BrIcc Program Package

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T. Kibédi (ANU), T.W. Burrows (BNL),
M.B. Trzhaskovskaya (PNPI),
& C.W. Nestor, Jr (ORNL).

BrIcc Program Package

- Data Base
- Additions to Original Band-Raman Table
- Testing
- Programs
- Implementation

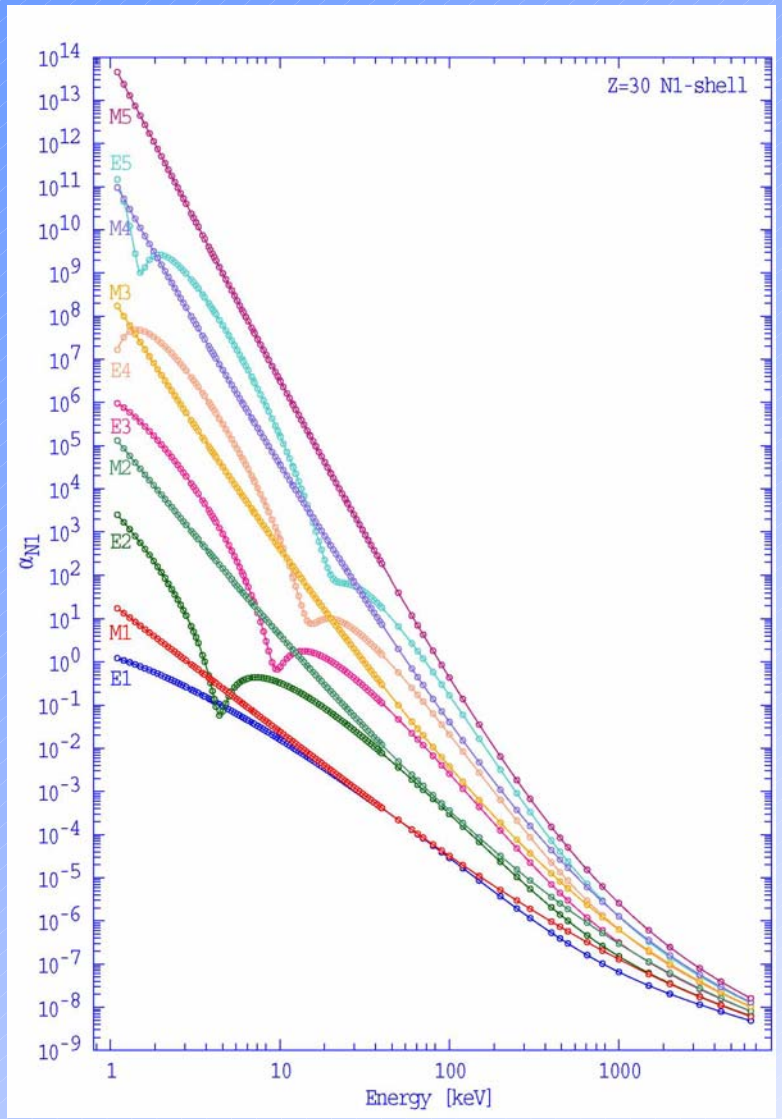
BrIcc Program Package
Data Base

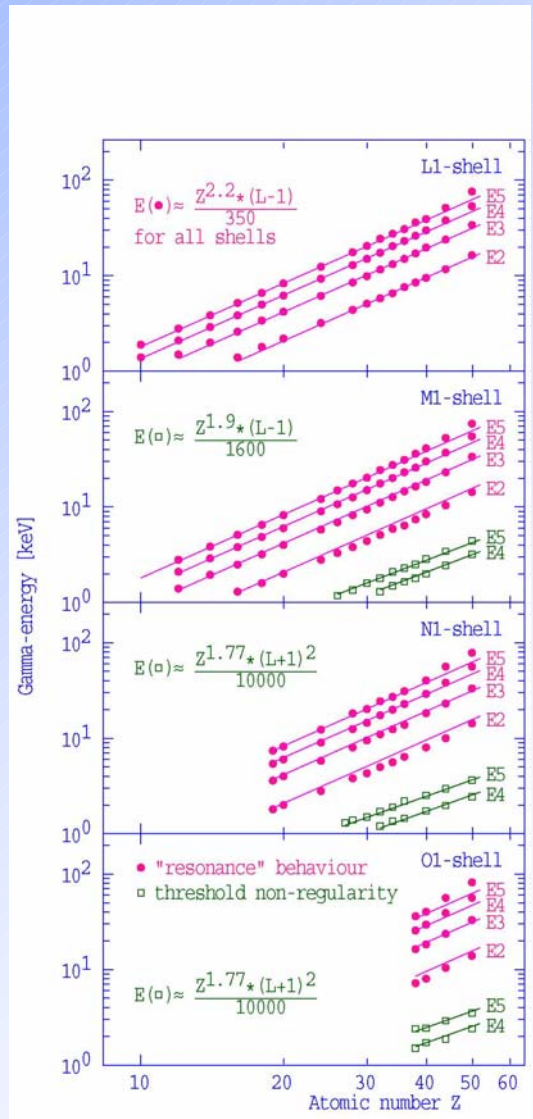
- Internal Conversion Coefficients
  - 2002Ba85 – Original Band-Raman Table (Z≥96)
  - 2004KiAA – Additions for BrIcc (Z=10 – 95)
  - 2002Ba85 and 2004KiAA merged in a consistent manner
- Conversion Coefficients for Electron-Positron Pairs
  - 1979Sc31 (Z<50)
  - 1996Ho21 (Z≥50)
- Electronic Factors for E0 Transitions
  - 1969Ha61 (Z=30 – 38)
  - 1970Be87 (Z=40 – 102)
  - 1986PaZM (Z=8 – 40)

BrIcc Program Package
Additions to Original Band-Raman Table

- Large changes ($\approx 10^3$) between adjacent points
  - Additional points added
- "Resonance"-like regions ($s_{½}$ shells, E2 – E5)
  - Additional points added
  - Interesting systematics?
- Lower limit changed from $\varepsilon_{L1}+1$ to $\varepsilon_{ic}+1$
  - Encountered threshold non-regularities ($s_{½}$ shells, E4 – E5) – Additional points added
  - Interesting systematics?
- Extended energy range to 6 MeV (Z=10 – 95)
  - Wild fluctuations – Program modified to increase mesh

BrIcc Program Package
"Resonance"-like Regions

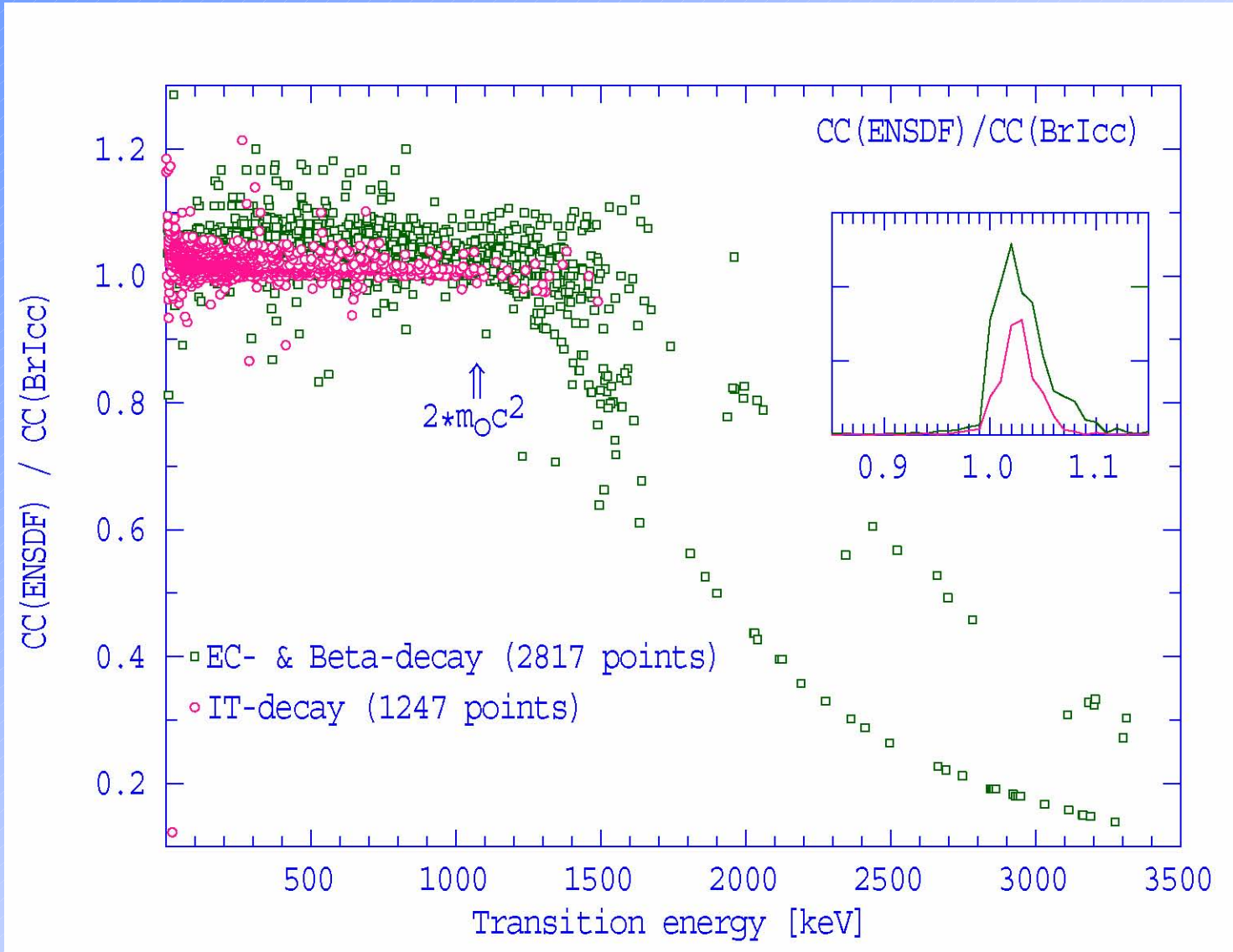




BrIcc Program Package Testing (CC's)

- Extracted all IT decay datasets (1773 transitions) and one B- or EC decay dataset per Z (17637 transitions)
- Looked into cases where CC(ENSDF)/CC(BrIcc) deviated from 1.0 by >10%
  - If probable ENSDF problem, removed from comparison
  - If BrIcc problem, removed from comparison and fixed the program
  - Others left in
- Average difference ≈2%

BrIcc Program Package
ENSDF to BrIcc Comparison (CC's)



BrIcc Program Package Testing (KC, LC, MC, & NC+)

- More limited testing done for KC, LC, MC, and NC+
  - IT decay datasets
  - Known problems (including round off) excluded
  - Missing or incorrect "S G" records in ENSDF (≈10%)

Shell	Order	Average	#γ's
KC	All	1.024±0.025	631
LC	All	1.011± 0.024	631
MC	All	1.009±0.036	481
NC+	L=1	1.079±0.022	83
	L=2	1.092±0.027	165
	L=3	1.118±0.043	63
	L=4	1.170 ±0.052	24

BrIcc Program Package Additional Testing?

- Observations from Murray Martin (Z=94, E=52-223 keV):
  - BrIcc E2 values are about 3% lower than HSICC as expected
  - BrIcc M1 values are about 7% lower than HSICC
    - K, L1, M1, and CC — 7%
    - L2 and M2 — 4.5%
    - L3 and M3 unchanged

BrIcc Program Package Programs

- Windows 95/98/2000/NT/ME/XP, Compaq Tru64 Unix, and Linux
- BldBrIcc – Builds direct access files from ASCII files
  - Replaces BLDHST
- BrIcc
  - Terminal input (bricc)
    - Chemical symbol or Z, E_γ, enable/disable list of subshells
  - ENSDF evaluation tool (bricc <*ensdf file*>)
    - Replaces HSICC
  - ENSDF merge tool (bricc <*ensdf file*> *merge*)
    - Replaces HSMRG

BrIcc Program Package
BrIcc Terminal Dialogue

```
C:\BrIcc>bricc ba1978bo18.ens<cr>
BrIcc v1.2 (22-Sep-2004) calculates conversion coefficients
 (for electron conversion and pair production)
          and E0 electronic factors
       using cubic spline interpolation
Index file: c:\BrIcc\BrIcc.idx
ICC file: c:\BrIcc\BrIcc.icc
Input ENSDF file: ba1978bo18.ens
Output Files
  Complete calculations report, (Def: BrIcc.lst):
  List conversion coefficients for all subshells (Def. N):
  Calculate conversion coefficients for all transitions (Def. N):
  New G/SG records, (Def: Cards.new):
  G/SG (New/Old) comparison report, (Def: Compar.lst):
      Processing a new data set
    1 : 172YB    172LU EC DECAY (6.70 D)
  104 : 172YB  G 155.87    7 0.032   7 M1(+E2)   0.7     LT    0.90   6
  107 : 172YBS G KC=0.72 8$LC=0.139 18$MC=0.032 5$NCC+=0.0085 12
                                                **************
          WARNING - Non-standard data will be over-written
  109 : 172YB  G 174.671   190.180   8
  112 : 172YB  G 348.83    220.015   11
  113 : 172YB  G 596.75    150.102   23
  114 : 172YB  G 604.65    190.050   23
  115 : 172YB  G 990.75    150.12    6 D,E2
  ...
  ...
  1251 : 172YB  G 770.4     2 0.012   2
  1257 : 172YB  G 588.3     2 0.0093  19
  1259 : 172YB  G 2197.3    2 0.006   3
  1265 : 172YB  G 1932.0    2 0.0019  5
  1267 : 172YB  G 2211.4    2 0.0034  6
  BrIcc finished processing ba1978bo18.ens
  Processed:
  #DataSets      :     1
  #AllRecords    :  1269
  #GammaRecords  :   286
  #Warnings      :     2
  Skipped:
  #DataSets      :
```

BrIcc Program Package
BrIcc "2 G" Record Comparison

```
   1 : 170YB    170LU EC DECAY                1990ABZT,1972CA21,1970DZ1102NDS    200211
Compare OLD/NEW cards
 105 : 170YB  G 223.40    1545.0    15M1                          0.360                    <Old Card>
 105 : 170YBS G KC=0.301 9$LC=0.0454 14$MC=0.0101 3$NC+=0.00298 9                         <Old Card>
 105 : 170YB  G 223.40    1545.0    15M1                          0.350                    <New Card>
 105 : 170YBS G KC=0.293 6$LC=0.0444 9$MC=0.00993 20$NC+=0.00268$                         <New Card>
 105 : 170YBS G NC=0.00233 5$OC=0.00033 1$                                                <New Card>
                                                .
                                                .
                                                .
Compare OLD/NEW cards
 546 : 170YB  G 1753.9    3 100     5 M1(+E2+E0)                                  G  ?  <Old Card Kept>
                                                .
                                                .
                                                .
Compare OLD/NEW cards
 694 : 170YB  G 2191.15   153.55E+3 10E1                                          C     <Old Card>
 694 : 170YBS G CC=0.00039$KC=0.00034$EKC=0.00039 2                                    <Old Card>
 694 : 170YB  G 2191.15   153.55E+3 10E1                          0.00109          C     <New Card>
 694 : 170YBS G KC=0.00034 1$                                                           <New Card>
 694 : 170YBS G IPC=0.00069 1$                                                          <New Card>
 694 : 170YBS G EKC=0.00039 2                                                           <New Card>
```

BrIcc Program Package Implementation

- Program Remarks
  - Treatment of uncertainties
  - Extend below Z=10?
  - “No hole” *versus* “hole”
- ENSDF dictionary and manual additions
- Implementation in ENSDF and *Nuclear Data Sheets*

BrIcc Program Package
Treatment of Uncertainties

$\Delta\alpha_{theory}$	2%	1% assumed for theory and 1% for interpolation. Increase in "resonance" regions?
$\Delta\alpha_{\delta}$	Maximum of $\lvert\alpha(\delta)-\alpha(\delta-\Delta\delta)\rvert$ and $\lvert\alpha(\delta)-\alpha(\delta+\Delta\delta)\rvert$	
$\Delta\alpha_{E\gamma}$	Maximum of $\lvert\alpha(E_\gamma)-\alpha(E_\gamma-\Delta E_\gamma)\rvert$ and $\lvert\alpha(E_\gamma)-\alpha(E_\gamma+\Delta E_\gamma)\rvert$	
$\Delta\alpha_{total}$	$\sqrt{(\Delta\alpha_{theory})^2+(\Delta\alpha_{\delta})^2+(\Delta\alpha_{E\gamma})^2}$	
$\Delta(\alpha/(1+\alpha_{total}))$ somewhat overestimated at present		

BrIcc Program Package
Extend below Z=10?

- Possible
- One experimental datum found ENSDF
- May require validation

BrIcc Program Package
"No hole" *versus* "hole"

- Current internal conversion coefficients table is based on calculations without taking into account the effect of the hole.
- About three weeks to calculate table taking into account the effect of the hole
  - May need to check mesh near threshold non-regularities
- Easy to rebuild direct access files
  - About one minute on a fairly modern PC
- Should have little effect on ENSDF evaluation tool
- Do the hole calculations need validation?

BrIcc Program Package
ENSDF Dictionary & Manual Additions

Needed by BrIcc		
MRKE0/E2	$q^2(E0/E2)=I_K(E0)/I_K(E2)$	*E0,E2* mixing ratio
ENSDAT, FTMCHK, NDS publication codes, Web codes		
Produced by BrIcc		
NC,…,RC N/T ,…,R/T	Additional shell conversion coefficients and ratios	
IPC,IP/T	Internal electron-positron pair formation coefficient and ratio	
ENSDAT, FTMCHK, NDS publication codes, RadList, Web codes		
May also need definition for E0 electronic factors		

BrIcc Program Package Implementation in ENSDF & *NDS*

- Can not automatically update ENSDF due to dependencies on α in other quantities (*e.g.*, $T_{1/2}$'s, normalizations, *etc.*)
- Set implementation date – All evaluations received after this date to use BrIcc
  - Give evaluators enough time to convert
  - Evaluations using BrIcc received before this date should note this use in the Comments dataset
- General policies need to be updated
  - Need archiving of old policies for conversion coefficients – Web site?
  - Refer to this archive in new policies?