Band-Raman Internal Conversion Coefficients

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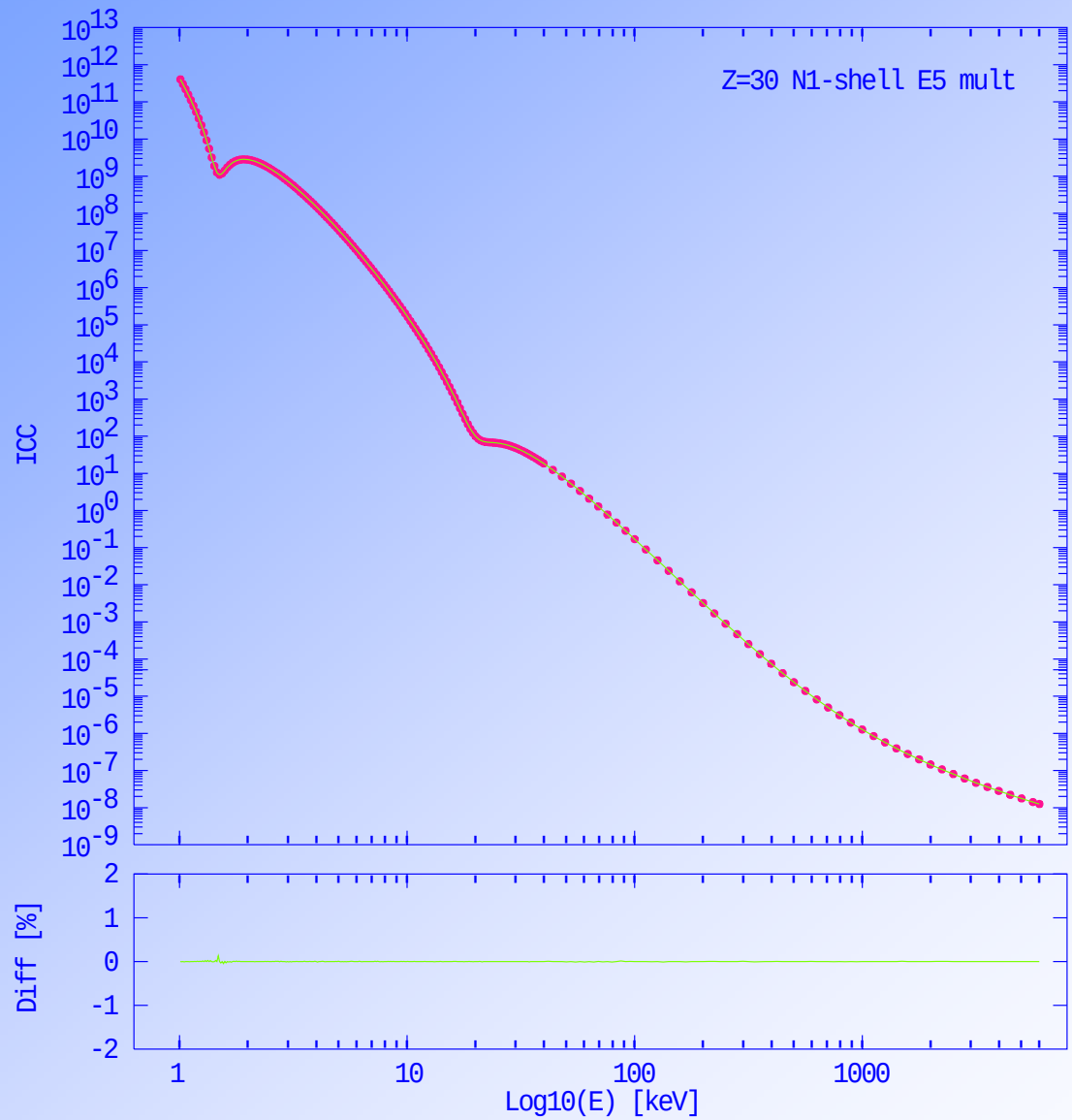
Band-Raman Internal Conversion Coefficients

- BrIcc 2.0 Program Package
  - Changes from Version 1.3
  - Future Plans
  - Implications of BrIcc on ENSDF Evaluations
- "How Good Are the Conversion Coefficients Now?"
  - Current Status
  - Methodology
  - To be done
  - Near Misses
  - New Review: Integration into ENSDF?

BrIcc 2.0 Program Package

- Changes from Version 1.3
  - More robust
    - Run through all of a recent release of ENSDF without crashing
    - E, DE, M, MR, DMR, CC, DCC field verified (FmtChk routines)
    - Extensive testing of two large subsets of ENSDF
      - Several “legal” variations of representing the information
      - Some “illegal” entries (*e.g.*, DMR with missing MR)
  - “Frozen-orbitals” approximation instead of “No hole”
  - Z=10 through 95 instead of 10 through 126
  - Estimated uncertainty of 1.4% instead of 2%
    - Theory: -1.01% *21*
    - Interpolation: 0.0% *3*

BrIcc 2.0 Program Package



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BrIcc 2.0 Program Package

- Better checking near table boundaries
  - If $E_\gamma - \Delta E_\gamma$, E_γ, or $E_\gamma + \Delta E_\gamma$ lie between ε_i and ε_i+1 keV, no calculations for the subshell or related totals and no new records will be generated.
  - If $E_\gamma + \Delta E_\gamma < \varepsilon_i$, no calculations for the subshell, but related totals will be calculated and new records will be generated.
- New atomic electron binding energies
  - K.D. Sevier, Atomic Data and Nuclear Data Tables 24, 323 (1979)
  - Supplemented with energies calculated by the RAINE code for higher Z
- Some cosmetic improvements

BrIcc 2.0 Program Package

- Future Plans
  - Extend Z range above 95 (to 105 by end of year?)
    - NuDat 2.1 (7/12/2005): No adopted gammas for Z>102
    - A=266-294: one $\alpha\gamma$-coincidence (^{266}Hs) and one suggested isomeric decay (^{270}Ds) reported
  - Resolve numeric differences between platforms
    - Creation of binary data files from ASCII files
    - Interpolation and calculation in BrIcc
  - More cosmetic improvements
    - Reduce size of output to terminal and report file
  - Implement three mixed multipolarities or E0 transitions
  - "Silent" BrIcc for Web interface or calling BrIcc from other applications (Java, VB, RadWare, programs generating databases such as RIPL, *etc.*)
    - Output file in XML format
  - Respond to user feedback

BrIcc 2.0 Program Package

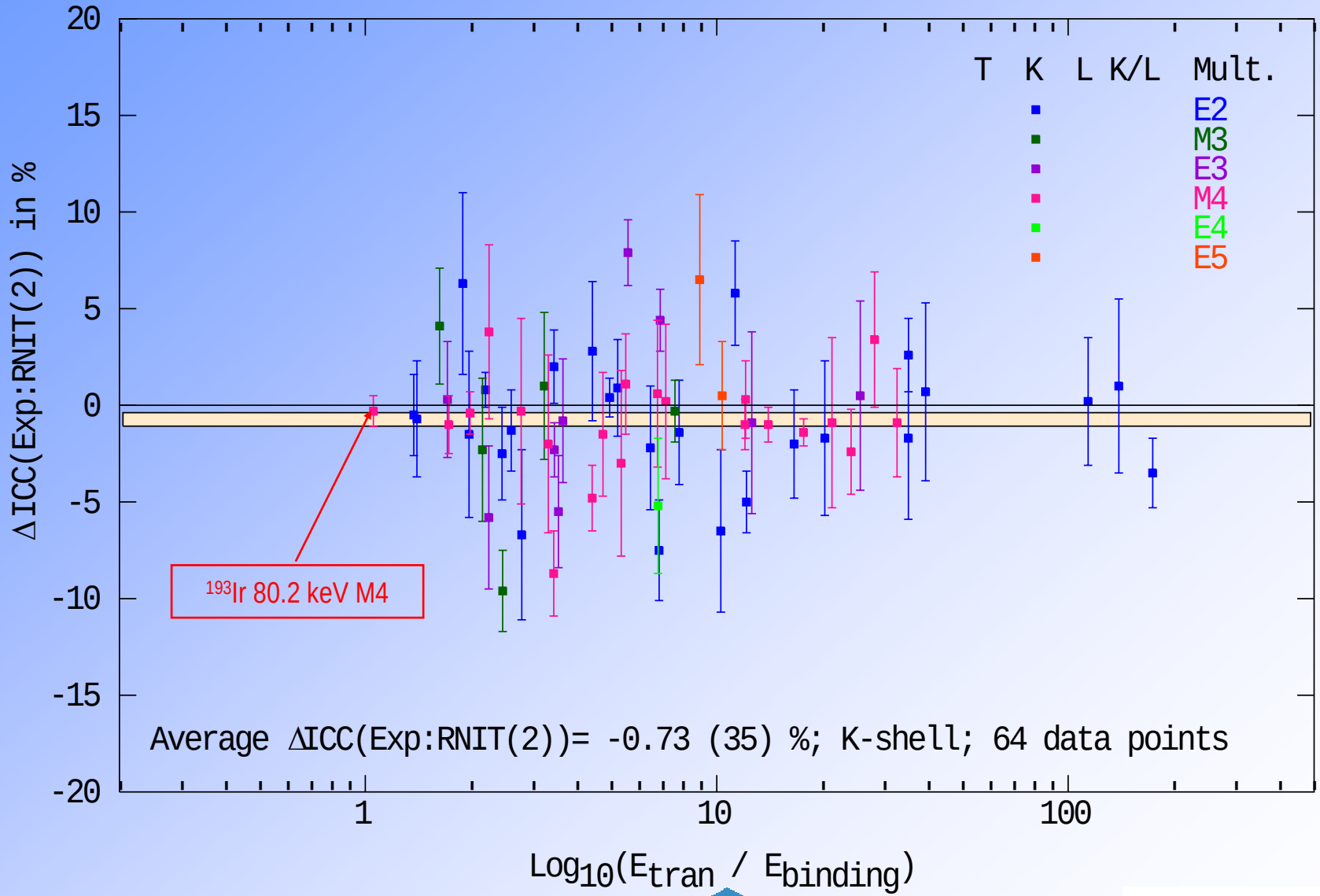
- Implications of BrIcc on ENSDF Evaluations
  - Values will change
    - 2002Ra45: Δ(Exp:HS)=-3.01% *24*; Δ(Exp:RNIT(2))=-1.18% *24*
    - Incomplete data for N, O, … in HSICC; L=5 transitions
    - Internal electron-positron pair formation contribution becomes increasingly dominant above ≈1500 keV
  - Possible effects:
    - Normalization factors
    - Net feedings of levels and associated log *ft*'s and α HF's
    - Half-lives derived from B(E2)'s
    - Reduced transition probabilities
    - Scaling of I_{ce} to I_{γ} and associated multipolarity assignments and δ
    - Comparison of derived and experimental X-ray intensities, *etc.*
  - New program – Possibility of errors
    - During testing, found that two internal pair formation coefficients had been incorrectly interpreted by the OCR software

"How Good Are the Conversion Coefficients Now?"

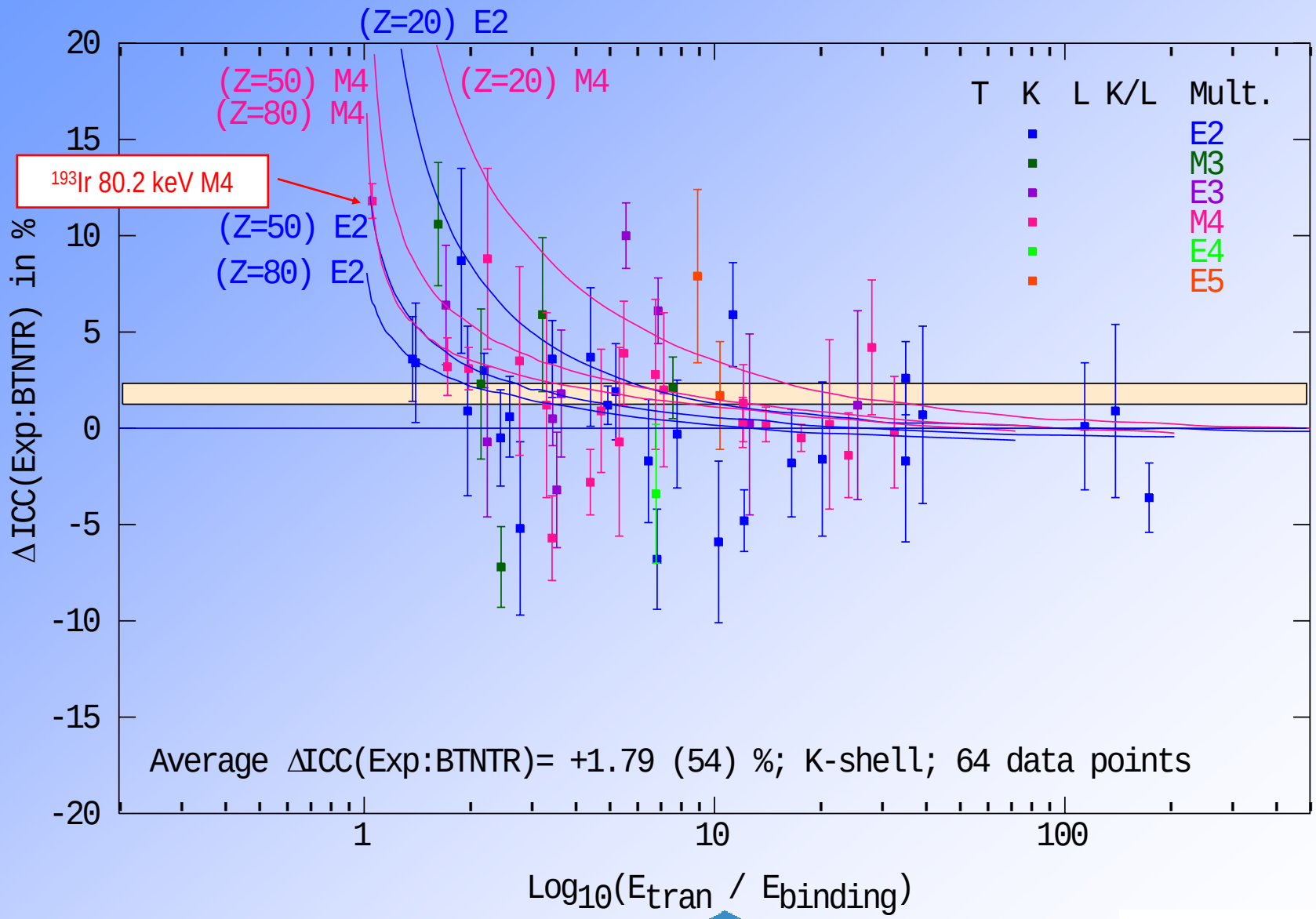
- Current Status – "Almost there"
  - "Frozen-Orbitals" preferred over "No Hole"

Shell	# Points	Ave. ΔICC(Exp:Theory)	
		BNITR [%]	RNIT(2) [%]
All	139	+0.59 *28*	-1.01 *21*
Total	57	+0.34 *37*	-0.88 *26*
K	64	+1.79 *54*	-0.73 *35*
L	11	-0.22 *87*	-0.57 *91*
K/L	5	-2.9 *14*	-4.6 *11*
Total & K	121	+0.87 *28*	-0.82 *21*

“How Good Are the Conversion Coefficients Now?”



"How Good Are the Conversion Coefficients Now?"



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"How Good Are the Conversion Coefficients Now?"

- Methodology
  - Based on that used by Raman, *et al.* (2002Ra45). Extended to include L, K/L, L-subshell ratios, and M.
  - Sources:

2002Ra45	Physical Review C66, 044312 (2002)
Evaluated Nuclear Structure Data File	
1981HaZY	Physics Data (Karlsruhe) 17-1 (1981)
1985HaYZ	Physics Data (Karlsruhe) 17-2 (1985)
1985HaZA	European App. Res. Rept. Nucl. Sci. Technol. 6, No.4, 777 (1985)
Decay Data Evaluation Project	
2001Ra27	Atomic Data and Nuclear Data Tables 78, 1 (2001)
Nuclear Science References	

"How Good Are the Conversion Coefficients Now?"

- Data Analysis:
  - Excluded transitions – Unplaced, doubtful multipolarity or multipolarity solely based on ICC being considered, ICC being considered used for scaling I_{ce} and I_{γ}, and discrepant data (LWEIGHT or other analysis)
  - Attempt to obtain all original papers and reanalyze results
    - Realistic uncertainties assigned?
    - Adjustment using currently adopted data
      - X-ray fluorescence yields (1996Sc07)
      - ICC's used to scale I_{ce} and I_{γ}
  - Results: Several adopted values (≈40) added to data in 2002Ra45 and modifications to values adopted by 2002Ra45

"How Good Are the Conversion Coefficients Now?"

- To Be Done
  - Handling discrepant data
  - Have we missed any data? For example, L-subshell ratios for $E_\gamma/\varepsilon_K<1$
  - K/L ratios are negative for both approximations with no discernable systematics – Try to explain
  - RNIT(1) not considered in the review
  - Number of processes near the shell binding energy
    - Not all were considered by Raman *et al.*
    - Effects may be significant 1 keV above the binding energy
  - M1 and E1? – Followed Raman and excluded from review

"How Good Are the Conversion Coefficients Now?"

- Near Misses:

Transition, Multipolarity, and Shell				Exp	BTNTR		RNIT2	
						Δ(%)		Δ(%)
^{73}Ge	13.2845 *15*	E2	K	297 *20*	265	+12 *8*	299	-0.6 *67*
(1970Do01,1971Ra10)								
^{104}Rh	115.960 *1*	E2	K	0.6893 *10*	0.6273	+9.9 *2*	0.6356	+8.5 2
(1986ChYZ)								
^{160}Dy	87.7882 *4*	E2	K	1.53 *4*	1.51	+1.1 *27*	1.57	-2.2 *26*
(1964TH02,1965Er02,1966Di02,1967JaZZ)								

"How Good Are the Conversion Coefficients Now?"

- New Review: Integration into ENSDF?
  - Isolated data (*e.g.*, study of precise conversion coefficients by Xγ measurements) – Probably easy to do
  - Extract from a larger dataset (*e.g.*, 937γ from ^{110}Ag β-Decay (249.76 d)) – Would need to reanalyze the other conversion coefficient data
  - Total α from $T_{1/2}$ and B(E2) – Consistency problems
    - ENSDF: Adopted $T_{1/2}$ from the measured $T_{1/2}$ and B(E2) values assuming an α_{tot} (HSICC?)
    - 2001Ra27: Adopted consistent $T_{1/2}$ and B(E2) values assuming the "No Hole" α_{tot}
    - Present: Experimental α_{tot} derived from independent evaluation of $T_{1/2}$ and B(E2)