18.051	1.693×10^{-3}	14.833	2.259×10^{-3}	13.237	2.786×10^{-3}	12.289
814.2	5.859×10^{-4}	19.308	6.409×10^{-4}	19.032	6.865×10^{-4}	18.890	1.449×10^{-3}	15.503	1.927×10^{-3}	13.824	2.368×10^{-3}	12.827
864.5	4.998×10^{-4}	20.219	5.470×10^{-4}	19.919	5.881×10^{-4}	19.774	1.237×10^{-3}	16.204	1.639×10^{-3}	14.442	2.009×10^{-3}	13.392
917.8	4.256×10^{-4}	21.177	4.660×10^{-4}	20.858	5.027×10^{-4}	20.703	1.053×10^{-3}	16.943	1.392×10^{-3}	15.090	1.702×10^{-3}	13.987
974.5	3.620×10^{-4}	22.181	3.965×10^{-4}	21.843	4.291×10^{-4}	21.681	8.947×10^{-4}	17.719	1.179×10^{-3}	15.771	1.439×10^{-3}	14.612
1034.7	3.035×10^{-4}	23.236	3.322×10^{-4}	22.880	3.598×10^{-4}	22.707	7.446×10^{-4}	18.535	9.800×10^{-4}	16.488	1.198×10^{-3}	15.267
1098.6	2.519×10^{-4}	24.348	2.755×10^{-4}	23.971	2.980×10^{-4}	23.790	6.115×10^{-4}	19.391	8.043×10^{-4}	17.240	9.820×10^{-4}	15.957
1166.4	2.087×10^{-4}	25.520	2.284×10^{-4}	25.123	2.472×10^{-4}	24.930	5.032×10^{-4}	20.290	6.614×10^{-4}	18.032	8.066×10^{-4}	16.681
1238.4	9.913×10^{-4}	26.752	1.892×10^{-4}	26.329	2.046×10^{-4}	26.129	4.148×10^{-4}	21.235	5.449×10^{-4}	18.861	6.639×10^{-4}	17.444
1314.9	8.033×10^{-4}	28.045	9.054×10^{-4}	27.602	6.520×10^{-4}	27.387	3.425×10^{-4}	22.229	4.498×10^{-4}	19.735	5.475×10^{-4}	18.243
1396.1	6.511×10^{-4}	29.406	7.309×10^{-4}	28.938	7.938×10^{-4}	28.714	2.834×10^{-4}	23.276	3.719×10^{-4}	20.654	4.524×10^{-4}	19.084
1482.3	5.280×10^{-4}	30.840	5.903×10^{-4}	30.347	6.411×10^{-4}	30.112	2.348×10^{-4}	24.376	3.080×10^{-4}	21.619	3.746×10^{-4}	19.969
1573.8	5.011×10^{-4}	32.349	4.768×10^{-4}	31.827	5.179×10^{-4}	31.583	1.947×10^{-4}	25.533	2.555×10^{-4}	22.637	3.107×10^{-4}	20.899
1671.0	4.050×10^{-4}	33.937	4.502×1									

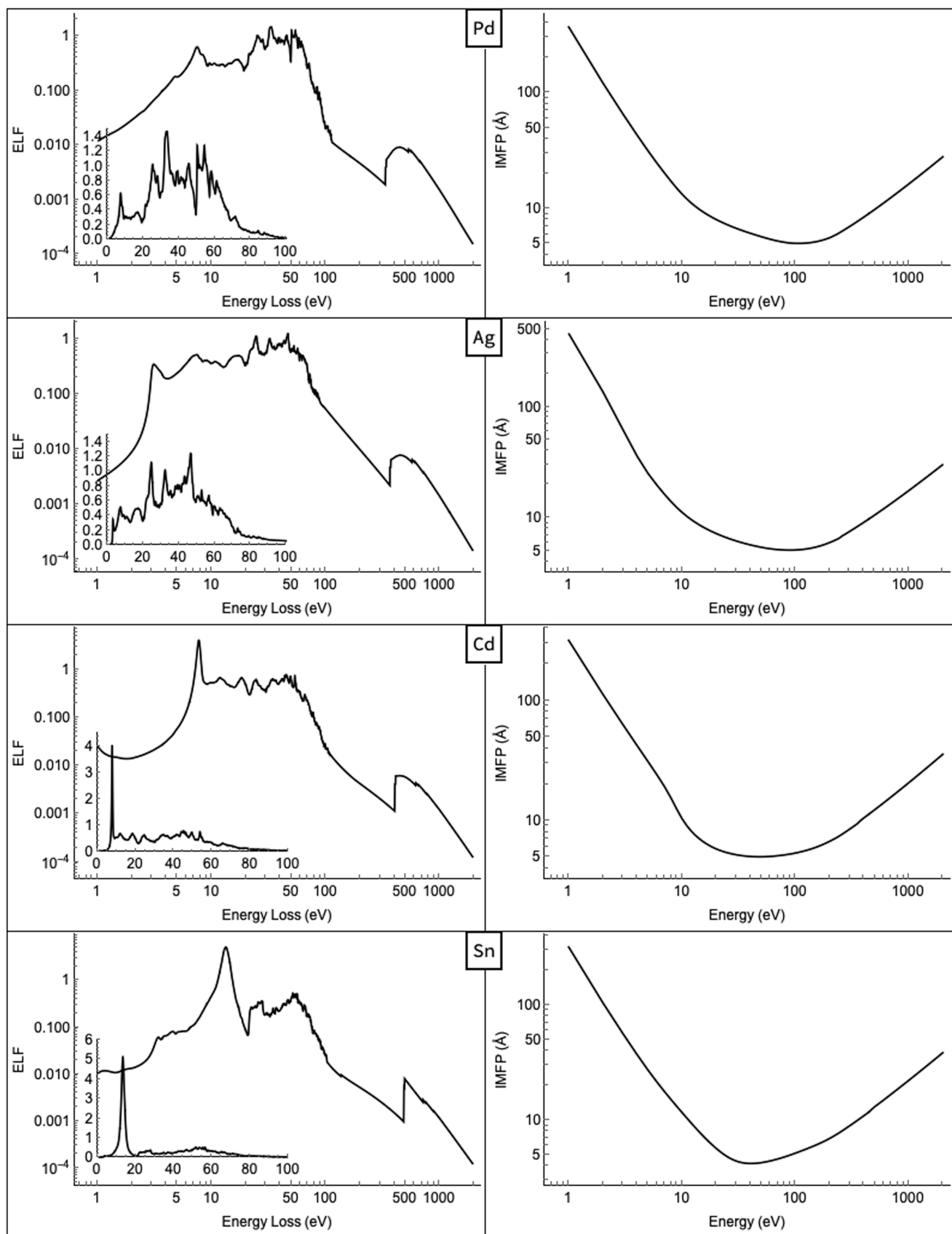
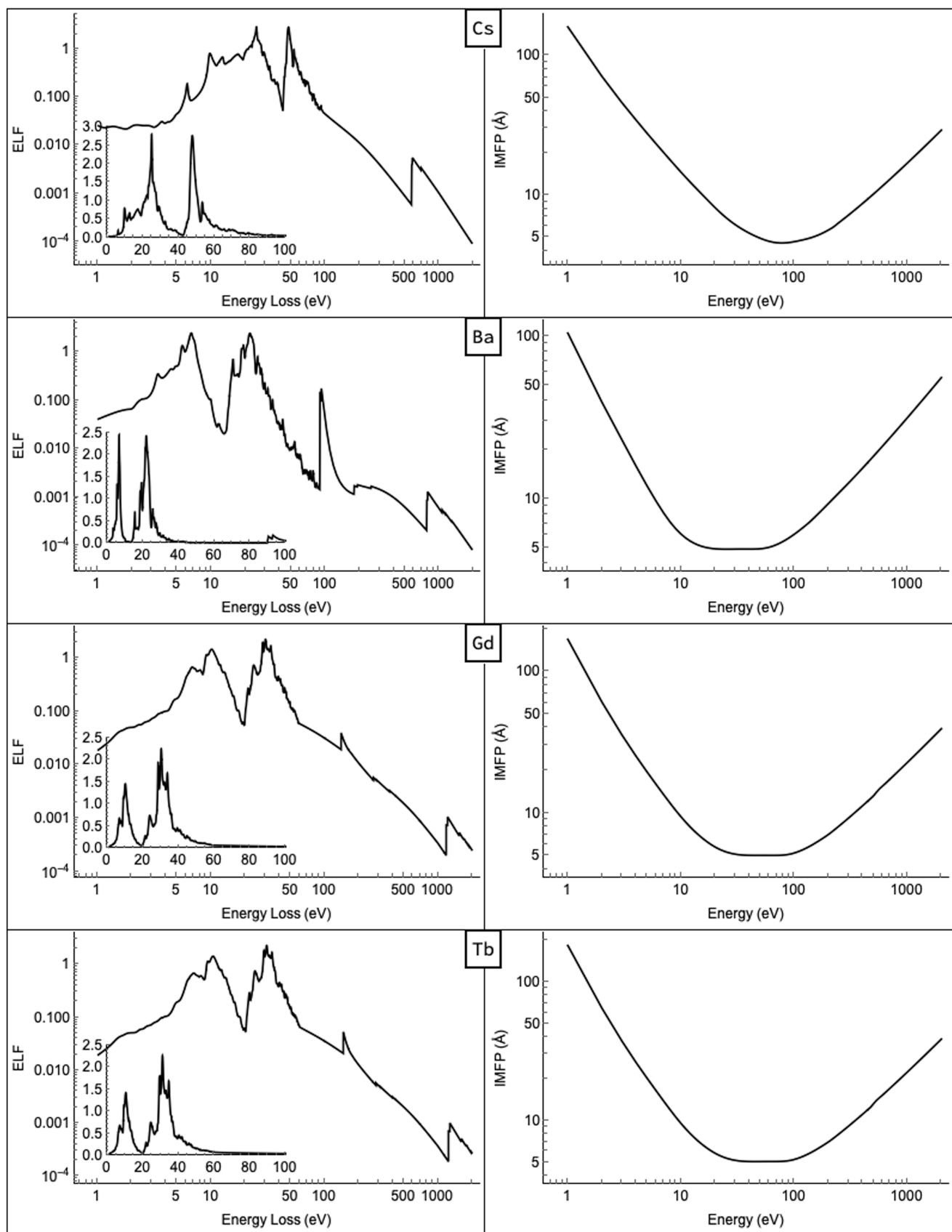


Figure 17

Optical energy-loss functions (ELFs, left) and resulting inelastic mean free paths (IMFPs, right) for the elements Pd, Ag, Cd and Sn. The insets in the ELF plots are magnifications of the low-energy spectra.


Figure 18

Optical energy-loss functions (ELFs, left) and resulting inelastic mean free paths (IMFPs, right) for the elements Cs, Ba, Gd and Tb. The insets in the ELF plots are magnifications of the low-energy spectra.

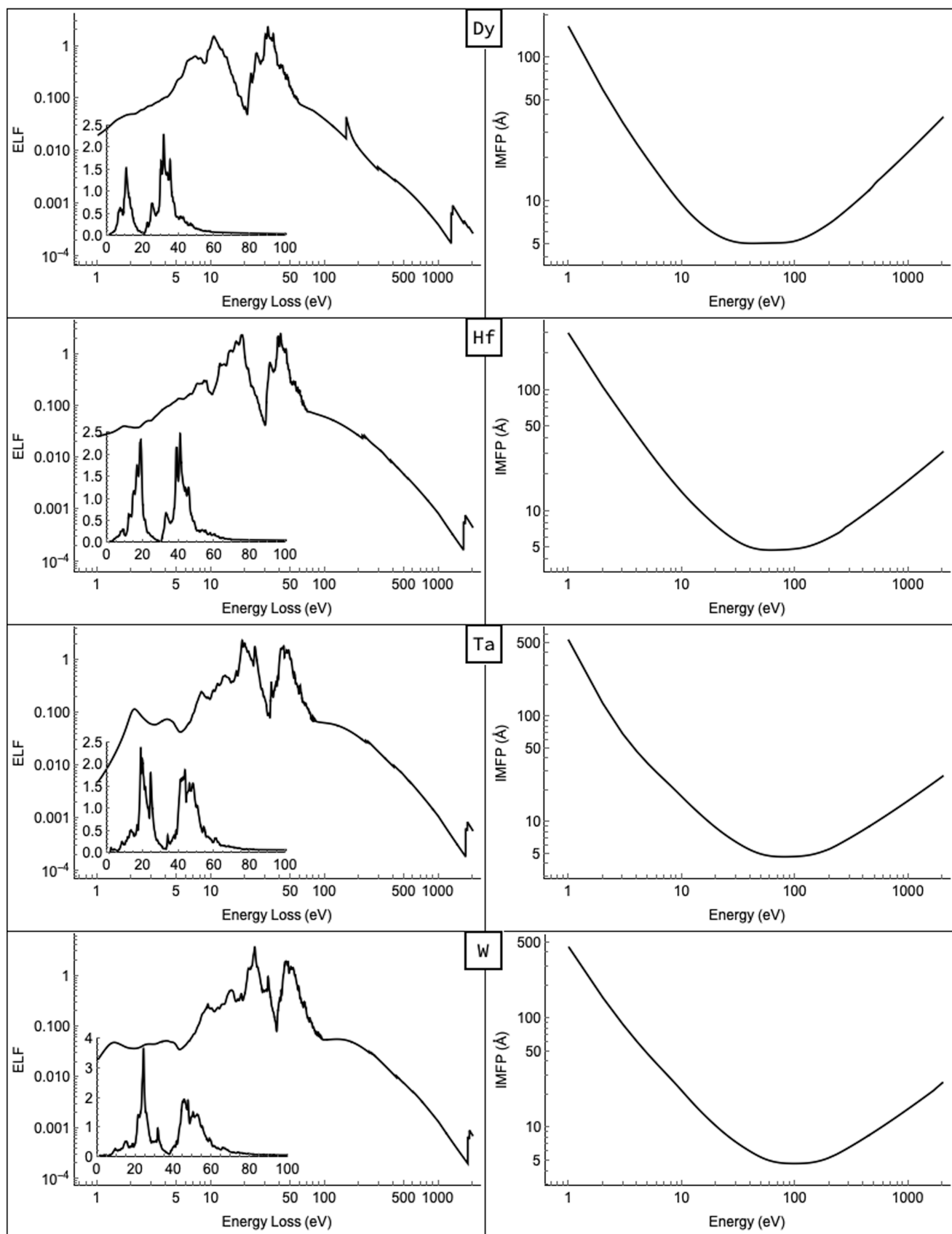


Figure 19

Optical energy-loss functions (ELFs, left) and resulting inelastic mean free paths (IMFPs, right) for the elements Dy, Hf, Ta and W. The insets in the ELF plots are magnifications of the low-energy spectra.

Table 13
ELF and IMFP data calculated for Re, Os, Ir, Pt, Au and Tl.

Energy (eV)	Re		Os		Ir		Pt		Au		Tl	
	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)
1.0	1.706×10^{-2}	545.080	1.212×10^{-2}	541.330	6.245×10^{-3}	818.410	7.779×10^{-3}	677.188	2.889×10^{-3}	593.510	1.702×10^{-2}	354.891
2.0	3.610×10^{-2}	180.795	1.718×10^{-2}	185.083	2.216×10^{-2}	242.229	2.474×10^{-2}	202.759	2.388×10^{-2}	156.951	2.214×10^{-2}	118.239
3.0	3.766×10^{-2}	101.988	2.105×10^{-2}	109.510	3.345×10^{-2}	124.386	5.628×10^{-2}	102.098	1.383×10^{-1}	71.028	3.317×10^{-2}	64.587
4.0	3.948×10^{-2}	70.151	2.999×10^{-2}	77.529	5.037×10^{-2}	79.572	1.012×10^{-1}	63.739	1.569×10^{-1}	43.385	1.165×10^{-1}	42.086
5.0	4.135×10^{-2}	53.280	3.947×10^{-2}	59.011	5.771×10^{-2}	57.268	1.887×10^{-1}	44.503	2.333×10^{-1}	31.215	1.544×10^{-1}	30.063
6.0	6.231×10^{-2}	42.827	6.316×10^{-2}	47.082	1.569×10^{-1}	43.966	3.153×10^{-1}	33.246	2.219×10^{-1}	24.535	1.994×10^{-1}	23.023
7.0	7.301×10^{-2}	35.596	8.575×10^{-2}	38.831	2.503×10^{-1}	34.915	1.842×10^{-1}	26.327	1.859×10^{-1}	20.447	3.243×10^{-1}	18.546
8.0	1.327×10^{-1}	30.368	1.707×10^{-1}	32.771	3.097×10^{-1}	28.506	2.039×10^{-1}	22.051	2.230×10^{-1}	17.801	5.597×10^{-1}	15.442
9.0	2.163×10^{-1}	26.378	2.740×10^{-1}	28.138	2.147×10^{-1}	23.970	2.020×10^{-1}	19.242	2.742×10^{-1}	15.921	$1.119 \times 10^{+0}$	13.161
10.0	2.956×10^{-1}	23.192	2.454×10^{-1}	24.469	1.938×10^{-1}	20.782	2.475×10^{-1}	17.241	3.812×10^{-1}	14.500	$1.971 \times 10^{+0}$	11.414
11.0	2.180×10^{-1}	20.613	1.980×10^{-1}	21.552	2.257×10^{-1}	18.480	3.500×10^{-1}	15.714	3.742×10^{-1}	13.363	4.922×10^{-1}	10.053
12.0	2.738×10^{-1}	18.528	3.121×10^{-1}	19.279	3.090×10^{-1}	16.766	3.545×10^{-1}	14.504	3.168×10^{-1}	12.439	6.436×10^{-1}	9.015
13.0	3.411×10^{-1}	16.855	3.622×10^{-1}	17.497	4.548×10^{-1}	15.411	3.727×10^{-1}	13.504	3.332×10^{-1}	11.663	7.102×10^{-1}	8.226
14.0	4.131×10^{-1}	15.500	4.264×10^{-1}	16.060	4.430×10^{-1}	14.299	3.546×10^{-1}	12.666	3.877×10^{-1}	11.016	6.408×10^{-1}	7.629
15.0	2.607×10^{-1}	14.376	4.237×10^{-1}	14.878	3.837×10^{-1}	13.374	3.565×10^{-1}	11.958	4.148×10^{-1}	10.471	5.955×10^{-1}	7.164
16.0	2.307×10^{-1}	13.433	2.294×10^{-1}	13.878	3.786×10^{-1}	12.580	3.766×10^{-1}	11.351	4.093×10^{-1}	10.006	6.081×10^{-1}	6.799
17.0	2.011×10^{-1}	12.632	2.115×10^{-1}	13.038	2.786×10^{-1}	11.900	3.184×10^{-1}	10.826	4.000×10^{-1}	9.605	5.637×10^{-1}	6.505
18.0	2.283×10^{-1}	11.941	2.029×10^{-1}	12.312	1.819×10^{-1}	11.309	2.169×10^{-1}	10.370	3.567×10^{-1}	9.254	6.141×10^{-1}	6.263
19.0	2.626×10^{-1}	11.343	1.946×10^{-1}	11.685	2.399×10^{-1}	10.794	2.133×10^{-1}	9.972	2.156×10^{-1}	8.946	7.674×10^{-1}	6.063
20.0	3.719×10^{-1}	10.822	2.588×10^{-1}	11.142	2.097×10^{-1}	10.342	2.015×10^{-1}	9.617	3.142×10^{-1}	8.673	4.359×10^{-1}	5.893
21.0	5.411×10^{-1}	10.363	3.594×10^{-1}	10.666	3.377×10^{-1}	9.947	4.133×10^{-1}	9.307	4.287×10^{-1}	8.428	4.191×10^{-1}	5.753
22.0	7.311×10^{-1}	9.955	4.312×10^{-1}	10.246	3.498×10^{-1}	9.594	3.701×10^{-1}	9.028	4.957×10^{-1}	8.211	5.577×10^{-1}	5.632
23.0	8.101×10^{-1}	9.591	6.054×10^{-1}	9.874	3.819×10^{-1}	9.280	4.859×10^{-1}	8.774	6.813×10^{-1}	8.011	4.292×10^{-1}	5.530
24.0	$1.043 \times 10^{+0}$	9.264	5.934×10^{-1}	9.540	5.392×10^{-1}	8.999	7.130×10^{-1}	8.548	9.123×10^{-1}	7.831	3.246×10^{-1}	5.439
25.0	$1.304 \times 10^{+0}$	8.969	6.314×10^{-1}	9.241	7.557×10^{-1}	8.747	8.021×10^{-1}	8.342	8.118×10^{-1}	7.667	3.234×10^{-1}	5.362
26.0	$2.241 \times 10^{+0}$	8.702	9.638×10^{-1}	8.970	8.460×10^{-1}	8.515	8.237×10^{-1}	8.152	6.856×10^{-1}	7.517	3.006×10^{-1}	5.297
27.0	$2.099 \times 10^{+0}$	8.456	$1.262 \times 10^{+0}$	8.723	9.208×10^{-1}	8.306	8.028×10^{-1}	7.980	6.096×10^{-1}	7.377	3.759×10^{-1}	5.237
28.0	$2.107 \times 10^{+0}$	8.229	$1.647 \times 10^{+0}$	8.496	9.944×10^{-1}	8.113	7.534×10^{-1}	7.822	4.323×10^{-1}	7.252	4.325×10^{-1}	5.187
29.0	$2.005 \times 10^{+0}$	8.022	$1.371 \times 10^{+0}$	8.290	8.278×10^{-1}	7.937	5.510×10^{-1}	7.674	5.220×10^{-1}	7.134	4.371×10^{-1}	5.141
30.0	$1.388 \times 10^{+0}$	7.830	$1.762 \times 10^{+0}$	8.098	8.999×10^{-1}	7.775	6.434×10^{-1}	7.539	6.485×10^{-1}	7.023	4.532×10^{-1}	5.102
31.0	$1.089 \times 10^{+0}$	7.652	$1.906 \times 10^{+0}$	7.918	$1.244 \times 10^{+0}$	7.622	$1.029 \times 10^{+0}$	7.412	$1.005 \times 10^{+0}$	6.923	5.287×10^{-1}	5.066
32.0	9.321×10^{-1}	7.486	$1.891 \times 10^{+0}$	7.754	$1.741 \times 10^{+0}$	7.481	$1.535 \times 10^{+0}$	7.293	$1.036 \times 10^{+0}$	6.829	5.683×10^{-1}	5.036
33.0	6.593×10^{-1}	7.330	$1.751 \times 10^{+0}$	7.599	$2.105 \times 10^{+0}$	7.350	$1.415 \times 10^{+0}$	7.183	9.538×10^{-1}	6.740	5.188×10^{-1}	5.008
34.0	4.657×10^{-1}	7.184	$1.582 \times 10^{+0}$	7.454	$1.581 \times 10^{+0}$	7.227	$1.404 \times 10^{+0}$	7.079	9.941×10^{-1}	6.656	5.103×10^{-1}	4.984
35.0	3.351×10^{-1}	7.047	$1.170 \times 10^{+0}$	7.317	$1.531 \times 10^{+0}$	7.112	$1.214 \times 10^{+0}$	6.980	8.924×10^{-1}	6.580	5.547×10^{-1}	4.962
36.0	2.753×10^{-1}	6.918	9.155×10^{-1}	7.189	$1.347 \times 10^{+0}$	7.002	$1.033 \times 10^{+0}$	6.887	8.742×10^{-1}	6.506	6.109×10^{-1}	4.945
37.0	2.512×10^{-1}	6.796	7.372×10^{-1}	7.068	$1.075 \times 10^{+0}$	6.900	$1.180 \times 10^{+0}$	6.800	9.907×10^{-1}	6.436	6.427×10^{-1}	4.928
38.0	2.748×10^{-1}	6.680	6.387×10^{-1}	6.954	$1.148 \times 10^{+0}$	6.802	$1.131 \times 10^{+0}$	6.716	$1.071 \times 10^{+0}$	6.370	6.154×10^{-1}	4.914
39.0	2.436×10^{-1}	6.572	4.979×10^{-1}	6.845	9.431×10^{-1}	6.711	$1.100 \times 10^{+0}$	6.637	$1.025 \times 10^{+0}$	6.307	8.616×10^{-1}	4.904
40.0	2.318×10^{-1}	6.467	4.432×10^{-1}	6.742	9.046×10^{-1}	6.622	9.551×10^{-1}	6.561	$1.058 \times 10^{+0}$	6.248	6.312×10^{-1}	4.893
41.0	2.092×10^{-1}	6.369	4.010×10^{-1}	6.644	7.366×10^{-1}	6.540	9.857×10^{-1}	6.489	9.030×10^{-1}	6.191	6.851×10^{-1}	4.884
42.0	3.597×10^{-1}	6.275	3.585×10^{-1}	6.551	6.339×10^{-1}	6.460	9.484×10^{-1}	6.419	$1.061 \times 10^{+0}$	6.137	7.835×10^{-1}	4.878
43.0	4.604×10^{-1}	6.185	3.227×10^{-1}	6.462	6.165×10^{-1}	6.384	8.872×10^{-1}	6.353	$1.196 \times 10^{+0}$	6.085	7.203×10^{-1}	4.872
44.0	4.442×10^{-1}	6.100	2.514×10^{-1}	6.377	6.832×10^{-1}	6.311	$1.059 \times 10^{+0}$	6.289	$1.260 \times 10^{+0}$	6.034	6.487×10^{-1}	4.866
45.0	4.574×10^{-1}	6.018	1.469×10^{-1}	6.295	8.062×10^{-1}	6.241	$1.256 \times 10^{+0}$	6.229	$1.262 \times 10^{+0}$	5.988	$1.040 \times 10^{+0}$	4.862
46.0	5.082×10^{-1}	5.940	1.949×10^{-1}	6.217	5.984×10^{-1}	6.174	9.771×10^{-1}	6.170	$1.317 \times 10^{+0}$	5.942	9.347×10^{-1}	4.860
47.0	$1.331 \times 10^{+0}$	5.865	3.044×10^{-1}	6.142	4.033×10^{-1}	6.110	8.467×10^{-1}	6.113	$1.305 \times 10^{+0}$	5.898	6.317×10^{-1}	4.858
48.0	$1.717 \times 10^{+0}$	5.794	3.801×10^{-1}	6.071	2.832×10^{-1}	6.048	7.379×10^{-1}	6.060	9.829×10^{-1}	5.857	5.170×10^{-1}	4.857
49.0	$1.906 \times 10^{+0}$	5.726	6.115×10^{-1}	6.002	1.706×10^{-1}	5.989	6.342×10^{-1}	6.007	8.015×10^{-1}	5.818	4.970×10^{-1}	4.858
50.0	$2.232 \times 10^{+0}$	5.661	$1.323 \times 10^{+0}$	5.936	2.277×10^{-1}	5.932	5.152×10^{-1}	5.958	7.987×10^{-1}	5.779	4.502×10^{-1}	4.858
52.0	9.735×10^{-1}	5.541	$1.625 \times 10^{+0}$	5.812	$1.447 \times 10^{+0}$	5.825	3.046×10^{-1}	5.864	8.265×10^{-1}	5.708	4.368×10^{-1}	4.861
54.0	$1.742 \times 10^{+0}$	5.431	$1.611 \times 10^{+0}$	5.698	$1.282 \times 10^{+0}$	5.726	$1.120 \times 10^{+0}$	5.778	6.375×10^{-1}	5.642	4.731×10^{-1}	4.868
56.0	$1.178 \times 10^{+0}$	5.333	$1.436 \times 10^{+0}$	5.591	$1.127 \times 10^{+0}$	5.634	$1.051 \times 10^{+0}$	5.698	5.164×10^{-1}	5.582	3.245×10^{-1}	4.875
58.0	$1.023 \times 10^{+0}$	5.243	$1.331 \times 10^{+0}$	5.494	8.766×10^{-1}	5.549	8.527×10^{-1}	5.624	5.484×10^{-1}	5.526	2.829×10^{-1}	4.884
60.0	9.463×10^{-1}	5.165	9.727×10^{-1}	5.405	$1.309 \times 10^{+0}$	5.470	9.480×10^{-1}	5.555	5.797×10^{-1}	5.475	2.199×10^{-1}	4.893
62.0	5.313×10^{-1}	5.095	9.645×10^{-1}	5.324	$1.017 \times 10^{+0}$	5.397	8.515×10^{-1}	5.491	6.014×10^{-1}	5.429	2.210×10^{-1}	4.904
64.0	4.439×10^{-1}	5.033	8.131×10^{-1}	5.249	8.627×10^{-1}	5.330	7.096×10^{-1}	5.433	5.871×10^{-1}	5.386	1.547×10^{-1}	4.916
66.0	2.927×10^{-1}	4.978	5.185×10^{-1}	5.181	7.934×10^{-1}	5.267	5.811×10^{-1}	5.378	5.166×10^{-1}	5.346	1.530×10^{-1}	4.929
68.0	2.790×10^{-1}	4.929	4.074×10^{-1}	5.120	4.497×10^{-1}	5.210	7.387×10^{-1}	5.327	4.521×10^{-1}	5.309	1.308×10^{-1}	4.942
70.0	2.360×10^{-1}	4.888</										

Table 13 (continued)

Energy (eV)	Re		Os		Ir		Pt		Au		Tl	
	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)	ELF	IMFP (Å)
76.0	1.651×10^{-1}	4.791	2.228×10^{-1}	4.927	2.185×10^{-1}	5.021	2.038×10^{-1}	5.158	2.096×10^{-1}	5.188	7.528×10^{-2}	5.000
78.0	1.426×10^{-1}	4.767	1.632×10^{-1}	4.891	1.998×10^{-1}	4.983	1.948×10^{-1}	5.124	1.529×10^{-1}	5.163	6.096×10^{-2}	5.015
80.0	1.169×10^{-1}	4.746	1.592×10^{-1}	4.859	1.815×10^{-1}	4.949	1.618×10^{-1}	5.091	1.197×10^{-1}	5.140	5.323×10^{-2}	5.031
82.0	9.298×10^{-2}	4.727	1.409×10^{-1}	4.830	1.634×10^{-1}	4.918	1.703×10^{-1}	5.063	1.196×10^{-1}	5.119	4.677×10^{-2}	5.048
84.0	8.270×10^{-2}	4.713	1.267×10^{-1}	4.804	1.399×10^{-1}	4.890	1.864×10^{-1}	5.036	1.260×10^{-1}	5.099	4.095×10^{-2}	5.064
86.0	7.239×10^{-2}	4.701	9.576×10^{-2}	4.783	1.139×10^{-1}	4.865	1.248×10^{-1}	5.012	1.730×10^{-1}	5.082	3.609×10^{-2}	5.082
88.0	7.004×10^{-2}	4.691	7.633×10^{-2}	4.765	1.051×10^{-1}	4.844	9.435×10^{-2}	4.989	8.673×10^{-2}	5.066	3.204×10^{-2}	5.098
90.0	6.192×10^{-2}	4.682	6.885×10^{-2}	4.749	9.538×10^{-2}	4.825	1.049×10^{-1}	4.971	8.636×10^{-2}	5.051	2.840×10^{-2}	5.117
92.0	5.939×10^{-2}	4.676	6.282×10^{-2}	4.735	7.347×10^{-2}	4.809	8.027×10^{-2}	4.955	6.782×10^{-2}	5.040	2.533×10^{-2}	5.136
94.0	5.674×10^{-2}	4.670	5.665×10^{-2}	4.723	5.343×10^{-2}	4.794	6.283×10^{-2}	4.940	4.852×10^{-2}	5.029	2.273×10^{-2}	5.156
96.0	5.492×10^{-2}	4.665	5.423×10^{-2}	4.713	4.529×10^{-2}	4.781	6.259×10^{-2}	4.927	3.495×10^{-2}	5.020	2.041×10^{-2}	5.177
98.0	5.026×10^{-2}	4.661	4.958×10^{-2}	4.705	5.189×10^{-2}	4.771	4.172×10^{-2}	4.916	3.684×10^{-2}	5.012	1.838×10^{-2}	5.197
100.0	5.023×10^{-2}	4.659	4.906×10^{-2}	4.698	3.889×10^{-2}	4.762	4.361×10^{-2}	4.906	3.934×10^{-2}	5.006	2.174×10^{-2}	5.217
106.2	4.930×10^{-2}	4.654	4.521×10^{-2}	4.683	3.749×10^{-2}	4.743	3.429×10^{-2}	4.884	2.500×10^{-2}	4.992	1.804×10^{-2}	5.283
112.7	5.029×10^{-2}	4.656	4.504×10^{-2}	4.677	2.901×10^{-2}	4.733	2.672×10^{-2}	4.873	2.201×10^{-2}	4.988	1.392×10^{-2}	5.355
119.7	5.129×10^{-2}	4.663	4.564×10^{-2}	4.679	2.952×10^{-2}	4.735	2.383×10^{-2}	4.874	1.903×10^{-2}	4.994	1.243×10^{-2}	5.436
127.1	5.228×10^{-2}	4.676	4.664×10^{-2}	4.686	2.987×10^{-2}	4.745	2.287×10^{-2}	4.884	1.712×10^{-2}	5.013	1.059×10^{-2}	5.526
134.9	5.305×10^{-2}	4.698	4.777×10^{-2}	4.702	3.079×10^{-2}	4.763	2.261×10^{-2}	4.905	1.608×10^{-2}	5.043	8.880×10^{-3}	5.630
143.3	5.342×10^{-2}	4.728	4.881×10^{-2}	4.725	3.210×10^{-2}	4.789	2.303×10^{-2}	4.936	1.573×10^{-2}	5.085	7.984×10^{-3}	5.745
152.1	5.333×10^{-2}	4.771	4.955×10^{-2}	4.757	3.359×10^{-2}	4.824	2.392×10^{-2}	4.979	1.589×10^{-2}	5.141	7.255×10^{-3}	5.873
161.5	5.273×10^{-2}	4.825	4.987×10^{-2}	4.802	3.507×10^{-2}	4.871	2.511×10^{-2}	5.031	1.648×10^{-2}	5.209	6.870×10^{-3}	6.013
171.5	5.152×10^{-2}	4.894	4.969×10^{-2}	4.860	3.637×10^{-2}	4.929	2.643×10^{-2}	5.096	1.737×10^{-2}	5.289	6.775×10^{-3}	6.166
182.1	4.966×10^{-2}	4.980	4.896×10^{-2}	4.942	3.734×10^{-2}	5.002	2.775×10^{-2}	5.174	1.845×10^{-2}	5.384	6.913×10^{-3}	6.336
193.3	4.724×10^{-2}	5.091	4.764×10^{-2}	5.036	3.788×10^{-2}	5.102	2.892×10^{-2}	5.269	1.959×10^{-2}	5.493	7.233×10^{-3}	6.519
205.2	4.438×10^{-2}	5.209	4.569×10^{-2}	5.141	3.791×10^{-2}	5.210	2.980×10^{-2}	5.394	2.069×10^{-2}	5.614	7.683×10^{-3}	6.715
217.9	4.123×10^{-2}	5.338	4.320×10^{-2}	5.258	3.741×10^{-2}	5.329	3.031×10^{-2}	5.523	2.162×10^{-2}	5.772	8.210×10^{-3}	6.928
231.4	3.791×10^{-2}	5.480	4.031×10^{-2}	5.389	3.637×10^{-2}	5.461	3.037×10^{-2}	5.665	2.230×10^{-2}	5.945	8.757×10^{-3}	7.165
245.6	3.453×10^{-2}	5.640	3.718×10^{-2}	5.534	3.486×10^{-2}	5.608	2.994×10^{-2}	5.821	2.264×10^{-2}	6.141	9.263×10^{-3}	7.437
260.8	3.161×10^{-2}	5.828	3.393×10^{-2}	5.702	3.288×10^{-2}	5.781	2.905×10^{-2}	6.013	2.258×10^{-2}	6.355	9.678×10^{-3}	7.724
276.9	2.978×10^{-2}	6.032	3.165×10^{-2}	5.896	3.055×10^{-2}	5.979	2.774×10^{-2}	6.221	2.215×10^{-2}	6.583	9.956×10^{-3}	8.029
294.0	2.627×10^{-2}	6.249	2.887×10^{-2}	6.103	2.797×10^{-2}	6.190	2.609×10^{-2}	6.442	2.136×10^{-2}	6.824	1.007×10^{-2}	8.351
312.2	2.320×10^{-2}	6.477	2.563×10^{-2}	6.323	2.616×10^{-2}	6.414	2.414×10^{-2}	6.677	2.025×10^{-2}	7.080	1.001×10^{-2}	8.691
331.4	2.039×10^{-2}	6.718	2.267×10^{-2}	6.556	2.375×10^{-2}	6.651	2.269×10^{-2}	6.926	1.890×10^{-2}	7.349	9.764×10^{-3}	9.049
351.9	1.785×10^{-2}	6.973	1.994×10^{-2}	6.802	2.118×10^{-2}	6.902	2.076×10^{-2}	7.189	1.782×10^{-2}	7.634	9.355×10^{-3}	9.426
373.6	1.559×10^{-2}	7.241	1.746×10^{-2}	7.061	1.873×10^{-2}	7.167	1.860×10^{-2}	7.466	1.648×10^{-2}	7.935	8.807×10^{-3}	9.918
396.7	1.358×10^{-2}	7.522	1.524×10^{-2}	7.334	1.645×10^{-2}	7.447	1.651×10^{-2}	7.760	1.486×10^{-2}	8.253	8.396×10^{-3}	10.442
421.2	1.181×10^{-2}	7.818	1.326×10^{-2}	7.620	1.436×10^{-2}	7.740	1.453×10^{-2}	8.070	1.324×10^{-2}	8.588	7.869×10^{-3}	10.906
447.2	1.099×10^{-2}	8.130	1.151×10^{-2}	7.921	1.249×10^{-2}	8.050	1.271×10^{-2}	8.395	1.169×10^{-2}	8.941	7.177×10^{-3}	11.373
474.8	9.552×10^{-3}	8.456	1.083×10^{-2}	8.238	1.083×10^{-2}	8.375	1.105×10^{-2}	8.738	1.024×10^{-2}	9.313	6.475×10^{-3}	11.877
504.1	8.303×10^{-3}	8.799	9.247×10^{-3}	8.571	9.951×10^{-3}	8.718	9.555×10^{-3}	9.099	8.901×10^{-3}	9.704	5.773×10^{-3}	12.406
535.3	7.339×10^{-3}	9.160	8.017×10^{-3}	8.920	8.597×10^{-3}	9.077	8.768×10^{-3}	9.478	7.699×10^{-3}	10.117	5.092×10^{-3}	12.961
568.3	6.382×10^{-3}	9.539	7.056×10^{-3}	9.287	7.413×10^{-3}	9.455	7.557×10^{-3}	9.879	7.054×10^{-3}	10.551	4.450×10^{-3}	13.546
603.4	5.543×10^{-3}	9.936	6.109×10^{-3}	9.672	6.482×10^{-3}	9.852	6.497×10^{-3}	10.299	6.068×10^{-3}	11.009	3.858×10^{-3}	14.160
640.7	4.929×10^{-3}	10.355	5.281×10^{-3}	10.076	5.576×10^{-3}	10.268	5.660×10^{-3}	10.740	5.205×10^{-3}	11.489	3.536×10^{-3}	14.805
680.2	4.273×10^{-3}	10.794	4.673×10^{-3}	10.501	4.788×10^{-3}	10.706	4.852×10^{-3}	11.203	4.522×10^{-3}	11.995	3.039×10^{-3}	15.483
722.2	3.697×10^{-3}	11.256	4.031×10^{-3}	10.948	4.206×10^{-3}	11.165	4.198×10^{-3}	11.690	3.866×10^{-3}	12.528	2.636×10^{-3}	16.198
766.8	3.188×10^{-3}	11.741	3.471×10^{-3}	11.417	3.605×10^{-3}	11.647	3.633×10^{-3}	12.201	3.372×10^{-3}	13.088	2.253×10^{-3}	16.950
814.2	2.707×10^{-3}	12.252	2.983×10^{-3}	11.910	3.085×10^{-3}	12.154	3.104×10^{-3}	12.737	2.877×10^{-3}	13.676	1.920×10^{-3}	17.738
864.5	2.294×10^{-3}	12.789	2.558×10^{-3}	12.429	2.635×10^{-3}	12.687	2.648×10^{-3}	13.300	2.452×10^{-3}	14.295	1.668×10^{-3}	18.570
917.8	1.941×10^{-3}	13.353	2.166×10^{-3}	12.974	2.246×10^{-3}	13.245	2.255×10^{-3}	13.891	2.087×10^{-3}	14.944	1.418×10^{-3}	19.444
974.5	1.640×10^{-3}	13.947	1.829×10^{-3}	13.547	1.912×10^{-3}	13.833	1.918×10^{-3}	14.512	1.774×10^{-3}	15.626	1.204×10^{-3}	20.363
1034.7	1.372×10^{-3}	14.570	1.528×10^{-3}	14.149	1.613×10^{-3}	14.451	1.616×10^{-3}	15.165	1.492×10^{-3}	16.343	1.010×10^{-3}	21.330
1098.6	1.131×10^{-3}	15.226	1.268×10^{-3}	14.783	1.352×10^{-3}	15.101	1.351×10^{-3}	15.850	1.246×10^{-3}	17.095	8.401×10^{-4}	22.346
1166.4	9.282×10^{-4}	15.915	1.045×10^{-3}	15.448	1.129×10^{-3}	15.784	1.130×10^{-3}	16.571	1.041×10^{-3}	17.883	6.991×10^{-4}	23.418
1238.4	7.633×10^{-4}	16.639	8.592×10^{-4}	16.232	9.323×10^{-4}	16.502	9.454×10^{-4}	17.326	8.690×10^{-4}	18.712	5.820×10^{-4}	24.545
1314.9	6.290×10^{-4}	17.400	7.075×10^{-4}	17.172	7.652×10^{-4}	17.257	7.865×10^{-4}	18.122	7.261×10^{-4}	19.581	4.846×10^{-4}	25.730
1396.1	5.194×10^{-4}	18.271	5.837×10^{-4}	18.129	6.290×10^{-4}	18.270	6.485×10^{-4}	18.959	6.038×10^{-4}	20.495	4.037×10^{-4}	26.974
1482.3	4.297×10^{-4}	19.322	4.824×10^{-4}	19.109	5.180×10^{-4}	19.337	5.324×10^{-4}	19.837	4.998×10^{-4}	21.454	3.365×10^{-4}	28.287
1573.8	3.561×10^{-4}	20.386	3.995×10^{-4}	20.026	4.275×10^{-4}	20.428	4.379×10^{-4}	20.761	4.134×10^{-4}	22.462	2.801×10^{-4}	29.670
1671.0	2.956×10^{-4}	21.509	3.314×10^{-4}	20.947	3.535×10^{-4}	2						

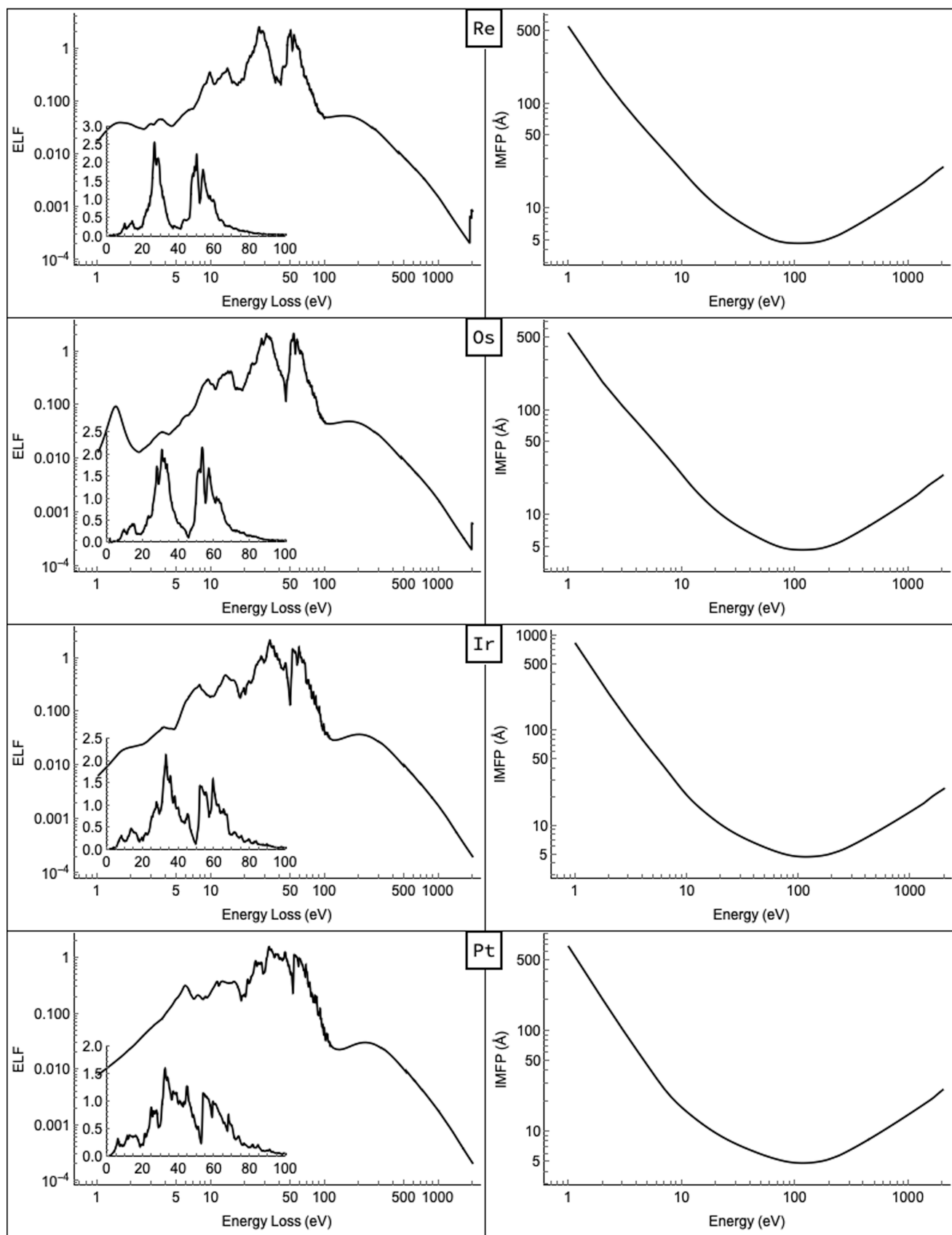


Figure 20

Optical energy-loss functions (ELFs, left) and resulting inelastic mean free paths (IMFPs, right) for the elements Re, Os, Ir and Pt. The insets in the ELF plots are magnifications of the low-energy spectra.

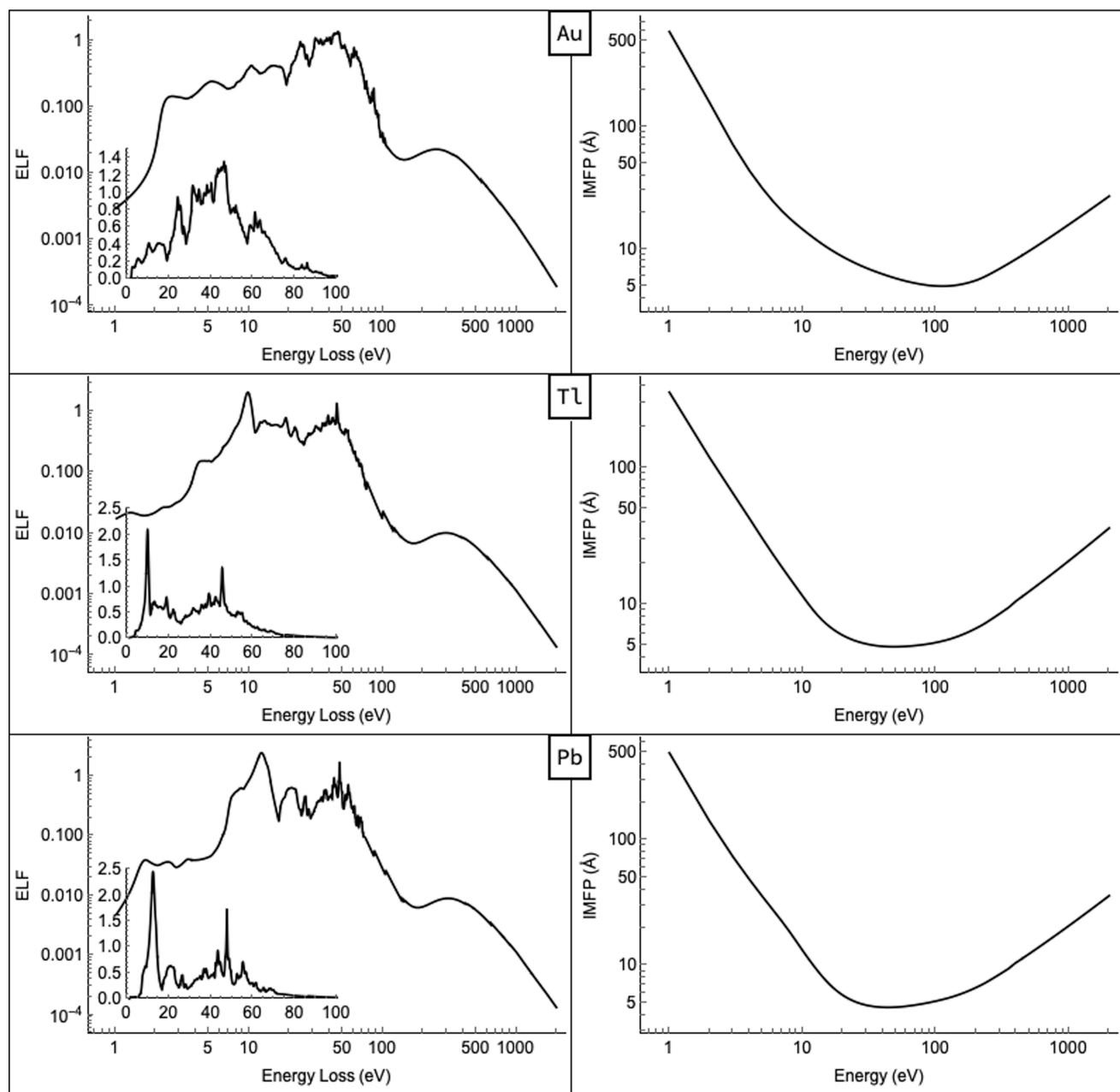


Figure 21

Optical energy-loss functions (ELFs, left) and resulting inelastic mean free paths (IMFPs, right) for the elements Au, Tl and Pb. The insets in the ELF plots are magnifications of the low-energy spectra.

11. Analysis and applications of IMFP and ELF data

The data in the previous section should be considered complementary to the extensive tabulations of optical loss data by Palik (1998) and to the IMFP calculations given by Shinotsuka *et al.* (2015) and tabulated in NIST Standard Reference Database 71. The ELF data presented here are entirely theoretical, while Palik's compendium collects experimental data covering a wide range of optical energies and measurement techniques.

The IMFP values given in the NIST database are similarly wide-ranging insofar as the tabulation covers a number of

competing theoretical models, many of which utilize measured optical data from Palik or elsewhere. Shinotsuka's tables may be considered a superior source to Palik's due to the relatively robust optical data model that was used along with the inclusion of a relativistic energy correction.

Our tables omit the relativistic correction due to their limited energy range, but explicitly include the plasmon-coupling effect via a Mermin representation of the oscillator components, which produces an improved account of excitations below around 200 eV. For higher energies the differences between our values and those of Shinotsuka are primarily due to the different optical data that we have used. Accordingly, it

Table 14
ELF and IMFP data calculated for Pb.

Energy (eV)	ELF	IMFP (Å)	Energy (eV)	ELF	IMFP (Å)
1.0	4.484×10^{-3}	493.718	78.0	7.402×10^{-2}	4.926
2.0	3.239×10^{-2}	141.054	80.0	6.412×10^{-2}	4.949
3.0	3.080×10^{-2}	73.386	82.0	5.686×10^{-2}	4.973
4.0	3.918×10^{-2}	48.160	84.0	5.035×10^{-2}	4.997
5.0	4.404×10^{-2}	35.313	86.0	4.580×10^{-2}	5.020
6.0	7.353×10^{-2}	27.608	88.0	5.204×10^{-2}	5.044
7.0	2.497×10^{-1}	22.390	90.0	4.651×10^{-2}	5.070
8.0	5.490×10^{-1}	18.478	92.0	4.176×10^{-2}	5.095
9.0	6.102×10^{-1}	15.445	94.0	3.759×10^{-2}	5.120
10.0	8.604×10^{-1}	13.129	96.0	3.374×10^{-2}	5.145
11.0	$1.362 \times 10^{+0}$	11.384	98.0	3.041×10^{-2}	5.170
12.0	$2.260 \times 10^{+0}$	10.053	100.0	2.758×10^{-2}	5.194
13.0	$2.076 \times 10^{+0}$	9.011	106.2	2.733×10^{-2}	5.271
14.0	$1.247 \times 10^{+0}$	8.191	112.7	1.974×10^{-2}	5.354
15.0	5.248×10^{-1}	7.544	119.7	1.521×10^{-2}	5.442
16.0	2.633×10^{-1}	7.026	127.1	1.177×10^{-2}	5.539
17.0	2.512×10^{-1}	6.615	134.9	9.164×10^{-3}	5.648
18.0	4.141×10^{-1}	6.285	143.3	8.219×10^{-3}	5.767
19.0	5.416×10^{-1}	6.013	152.1	7.556×10^{-3}	5.896
20.0	6.203×10^{-1}	5.789	161.5	6.802×10^{-3}	6.038
21.0	6.361×10^{-1}	5.604	171.5	6.377×10^{-3}	6.193
22.0	6.094×10^{-1}	5.450	182.1	6.240×10^{-3}	6.362
23.0	3.976×10^{-1}	5.321	193.3	6.334×10^{-3}	6.545
24.0	2.750×10^{-1}	5.211	205.2	6.605×10^{-3}	6.742
25.0	2.341×10^{-1}	5.118	217.9	6.999×10^{-3}	6.957
26.0	4.264×10^{-1}	5.037	231.4	7.462×10^{-3}	7.191
27.0	2.557×10^{-1}	4.972	245.6	7.935×10^{-3}	7.456
28.0	2.740×10^{-1}	4.915	260.8	8.357×10^{-3}	7.742
29.0	1.978×10^{-1}	4.864	276.9	8.684×10^{-3}	8.045
30.0	2.324×10^{-1}	4.823	294.0	8.883×10^{-3}	8.365
31.0	2.860×10^{-1}	4.786	312.2	8.930×10^{-3}	8.703
32.0	3.433×10^{-1}	4.756	331.4	8.816×10^{-3}	9.060
33.0	3.765×10^{-1}	4.731	351.9	8.545×10^{-3}	9.436
34.0	3.930×10^{-1}	4.709	373.6	8.137×10^{-3}	9.952
35.0	4.393×10^{-1}	4.690	396.7	7.617×10^{-3}	10.469
36.0	4.267×10^{-1}	4.675	421.2	7.268×10^{-3}	10.904
37.0	5.338×10^{-1}	4.662	447.2	6.806×10^{-3}	11.380
38.0	5.433×10^{-1}	4.652	474.8	6.188×10^{-3}	11.885
39.0	4.024×10^{-1}	4.643	504.1	5.560×10^{-3}	12.410
40.0	4.586×10^{-1}	4.636	535.3	4.943×10^{-3}	12.963
41.0	4.656×10^{-1}	4.632	568.3	4.352×10^{-3}	13.545
42.0	4.975×10^{-1}	4.628	603.4	3.797×10^{-3}	14.157
43.0	7.980×10^{-1}	4.627	640.7	3.288×10^{-3}	14.802
44.0	6.821×10^{-1}	4.627	680.2	3.018×10^{-3}	15.479
45.0	5.509×10^{-1}	4.628	722.2	2.594×10^{-3}	16.190
46.0	4.419×10^{-1}	4.630	766.8	2.244×10^{-3}	16.942
47.0	8.527×10^{-1}	4.633	814.2	1.911×10^{-3}	17.728
48.0	9.154×10^{-1}	4.636	864.5	1.624×10^{-3}	18.557
49.0	6.188×10^{-1}	4.641	917.8	1.409×10^{-3}	19.429
50.0	3.504×10^{-1}	4.646	974.5	1.199×10^{-3}	20.346
52.0	3.640×10^{-1}	4.658	1034.7	1.004×10^{-3}	21.312
54.0	4.342×10^{-1}	4.674	1098.6	8.316×10^{-4}	22.328
56.0	5.091×10^{-1}	4.689	1166.4	6.891×10^{-4}	23.394
58.0	3.376×10^{-1}	4.708	1238.4	5.721×10^{-4}	24.520
60.0	2.768×10^{-1}	4.726	1314.9	4.758×10^{-4}	25.703
62.0	2.164×10^{-1}	4.747	1396.1	3.962×10^{-4}	26.946
64.0	1.513×10^{-1}	4.768	1482.3	3.304×10^{-4}	28.258
66.0	1.382×10^{-1}	4.789	1573.8	2.761×10^{-4}	29.636
68.0	1.933×10^{-1}	4.811	1671.0	2.306×10^{-4}	31.088
70.0	1.687×10^{-1}	4.834	1774.1	1.913×10^{-4}	32.610
72.0	9.925×10^{-2}	4.856	1883.7	1.583×10^{-4}	34.219
74.0	9.307×10^{-2}	4.879	2000.0	1.311×10^{-4}	35.910
76.0	8.456×10^{-2}	4.902			

is recommended that our tables be favored for the lower-energy IMFP, while at higher energies either source may prove to be more or less appropriate depending on the relative veracity of the experimental or theoretical optical loss data.

12. Conclusion

We hope that it is clear that there are many excellent resources for reference parameters and key parameters within XAFS, and yet also that there are many complex questions, for which this chapter provides some useful summary of the current and future challenges.

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