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Graphical Comparison of Calculated Internal Conversion Coefficients

W. Bruce Ewbank

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GRAPHICAL COMPARISON OF CALCULATED INTERNAL CONVERSION COEFFICIENTS

W. Bruce Ewbank

Abstract

Calculated values of the coefficients of internal conversion of gamma rays in the K shell and L_1 , L_2 , L_3 subshells from published tabulations by Band and Trzhaskovskaya [1] (referred to as 'Band') and by Rösels et al. [2] ('Rösels') have been compared with values obtained by computer interpolation among tabulated values of Hager and Seltzer [3] ('HSICC'). In some cases, agreement among the three calculations is remarkably good, and differences are generally less than 5%. In a few cases, there are differences as large as 20-50%, corresponding to the "threshold" effect described by Rösels et al. [2]

The Z-dependent "resonance" minimum described by Rösels et al. [2] is also observed in the comparison of E1-E4 conversion in the L_1 subshell. These large oscillatory differences (as much as a factor of 2) between Band or Rösels and HSICC illustrate the importance of the smaller energy steps used by Rösels et al. to provide a reliable interpolation. The actual table entries in HSICC agree reasonably well with the newer calculations; the wide fluctuations occur between pairs of HSICC entries.

The large "gap" between the curves for $Z = 90$ and $Z = 100$ of the Rösels-HSICC comparison (especially noticeable for K and L shells at higher multipolarity) is caused by the use of different electron binding energies for $Z \geq 98$. [4] Unfortunately, one of the newer calculations [2] uses older binding energies [5], while the other calculations [1,3] use more recent values. [6,7]

In several cases (notably M1-M4 conversion in the K shell and L_1 subshell), the Band and Rösels calculations show dramatically different dependence on gamma energy and atomic number.

For $Z = 100$, the 'Band' calculation for E4 conversion in the L_3 subshell shows irregular behavior at energies below the K-shell binding energy.

The illustrated differences between the calculations indicate that a few high quality measurements of internal conversion coefficients ($\pm 5\%$) would help greatly to establish a basis for choice among the theoretical calculations.

Graphical Presentation

Each page contains two graphs, which compare HSIICC with Band and with Rösels, for internal conversion in one shell or subshell for transitions of a specified multipolarity. A separate curve connects values for each atomic number (Z). The same symbol is used for each Z value (50 to 100 by 10) on all graphs. A uniform grid spacing (2.5%) along the vertical axis is used for all graphs, so that the density of the grid reflects the maximum deviation. Graphs for different shells and multipolarities are organized as follows:

K shell: E1-E4, M1-M4
 L_1 subshell: E1-E4, M1-M4
 L_2 subshell: E1-E4, M1-M4
 L_3 subshell: E1-E4, M1-M4

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Rösel - HSICC
K-Shell: E1

Band - HSICC
K-Shell: E1

Rösel - HSICC

K-Shell: E2

Band - HSICC

K-Shell: E2

Rbse1 - HSICC
K-Shell: E3

Band - HSICC
K-Shell: E3

Rösei - HSLCC

K-Shell: E4

Band - HSLCC

K-Shell: E4

Rbse1 - HSICC

K-Shell: M1

Band - HSICC

K-Shell: M1

Rbse1 - HSICC

K-Shell: M2

Band - HSICC

K-Shell: M2

Rbse1 - HSICC
K-Shell: M3

Band - HSICC
K-Shell: M3

Rbse1 - HSICC

K-Shell: M4

Band - HSICC

K-Shell: M4

Rösel - HSICC L1-Shell: E1

Band - HSICC L1-Shell: E1

Rbssel - HSICC

L1-Shell: E2

Band - HSICC

L1-Shell: E2

Band - HSICC

L1-Shell: E3

Rösel - HSICC

L1-Shell: E3

Rösel - HSIICC

L1-Shell: E4

Band - HSIICC

L1-Shell: E4

Rbse1 - HSICC

L1-Shell: M1

Band - HSICC

L1-Shell: M1

Rösel - HSICC

L1-Shell: M2

Band - HSICC

L1-Shell: M2

Rösel - HSICC

L1-Shell: M3

Band - HSICC

L1-Shell: M3

Rösel - HSICC

L1-Shell: M4

Band - HSICC

L1-Shell: M4

Rösel - HSICC L2-Shell: E1

Band - HSICC L2-Shell: E1

Rbse1 - HSICC

L2-Shell: E2

Band - HSICC

L2-Shell: E2

Rbse1 - HSIICC

L2-Shell: E3

Band - HSIICC

L2-Shell: E3

Rbse1 - HSICC

L2-Shell: E4

Band - HSICC

L2-Shell: E4

Rbse1 - HSIICC

L2-Shell: M1

Band - HSIICC

L2-Shell: M1

Rösel - HSICC

L2-Shell: M2

Band - HSICC

L2-Shell: M2

Rösel - HSICC

L2-Shell: M3

Band - HSICC

L2-Shell: M3

Rbse1 - HSICC

L2-Shell: M4

Band - HSICC

L2-Shell: M4

Rösel - HSICC

L3-Shell: E1

Band - HSICC

L3-Shell: E1

Rösel - HSICC

L3-Shell: E2

Band - HSICC

L3-Shell: E2

Rösel - HSICC

L3-Shell: E3

Band - HSICC

L3-Shell: E3

Rösel - HSICC

L3-Shell: E4

Band - HSICC

L3-Shell: E4

Rösel - HSICC

L3-Shell: M1

Band - HSICC

L3-Shell: M1

Rösel - HSICC

L3-Shell: M2

Band - HSICC

L3-Shell: M2

Rösel - HSI CC
L3-Shell: M3

Band - HSI CC
L3-Shell: M3

R0sel - HSICC

L3-Shell: M4

Band - HSICC

L3-Shell: M4